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FLIGHT DAILY NEWS

SINGAPORE AIRSHOW 2020 11-16 Feb

The crew of the Royal Malaysian Air Force's 22 Sqn, responsible for the Airbus A400M, take special measures as they arrive at the show

BlogPix

NO STOPPING US

With health precautions in place, sized-down air show takes off

The show must go on. That was the defiant message from organisers as the expo opened its doors this morning, minus many of its biggest names.

Experia Events managing director Leck Chet Lam vows that the biennial event will continue as normal, despite the early trickle of exhibitors deciding to stay at home turning into something of a flood after Singapore elevated its warning level about the spread of novel coronavirus on Friday. Visitor numbers are also expected to be heavily down.

By **GREG WALDRON**

Lam says already rigorous hygiene and health-checking measures have been stepped up, following new government guidance.

Notable absentees include Bombardier, CAE, Collins Aerospace, De Havilland Canada, Eaton, Gulfstream, Leonardo, Lockheed Martin, Raytheon and Textron. Some took the decision to stay away even after executives had flown into Singapore, leaving exhibits and chalets furnished but empty.

However, Lam is stressing that 92% of booked exhibitors are here, including Airbus and Boeing.

Experia put in place a range of additional measures following the Singapore government's decision on 7 February to elevate its disease outbreak response system condition to orange from yellow, citing a handful of new local cases of the illness, which originated in Wuhan, China last month.

As a result, attendees are having their temperature checked before they enter the show site, and there will be ample supplies of hand sanitizer at the event.

"We can proceed with some level of normalcy, and we will advise [show attendees] along the way," said Tan Kong Hwee, the assistant managing director of Singapore's Economic Development Board at a media briefing Sunday.

Lam adds that the safety of show attendees is the utmost priority, and that Experia will take guidance from the government.

Lam says focus areas for this year's show will include electric aircraft, unmanned systems, data analytics, artificial intelligence, and how digitisation is affecting the MRO sector.

Continued on P3

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SLATTERY HAS EYES ON THE ASIA-PACIFIC 'PRIZE'

By **ALFRED CHUA**

Embraer is hunting for sales in the Asia-Pacific as it bids to take its "fair percentage" of future demand – but acknowledges a need to boost its brand across the region.

John Slattery, chief executive of Embraer Commercial Aviation, speaking at the Singapore air show where it has its E195-E2 TechLion on static display, said: "This region… is the prize. This is where the action is."

Embraer's 20-year outlook indicates 28% of all aircraft with 150 seats and under will be delivered in the Asia-Pacific, of which two-thirds, or about 2,000 aircraft, will be jets, with the remainder turboprops.

"To date, we are the leading regional aircraft manufacturer on the jet side, so I would want my fair percentage, and we will be hunting in the marketplace to win our fair percentage of that market," Slattery says.

Embraer currently has about 35% market share globally in the sub-150 seat segment, he says.

He believes that Embraer's second-generation E2-aircraft family can help address a key issue for Asian operators: lower margins per seat. This, says Slattery, is because there is "a lot of excess capacity on primary trunk routes" in the region.

"Therefore, Embraer believes that as airlines want to grow their network and their franchise footprint, they will expand beyond those larger cosmopolitan areas, into the secondary and tertiary markets," he says.

Slattery says that the E2 family, which comprises the E175, E190 and E195, will help airlines up their profitability, while expanding into thinner routes.

Low-cost carriers will also form part of that mix, says Slattery. "As the LCCs now focus on profitability and not market share, we think they will need to do everything to bring costs down," Slattery says.

There is "growing acceptance that one size does not fit all", he adds – with the result that LCCs see the benefits of operating both larger narrowbodies and smaller regional jets below 150 seats.

However, Slattery acknowledges that in order to secure a bigger market share, Embraer will need to increase awareness of its brand in the region. While the manufacturer is well recognised elsewhere in the world, in the Asia-Pacific "we have a lot of work to do".

"We are now starting to see the rewards of the efforts from our team in Singapore. I would be disappointed if we don't see more opportunities materialise in 2020 and beyond," he adds.

Drawing parallels with a game of rugby, Slattery says Embraer is focused on "winning one yard at a time", adding: "We are very focused on wanting to bring the E2s to the Asia-Pacific."

Embraer's CEO has a vision for E192-E2 sales in Asia

BillyPix

BillyPix

Continued from P1

In addition to a number of the world's biggest aerospace companies, the show features a number of smaller exhibitors, including 20 homegrown aerospace firms, of which "more than half" are new participants.

However, the show is without its Chinese exhibitors. Companies such as Comac and AVIC were an early casualty of the health scare, as Singapore last week stopped permitting people who have been in China the previous two weeks to enter the country.

Boeing also cancelled the appearance of its 777 ecoDemonstrator jet, and Experia axed its Airline Leadership Summit, due to take place yesterday.

USAF BUILDS PARTNERSHIPS FOR TRADE AND REGIONAL SECURITY

The US Air Force is placing a high priority on developing partnerships with regional air forces in the areas of procurement, training, and support.

Kelli Seybolt, deputy under secretary of the air force for international affairs, plays a prominent role in working with the USA's international partners. She points out that the Asia-Pacific has significant security issues, and is also a key part of the global economy.

"Challenges in the region could have big effects on the global economy, so security is paramount to securing the economic benefits of the region and the trade relationships. So the Pacific is a high priority for us," she says. "We have many security commitments here as well."

In addition to working with important long-term partners such as Japan and South Korea, the USAF is developing deeper relationships with air forces in countries such as Indonesia, Malaysia, and Vietnam.

Efforts with Vietnam include the possible provision of Beechcraft T-6 Texan trainers, as well as improving the English proficiency of personnel. The Philippines is also in the market for new fighters, with the Lockheed Martin F-16 in contention.

One challenge is the amount of technology transfer that countries desire in defence acquisitions. Seybolt says that finding the right balance is important, but stresses that the degree of technology shared is not necessarily static.

Perhaps one of the region's biggest technology transfer projects is Tokyo's FX future fighter programme to replace the Mitsubishi F-2. In addition to considerable indigenous work, including the X-2 demonstrator aircraft, Japan's Acquisition, Technology & Logistics Agency is looking at several options for the aircraft, which is likely to include working with either US or European partners.

"Japan has approached us regarding their FX programme to replace the F-2 and the United States government's position is that we want to work with Japan to help them create an interoperable capability," says Seybolt.

"And our desire is that the fighter they want to develop will be interoperable with our capabilities… we're open to Japan working with industry to formulate some partnerships, so that Japan can gain the benefit of some of what our industry has learned."

CASH CRUCIAL IN VIRUS CRISIS, SAYS AAPA CHIEF

By **GREG WALDRON**

Cash conservation will the priority of airline chiefs hit by the outbreak of novel coronavirus, although the longer term impact of the pandemic is harder to quantify, according to Andrew Herdman, the outgoing director general of the Association of Asia Pacific Airlines.

This is not Herdman's first experience of a disease-induced crisis: during the SARS outbreak of 2003, which also afflicted carriers in the region, he was working for Cathay Pacific Airways.

Herdman, speaking ahead of the Singapore air show, noted that profit margins are tight even when things are stable, but during the current outbreak airline chiefs will not be thinking about profits or even losses.

"You worry about cash-flow and you worry about survival – you don't worry about your P&L, but your balance sheet, because you're going to have negative cash-flow. You have got to focus on that."

He points out that the region's airline industry is far bigger than it was in 2003, which will make the financial effect of coronavirus proportionally greater. Some Asian carriers, particularly those from China, will see a "massive" impact, he says.

However, Herdman believes the ad hoc responses of specific countries – including travel bans and other measures – cause more problems than they solve.

"Some of these measures, whilst well-intentioned, seem to lack any proper public health justification, whilst causing significant and widespread disruption to travel and trade activities across the world," he says.

"Arbitrary restrictions and blanket travel bans are inconsistent with the international health regulations, and result in unnecessary inconvenience and added uncertainty amongst members of the public."

Herdman was working for Cathay Pacific during the SARS crisis of 2003

Credit

In addition, Herdman says that passengers must be screened at both ends of the journey: "One thing we learned from SARS, there were a lot of countries who imposed arrival screening," he says. "And the analysis was that what you need is departure screening. You want to catch sick people and symptomatic people before they get on planes."

The outbreak has also dented the cargo sector, with some Chinese factories closed and belly-hold capacity cut due to flight reductions. Additionally, some countries have banned freight shipments from affected areas, even though there is no evidence of disease transmission via this route.

On a more positive note, Herdman says that when the SARS crisis came to end, air traffic bounced back very quickly.

P&W LEASES LONG TERM

Pratt & Whitney has launched a long-term engine leasing programme, beefing up its existing suite of spare engine solutions.

Under the programme, operators can lease an engine, or an APU, for 12 months or longer, combining a fixed monthly rate and an hourly rate, based on the time flown. P&W adds that the leasing solution can be integrated into existing maintenance programmes.

Satheeshkumar Kumarasingam, P&W vice-president for customer service, says that the engine maker is seeing "growing interest" in new solutions to address a wide range of operational and financial needs.

"Our spare engine long-term leasing programme gives our customers another option to help grow their business, maximise their budget's stability, increase aircraft availability and extend the life of their asset," he adds.

P&W has more than 40 owned and designated service facilities, two round-the-clock customer support centres in Montreal and Singapore, seven parts distribution centres, as well as an inventory of more than 1,000 rental engines.

An artist's impression of the engine

ULTRAFAN IS ON A ROLL

Parts production for the Rolls-Royce UltraFan demonstrator engine is under way, with the propulsion specialist now manufacturing the powerplant's composite fan blades.

The company at the show released an artist's impression of the new design.

With an eventual 355cm (140in) diameter – almost the size of a narrowbody fuselage – the components are being made at the company's technology hub in Bristol, UK.

The fan blades are created through the build-up of hundreds of layers of carbonfibre, pre-filled with resin material. Heat and pressure are then applied, and each blade is finished with a thin titanium leading edge.

R-R promises that UltraFan will cut fuel consumption by 25% over the first generation of Trent engines.

Part of the efficiency improvement comes from UltraFan's composite fan blades and fan case, which reduce weight on a twin-engined aircraft by 700kg (1,540lb).

Chris Cholerton, R-R president – civil aerospace, says: "This is the decade of UltraFan and it's exciting to enter the 2020s with the start of production of the demonstrator engine. We have got all the building blocks in place, the design, the technologies, a brand-new testbed, and now we are actually seeing the engine come together."

UltraFan, which will start ground tests in 2021 and be available towards the end of this decade, is a scalable design from 25,000lb (112kN) thrust all the way up to 100,000lb.

COLLINS IS PALS WITH JAL

BillyPix

Collins Aerospace has landed a $200 million deal to maintain air management and electric power components on Japan Airlines' Boeing 787s for five years.

The US aerospace company announced the deal during the air show – although the manufacturer is one of many that pulled out of the event at the eleventh hour. It will carry out the work under its FlightSense asset management and maintenance programme.

The agreement extends an existing 14-year Collins-JAL partnership to cover maintenance on 51 787s through to 2025, the US firm says.

Collins will provide JAL with maintenance, repair and overhaul services, manage the airline's MRO supply chain and give it access to a global component network.

Additionally, Collins will offer the airline a range of technical support and custom reliability enhancements, and support JAL's in-house repair efforts, the company says.

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1st Floor, Chancery House,
St Nicholas Way, Sutton, Surrey
SM1 1JB, UK

HOW TO CONTACT US:
We are located at stand P103

Editor
Murdo Morrison
murdo.morrison@flightglobal.com
News editor
Dominic Perry
dominic.perry@flightglobal.com
Executive director content
Max Kingsley-Jones
Online content manager
Amber Elias
Content team
Alfred Chua, Jon Hemmerdinger
Garrett Reim, Greg Waldron
Production
Clare Goldie
Copy editor
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DISPLAY OF AGILITY

By GREG WALDRON

F-22 shows off its moves during Sunday's rehearsals

BillyPix

The flying display at this year's show offers an impressive demonstration of capability, with the USA providing two fifth-generation fighters, and its August 1st demonstration team.

Making their flying debut appearances are a Lockheed Martin F-22 from the US Air Force, and an F-35B from the US Marine Corps.

The F-22 is the world's most advanced air supremacy fighter. The jet uses thrust vectoring to perform manoeuvres such as the power loop and tail slide. In the case of the latter, the fighter descends tail first before dipping its nose and recovering into a short dive.

The appearance of the F-35B is a nod to Singapore's decision to obtain the variant. The country's bid to become Southeast Asia's first operator of a stealth fighter received a boost in January, when the US State Department approved a possible Foreign Military Sale of up to 12 examples for an estimated $2.75 billion.

Initially, Singapore plans to obtain four aircraft to test the type's capabilities. Longer term, the F-35 could replace the Lockheed Martin F-16 in Republic of Singapore Air Force (RSAF) service.

In addition to a high-*g* performance, the F-35B's display will include a signature hover. This is enabled by its Rolls-Royce lift fan and the swivelling nozzle for its single Pratt & Whitney F135 engine. This demonstrates the type's short take-off and vertical landing (STOVL) capability. A STOVL aircraft is regarded as attractive for Singapore given the crowded island's limited space for air bases.

The debut Singapore appearance of the August 1st's AVIC/Chengdu J-10As is not without controversy, as it was announced days before the show amid Singapore's general ban on visitors who have been in mainland China within the last two weeks. The restriction stems from concerns about the spread of novel coronavirus.

Explaining the decision to allow the team in Singapore, show organiser Experia Events says the health of the team's pilots and crews was carefully monitored before they came to Singapore.

The J-10 family of single-engined fighters is a key asset for the People's Liberation Army Air Force, filling a role roughly equivalent to that of the F-16 in Western air forces. The August 1st team flies the J-10A, but more advanced variants of the jet, the J-10B and J-10C, have been developed.

The RSAF has again highlighted its creative flair for flying displays by pairing a single Boeing F-15SG with two AH-64D Apache attack helicopters. Over the years, the RSAF has developed a speciality for flying displays using dissimilar aircraft.

Past events have seen F-15SGs paired with F-16s, and F-16s paired with the now Douglas retired A-4SU Super Skyhawk.

Freight new future for older A321s

ST Engineering has revealed new business for the Airbus A321P2F programme as it works towards securing certification for the freighter conversion later this quarter.

The modification is being developed by ST Engineering, Airbus and their EFW joint venture. The first A321P2F post-conversion test flight was completed on 22 January from ST Engineering's facility at Seletar in Singapore. ST says it expects to receive European certification by the end of the first quarter of 2020.

Aircraft lease management specialist BBAM has confirmed a letter of intent (LoI) announced in June 2019 for several A321P2F conversions, says ST. It adds that BBAM's first A321P2F entered ST's Seletar facility in January, and modification of the second unit will start in March.

Meanwhile, Keystone Holdings, an ST Engineering leasing joint venture, has signed a LoI with Qantas for the conversion and lease of an A321P2F. The aircraft, which is leased by Qantas Group in the passenger role, will be converted and redelivered at the end of 2021.

Vallar

Jet Aviation has sorties all sorted

During the show, many prospective customers have a chance to sample the metal first hand with a sortie over the Changi site. Making sure these run smoothly is Jet Aviation, which has the contract from organiser Experia Events to support all demonstration flights.

These flights "allow OEMs and operators to showcase their products in an experiential manner, so passengers can experience the features and capabilities of the aircraft," says Louis Leong, Jet Aviation's vice-president regional operations for Asia.

Meanwhile, the General Dynamics subsidiary says it has received US Federal Aviation Administration authorisation to install aural alerting equipment on aircraft at its Hawker Pacific centre in Cairns, Australia.

The system alerts pilots with a warning sound as they approach an exceedance, and complements Pratt & Whitney Canada's engine diagnostic systems.

The company has also added a Gulfstream G550 to its European, Middle East, African and Asia management and charter fleet. The long-range jet is based in Switzerland.

FARNBOROUGH FLYING

Farnborough International

The organiser of the next big air show after Singapore – Farnborough – says it is expanding its facilities after experiencing record demand from exhibitors.

Farnborough International chief executive Gareth Rogers says: "We know that the convening power of Farnborough is the major factor driving demand for space; it provides an important opportunity for companies from around the world to meet and do business. We've had a great response from customers following moves by the Farnborough International team to establish a more informed understanding of their objectives. Exhibitors are moving beyond simply taking space – they're using the show as a platform from which to tell their organisation's story and are relying on us to provide solutions that amplify their presence."

Sustainability, future workforce and the emerging urban air mobility sector will be major themes for this year's event in July.

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AVIAGE EYES US AVIONICS BREAK

By **ALFRED CHUA**

Aviage Systems is known as the provider of avionics to Chinese airframer Comac's C919 narrowbody programme, but it is setting its sight on expanding the scope of its business.

Speaking to *Flight Daily News* before the Singapore air show, which it was forced to pull out of as a result of the Coronavirus ban on travel from China, Aviage chief executive George Chang said the company will continue its strategy of diversification, even while it continues to make strides in its core avionics business.

The Shanghai-based firm, a joint venture between GE Aviation and Chinese aircraft manufacturing giant AVIC, has identified three key growth areas in the short to medium term – avionics MRO, connectivity, as well as digital solutions. For one, Aviage is working to gain certification from the US Federal Aviation Administration (FAA) for MRO work on Boeing 787 avionics. It is already certificated by the Civil Aviation Administration of China for 787 avionics MRO, and in the longer term, on C919 avionics.

Chang says he is hopeful Aviage will secure FAA certification by the year-end.

"Ultimately, by the end of this year, we can extend our [avionics MRO] service to all our Asia-Pacific airline customers," Chang adds.

Aviage's plans to diversify the business have been ongoing for a while: in a 2018 interview, the company stated that diversification would allow it "to balance our revenue profile to ensure a long-term sustainable growth".

Still, Chang is cognisant of the potential challenges that could upend the company's growth strategy.

Aviage

Chang is hoping the firm will secure FAA certification for 787 by the end of this year

Talent acquisition is one such issue. Chang says that because the avionics industry is a fairly niche sector, it is hard to find "strong expertise" in the area. "The experienced avionics engineer that serves the civil aviation industry in China is limited," Chang says. He adds that "from a supply chain standpoint", there are also not many certified local partners it can work with in China.

SUPERJUMBO TO REMAIN BIG BUSINESS FOR LUFTHANSA

The Airbus A380's days may be numbered as a production aircraft, but Lufthansa Technik chief executive Johannes Bussmann expects the superjumbo to remain big business on the aftermarket for some time. The German MRO specialist is increasing its A380 capacity in Manila in anticipation of a rise in demand for interior overhauls from operators of early examples of the type.

"We are expanding because, even though the number of new aircraft is limited, there is a strong requirement for cabin reconfigurations," says Bussmann.

Lufthansa Technik Philippines (LTP) announced the construction of its latest, 10th hangar at the facility on the MacroAsia special economic zone at Villamor air base, Pasay City, in November. Bussmann says the hangar will become the hub for the company's A380 projects globally.

The facility, set up 20 years ago, serves various airlines, including flag-carrier Philippine Airlines, as well as Asiana Airlines , British Airways, Korean Air, and Saudi. Lufthansa Technik expects the move to add 400 jobs to a 3,200-strong LTP workforce at Manila, as well as at sites in Clark, Cebu, Davao, Kalibo and Puerto Princesa. The site will open next year.

Lufthansa Technik is one of the biggest MRO providers in the region. Its other operations include a thurst reverser repair business in Shenzhen, China, and it has a 20% shareholding in Ameco Beijing.

Bussmann says the outlook for the MRO sector this year depends on the effect of the coronavirus crisis. "It's difficult to have a clear view. I'm convinced we will see some groundings and even drop-outs if this carries on for some time. Lots of carriers are not in great shape to survive for many months," he says.

IN BRIEF

BOMBARDIER SELETAR BOOST

Bombardier says the expansion of its Singapore service centre will be completed in the second half of this year. The Canadian manufacturer, which had been planning to attend the show but pulled out over Coronavirus concerns, says the additional construction will make it the largest airframer-owned business aviation service facility in the Asia-Pacific region. The Seletar-based centre will more than quadruple its current footprint to around 40,000sq m.

EXECUJET ANNIVERSARY

ExecuJet is marking its 20th year as a Gulfstream authorised warranty facility in Australia. The Sydney-based centre supports the whole US business jet manufacturer's range, adding the largest G650 and G650ER in 2013.

Outsourcing drives AAR growth

The need for Asia-Pacific's expanding airline sector to find cost-effective ways to manage supply of aftermarket parts is driving business for specialist provider AAR as it expands its footprint in the region.

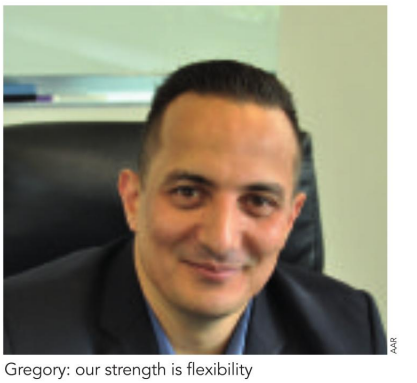
The US company, which offers spares support and repairs to operators, has warehouses in Singapore as well as Auckland. It also runs a six-narrowbody-bay MRO hangar in Nagpur, India, in a joint venture with Indamer Aviation, and is planning to expand that facility in the next year.

Colin Gregory, senior vice-president sales for Asia-Pacific, said young, expanding airlines keen to outsource their non-core activities are boosting prospects for AAR, which has served the region for more than 35 years.

"These carriers – not all of them low-cost – are looking for solutions that save time and bring the cost down. What makes us different is that we are flexible enough to be able to offer the solutions they need, whether it is just-in-time supplies or fixed pricing contracts over a period of time," he says.

Other near-term opportunities for AAR, which is marking its 65th anniversary at the show, include a spike in engines due for maintenance, as well as landing gear due 10-yearly major checks, says Gregory.

Chicago-based AAR was founded 65 years ago and employs approximately 6,000 people. It claims to have the third-largest MRO network in the world and has diversified into the defence market, supplying expeditionary services to the US military and the United Nations.



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BOEING BACKS MAX GROWTH IN ASIA-PACIFIC


Tinseth sees big potential for single-aisle sales in the region

Boeing

Boeing continues to see Southeast Asia as a strong future growth area, particularly for single-aisle jets, as it works to get the 737 Max back in the skies.

Randy Tinseth, vice-president of marketing at Boeing Commercial Airplanes, notes that Southeast Asia has seen a decade of strong growth, with three of the world's fastest-growing markets located in the region: Indonesia, Thailand and Vietnam.

"Developing and emerging economies have been a catalyst for growth in the market," said Tinseth ahead of the show. "As the economy and wages grow, so does traffic."

He points out that "not many years ago" only a small fraction of Southeast Asia's inhabitants had incomes over $20,000 – but that this number is closer to 55% today, ensuring the region stays among the world's fastest growing for air travel.

He also notes that in the past decade the region has seen a profound shift to narrowbody aircraft from widebodies. Boeing estimates that available seat kilometres (ASKs) generated by widebodies and narrowbodies in Southeast Asia is at parity, but within 10 years narrowbodies will account for the majority.

This translates into a 20-year narrowbody forecast for 3,650 units (for all manufacturers) and 820 widebodies, but just 10 main-deck freighters.

Tinseth observes that main-deck freighters are ideal for long flights between the Asia-Pacific, Europe and North America, but that within Southeast Asia belly-hold capacity is sufficient. Boeing's forecast of 10 sales is largely based on potential replacement buys by regional cargo operators such as Singapore Airlines and Malaysia Airlines.

The grounding of the 737 Max, however, has been a major setback for Boeing's narrowbody strategy in the region. The first of the two crashes involved a Lion Air 737 Max 8 in late 2018. Garuda, Lion, Malindo, Thai Lion and Silkair were all operating the type when the grounding was imposed.

Some executives have also expressed concern that the regulatory un-grounding of the type will be staggered among jurisdictions, creating markets where the jet cannot be flown.

LEAD REGULATOR

"There are a lot of regulators at the table," says Tinseth. "We continue to work with them all across the world. Clearly we're in a position where the FAA is the lead regulator, the regulator of record because of the US. We're making sure that we understand step-by-step, task-by-task what we have to do. Then we're taking those items and those tasks one by one, and working through them in a meticulous, thoughtful way."

A major aspect of the original 737 Max proposition was that 737NG pilots would require no simulator time to convert to the new variant. In early January, however, Boeing reversed its long-held position on this issue, stating that it now recommends simulator training. It is not clear if regulators will mandate training when the type is re-certificated, but a shortage of Max simulators globally could delay the return to service.

Tinseth, however, does not see simulator training being a major issue.

"I see it having a minor impact in recurring training going forward," he says. "Frankly it's a simulator session and pilots are going to be in a simulator every six months. It will be a little bit of a cost and inconvenience as we get these airplanes back into service. But the airplane has been out of service for so long that Max pilots have to go through recurring training anyway. All-in-all [simulator training] is the right thing for us to do."

Tinseth adds that customers who had been considering simulator training have effectively had the decision taken for them. "It's the right thing for the market and the right thing to get that confidence back with our customer and the flying public."

Tinesh stresses that the priority is the safe return to service of the 737 Max. This is intertwined with returning nearly 400 grounded aircraft to service, and then delivering the "close to 300 airplanes on the ground in inventory". He adds that, even before the 737 Max grounding, Airbus and Boeing were already selling aircraft for delivery in 2023 to 2024.

"I think we have customers out there that see the value proposition, and we'll be working with them to make sure they have confidence in the airplane, that their teams have confidence in the airplane, and that we restore confidence in the aircraft" he says.

"At some point the orders will come back. By having confidence in the airplane, that their teams have confidence in the airplane, and that we restore confidence in the aircraft," says Tinseth. "At some point the orders will come back."

FAA chief predicts uneven return for grounded fleet

The US Federal Aviation Administration (FAA) is confident that it can avoid a splintering of the design-change approval to the Boeing 737 Max by overseas regulators, but concedes the return to service is likely to be staggered globally.

"We need to draw a distinction between design approval and the operational process associated with un-grounding beyond that," FAA administrator Steve Dickson told the Aviation Club of the UK just ahead of the show.

"On the technical alignment with respect of the design change, I'm seeing pretty close alignment [with foreign regulators]. Probably as close as we've seen," he said.

However, Dickson, who is at the air show this week, warns that overseas authorities will not necessarily permit local operators to reintroduce their 737 Max fleets simultaneously with that FAA approval of the design changes.

"We need to recognise that any regulator around the world is going to understand their aviation system better than anyone else. So if they have to take additional actions in order to actually introduce the airplane into service, then we will certainly set that foundation.

"But they may want to go above and beyond that, and that's OK – and frankly that's what happens in any certification programme… because operational implications in terms of training and the competency of operators is something that that state regulator will have to look at."


Boeing

US safety authority recognises overseas regulators will want to examine the approvals it makes


The LSRAMs will be used on RAFF's F-18s

Australia on target for $900m LSRAM buy

Australia's prospective purchase of 200 Lockheed Martin Long Range Anti-Ship Missiles (LSRAMs) to equip the RAFF's fleet of Boeing F/A-18F Super Hornets has been cleared by the USA. Approved by the Defense Security Cooperation Agency on 7 February, the deal, under the Foreign Military Sales process, is worth $900 million. Should the sale proceed, Canberra will be the first export customer for the munition.

"Australia intends to use the missiles on its F-18 aircraft and will provide enhanced capabilities in defence of critical sea-lanes," said the DSCA. "The sale of the missiles and support will increase the [Royal] Australian Navy's maritime partnership potential and align its capabilities with regional baselines."

The deal includes training assets and instruction, as well as test equipment. No offsets are proposed as part of the deal.

The USA limits the sale of its cutting-edge weapons, especially its stealthy cruise missiles, but the potential sale of LRASM illustrates how important Canberra is to the Pentagon's strategy of countering the increasing presence of China in the Pacific Ocean. Crucially, Australia is a member of the Five Eyes intelligence sharing alliance – with Canada, New Zealand, the UK and USA – which means Washington trusts the country with its closest-held secrets.

The potential sale came after the US Department of Defense said in September 2019 that it wanted to increase its long-term acquisition total from 110 to a possible maximum of 400 missiles.

MAINTAINING READINESS

Boeing P-8A Poseidon is again making an appearance

US Navy

Although Southeast Asia is at peace, nations face clear defence challenges. We look at four segments that will be getting attention at this year's show

PRECISION WEAPONS

Southeast Asian governments are increasingly concerned about the potential for insurgencies at home, particularly in built-up areas. While airpower is but one aspect of dealing with such problems it can play a key role. Yet, it is essential in such situations to avoid collateral damage to people and property.

Regional militaries closely observed Manila's efforts to put down an Islamic insurgency in the town of Marawi in 2017. The campaign took five months and virtually destroyed the city. A source familiar with the conflict says that when Filipino soldiers spotted an enemy in a hardened position, their fear of friendly fire would force them to pull back before airpower was employed. The enemy, predictably, would move before the bombs arrived. This greatly slowed the campaign. Malaysia also had issues with precision weapons delivery when an armed gang from the southern Philippines invaded a small town in Sabah during 2013.

These incidents highlighted the need for the region's militaries to obtain precision ground attack capabilities. Some progress has been made, such as Jakarta's acquisition of Boeing AH-64E Apache attack helicopters and Embraer A-29 Super Tucanos. Similarly, Manila has an attack helicopter requirement and has ordered six Super Tucanos.

Still, a great deal of work remains to employ such systems effectively. In addition to training pilots, different branches of the region's militaries will need to work closely together to achieve maximum effect, for example ground units quickly passing actionable intelligence to fixed- and rotary-wing attack assets. Weapons are only as effective as those using them.

US Navy

MQ-8B Firescout UAVs can greatly enhance a warship's situational awareness

MARITIME SURVEILLANCE

Southeast Asia is defined by some of the world's most important bodies of water. To the north of Singapore, and closely embraced by Malaysia and Singapore, lie the Straits of Malacca, a crucially important chokepoint through which flows 40% of the world's trade.

Across the Malayan Peninsula lies the South China Sea. In addition to being a critical highway for shipping, there are significant offshore oil reserves. The region is riven with conflicting territorial claims, compounded by China's claiming the entire area for its own – and fortifying islets with radars and missile batteries.

To keep an eye on all this water, regional governments have placed increasing emphasis on maritime patrol aircraft and medium-altitude, long-endurance UAVs. Previous iterations of the Singapore air show have seen the promotion of aircraft ranging from light, twin-turboprop maritime surveillance aircraft such as the Viking Twin Otter all the way up to the Boeing P-8A Poseidon.

One challenge in the region is the proliferation of submarines. Beijing is rapidly adding to its submarine capability, as are other regional navies. In addition, the region has plenty of lower-level, but still pressing issues with piracy, smuggling, and fisheries violations.

ROTARY-WING UAVS

A prominent theme at last year's IMDEX naval show in Singapore were small, unmanned vertical take-off and landing (VTOL) aircraft that can be deployed from warships.

Regional navies are looking to fill a range of airborne roles, including the traditional intelligence, surveillance, and reconnaissance (ISR) mission, to parapublic work such as countering drug smuggling and human trafficking.

The opportunity is broad for providing small UAVs for ships ranging from small offshore patrol craft to larger corvettes and frigates. While standing up a VTOL UAV capability on a ship requires some investment, operating costs will be cheaper than operating large, shipborne helicopters.

A key advantage of VTOL UAVs with a helicopter layout is the ease of launch and recovery at sea. No catapult is necessary to launch the system, and no special equipment is required to recover it. All that is needed is a flat flight deck.

The trend in the region reflects a global interest in such systems. The Littoral Combat Ship USS *Montgomery* spent time in the South China Sea last year conducting work with a Northrop Grumman MQ-8B Fire Scout.

From the crew's perspective, the primary mission of the MQ-8B was ISR. By comparison, the ship's embarked Sikorsky MH-60S Seahawk was also tasked with missions such as vertical replenishment and search and rescue.

A small, easily-launched UAV could be of great use should a warship spot a speedboat several miles away, especially if the vessel cannot catch up. In addition to the ability to react quickly, VTOL UAVs offer a degree of persistence. Three MQ-8Bs embarked on a warship can provide 12h of continuous coverage out to 100nm from the launch coordinates.

FIGHTERS

In addition to Singapore's decision to acquire the Lockheed Martin F-35B, several neighbouring nations have pressing, even urgent, requirements for fighter aircraft.

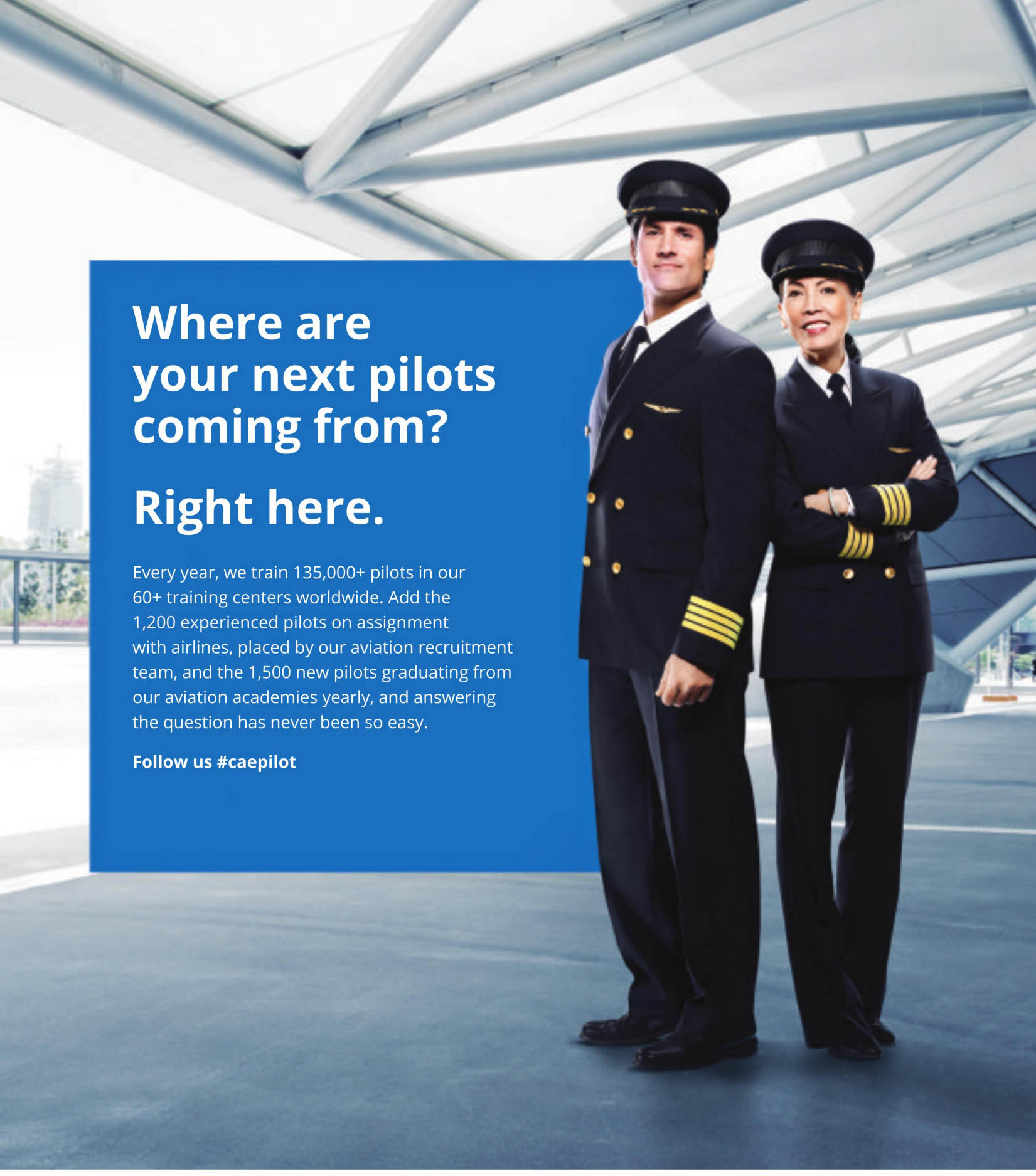
Kuala Lumpur has a requirement for 36 light combat aircraft. Contenders include the Hindustan Aeronautics Tejas, AVIC-Pakistan Aeronautical Complex JF-17, Korea Aerospace Industries FA-50, and the Yakovlev Yak-130. Funding, however, is a major challenge, so it is it difficult to gauge when, or if, the acquisition will be concluded.

Indonesia, meanwhile, wants to buy two squadrons of Lockheed Martin F-16V fighters. For years it has also wanted to purchase a squadron of Sukhoi Su-35s, but this deal with Russia appears to be held up by the threat of US sanctions.

Jakarta has expressed interest in the Dassault Rafale. In addition to these potential acquisitions, the country is a junior partner in the Korea Aerospace Industries K-FX fighter, although it has bickered about development costs.

The Philippines also wants more fighters to add to its 12 KAI FA-50s. The country is considering two single-engined types: the Saab Gripen C/D and the F-16V. The requirement is particularly urgent for Manila, which faces insurgency issues on Mindanao, as well as an increasingly assertive presence from Beijing in the South China Sea.

Vietnam has reportedly bought the Yak-130, and is apparently also interested in obtaining the Su-35. ■



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DEFENDING PROSPERITY

F-15SGs provide the backbone for the air force, with a detachment based at Mountain Home AFB in the USA

Greg Waldron/FlightGlobal

Tiny though it is geographically, the Republic of Singapore continues to punch well above its weight in terms of air capabilities in order to address two key strategic challenges

By **GREG WALDRON**

Air power is fundamental to Singapore's status as a sovereign nation. The tiny country, among the world's most prosperous, utterly lacks strategic depth. It relies on foreign nations for its food and energy needs. Its economy is highly exposed to global trade.

Yet despite its lack of landmass, Singapore's geography commands the vital chokepoint where the Straits of Malacca meet the South China Sea, through which passes the shipping that is the lifeline for the major powers of North Asia: China and Japan. Location has made Singapore rich, but this prosperity requires insurance in the form of a strong military, the backbone of which is the Republic of Singapore Air Force (RSAF).

Among its Southeast Asian counterparts, the RSAF is unmatched. In addition to a powerful force of fighter aircraft, it has invested in crucial enablers such as airborne early warning & control (AEW&C), air-to-air refuelling, force networking, and advanced unmanned systems. Moreover, it takes training and maintenance seriously. From the perspective of both capability and size, the RSAF resembles the large, powerful air forces of North Asia, as opposed to the somewhat ramshackle air forces of regional neighbours. While Singapore is on good terms with its neighbours and plays an important leadership role in the region, the country's leaders are mindful of the far larger size of nations such as Indonesia and Malaysia.

Perhaps more concerning is China. While Sino-Singapore ties are strong, Beijing is aggressively increasing its ability to project power into Southeast Asia. With no justification under international law, Beijing has laid claim to the entire South China Sea, where it has developed a string of island air bases.

A recent *New York Times* report detailed its development of a major runway in a remote part of Cambodia that will be able to support Chinese air power in the South China Sea.

Moreover, analysts speculate that its recently commissioned second aircraft carrier, the CNS *Shandong*, will spend most of its time in the South China Sea. Analysts fret that the South China Sea, not Taiwan, has the greatest potential to be a flashpoint between Beijing and the USA.

"Singapore is an important partner of the USA and Australia, which is also facing increasing pressure from a rising China that is clearly establishing control of the South China Sea, and seeking ultimately to get the Association of Southeast Asian Nations (ASEAN) into a compliant position that acquiesces to Beijing's interests," says Malcolm Davis, senior analyst, defence strategy and capability at the Australian Strategic Policy Institute.

TWO CHALLENGES

"For air power, Singapore has two challenges: how to respond to China's growing airpower reach, particularly if it forward deploys air power into contested territories on artificial islands in the South China Sea and also into bases in Cambodia; and how to protect its interests in the event of an intra-ASEAN dispute, notably with Malaysia."

Given this context, Singapore's most important air power move since the last Singapore air show in February 2018 was the decision to acquire four Lockheed Martin F-35s for testing purposes, with options for an additional eight. The early 2019 announcement was not entirely surprising: Singaporean leaders had hinted at F-35 interest for several years, and Singapore is an observer in the programme. The deal moved a step closer to reality in January, when the US Department of State approved the Foreign Military Sales case for up to 12 F-35Bs, finally confirming that Singapore will take the short take-off and vertical landing (STOVL) variant.

While long expected, the acquisition raises the stakes in the region, with Singapore to become the first regional operator of a stealth aircraft. The F-35B makes eminent sense, given Singapore's small geography and limited basing options.

The ability to disperse small numbers of F-35Bs in the event of a conflict would have an obvious attraction to the country's defence planners.

"The F-35 – and particularly the STOVL variant – makes sense for Singapore as it allows it to add a next-generation fighter that enables it to maintain mil-tech superiority over its neighbours and meet a long-standing power projection approach aimed at identifying, targeting and engaging a foe long before it reaches the country's borders," says Forecast International analyst Dan Darling.

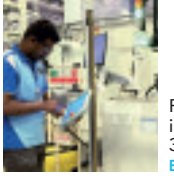
"Due to its limited land area and thus its vulnerability to enemy air strikes and missile/rocket strikes on its runways, the STOVL capability eliminates the need to line up aircraft on an airfield, instead giving the RSAF the ability to disperse its fleet, rather than subject them to being hit on the ground or rendered inoperable due to damage to its runways."

He adds that the F-35 will enhance interoperability with two key allies – Australia and the USA. Defence minister Ng Eng Hen has spoken of the stealthy type replacing Singapore's powerful fleet of 60 Lockheed F-16s. Still, the F-16 will be around for a while yet.

Most or all of the fleet will be upgraded to the F-16V standard, with improved avionics and Northrop Grumman's APG-83 active electronically scanned array (AESA) radar. Following the upgrade programme, the F-16V is likely to serve into the 2030s.

FORMIDABLE FLEET

The mainstay of RSAF power remains its fleet of Boeing F-15SGs. A descendant of the US Air Force's F-15E Strike Eagle, the F-15SG is the most capable type in Singapore's air force. It includes the Raytheon APG-63(V)3 AESA radar; the Lockheed Sniper targeting pod; an infrared search-and-track sensor; and an Israeli-supplied electronic warfare system. Officially, Singapore has 24 exam-



Robotics, artificial intelligence and 3D printing
Engineering p21

ples, but the actual number is understood to be 40. While Singapore's defence establishment is quite open on topics such as its participation in international exercises and humanitarian relief work, it tends to be coy about its order of battle.

To co-ordinate this comprehensive aerial armada Singapore has the region's most advanced airborne early warning capability. This comes in the form of four Gulfstream G550 AEW&C aircraft, modified to carry Elta Systems' EL/W-2085 multi-band radar.

Another major development in the past two years is the arrival of the Airbus Defence & Space A330 multi-role tanker transport. Singapore confirmed an order for the type in 2014 and received its first of six examples in 2018. The type has replaced the RSAF's geriatric fleet of Boeing KC-135Rs and made its overseas debut during Exercise Forging Sabre, which ran at Mountain Home AFB in Idaho in early October 2019 – the RSAF has a detachment of F-15SGs located at the base.

Other examples of RSAF capability growth include the final operational clearance of the Israel Aerospace Industries Heron 1 unmanned air vehicle (UAV) system in 2017, and the 2016 decision to acquire an undisclosed number of Airbus Helicopters H225M and Boeing CH-47F rotorcraft, as part of a fleet modernisation programme. The Caracals and Chinooks will respectively replace the RSAF's existing AS332 Super Puma and CH-47SD helicopters.

Greg Waldron/FlightGlobal

Service operates four modified Gulfstream G550s with Elta EL/W-2085 radars fulfilling an AEW&C role

These have been in service since 1983 and 1994, respectively.

Given the vital importance of open sea lanes, Singapore places a high premium on maritime awareness. In the maritime patrol mission, it operates five Fokker 50 MPA Enforcer Mk 2 aircraft, which also have an anti-submarine warfare capability.

These aircraft have been in service since 1995. In a 2018 interview, the former chief of the RSAF, Major-General Mervyn Tan, said the country would continue to operate them as long as "it is operationally and economically feasible… We will explore further upgrades or procure new systems when necessary to ensure we remain capable of meeting Singapore's security needs."

If exhibits at the 2018 Singapore air show are anything to go by, Singapore is willing to consider some innovative approaches to maritime patrol missions, including extended use of UAVs for roles such as deploying and monitoring fields of sonobuoys. At Singapore's biennial IMDEX naval show in May 2019, several UAV makers said they see significant potential in the region for small, unmanned vertical take-off and landing (VTOL) systems that can be deployed from warships. Such systems would be highly effective operating from Singaporean naval vessels.

Davis gives the RSAF high marks, yet notes distinct strengths and weaknesses: "In terms of strengths, there is clearly a qualitative edge generated by advanced technology capabilities, notably networked and joint forces with high sustainability and readiness and a recognition that absence of territory means they have to project power in a timely and responsive manner. Weaknesses – I'd say that lack of strategic depth is always going to be a challenge if they face a major power like China, or if their neighbours were to suddenly adopt a more modern approach to force development." ■

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Leading The Situational Awareness Revolution

INNOVATION CENTRAL

By ALFRED CHUA

Singapore is eyeing a leading role in advanced engineering, with aviation sector companies based there developing a number of techniques including robotics, artificial intelligence and 3D printing

Rolls-Royce campus at Seletar Aerospace Park in northern Singapore is employing automation in fan blade casting

At Rolls-Royce's sprawling facility in Singapore, the robots are feeling the heat – literally.

Inside the engine-maker's Trent fan blade manufacturing facility – the only other such plant besides R-R's Derby headquarters – the robots take the lead in a process known as super plastic forming. They place a titanium alloy fan blade into a furnace, twist it and inflate it with inert gas at high temperature, which results in an aerodynamically efficient hollow structure.

The machines, which were jointly developed with local company KA Industrial Engineering, were introduced to the Singapore production line in the second quarter of 2019. R-R's Derby unit will be installing them this year, FlightGlobal understands.

The automated process replaces one that usually requires three workers, decked in protective suits. The workers would use a manipulative platform to carefully place the blade into the furnace. Using robots improves productivity, safety and quality, R-R says.

The manufacturer's Singapore campus now has two production units – an engine assembly plant, which makes Trent 1000s (for Boeing 787s) and Trent 7000s (for Airbus A330neos), as well as the fan blade facility.

But R-R's advanced process is only one example of innovation and technology that aerospace companies in Singapore have adopted.

The city state may not have an indigenous aerospace programme, as its Asian counterparts China, India or Japan have, but it is home to a sizeable number of aerospace industry companies – 130 in total.

Many, like R-R, set up shop at the Seletar Aerospace Park in northern Singapore. The park is managed by state-owned JTC Corporation and besides R-R, counts Airbus and Pratt & Whitney as tenants. Plans for the park were first unveiled in 2006, as part of a push to tap into the growing Asian aerospace industry.

STEADY GROWTH

According to figures from Singapore's Economic Development Board (EDB), total aerospace industry output was worth S$8.9 billion ($6.6 billion) in 2016. The industry has also seen an 8.6% compound annual growth rate over the past two decades, the board states. And Singapore accounts for 10% of global MRO output.

The city state was named the "aerospace city of the future" in 2016 by the *Financial Times*, which said at the time it had outperformed other countries in attracting investments and was an "attractive location for innovation".

On the other side of Seletar Aerospace Park lies another engine-maker's facility, and one where innovation is also making its presence known.

At P&W's component solutions unit, processes are getting assistance from automation. The engine-maker announced last September that the facility is automating inspection, engraving and machining loading, which will help improve inspection quality and part inspection time.

P&W's component solutions unit will be the first in the world to pilot these "transformational" work processes, and is part of four Singaporean aftermarket units that are embarking on a digital transformation, as part of the wider "connected factories" initiatives announced in June 2019.

The engine-maker's joint venture with Singapore Airlines Engineering – Component Aerospace Singapore – is going to incorporate artificial intelligence (AI), as well as robotics, into its work processes.

It states that it will pioneer the use of an "AI robotic visual-aided system with self-learning capability", as well as automation using robotics, to "streamline labour-intensive, manual processes".

P&W's blade and vane repair specialist, Turbine Overhaul Services, will be introducing AI into its inspection process. The technology, P&W says, will be a proprietary process called Piece Part Inspection.

The connected factories initiative, which these projects are part of, will "enhance product quality, improve order fulfilment time up to 30%, reduce machine idle time up to 30% and reduce energy consumption by up to 10%", P&W states.

The company is also studying additive manufacturing closely. Brendon McWilliam, P&W's executive director for aftermarket operations in the Asia-Pacific region, tells FlightGlobal: "We are very close to industrialising an MRO process involving our first printed part for the PW4000 engine and hope to have that by the Singapore air show in February."

Home-grown company ST Engineering has also been at the forefront of pushing innovation through its work processes. Its aerospace unit has touted a future with "smart MRO", which involves adopting a myriad of advanced technology.

In one example, drones equipped with 3D scanners inspect aircraft fuselages for defects. Last June, ST Engineering said it was partnering with Air New Zealand for such trials, under its DroScan system.

Drones are being used to inspect the carrier's 777s during heavy maintenance checks at Singapore Changi airport, cutting inspection time from 6h to 2h. The drone takes a planned route around the aircraft's exterior, taking a series of high-definition pictures that are then processed by specialist software to detect and classify defects.

> **"We are very close to industrialising an MRO process involving our first printed part for the PW4000"**
>
> **BRENDON MCWILLIAM**
> *Executive director, aftermarket operations Asia-Pacific, Pratt & Whitney*

ST Engineering is also adopting a number of other forms of advanced technology, such as augmented reality, AI and automation.

"Augmented reality glasses provide technicians with visual cues for each task and provide remote connectivity support, while wrist-worn devices track the activities in real-time," ST Engineering says.

The company is also looking at going paperless in its work processes. "Images of defective parts are uploaded for direct assessment and approval of replacement parts. Information collected will feed into the data analytics server for predictive analysis," ST Engineering adds.

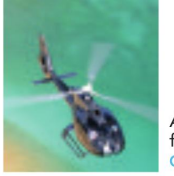
Airbus, which has a large facility at Seletar as well, has used its Singapore base to explore what the "hangar of the future" would look like.

Launched in 2016, the project calls for research into new technologies that can improve the efficiency and productivity of MRO operations. Examples include using 3D printing and data analytics.

Boeing, meanwhile, has chosen Singapore for its largest Boeing Training & Professional Services facility. It has six full-flight simulators and four flight training devices and is one of only two Boeing sites in the world that can also train engineers and technicians to support composite structure maintenance on the 787.

SMART TECHNIQUES

When it announced plans for a Singapore plant in 2007, R-R hailed its proposal as a "factory of the future", representing "an important step forward in the development of the Trent programme and in [R-R's] wider relation- »



Airframers look for long-term lift
Civil rotocraft p26

»ship with Singapore".

R-R in 2017 also touted its Seletar campus as "a centre of gravity" for Singapore's digital transformation, particularly with reference to the country's aerospace sector.

"Innovation is in Rolls-Royce's DNA and it is fuel for Singapore's ongoing transformation. The Applied Technology Group, one of Rolls-Royce's innovation 'strike teams', is located in the Seletar Campus," the engine-maker says.

"The group's objective is to develop advanced technologies to support core business areas – including aerospace, marine and power systems."

It adds that it is also committed to growing the pool of local talent, through tie-ups with local tertiary institutions, for example.

McWilliam says the company is "confident that Singapore will remain an important market in the wider aerospace value chain, especially as demand for air travel by consumers in this region continues to grow".

He also notes that the Asia-Pacific region is home to P&W's "most comprehensive aftermarket presence" outside its US home.

"[Singapore] is also a fantastic place to incubate new innovations such as our connected factory initiative, especially with the support from organisations such as Singapore's EDB and the Agency for Science, Technology and Research," McWilliam tells FlightGlobal. ■

Pratt & Whitney component unit has improved quality control by implementing robotic inspections, engraving and machining loading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AIRFRAMERS LOOK FOR LONG-TERM LIFT

Southeast Asia could offer big opportunities for rotorcraft manufacturers, but low average GDP and tight regulations mean growth may be steady, rather than spectacular

By **GREG WALDRON** SINGAPORE

Those who have seen the film *Crazy Rich Asians* may have received the impression that civilian helicopter operations in Southeast Asia are a simple matter of "get in and go". One scene depicts a trio of three (clearly digitised) VIP helicopters flying in close formation from Singapore to a container ship sailing in the South China Sea where an outrageous bachelor party is being held. Later, seeking some quiet time, a best man and groom (one of whom happens to be a pilot) rotor off to the Malaysian resort island of Rawa, where they land on a floating platform next to a fishing dock.

In reality, non-military helicopter operations in Southeast Asia are still subject to a good deal of regulation – although this varies by country – and flights have to be planned a good bit in advance, sticking to pre-planned routes. The region's billionaires are certainly able to afford a helicopter jaunt to a party, perhaps even a mega yacht, but such expeditions are not as easy, or as common, as they would be in the USA, Europe or the Middle East. Still, the region of 500 million people represents an important frontier market for the sector.

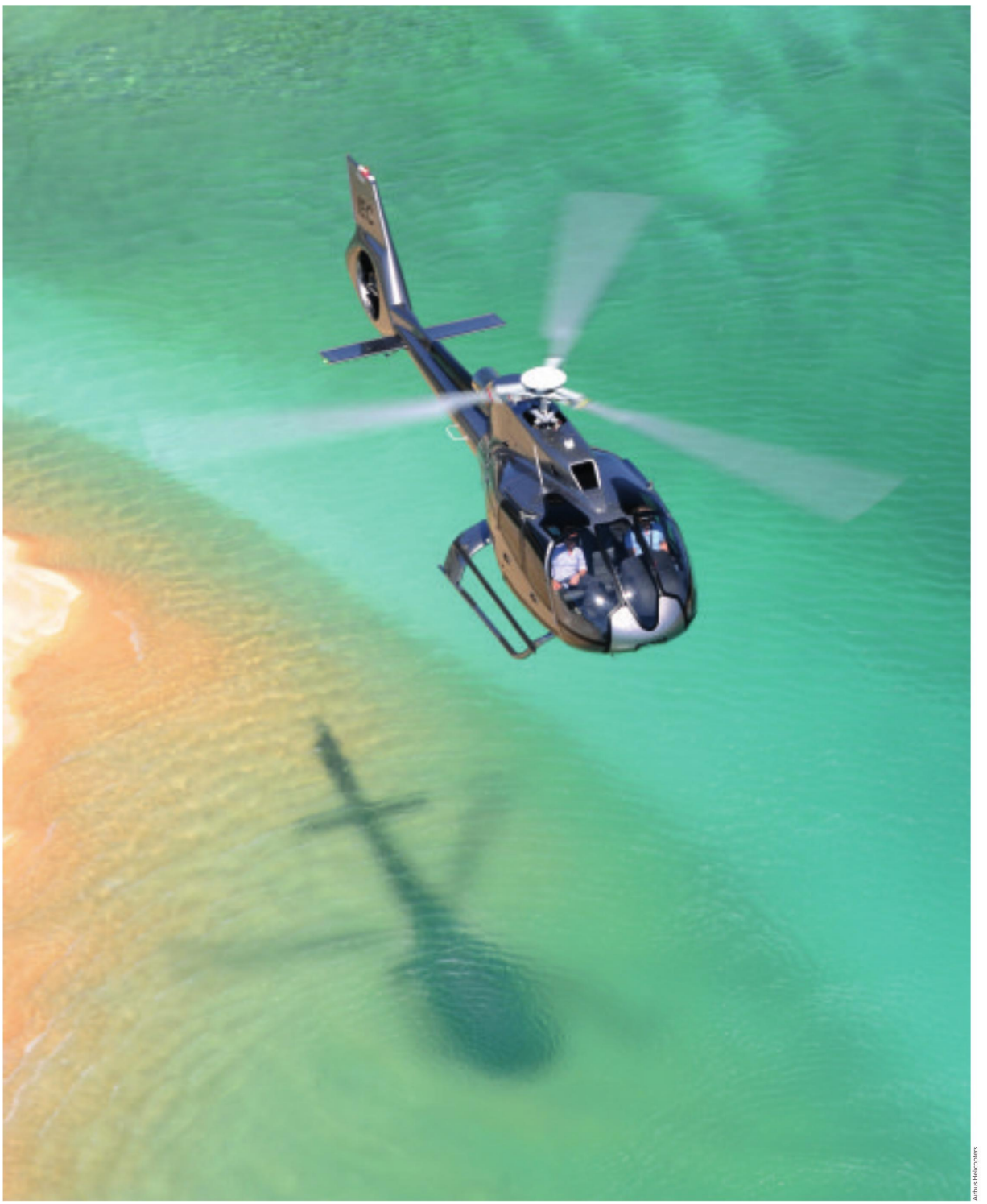
Cirium fleets data indicates that as of January 2020 there were about 679 non-military turbine helicopters between the 10 nations that comprise the Association of Southeast Asian Nations (ASEAN): Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam. This is a 4.9% increase from 646 non-military helicopters in January 2019, and a 15% increase over the 565 in January 2015.

"While we do not expect a significant surge, we should see a steady growth in the next one or two decades," says Vincent Dubrule, head of Asia-Pacific at Airbus Helicopters. "We see fleet growth that will more or less follow GDP growth, meaning that all manufacturers will deliver around 2,500 helicopters in the entire Asia-Pacific over the next 20 years."

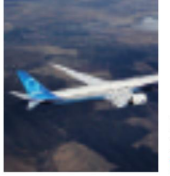
Key focus areas for Airbus Helicopters in Southeast Asia this year, and at the Singapore air show, will be the H145, which can be used for a number of parapublic missions; the super-medium H175; and the 6t H160.

While the overall numbers suggest respectable growth, they hide significant usage trends. Over the past five years the number of helicopters used for business purposes, such as air taxis, charters, and private companies, has grown to 216 from 164 – a 32% increase. The number of utility helicopters has grown to 141 from 129, and the region's police helicopter fleet has risen to 109 from 86 five years ago. That said, continued weakness in energy markets has seen the number of helicopters dedicated to the offshore mission decline to 110 examples from 122. Industry sources suggest that a good number of the region's offshore support helicopters are under-utilised, if not grounded altogether.

Vincenzo Alaimo, Leonardo Helicopters' vice-president of sales for Asia-Pacific, says there are signs of life in the beleaguered offshore energy sector, however – particularly in Malaysia, where oil comprises a significant proportion of GDP. He acknowledges that things have slowed down over the past few years,



Airbus Helicopters



High hopes for Boeing 777X
Programme p28

particularly in flight hours, but notes that national oil firm Petronas is looking to renew its contract with helicopter operator Weststar Aviation Services, which could drive a fleet update.

Cirium fleets data shows that the company is a major operator of Leonardo products, with 19 AW139s, four AW189s and two AW169s. The average age of the AW139s is 7.6 years, and it also has a single Sikorsky S-76 that is 13.9 years old.

Another area showing considerable vibrancy is the use of helicopters for business transport in traffic-congested cities such as Jakarta and Manila. In Jakarta, Whitesky Aviation has set up more than 70 helipads around the capital, ferrying customers from the airport into the city and to other cities on Java. The company's fleet is comprised of two Bell 505s, two 429s, and a single Airbus Helicopters H130. The company has been able to greatly reduce the time required to file flightplans.

SPIN DOCTORS

One area that has seen marginal (if not disappointing) development is dedicated emergency medical services (EMS), although manufacturers have talked this segment up as a growth area. Cirium shows that in January, the ASEAN states had just nine dedicated medevac/air ambulance helicopters, compared with seven five years earlier – though other assets may have basic EMS capabilities, such as the ability to transfer a patient on a stretcher. By comparison, Switzerland has 10 medevac helicopters for its population of 8.7 million.

"EMS is always difficult in this part of the world, just because who pays for it?" says David Sale, managing director for Bell Asia-Pacific. The issue of cost in a region characterised by relatively low GDP per capita is echoed by other industry observers.

Sale points to Thailand as a country that is making progress, with the police taking on the mission. While he believes the EMS mission is still in its infancy in the region, he says governments will increasingly take on the role of providers. He adds that as part of its efforts to promote the mission, Bell held an event in China – which emphasised not just the helicopter aspect of EMS, but also the organisation and infrastructure required.

Sale adds that the Singapore air show will see the company promoting the new Bell Subaru 412 EPX, which is making its show debut there. The company hopes to sell the updated type, which is being built in Japan as part of the country's UH-X acquisition, to operators of the legacy Bell 412EP and 412EPI.

Russian Helicopters is also keen to develop its presence in Southeast Asia. Owing to the broad usage of military types – namely, the Mil Mi-8/17 family – it estimates that the region has "more than 1,100 registered" aircraft of Russian or Soviet Union manufacture.

In 2018 the company conducted a tour of the region with the new Kazan Ansat and Mi-171A2 helicopters. During the visit, Russian Helicopters director general Andrey Boginskiy pegged the company's share of the Southeast Asia market at 2%, but said that it aimed to increase this to 5-7% by the mid-2020s.

Whitesky Aviation has more than 70 helipads in Jakarta and two Bell 505s in its fleet of five

Bell

One challenge manufacturers see in the region is in the area of maintenance, particularly for government-owned helicopters. In some cases, regional governments will put out support tenders and select the lowest-cost provider. In the case of overhaul or major maintenance work, however, it can be difficult to assess the total cost of the work before opening up a helicopter and looking inside. Moreover, there are often cases where helicopters are not maintained correctly by operators.

"Some of the military customers and governments are slightly changing the approach, although there is another obstacle to consider – the involvement of local companies in MRO," says one industry executive. "There is always this push to develop local capabilities."

SAFETY FIRST?

One OEM executive involved in helicopter MRO tells stories of losing bids for component work to companies without proper accreditation or experience. Then, a week or two later, the tender's winner will reach out seeking parts at an uneconomical rate. Overall, he says, this dynamic can damage readiness and potentially have safety implications.

To help with this, the big OEMs have a growing service presence in the region: Airbus Helicopters and Leonardo Helicopters operate extensive maintenance and support facilities in Kuala Lumpur's Subang airport. Bell has a large presence at sister company Textron Aviation's hangar at Singapore's Seletar Aerospace Park.

"An important point for ensuring the successful operation of helicopters abroad is after-sales service," says Russian Helicopters. "We are taking a number of steps in this area. Today, there are more than 20 service centres in Africa, Southeast Asia, Latin America, Europe and the Commonwealth of Independent States countries, some of which are certified by Russian Helicopters repair organisations."

While the focus of the Singapore air show tends to be defence, followed by commercial aviation, it is also a key venue for civil helicopter OEMs. Southeast Asia may not be set to drive a boom in helicopter sales yet, but the region's steady growth makes it an important long-term market. ■

CAMPAIGN KICK-OFF

Boeing has begun the certification effort for the 777X, with the first example taking to the air in late January. The airframer is hoping a strong sales start for its big twin will lift some of the gloom resulting from the prolonged 737 Max grounding

777X uniquely positioned to capture replacement widebody demand, says manufacturer

Boeing

By **JON HEMMERDINGER**

Boeing's 777X flight-test programme finally got under way when the first aircraft roared off Paine Field's runway on 25 January.

The flight marked a notable spot of positive news for Boeing, which has been mired for months in the 737 Max issues. Now the 777X flight-test programme is moving forward and counting down to first deliveries, which Boeing says will occur next year.

The first flight-test 777-9, designated WH001, had flown four times as of 6 January and is based at Boeing Field in Seattle.

Over the next year, that aircraft's job will include testing avionics and related system, brakes, flutter, icing, stability, control and low-speed aerodynamics, Boeing says.

Three more 777-9s, all of them currently on Boeing's Everett flight line, will join the test fleet and be flying by the second quarter, Boeing says.

The second aircraft, WH002, will test auto-land, ground effects, stability and control, while WH003 will test the auxiliary power unit, avionics, flight loads and propulsion performance.

WH004 will test the environmental control system, extended twin-engine operations, noise and general functionality and reliability, Boeing says.

CERTIFICATION TIMELINE

The Chicago-based airframer declines to provide specific details about its certification timeline, but industry experts expect flight testing will take about one year – a fairly standard duration that would put certification in January 2021.

"We're taking the lessons learned from the 737 Max and applying them to the 777X to ensure we are as prepared as possible for 777X certification," Boeing says.

"Given the unknowns around development programmes as well as the certification process, we do not want to be overly specific about hours of testing or timing."

Experts doubt the 737 Max crisis will significantly impact 777X certification, though say it will likely spur closer review of safety analyses and pilot response assumptions – concerns raised by the two deadly Max crashes.

"I really anticipate a fairly smooth ride. A very diligent and methodical and smooth ride," Michel Merluzeau, an aerospace analyst with consultancy AIR, says of 777X certification. "The real area of focus will be the engines and flight control system."

The Max crisis stemmed from Boeing's decision to counteract the narrowbody's nose-up pitch tendency with a system that pushes the nose down. Assumptions about how pilots would respond to erroneous activation of that system also played a role, investigations concluded.

But the 777X does not have an Maneuvering Characteristics Augmentation System-like system, Boeing confirms. And, regardless, its advanced fly-by-wire system could address any unexpected pitch, says Peter Lemme, an aerospace consultant and former Boeing engineer, who worked on several of the manufacturer's commercial aircraft flight-test programmes.

Boeing says it intends to certify the 777X as a 777 variant, not an entirely new aircraft.

That could enable the 777X to take "credit" for some validation work performed by the first-generation 777, though the extent of the 777X's updates are likely to mean such credit would be limited, says Lemme, who himself participated in flight tests for several Boeing commercial aircraft.

Boeing stretched the 777X's fuselage and equipped it with a new and larger composite wing. The 777-9's fuselage measures 76.7m (252ft), almost 3m longer than the 777-300ER's fuselage, which enables the 777-9 to carry about 30 more passengers.

The 777X has a 71.8m wingspan – 7m longer than the span of the 777's metallic wings. Due to concern about airport constraints, Boeing equipped the 777X's wings with folding tips, each 3.4m long, which retract upon landing.

The 777X also has new-generation engines – GE Aviation GE9X powerplants, which can throw off 105,000lb thrust (467kN). Issues with the GE9X's stator vanes delayed the first 777X flight several months, though GE insists it fixed the problem.

Flight-test programmes typically involve a few thousand hours of flight time, with a handful of test aircraft flying several times weekly, says Lemme.

For example, the Airbus A350-900 flight-test campaign lasted 15 months and used five aircraft flying some 2,600h.

Lemme calls flight testing "opportunistic" due to unpredictable weather, and notes unforeseen issues such as bird strikes or inaccurate aircraft performance assumptions can cause delays.

The first few weeks typically involve simply proving the aircraft flies as engineers anticipated, Lemme says. The team is "hyper-focused on demonstrating… that the airplane is a good airplane".

Flight-test programmes then typically move to validating engineering models and assumptions related to aerodynamics, engine performance and fuel flow. Next may come more-advanced tests involving system and engine failures and performance at hot and cold temperatures and with crosswinds, tailwinds and headwinds, Lemme says.

Flight-test aircraft might carry as many as 15 or 20 people during flights, including two pilots, a test director who instructs the pilots, flight engineers and mechanics who monitor data, instrumentation engineers who monitor computers and sensors, and flight-test engineers who work with the pilots, Lemme says.

'ABUSE' TESTS

Testing will involve what Lemme calls "abuse" tests such as full-brake rejected takeoff tests and tail-strike-inducing "velocity minimum unstick" tests, which determine the minimum speed at which the aircraft will fly.

Boeing says the 777X, thanks to its additional passenger capacity and new wing and engines, drives down unit costs. It says the aircraft will cost 10% less to operate than previous-generation competitors such as the 777 and A350-1000.

"We believe the 777X will be very successful in the market and continue to extend the 777's operational and sales success," the company says.

The 777-9 will have 7,290nm (13,500km) range and carry up to 426 passengers in two classes, while the 777-8, development of which remains on hold, will have 8,730nm range and carry up to 384 passengers, Boeing says.

But sales have been modest. Boeing holds 309 firm orders from carriers such as All Nippon Airways, British Airways, Cathay Pacific, Emirates Airline, Etihad Airways, Lufthansa, Qatar Airways and Singapore Airlines, its figures show.

But Boeing predicts – and analysts agree – that orders will uptick in the coming years as airlines retire existing widebodies.

Boeing of course pitches the 777X as a replacement for 777s, of which 1,458 remain in service, according to Cirium fleets data. But it also views the 777X as a replacement for 747s, Airbus A340s and A380s, of which a combined roughly 880 remain flying, Cirium shows.

Boeing says the "replacement demand cycle is just beginning". Airlines could retire 60-100 older widebodies annually starting within a few years and lasting to the end of the decade, Boeing says.

"The 777X is uniquely positioned to capture the replacement demand and help airlines grow as it is the largest and most-efficient twin-engine airplane in the world, unmatched in every aspect of performance," Boeing says.

But, unlike in the past, the 777 no longer has its market segment cornered. Airlines can now choose from several ultra-long-haul widebody options, including the 777X, A350 and, to some degree, 787-10, analysts note.

"The 777X is facing a fragmented market," Merluzeau says. He suggests the 777X might grab around 45% of ultimate market share, with the A350 and 787-10 taking the rest.

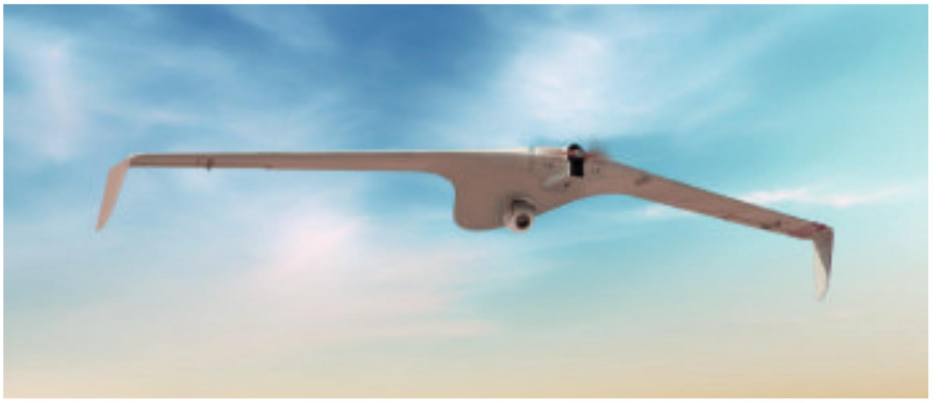
He suspects Boeing will produce 800 or 900 units in the next roughly 20 years. "It's going to have a nice, very strong niche, and will do very well," Merluzeau says. ■

BirdEye 650D – a Small Platform with Big Potential

As a world pioneer in the field of Unmanned Aerial Systems (UAS) since the 1970s, Israel Aerospace Industries (IAI) has miniaturized and automated UAS systems to provide the tactical user with organic UAS assets that are agile, compact, lean and capable to deliver battlefield intelligence, surveillance, target acquisition and reconnaissance (ISTAR) in real time.

While users at the national security levels, air forces and navies often operate large UAS that fly missions for days over very long distances, the land forces operations require systems with different capabilities. While uncompromising on ISR performance, military tactical users, law enforcement and counter-terror units, border and coast guards need much small UAS that can be operated by the troops as organic assets. They need systems that can deploy anywhere the unit may go and be ready to move on short notice and be independent of an airstrip for its operation.

Small Tactical Unmanned Aircraft Systems (STUAS) often operate at medium altitude and short range where they are least noticed by adversaries. Key to this category are the new generation of multi-sensor payloads are light and compact to fit into STUAS and deliver imagery at the same level, or even better than their bigger brothers.



The BirdEye 650D Aerial Vehicle

Introduced in 2016, BirdEye 650D answers all those requirements, and more. A blended body 'flying wing' design with four-meter wingspan, BirdEye 650D weighs only around 30 kg but carries six kilograms of useful payload, fueled and equipped for a 15-hour missions. Powered by a small gasoline fueled engine, it can soar to altitude of 15,000 ft, dash at 80 knots maximum air speed or loiter over the target at half that speed, securely linked with the control unit up to 150 km.

Aerial Segment

Different types of payloads can be used, including a mix of EO/IR and other types. Specific payload functions and performance may vary according to the user preference, but often includes full stabilization of multiple sensors, wide and narrow field of view, and various automation functions such as moving target trackers.

With minimal visual and acoustic signature, the drone looks to the naked eye like a bird of prey when flying at 3,000 ft above ground, therefore, it can be deployed without drawing suspicion on the ground.

The drone is also designed for automatic rail launch and safe retrieval at a designated point, even on rough terrain or at a small clear in a jungle. Using a belly placed parachute that opens on the terminal descent, the parachute flips the drone on its back, protecting the payload from ground impact.

Ground Segment

Designed for operation with ground forces, BirdEye 650D has a small logistical footprint, as the whole system requires one vehicle and trailer to operate, with the trailer providing the storage, preflight procedures and catapult launching. The trailer accommodates three air vehicles, a service and test bench, lift and accessories and a pneumatic rail launcher.

The trailer is designed for quick field deployments, as it takes up to 60 minutes to set up or tear down. Undergoing extensive user tests, the 650D have passed a recent evaluation with flying colors. That test included using numerous field deployments, air mobility missions with internal and sling loads. Using a trailer to support the system enables users to deploy the system using standard logistical tucks, rather than dedicated vehicle platforms.

The unit is manned by three persons operating mission command, control, communications and logistics in dismounted configuration or form the vehicle's cabin. Mission automation and autonomy make BirdEye 650D simple to launch, fly, control and retrieve. The ground control system employs automatic mission modes and functions that support mission planning and operations. Once launched on the mission, the drone follows the preplanned flight path or conduct a semi-autonomous flight that adapts to changing conditions or mission developments, to cover new points of interest defined by the user.

The primary mission for STUAS platform such as the BirdEye 650D is intelligence, surveillance, target acquisition, and reconnaissance comprising multi-sensor EOIR payloads and signal interception. Other missions carried out by the BirdEye 650D are coastal security and homeland defense. On such missions the drone can be launched from ships at sea, carry out a long patrol up to 150 km from the shore, then, lands on the coastline. The drone also proves highly effective in homeland security, border protection and emergency response, being able to quickly deploy and conduct long surveillance missions in response to emerging needs.

Argentine is one of the countries using the BirdEye 650D for border security. On such missions, drones are launched automatically from forward bases, to conduct routine missions along borders, sending live video streams to the guard posts, upon the completion of their missions the drones are retrieved automatically at the designated points nearby.

On other missions the drone can operate mapping, monitor oil, gas and electrical distribution lines, manage water reservoir and pollution over land and sea, and perform rapid surveillance of disaster areas.

Since the completion of development in 2016 over 400 BirdEye 650D systems have been sold to customers worldwide, including Brazil, Argentina and Vietnam. As the world pioneer in the field of unmanned aerial systems (UAS) more than 50 customers use IAI's UAS, from large Medium Altitude Long Endurance drones to STUAS that have flown over 1,800,000 operational flight hours.

CITY OF DREAMS

Singapore is positioning itself as a test-bed for novel forms of urban air mobility, and linking with developers like Volocopter

By **ALFRED CHUA** SINGAPORE

Against the backdrop of the iconic Marina Bay Sands in downtown Singapore, an aircraft takes off, circles the Marina Bay area for 2min, and lands. That may not sound remarkable in itself, but it was the first-ever manned flight in an Asian city for urban air mobility company Volocopter, which used its 2X prototype for the test flight in October last year.

Meanwhile, halfway across the island at Nanyang Technological University (NTU), Professor James Wang has been building up a team of researchers, and is actively on the hunt for funding and industry partners. His goal? To build the first made-in-Singapore electric vertical take-off and landing (eVTOL) aircraft within a decade.

As the urban air mobility scene heats up across the world, Singapore has joined the growing number of cities studying the concept closely, even if it is taking small, cautious steps.

In Asia, Guangzhou was last August chosen as an urban air mobility testbed city by Chinese autonomous unmanned air vehicle firm EHang. EHang's foray into urban air mobility has been gathering pace, with the company having conducted more than 2,000 test flights so far. It recently made its first test flight in the USA, and is working towards getting certification for unmanned air vehicle flights in the country.

Airbus is also aware of broad opportunities in the Asia-Pacific region for urban air mobility. In an August 2019 interview with FlightGlobal, the airframer said it was hopeful that urban air transport would become more affordable and accessible in the coming years.

MAIDEN SORTIE

Back in Singapore, Volocopter's maiden sortie last year was part of the German firm's efforts to bring commercial air taxi services to the city state. It was also the last stage of tests – which began early last year – to verify and validate Volocopter's ability to fly over the Marina Bay area.

Volocopter's plans to run test flights in Singapore were first unveiled in 2018, on the back of trial flights in Dubai a year earlier. The company has also constructed a prototype of its VoloPort in Singapore, collaborating with UK ground infrastructure developer Skyports. The VoloPort has been described as "the world's first vertiport for electric vertical take-off and landing aircraft". Volocopter adds that VoloPorts "are the only physical infrastructure required for air taxis and they are one important step to commencing operations in cities".

The Civil Aviation Authority of Singapore (CAAS) has told Singapore's media that air taxis have the potential to transform mobility and logistics in urban cities – and Volocopter, CAAS says, is at the forefront of such new and innovative technology in the aviation industry. "CAAS is pleased to work together with Volocopter to study the technical capabilities and develop appropriate operational guidelines to facilitate such trials in Singapore," the authority says.

In 2018, CAAS also earmarked a drone estate in western Singapore "to facilitate the trial of innovative UAS [unmanned aircraft systems] technologies and commercial use-cases in a controlled urban environment". As of 2018, there were at least five entities, including Airbus, cleared to test new technologies in the area.

The CAAS has also worked with the European Union Aviation Safety Agency (EASA) and Airbus, to develop safety standards and regulatory requirements for the use of unmanned aircraft

Could Singapore see the first e-taxi network?

Volocopter

Business of survival
Israel p31

First Volocopter X2 test flight in Singapore took less than 2min

Volocopter

systems in urban environments.

According to Wang, Singapore is well placed to be at the forefront of the push into urban air mobility. The country, he tells FlightGlobal, has the advantage of being "the gateway to Asia". "We are very close to China, Japan, Australia – so if we can develop this technology here in Singapore, we can export it and also [be the provider] of [the] technology to Asia and beyond," he says.

Wang, who heads the university's eVTOL Research and Innovation Centre, notes that Singapore is also home to an educated workforce: "It is a good opportunity to train young people in Singapore, and put Singapore on the world map for aerospace and transport technology."

He adds that, at the moment, less than 20% of research on eVTOL and urban air mobility comes from Asia – but in 10 years more than 45% of eVTOL operations will be taking place in the region. This, Wang says, is why there is a good reason for research to begin in Singapore, and is the reason NTU has launched a research institute, the first of its kind in the region. Because the industry there is still in its infancy, the "barrier to entry is not so high yet", he says.

PUBLIC IMAGE

Despite the exuberance in getting urban air mobility off the ground, challenges remain. One key concern for the urban air mobility industry is how to "manage its public image", says Wang. Given the relatively new concept, all parties will need to carefully ensure public perception – a key issue for the fledgling industry – does not become negative. "It is a whole new start, a clean slate for the eVTOL industry. It should be pitched as a slick, green and different concept," he says.

The challenges of urban air mobility were discussed at last year's Unmanned System Asia exhibition. Forum panellists underlined that safety is, by far, the primary consideration as the industry develops.

Maintaining communications with unmanned air systems will be a challenge. Another major issue will be wind and weather, particularly for the smaller unmanned vehicles such as drones. Other major hurdles, raised during the panel discussions, included infrastructure, traffic management, and even the business model under which air taxi operations are run.

Some argue that, given Singapore's relatively small size and well-designed public transport system, there may not be the need for an urban air mobility system. But while Singapore is no Tokyo or New York in terms of urban density, there is still opportunity for urban air mobility to take root.

Wang points out one example of a route an eVTOL aircraft could take in Singapore: from Changi airport to Sentosa Island. This would cut down travel time between both points, help alleviate ground traffic and "improve the image as a modern city".

The aim, Wang adds, is to make it "price competitive", to attract people to use air taxis.

In terms of regulation, Wang is generally optimistic. The Singapore government, he says, is "encouraging" of urban air mobility as a future concept. That Volocopter was able to conduct its test flights in Singapore is indicative of the receptivity of the authorities towards such a concept, he says. The Unmanned Systems Asia panellists shared similar sentiments.

NEW CONCEPTS

While regulations vary widely between countries in areas such as flight clearance, generally the world's watchdogs understand the potential for urban air mobility and are engaged in the process of how to help the new industry develop. One way to allow for better regulatory oversight would be to have a "sky bus" concept, with designated pick-up and drop-off points at regular intervals, Wang says. This would be easier to control and plan, he notes.

Much still has to be done to push the urban air mobility concept in the mainstream, but hopes are high that, one day, air taxis in Singapore will be just as ubiquitous as the many taxis currently on the city state's roads. Until then, researchers such as Wang are doubling down on their work. "Perhaps you can put in a plug for me, that we [at NTU] are looking for financial partners to help us fund our work," he jokes. ■

BUSINESS OF SURVIVAL

Rafael's acquisition of Aeronautics takes it into UAVs for the first time

Aeronautics

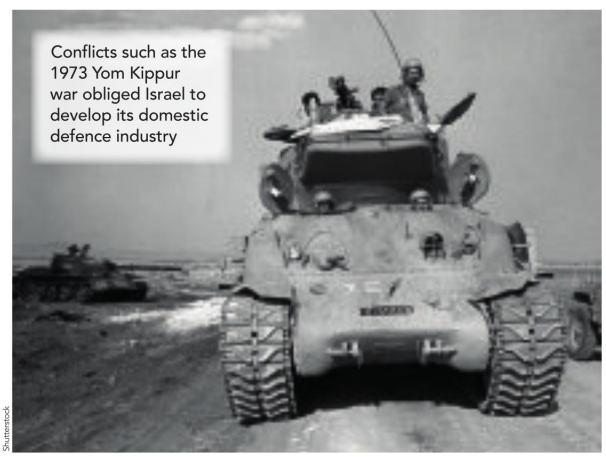
Israel's aerospace and defence sector is pivotal in guaranteeing the nation's existence – but success also depends on winning lucrative export business

By **MURDO MORRISON**

No country perhaps has a defence sector as entwined to its national security interests as Israel. Surrounded by hostile territories from its birth in 1948, the Jewish state had to rapidly establish a military-industrial complex to supply its armed forces with assets they could not source from abroad. That capability was put to the test in clashes that threatened the infant state's survival, including 1967's Six-Day War and the Yom Kippur conflict in 1973. And today, with neighbourhood tensions rising with Iran and its proxies, an innovative, capable, and responsive domestic industry remains as crucial as ever.

A first-class education system and national service among Israel's Jewish population of around 7 million has helped maintain a talent pool of engineers and developers and close-knit links between customers and suppliers. Almost all of those who work in the defence industry have hands-on experience of its products as users in the military or reserve.

However, the aerospace and defence sector has had to look beyond Israel's tight borders to fully flourish. Despite the country's constant war footing, Israel's defence spending as a percentage of GDP – at 4.3% in 2018 – was less than half that of Saudi Arabia, which spent 8.8%, according to research by the Stockholm International Peace Research Institute (SIPRI). Israel is the eighth-biggest arms exporter in the world, says SIPRI, behind much larger countries such as the USA in first place, followed by Russia, France, Germany, China, the UK and Spain.



Conflicts such as the 1973 Yom Kippur war obliged Israel to develop its domestic defence industry

Shutterstock

COMBAT PROVEN

Elbit Systems, Israel Aerospace Industries (IAI) and Rafael have been successful largely because they have managed to market their technology overseas – often with a "combat proven" endorsement from the domestic customer. Elbit in particular has also boosted its revenues with major overseas acquisitions, while a considerable proportion of IAI's sales come from the commercial sector, including a unit manufacturing business jets for Gulfstream and an airliner freighter conversion business, almost all the output of which is exported.

At home, the industry has seen consolidation since our previous country focus in early 2018. In November that year, four big contractors to the Israeli government became three when Elbit completed its $495 million acquisition of weapons and land systems house IMI Systems – formerly Israel Military Industries – expanding the reach of the industry's number-two player into munitions.

State-owned rival Rafael, Israel's third-biggest aerospace and defence firm, swooped for venture capital-backed Aeronautics in September 2019 – in a 50:50 purchase with a private investor worth $240 million – propelling the missile and air defence specialist into unmanned air systems (UAS) proper. The move also tightened Rafael's control of Controp, a maker of specialist cameras and surveillance systems, which it co-owned with Aeronautics.

Elbit – the aerospace and defence company with the largest overseas industrial footprint – extended its reach further. It followed its takeover of Tucson-based general aviation cockpit equipment specialist Universal Avionics in March 2018 with the $350 million acquisition in September last year of L3Harris's Night Vision unit. The US-based business had been divested in the wake of the merger between L3 and Harris, and the acquisition has increased Elbit's considerable US presence.

Rafael's takeover of Aeronautics with businessman Avichai Stolero will see the company integrate some of its missile technologies with Aeronautics' competencies in developing UAS. The latter's range spans the man-portable Orbiter 2 to the medium-altitude, long-endurance Dominator, based on the airframe of the Diamond DA42 general aviation aircraft.

Aeronautics deputy chief executive for marketing and sales Dany Eshchar, says the new ownership structure gives the Yavne-based business – with revenues of some $200 million, less than one-tenth of those of Rafael – "more of a strategic future" and "makes us much stronger". Its venture capital backers had funded the company through a crucial period but were "coming at it purely from a financial perspective", he says. "We needed both a technical and a financial backbone. Government-owned Rafael gives us that."

The takeover means Aeronautics will be able to more easily integrate its platforms with Rafael's sensors and communications equipment. "Combining these technologies gives us a huge advantage," he says. "It means that we can now compete on big tenders – the ones for hundreds of millions of dollars, rather than the tens of millions we were used to. We are in the bigger guys' game, able to compete with the likes of Airbus, Northrop Grumman, Thales and Textron, as well as Elbit and IAI."

GUIDANCE CAPABILITY

Likewise, Elbit's merger with IMI allows the former – already one of the biggest names in UAS – to move into the market for loitering munitions, or at least bring the technologies under one roof. "IMI brings us munitions capabilities. We bring guidance capability," says Elbit chief executive Bezhalel Machlis.

Israel's aerospace and defence sector may seem a closed shop or cosy cartel, with defence ministers intent on carefully dividing the spoils of their budgets to keep each company in business, and Israeli citizens moving seamlessly from procurement or operational duties to industry, and often back again.

But that would be a misconception. The country's main players – and a number of smaller suppliers – remain fiercely competitive at home and abroad, aware that their future depends on developing affordable and reliable technologies that address the needs not just of the country's own military but dozens of foreign governments as well.

While Israel's defence sector may have a symbiotic relationship with its domestic customer, equally, no other national industry is more export-driven relative to its size. ■

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LOITERING WITH INTENT

Israel has long been a power in UAVs – but it is a changing market, with new intelligent missiles and an increasing trend towards miniaturisation

Aeronautics' Orbiter 4 can stay in the air at 10,000ft for 25h

Aeronautics

By **MURDO MORRISON**

From medium-altitude, long-endurance (MALE) platforms to loitering munitions and miniature reconnaissance types weighing a few kilogrammes, Israel has been a leader in unmanned air vehicles (UAVs) for decades.

Like much in Israel's aerospace and defence industry, invention has sprung from necessity. While the USA fast-tracked the development of indigenous UAVs for campaigns against a post-Cold War enemy in Afghanistan and Iraq, Israel's constant need to watch over hostile neighbours has spawned a home-grown capability that has kept the nation safe and turned companies such as Aeronautics, Elbit Systems and Israel Aerospace Industries (IAI) into prolific exporters of the technology. Israeli products are operational with customers from Azerbaijan to the UK.

INTELLIGENCE NEED

Israel began seriously developing unmanned platforms able to provide over-the-hill intelligence in the 1970s and 1980s, after the Yom Kippur and Lebanon wars, with IAI and Tadiran (a forerunner of Elbit) early pioneers. Today, Israel's big two aerospace and defence contractors – IAI, with its flagship Heron range, and Elbit, which is behind the Hermes 450 and Hermes 900 types – dominate the MALE market. Aeronautics – now effectively owned by Israel's number three, Rafael – is another significant player, with a range including a MALE and loitering munition platform but specialising in small, tactical UAVs. A newer name, UVision, focuses on loitering munitions, a segment in which IAI is also a major presence. Loitering munitions differ from cruise missiles in their ability to monitor potential targets for a long time, often providing real-time visual intelligence to the operator.

IAI's big talking point at Singapore will be the Heron Mk II, an updated model of the original Heron that is used by the Israeli air force and more than 20 other customers worldwide. IAI is pitching the Rotax 915 iS-powered type primarily at existing Heron users, stressing tweaks such as a "wider and stronger body structure" that allows additional payload, including larger sensors that allow it to "gather intelligence from tens of kilometres away without crossing borders", says the company.

It follows the launch last year of another member of the Heron family, the Tactical or T-Heron, which is 30% smaller than the standard version and, unlike its sibling, can be deployed by forces in the field without access to airfields, according to IAI.

Loitering munitions emerged in the 1980s with the likes of early versions of the IAI Harpy and address the need – says one Israeli industry executive – to "hit targets that you know are there, but not exactly where, because they might be relocatable". Since then, technology has allowed manufacturers to increase both their detection capabilities and their endurance, as well as to design ever-more compact variants. The IAI Rotem family, which can be launched by a soldier in the field, starts with a 3kg (7lb) version that carries a 0.5kg warhead and has a 15min

IAI's upgraded Heron Mk II vehicle will be on show in Singapore

Israel Aerospace Industries

»

endurance. The latest version in the IAI Harpy range is the Mini Harpy, a tactical system that combines detection of broadcast radiation – from the likes of enemy radars – with electro-optical capabilities that give the operator high-quality video footage of the target.

SURPRISE ATTACKER

Elbit's main offering in loitering munitions has been its electrically powered SkyStriker, which typically carries a 5kg warhead with a 10.8nm (20km) range, and which the company says gives units in the field "a silent, invisible and surprise attacker". However, Elbit's takeover of IMI (previously Israel Military Industries) has taken it into a new segment by giving it access to that company's range of heavy airborne munitions, including IMI's Delilah long-range loitering missile, a 135nm-range weapon fitted with a 30kg warhead that can surveil a target area before being activated (usually by an operator on a fighter aircraft).

UVision was established in 2011, with a management team largely drawn from other aerospace and defence companies, and, after spending "five or six years" developing its range, is now in full "operational mode", says its vice-president of marketing and sales, Shane Cohen. It has a full range of tactical loitering munitions under the Hero brand, but most interest is in three products, he says. The 3kg man-portable, canister-launched Hero-30 has a 0.5kg warhead and a 30min endurance and is pitched at anti-personnel missions. It is "combat proven", but UVision will not confirm with whom.

The 12.5kg, anti-tank Hero-120 is the company's "largest of its short-range systems", with a 3.5kg warhead, a range of 21.6nm and an endurance of 60min. Able to "track moving targets", the product was late last year "demonstrated under an order from a strategic customer", says Cohen.

The company's latest loitering munition, the 40kg maximum take-off weight (MTOW) and 81nm-range Hero-400, was unveiled in mid-2017. An 8kg tandem-charge warhead allows it to penetrate targets protected by reinforced concrete, says Cohen. UVision carried out a demonstration of the weapon in the USA last year and will "hold several more trials" during 2020, he says. A new folding-wing mechanism – "a technical challenge" – allows the Hero-400 to be deployed from a canister. The wings open in flight to improve aerodynamics, and a 2h endurance allows operators to "change the target or wait for one to become relevant", says Cohen. Ultimately, a mission can be aborted roughly 100m (130ft) before impact.

Canister-launched Hero-30 weighs 3kg and is designed for anti-personnel missions

UVision

NEW CAPABILITIES

Cohen says that what differentiates UVision from other loitering munitions manufacturers is "our range of capabilities", including a "top attack capability" derived from a cruciform four-wing design. "Most competitors have flat wings, but when you want to come in at a steep attack angle, you are fighting against the lift," he says. "It means we can come in through the thinner roof of a tank, for instance. Also, our gimbal-based camera means you can loiter and keep eyes on the target at all times."

UVision's strategy, he says, has been to bring affordable loitering munitions to field operations so that even platoons that might have been equipped with mortars can now "have the ability to have eyes on the target and strike from the same platform". He adds: "Until now, loitering munitions have been used as a strategic procurement. We have made it a tactical capability."

Small UAVs – surveillance platforms, rather than loitering munitions – are also crucial to Aeronautics' strategy. Dany Eshchar, deputy chief executive for marketing and sales, believes technology advances mean that operators can perform the same missions on smaller platforms. "With miniaturised sensors, you don't always need a 25kg payload – 3.5kg will allow you to see in very high resolution, which yesterday you needed 35kg for," he says. "The market today is asking for transportability, independence from an airstrip, a small logistics footprint and [for the device to be] easy for personnel in the field to operate."

MARKET FOCUS

The company offers the larger Aerostar and Dominator, but Eshchar describes the small tactical UAV market – which it focuses on with its Orbiter family (with 35 customers around the world) – as "huge", adding: "We have at least 10 tenders out there at $200 million and up. It's a segment that we excel at."

He describes the company's latest product, the catapult-launched, 50kg MTOW Orbiter 4, as a "game-changer" because it is able to carry two 6kg sensors, and stay in the air at 10,000ft for 25h, an endurance it demonstrated during a proving flight in December. "It's everything that you used to need a 1.5t aircraft for. Once you have this sort of performance, it's transformative. You can conduct a long mission beyond line of sight," he says.

> **"The Orbiter 4 is transformative. You can conduct a long mission beyond line of sight"**
>
> **DANY ESHCHAR**
> *Deputy chief executive for marketing and sales, Aeronautics*

Eshchar believes the MALE market will continue but, within "four or five years" the small tactical segment will squeeze out smaller MALE types. "At this stage there are sensors that cannot be miniaturised, but that will not be the case for long," he says.

The sector will then split into highly complex platforms that are able to operate at 25,000ft to 60,000ft and smaller types flying at around 10,000ft, with "nothing in between". He reckons that the Orbiter 4 – a development of the 30kg, electric Orbiter 3, in operation since 2010 – will eventually represent up to 50% of Aeronautics' revenue.

Elbit chief executive Bezhalel Machlis is less convinced that compact UAVs are the future. "Will the market go to smaller UAVs and swarms? It might be a direction, but I believe it has limitations. It is not just the UAV but the data network that comes with it. People are not buying UAVs, but solutions," he says. "We have both (small tactical and larger types), but with bigger platforms you can fit several systems, which you can control. Small UAVs can be more complicated to manage and to operate.

"They have potential at battalion level and in niche markets such as recoverable loitering munitions, which are very relevant for urban fighting. But in my opinion they will never replace big UAVs." ■

Controp's compact eyes in the sky make easy work of remote airborne surveillance

Like many in aerospace, Controp is constantly watching its weight. With the trend in unmanned air vehicles (UAVs) to smaller platforms, the Israeli pioneer in electro-optical/infrared surveillance cameras has been working on payloads that offer the same or better capabilities in a lighter package. Although the company's equipment is found on land vehicles, ships and ground installations, Controp is best known for its gyro-stabilised airborne iSky and Stamp ranges. "Our DNA is from UAVs, so we have a heritage in making things compact," says Nir Bar Natan, senior director of marketing.

Another driver for the company – founded in 1988 and jointly owned by Rafael and Aeronautics – is introducing artificial intelligence and combining its technologies into "systems" that can be installed on one UAV. Both of these factors were behind the launch last year of its latest additions to its Stamp family, the Stamp-VMD and its larger sibling, the T-Stamp-XD. The new products, says Controp, introduce a "complete ISTAR [intelligence, surveillance, target acquisition and reconnaissance] concept – covering a large area and closing the sensor-to-shooter loop in real time".

The Stamp-VMD, weighing 1.3kg (3lb), is pitched at group one UAVs (those lighter than 10kg) and optimised for flight below the cloud ceiling and coverage of areas up to 1sq km (0.39sq mile). However, its unique feature, for a product this size, says Controp, is an embedded processing unit that compresses and edits data before transmission, solving the problem of constrained bandwidth.

The T-Stamp-XD, a larger, 5.7kg unit designed for group two UAVs (weighing 10-25kg), is a surveillance and targeting system that guides munitions using laser technology, and includes an automatic video tracker that enables the operator to retain eyes on the target even when there is a communication loss. Controp describes it as "a game-changer in terms of optics performance versus weight".

A third new product being showcased at the Singapore air show is the MD-Stamp, which, at 1kg, is a miniature version of the T-Stamp-XD. Controp says it has many of the functions of its larger sibling, including a laser-designator capability that closes the sensor-to-shooter cycle on tactical missions, as well as supporting munitions with laser-homing seekers.

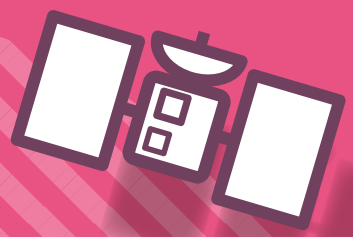
Despite its effective ownership by Rafael – following the state-controlled company's purchase of a 50% stake in Aeronautics last year – Natan describes Controp, which employs around 300 people, more than 40% of them graduate engineers, as "a small, vertically integrated business where we pride ourselves on personal contact with customers". He adds: "Everything is done in house, which gives us a lot of flexibility and control of our budget. We can deliver a solution to a customer very fast."

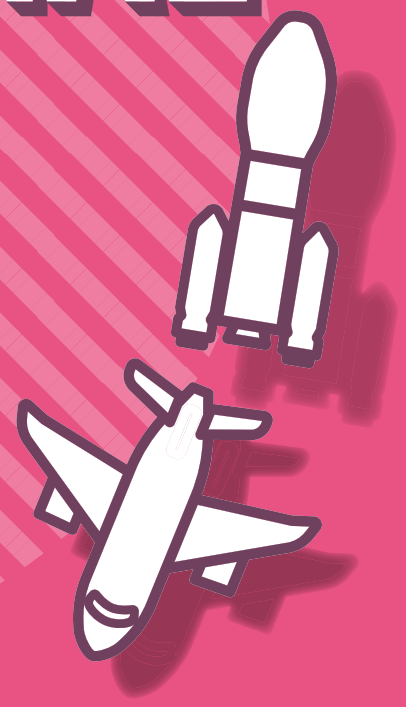
Stamp range is designed for smallest UAVs

Controp

The company's airborne ranges span the D-Stamp-HD, which weighs in at 850g (30oz), to the 29kg iSky 50HD, with other products including the iSea family for naval applications and the 90kg Speed-ER for border and coastal surveillance. Controp prides itself on the speed at which it brings products to market. "We launch three or four systems every year," says Natan. ■

JAPAN INTERNATIONAL AEROSPACE EXHIBITION 2021





Venue Tokyo Big Sight(Tokyo International Exhibition Center)

Sep 29 (Wed) to Oct 2 (Sat) 2021

Organizers : The Society of Japanese Aerospace Companies(SJAC)

Tokyo Big Sight Inc.

JAPAN AEROSPACE INTERNATIONAL EXHIBITION 2021

GLOBAL OUTLOOK

An Elbit Systems Hermes 900 UAV carries the SkEye wide-area persistent surveillance solution

David Azmon/Elbit Systems

Elbit, more than any other Israeli aerospace and defence concern, has expanded its international presence. Investing in innovation remains at the core of its successful strategy

By **MURDO MORRISON**

For Elbit Systems chief executive Bezhalel "Butzi" Machlis, being a truly international company means more than offering Israeli equipment to foreign customers. It is about operating as a "multi-domestic" player by manufacturing and developing products across a network of subsidiaries and joint ventures. "Our Israeli market is important, but our future growth will come from abroad," he says. "Our strategy is to extend our industrial footprint, but also our IP [intellectual property] in the West."

Elbit is unique among Israel's now big three aerospace and defence contractors in that it is stock market listed (rivals Israel Aerospace Industries and Rafael are ultimately owned by the government). The company has since its foundation in 1996 funded an aggressive acquisition strategy at home and overseas, from its merger with electronics specialist El-Op in 2000 – which propelled it into the big league in Israel – to its absorption of then-fourth-placed player IMI Systems (formerly Israel Military Industries) in 2018 and the former Harris Night Vision business late last year.

And while each of Israel's big three makes the majority of its revenues from exports, Elbit's proportion is particularly high at 80%, with 30% coming from the USA and 25% from Europe. "We are not government controlled, so it is a very different game," insists Machlis, an Elbit veteran who took over in 2013 from Yossi Ackerman, the boss behind the company's relentless expansion for 16 years. "Our strategy is to create innovation abroad, as well as in Israel, and become a truly global company."

That policy has seen Elbit establish sizeable footprints in, among others, Australia, Brazil, India, Switzerland, the UK, and the USA. The US market represents the biggest single slice of its revenues, and its Elbit Systems of America unit, which employs some 2,000 of the company's 16,000-strong workforce, will be the "centre of excellence" for its latest Night Vision acquisition. "That technology is not available in Israel, so that IP will remain in the USA," says Machlis.

The addition of IMI – a business more dependent on Israeli government contracts because of the sensitive nature of its products – should take revenues for 2019, the first full year of the combined business, to about $4.5 billion, compared with $3.68 billion the previous year. It also gives Elbit a foothold in munitions for the first time, to add to an extensive portfolio that spans unmanned air vehicles (UAVs), helmet-mounted and head-up display systems, electro-optical (EO) and countermeasures systems, electronic warfare and signals intelligence, and command, control, communications, computers and intelligence (C4I) capabilities.

Machlis is investing in AI start-ups

Ariel Shiloh/Israel Sun

This breadth of competencies and a high degree of vertical integration gives Elbit a "huge advantage when it comes to sharing technologies", says Machlis. "We can move them around depending on export controls and employ local citizens when there are local sensitivities." Elbit has also been happy to partner with other aerospace and defence companies on key programmes, including RUAG in Switzerland, Collins in the USA, and Thales on the UK's Watchkeeper surveillance UAV, which shares a platform with the Elbit Hermes 450.

COST SYNERGIES

However, while that "huge portfolio helps make us more efficient in terms of synergies and cost", Machlis admits that "it is difficult to maintain that leadership position without investing in R&D". Elbit, he says, invests 9% of its revenues, "double the usual percentage in the industry". Among the many fruits of this policy – and likely to be highlighted at the Singapore air show – is an airborne high-powered laser that builds on work by the company on miniaturised directed energy systems and improving stabilisation techniques on board aircraft.

The company has been a leader in military lasers for many years, coming up with the Music directional infrared countermeasures system in response to a government requirement to fit all Israeli airliners with defences against shoulder-launched missiles, following a failed terrorist attack on a passenger jet in Kenya in 2002. Since the system was declared operational in 2014, Elbit has marketed the Music range around the world, winning contracts from a number of governments for head of state aircraft and – in partnership with Diehl – from the German air force for its fleet of Airbus Defence & Space A400Ms.

> **"It is difficult to maintain that leadership position without investing in R&D"**
>
> **BEZHALEL MACHLIS**
> *Chief executive, Elbit Systems*

Its acquisition of Tucson-based Universal Avionics in 2018 not only increased its industrial presence in the USA, but took Elbit into the commercial market. It also merged the US company's "head-down" technology – flight management systems and other cockpit displays for business and general aviation aircraft – with the Israeli firm's speciality helmet-mounted and other head-up displays to create a wider portfolio of flightdeck products. This includes SkyLens, a wearable head-up display that shows images generated by Universal's enhanced flight vision system.

"We see a lot of synergies with Universal," says Machlis. "They can leverage our defence portfolio, selling helmet technology into the commercial market." In addition, Universal's presence in the MRO segment – much of its business involves retrofitting older aircraft with modern avionics – means Elbit can access a further base of customers. "The aftermarket was not somewhere we were really in before the acquisition," he says.

Another development already in service that Elbit describes as an "intelligence breakthrough" is its SkEye wide-area persistent surveillance solution, part of a trend that Sasson Meshar, vice-president of airborne optronic systems, maintains is taking intelligence gathering from "data processing to wisdom" by using artificial intelligence (AI). The system allows operators of the EO equipment to zoom into several local areas of interest at any one time, while maintaining an eye on a region up to 80sq km (31sq miles) in area. AI tools highlight connections between incidents that might be taking place in different zones.

"AI is an area where we are investing a lot, in the sensor itself, in EO and in EW [electronic warfare], but also at a system level in the form of big data," says Machlis. The firm has invested in a number of start-ups specialising in AI with a view to identifying "out of the box" technologies that could be used in its products. "This has potential to be a real revolution," he says. "If you combine AI and big data, you can create lots of intelligence, which is relevant to everything that we do." ■

Geared for success
Face the facts p41

DEADLY LEARNING

Rafael's latest Spice missile identifies targets using artificial intelligence, as the firm takes smart systems to a new level

By **MURDO MORRISON**

Rafael has been a pioneer of precision weaponry since the era when Israel's survival was still in question, but one of the defence technology firm's latest products – the Spice 250 air-to-surface munition – takes intelligent munitions to a new level. So asserts Gideon Weiss, vice-president of business development, marketing and strategy at the company's air and C4ISR systems division. "It is the first AI [artificial intelligence] weapon," he says.

Last year, the Haifa-based company tested and demonstrated a new automatic target recognition (ATR) capability for the smallest member of a family that has been in service since 2003 and also includes the larger Spice 1000 and Spice 2000 variants. The new, deployable-wing missile, which is not yet operational, has a stand-off range of 54nm (100km) and carries a 75kg (165lb) warhead.

It is intended mainly to attack moving targets and uses AI to "learn" specific target characteristics ahead of the strike.

> **"By scene matching it can make out a target with no human involvement"**
>
> **GIDEON WEISS**
> *Vice-president of business development, marketing and strategy, air and C4ISR systems, Rafael*

Once the pilot has selected the target type to be attacked, the weapons are launched towards the vicinity of the threats, initially using an inertial navigation system. On approach to the target area, the weapons switch to ATR to detect the target itself. The weapon then hones in on its quarry either autonomously or with the involvement of an operator, aided by an ATR algorithm. "By scene matching it can make out a target with no human involvement," says Weiss.

Spice is one of Rafael's flagship ranges. Unlike many long-range air-to-ground rivals, the weapons use electro-optical (EO)/infrared-based guidance systems, rather than GPS, which makes them immune to GPS countermeasures. The original variant, the 454kg-warhead Spice 1000, was last year recognised by the government with an Israel Defence Prize. Rafael also signed a teaming agreement with Lockheed Martin in 2019 to jointly develop, market and manufacture Spice guidance kits for the US market.

TACTICAL ARMAMENT

Spike is another key weapon family for Rafael, which is also expanding. A tactical armament, it is described by Gal Papier, director of marketing and business development for precision tactical weapon systems, as the first anti-tank EO missile in the world. The product originated from an urgent government request in 1973 after Israel was threatened by Egyptian and Syrian tank units. Originally ground launched, its capabilities have been developed considerably since then and it has been deployed on helicopters since 1985.

Two of the latest variants, which will very much be talking points for Rafael at the Singapore air show, are the Spike SR, for short range, and an enhanced version of the LR, the LR II. The 1nm-range, 10kg SR is a shoulder-launched missile for use at platoon level and as a stepping stone between unguided rockets and the larger Spike MR. Singapore's armed forces began to take deliveries in 2016 as the Spike SR's first export customer.

Meanwhile, the LR II is a fifth-generation missile that entered service in 2018 and is now used by six nations. The weight has been reduced to 12.7kg and its range is 3nm at ground level or 5.4nm from helicopters. Another addition is a datalink that allows operators to fine tune its mission during flight. Rafael has also unveiled a new variant of its longest-range Spike, the ER II, which can reach targets 8.6nm away when fired from a helicopter. The top of the range is the air-launched Spike NLOS – for "non-line of sight" – a missile that uses inertial navigation to seek targets 16nm distant.

All versions of the Spike are in service with 34 nations, including 19 NATO members, and operate on 45 platforms, says Papier. Among the company's marketing targets with the weapon is the German armed forces, currently looking to upgrade the missile system on its Airbus Helicopters Tigers. Rafael produces and sells Spikes in Europe through the EuroSpike joint venture with German companies Diehl Defence and Rheinmetall Electronics.

Lockheed Martin is to promote Spice in US market

Rafael

EXTENDED RANGE

Rafael's other products include the Python and Derby ranges of air-to-air missiles. It sells these to 13 air forces worldwide. The latest version of the latter, the I-Derby ER, takes its predecessor's range from 32nm to 54nm, thanks to the addition of a pulse device to its rocket motor, and is likely to enter service within three years. Rafael also co-operates with Raytheon on the David's Sling national defence system designed to intercept ballistic missiles and other long-range attacks, as well as with Israel Aerospace Industries on Iron Dome, a second shield of protection against short-range rockets and artillery shells.

Another main line is its Litening and Reccelite surveillance pods, new versions of which it unveiled last year, featuring a synthetic aperture radar mode. This sensor complements each pod's EO suite, adding to its surveillance range, and representing, says Rafael, a "quantum leap in all-weather" capabilities. Litening is used by 27 air forces, with some 1,900 units in service. Reccelite is in operation with more than 10 customers and integrated on fighters including the Eurofighter Typhoon and Saab Gripen. ■

How Israel is leveraging its aerospace industry's expertise to take a place in space

On 11 April last year, Israel landed an unmanned spacecraft on the Moon – but not quite in the way it hoped. Its *Beresheet* (Hebrew for "the beginning" or "Genesis") crashed on to the lunar surface after a seven-week journey designed to plant the nation "on the space map", "open a new horizon for the Israeli economy", and inspire youngsters to take up careers in science.

The 600kg (1,320lb) vehicle was designed by Israel Aerospace Industries (IAI) and the private organisation SpaceIL, and while the effort failed to deliver all its objectives, Israel has made a great play of the fact that it has now joined an elite group of countries – China, Russia and the USA – that have flown to the Moon, and is the only non-superpower to have done so.

IAI is industrial lead in satellite programmes, including the Ofek-11 surveillance orbiter

Israel Aerospace Industries

However, the Jewish state is no newcomer to the cosmos, having invested in its own satellite and launcher capabilities in the 1980s in an effort to establish an independent competence in Earth observation and satellite communications. It launched its first satellite in 1988 and is one of only seven countries able to conduct its own space missions. Since then, it has sent about 70 orbiters into space.

In addition, it has partnered on a number of international programmes, including the European Space Agency's ExoMars mission, and with France's space agency to construct the Venus Earth observation satellite, launched in 2017 and intended to monitor vegetation. The country's first astronaut, Ilan Ramon, died with six colleagues in 2003's Space Shuttle *Columbia* disaster. He had been the mission's payload specialist.

IAI is the government's space house, taking the industrial lead on all Israel's major programmes. However, Israel's other two big aerospace and defence players also play a role, with Rafael the champion of space propulsion – making tanks, thrusters and valves – and Elbit Systems specialising in electro-optical payloads, structures and communications.

Elbit has recently moved into the emerging field of so-called nanosatellites in its own right, launching its Nanova platform in December as part of a joint initiative with the USA to establish a commercial constellation. The 5kg CubeSat hosts an ultra-high-frequency communication payload providing a direct satellite link for data, voice and text messaging.

On a much bigger scale, IAI announced in January that it was to develop and build Israel's national communications satellite, Dror 1, intended to meet the country's satellite communication needs for 15 years. According to Boaz Levy, executive vice-president and general manager of the systems, missiles and space group, Dror 1 will be "the most advanced satellite ever built in Israel" with "state-of-the-art technologies" and "highly advanced digital capabilities". ■

BIG BROTHER

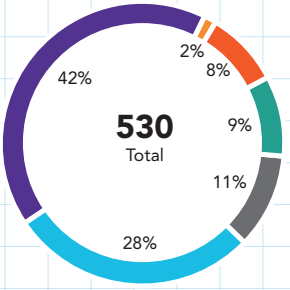
Paul Lewis/Boeing

Boeing

BOEING 737 MAX 10

Launched at Paris air show in 2017 as a rival to the A321neo, the largest and longest-legged Max family variant is expected to conduct its first flight in 2020

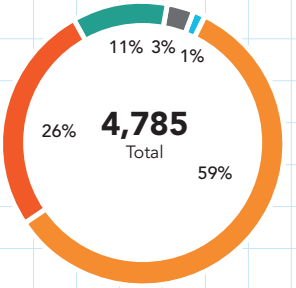
737 Max 10 total orders by region



Asia-Pacific	220
North America	151
Europe	56
Middle East	50
Latin America	45
Unassigned	8

Source: Cirium fleets data (January 2020)

737 Max family orders by variant



Max 8	2,801
Undecided	1,253
Max 10	530
Max 9	146
Max 7	55

Firm orders (including delivered aircraft)
Source: Cirium fleets data (January 2020)

42%

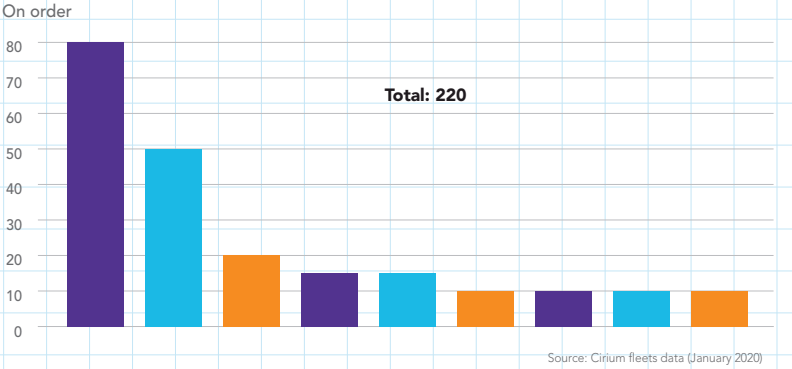
More than two-fifths of 737 Max 10 orders are from Asia-Pacific customers

737 Max 10 top 10 airline customers

Operator	On order
United Airlines	100
VietJet Air	80
Flydubai	50
Lion Air	50
Gol	30
SpiceJet	20
TUI	18
Copa Airlines	15
Virgin Australia	15
WestJet	12

Airline customers only
Source: Cirium fleets data (January 2020)

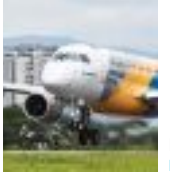
737 Max 10 Asia-Pacific customers



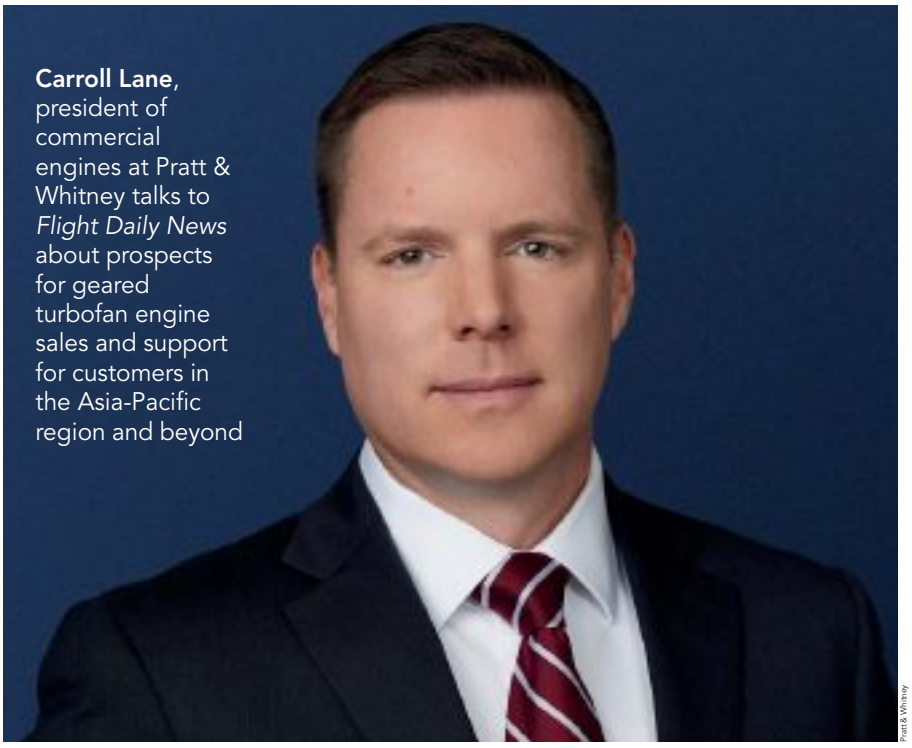
Source: Cirium fleets data (January 2020)

VietJet Air 80	Lion Air 50	SpiceJet 20	China Aircraft Leasing 15	Virgin Australia 15
BOC Aviation 10	CDB Aviation 10	Donghai Airlines 10	Malaysia Airlines 10	

FlightGlobal CIRIUM



Progress report
New aircraft p42



Carroll Lane, president of commercial engines at Pratt & Whitney talks to *Flight Daily News* about prospects for geared turbofan engine sales and support for customers in the Asia-Pacific region and beyond

Pratt & Whitney

ALL GEARED FOR SUCCESS

Q How would you characterise Pratt & Whitney's market presence in the Asia-Pacific?

A Pratt & Whitney is shaping the future of flight with our game-changing propulsion solutions for civil and military aviation, and the Asia-Pacific region is a critical market for our engines, products and services. The region will see tremendous growth in commercial aviation in the next 20 years, with more than 18,000 new aircraft required. Nearly 400 GTF-powered aircraft are currently operating across Asia Pacific, in addition to our sizeable V2500, GP7000 and PW4000-powered fleets, and the company has a large footprint in the region to support our growing customer base.

On the military side, there are more than 1,000 F100 engines in service, with customers in the Asia-Pacific region powering Boeing F-15 and Lockheed Martin F-16 fighter aircraft. There's also a growing fleet of F135s – which power the fifth-generation Lockheed Martin F-35, operated by South Korea, Japan and Australia. Additionally, IHI in Japan operates the first international F135 final assembly and check-out facility, and the first international F135 MRO and upgrade facility – located in Australia – will achieve initial depot capability later this year.

The regional, general, business and helicopter segments serve more than 1,200 customers who are powered by more than 10,000 of our engines in the region, which accounts for 15% of the total Pratt & Whitney Canada engine fleet in service worldwide. The APAC operational hub in Singapore provides those operators with 24/7 comprehensive support.

Q What can visitors to your stand at the air show expect to experience?

A This year marks 95 years since Pratt & Whitney's founding and we will highlight our heritage of innovation and the latest in propulsive technology. We plan to showcase our GTF engine architecture, featuring the revolutionary fan drive gear system that powers five aircraft platforms, enabling significant fuel savings, sustainable economic growth and new routes for our customers. Within our military portfolio, Pratt & Whitney's F135 propulsion system – the world's most advanced fighter engine – continues to redefine what's possible for our customers and their missions. And finally, our PW800 engine is the choice for long-range business jets, delivering performance and a cabin experience second to none.

Additionally, the company has a booth at AeroCampus and will host Career Talks for those interested in learning more about working at Pratt & Whitney.

Q The Airbus A320neo family – on which you compete with CFM International – is a very strong product in the region, but how optimistic are you for those aircraft programmes on which you are exclusive engine supplier – the Airbus A220, Embraer E2 family and Mitsubishi SpaceJet?

A Aircraft powered by GTF engines were delivered on six continents last year. We are seeing strong market interest in the Airbus A220, with a growing list of customers placing orders. There were 50 aircraft ordered by lessor ALC and 20 aircraft orders from Nordic Aviation Capital announced during the Paris air show last year. Air France ordered 60 A220 aircraft in July, with an additional 30 options and 30 purchase rights.

The Embraer E190-E2 will celebrate two years of revenue service in April with Norway-based Widerøe and last September, the first Embraer E195-E2 aircraft, the largest in the E-Jets E2 family, was delivered to Azul Brazilian Airlines. New E2 customers Helvetic Airways, Binter Canarias and Air Kiribati joined the GTF engine family. KLM-Cityhopper recently firmed up its order for up to 35 E195-E2 aircraft.

Q How does Pratt & Whitney's geared turbofan technology help operators reduce costs?

A Pratt & Whitney is focused on providing customers with fuel-efficient, environmentally friendly engines that help keep operating costs low. The GTF engine's geared fan enables all modules to run at their optimum rotational speed, reducing fuel, noise and part count. Operators enjoy fuel savings of up to 20% compared with previous-generation aircraft. GTF engines have saved customers more than $500 million in fuel and 2.5 million metric tons of carbon emissions since the engine's entry into service. Demand for the GTF engine is strong, with more than 10,000 orders and commitments.

Q MRO support is obviously one of the most crucial factors for airlines operating your engines. How would you describe your network in the region and what are your plans for it?

A The goal of the GTF MRO network is to provide the highest-quality maintenance support for our GTF engine customers. The company has a large and growing presence in Asia, with dozens of facilities and field offices, and thousands of employees.

Along with our MRO network partners, we are making significant investments to increase maintenance capability to support the GTF fleet. There will be 10 active GTF MRO engine centres worldwide by end of the year, with three in Asia-Pacific – ESA in Singapore, and IHI and MHIAEL in Japan. We are sharing best practices among the facilities to drive down maintenance costs, and using data analytics to leverage fleet-wide learnings. As MRO volumes continue to grow, the network is expected to expand, and we are continually evaluating to ensure we have the right footprint to support customers in each region.

We're continuing to invest in technology and infrastructure, including the introduction of our connected factories approach at our facilities in Singapore.

Through connected factory, we aim to drive efficient energy consumption, enhanced product quality, improved real-time maintenance, more efficient equipment operations, and improved supply chain management.

Q How is Pratt & Whitney employing big data analytics to help airlines manage MRO costs with predictive maintenance?

A Pratt & Whitney is continuing to invest to create customer value across our business. Our engineers and digital teams are developing advances in data analytics, an enhanced customer portal and new customer apps. With our eFAST data ecosystem, we are able to capture thousands of data parameters throughout the full-flight cycle, allowing us to better monitor engine performance, minimise disruptions and predict future maintenance visits.

For GTF fleets, we are collecting significantly more data at different times in the flight envelope, including at engine start, climb and descent. The engine incorporates 40% more sensors than the [International Aero Engines] V2500, and can generate approximately 4 million data points per engine per flight.

Our Advanced Diagnostics & Engine Management system is a suite of web-enabled software tools that analyzes the real-time health data of more than 8,000 engines in service to spot operational trends and maintenance issues early. This capability allows us to conduct proactive and targeted maintenance for our customers. ■

Pratt & Whitney

GTF undergoing maintenance at one of P&Ws MRO facilities in Asia

GET SET FOR SUCCESS

We update progress on half a dozen key commercial aircraft programmes that will be featuring heavily in the headlines during the course of 2020

Comac

C919: final prototype takes flight

Flight-testing of China's indigenous single-aisle, the Comac C919, reached a key milestone late last year when the sixth and final prototype completed its maiden sortie.

The 2h 5min flight of the CFM International Leap-1C-powered twinjet from Shanghai's Pudong International airport took place on 27 December. The aircraft, numbered 106, joins five other prototypes in the test campaign of the narrowbody. Launch operator will be Shanghai-based China Eastern Airlines and production has already begun on customer aircraft.

The advent of aircraft 106's testing campaign came shortly after the 5 December departure of aircraft 105 for Nanchang in northeast China. Aircraft 105 had its first flight in late October.

The fifth C919 test aircraft had completed its maiden flight from Shanghai on 24 October. It undertook a 1h 37min test flight, during which operational checks were conducted.

Comac says the fifth test aircraft will undergo tests primarily in extreme weather conditions: high heat and cold. It will also perform test flights relating to environmental control and drainage, as well as electrical supply.

Cirium fleets data shows that there are 305 firm orders for the C919. Comac has also secured more than 700 commitments.

FlightGlobal understands that the C919 is likely to enter service in 2021 or 2022, compared with the originally planned timeframe of 2020-2021.

E175-E2: Embraer seeks sales

Embraer aims to secure orders for the smallest E-Jet E2 variant in the coming months as it targets non-US customers for the E175-E2. Meanwhile, production of the original E175-E1 could continue alongside the re-engined variant "for ever" as Embraer awaits a widening of the US scope clauses.

The first Pratt & Whitney PW1700G-powered E175-E2 was flown on 12 December, despite Embraer currently holding no firm orders for the latest and final E-Jet derivative to be developed.

Embraer Commercial Aviation chief executive John Slattery told FlightGlobal this January in Dublin that flight testing is progressing on "a timeline of two years for the certification".

He expects the first E175-E2 delivery could take place "somewhere between the end of 2021 and first quarter of 2022. I'd like to be delivering an aircraft by December 2021."

While there are no firm orders, Embraer holds contractual commitments from US carriers SkyWest and Trans States which are subject to a change in the US pilot scope clause regulations to enable the E175-E2 to be compliant.

"My team is working on securing firm orders in the first half of this year outside the US and we have a high degree of confidence… in [securing] meaningful orders," Slattery says. "There is plenty of demand in Western continental Europe and Southeast Asia and other jurisdictions."

Embraer

Boeing

777-9: campaign gets under way

Boeing is steadily building up the flight-test hours on the first 777-9 airframe, following the successful completion of big twinjet's maiden flight on 25 January.

The 3h 51min first flight signalled the start of at least a year of flight testing for Boeing that will involve four 777-9 test aircraft.

Boeing says it is aiming to begin deliveries in 2021. Launch customer Emirates had been expecting to take delivery of its first 777X by mid-2020, but the schedule has been subject to a major slippage after an extensive delay to the first flight, resulting from a design issue with its GE Aviation GE9X-105B powerplant.

The first aircraft, designated WH001, was unveiled to Boeing employees at its Everett, Washington production plant in March 2019 and had been expected to fly within months. However GE discovered it required a late redesign to a stator in the GE9X's high-pressure compressor, which has kept the 777-9 grounded until January 2020.

WH001 finally took off from Everett's Paine Field at 10:09 local time on 25 January. After undergoing testing over Washington State, WH001 returned for a landing at Everett at around 14:00.

The flightcrew for the test comprised 777/777X chief pilot Capt Van Chaney and Boeing chief pilot Craig Bomben. They undertook an initial test programme to evaluate the aircraft's systems and structures, monitored in real time by the test team in Seattle.

737 Max 10: progress continues

Although the Boeing 737 Max remains grounded for airline operations, progress is being made with development of the latest and largest variant, the Max 10.

The first Max 10 was quietly unveiled to employees at Boeing's plant in Renton, Washington State, on 22 November 2019. At the unveiling, the company stressed its commitment to safety and customers, and said the Max 10 "offers the lowest seat-mile cost of any single-aisle airplane ever produced".

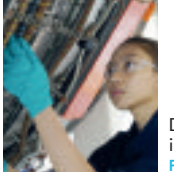
At the time, Boeing said it expected to conduct the first flight of the Max 10 in 2020, but as of February it still remains on the ground.

Boeing launched the Max 10 – which is the fourth size variant of the 737 Max family – at the Paris air show in 2017 as a competitor to the A321neo. It can seat up to 230 passengers and, with an auxiliary fuel tank, has a range of 3,300nm (6,100km).

The aircraft is more than a simple stretch as it features a revised main landing gear design. It is about 1.6m (5ft 3in) longer than the Max 9, which required modified landing gear to ensure the appropriate clearance between the rear fuselage and the ground during take-off rotation.

Boeing has incorporated a semi-levered main gear design, which enables it to extend 241mm (9.5in) upon rotation during the take-off run and provides the required clearance. A steel compressing mechanism called a "shrink link" pulls the inner cylinder as the gear retracts.

Boeing



Driving innovation
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Airbus

BelugaXL: freighter in production

Airbus began operating its new BelugaXL high-capacity freighter in January as it works to ramp up production across its plants.

The A330-based aircraft, one of six being produced, completed its first operational flight on 9 January.

This followed European certification in November 2019, after a test campaign of more than 700h across some 200 flights since the first in July 2018. Two aircraft were used for the certification programme.

The BelugaXL, which has a maximum payload of 51t, has been designed to offer greater internal capacity. All six BelugaXL freighters will be operating by the end of 2023, says Airbus.

The Rolls-Royce Trent 700-powered aircraft – formally named A330-700L – has been developed to replace Airbus's in-service fleet of five A300-600-based BelugaSTs and provides about 30% more capacity than its predecessor. Unlike the A300-based variant, the XL is equipped with fly-by-wire controls.

"The BelugaXL has the largest cargo bay cross-section of all existing cargo aircraft," Airbus notes. While an A300-600ST can transport one A350 wing, the new freighter has space for two.

Like its predecessor, the BelugaXL will be deployed to transport components between 11 European sites. The A300-600STs will be phased out from 2021.

MC-21 bids for dual-certification

Russia's all-new single-aisle, the Irkut MC-21-300, is progressing through flight trials. The fourth aircraft joined the programme on 25 December when it departed from the assembly facility in Irkutsk.

The Pratt & Whitney PW1400G-powered twinjet operated to an altitude of 3,000m (9,800ft) and at speeds of up to 270kt (500km/h).

"According to the crew report, the [flight tasks] were performed completely," says Irkut.

Three other MC-21-300s have been carrying out certification test flights from a facility in Moscow.

"Results from the first three MC-21-300 [test aircraft] were taken into account during production of this new airframe," says Irkut.

The aircraft will join the campaign to certify the MC-21 not only under Russian standards but also under those of the European Union Aviation Safety Agency (EASA).

Irkut is progressing towards completion of the first MC-21-300 to be fitted with the rival Aviadvigatel PD-14 powerplant, which is domestically built. It completed fuselage assembly of the first PD-14-powered MC-21 on 10 December.

The PD-14, manufactured by Perm Motors, is available as an alternative option. It secured Russian certification last year and Irkut intends to obtain EASA approval.

The PD-14 will deliver up to 137kN of thrust for take-off, while the PW1400G is capable of 125-137kN.

Aeroflot is among the customers potentially set to take the PD-14 version of the MC-21, as part of an order for 50 aircraft.

Irkut

Propects and challenges at ATR
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INVESTING IN THE EAST

CHRIS DAVIE, senior vice-president, customers for Asia Pacific at Rolls-Royce Civil Aerospace, talks about the UK firm's market presence in the region, as well as its growing industrial footprint in Singapore

Rolls-Royce

Q Rolls-Royce's Singapore Seletar campus is a key node in the company's production strategy. How does it complement your main production facility at Derby?

A The Rolls-Royce Seletar campus in Singapore has significantly increased our global manufacturing capacity. Since we opened the campus in 2012, engine assembly has increased year-on-year and the production of our hollow titanium wide chord fan blades has gone up by 250%. The Seletar campus also allows us to get closer to and offer better support to our customers in the Asia Pacific region.

IATA estimates that in 10 years' time air travel in Asia Pacific will be greater than in North America and Europe combined. Our aviation customers will experience rapidly growing requirements in terms of engine performance, longevity and efficiency. Therefore, our Singapore factory helps in building up a technological presence that will improve our production capacity, facilitate research processes and help enrich the MRO ecosystem in the region – complementing the capabilities of our Derby facility.

Q Can you give some sense of the number and type of engines the Singapore factory has produced since its induction in 2012? Also, can you discuss how fan blade production in Singapore fits into Rolls-Royce's global production footprint?

A The Singapore Assembly & Test Unit (SATU) has the capability to produce three members of the Trent family: Trent 900, Trent 1000 and Trent 7000.

In 2019, we produced just over 200 engines from SATU. The target for 2020 is more than 230 , which represents just under half of all the widebody engines that R-R will produce in 2020.

The Fan Blade Singapore (FBSG) facility manufactures our hollow titanium wide chord fan blades for Trent 900, Trent 1000, Trent 7000 and Trent XWB.

FBSG is the group's only facility outside the UK to manufacture hollow titanium wide chord fan blades, a unique technology which has played a key role in the success of the Trent aero engine family. At full capacity, FBSG can produce more than 8,600 fan blades per year. In 2019, FBSG produced more than 6,200 fan blades, which equates to an average of one fan blade every hour.

Q Rolls-Royce has had its share of challenges with the Trent 1000. Can you share the role the Singapore factory has played in dealing with this situation?

A Returning the Trent 1000 fleet to full health has been – and remains – our number one business priority. SAESL (Singapore Aero Engine Services), our joint venture with Singapore Airlines Engineering, has played an important role in supporting this recovery. As a centre of excellence for Trent engine repair and overhaul, with capacity for more than 300 engine overhauls per year, SAESL is the biggest MRO facility in our network and has absorbed a large proportion of the Trent 1000 recovery work. In 2019, output from the facility increased by 10%, a reflection of the increased demand from the Trent 1000 fleet.

Q Can you describe the role of automation in the Singapore factory?

A Automation plays a key role in transforming not just our factory but our entire organisation with smart manufacturing and Industry 4.0 technologies.

We harness the stability and repeatability of robotics for module assembly, testing and inspection, advanced repair and remanufacturing methods, which includes laser metal deposition, adaptive technology for smart inspection, and factory simulation.

Automation helps us gain the best of both worlds in terms of productivity and safety. It ensures consistency, speed and quality in our production output and helps create a safer working environment. For example, the wide chord fan blade manufacturing facility uses a robotic arm to hoist blades into a furnace and for loading and unloading. Likewise, an automated finishing process has helped to reduce scrap rates and improve the process flow.

Q Modern aircraft engines such as the Trent XWB and Trent 1000 produce masses of data, which can be analysed to develop and implement improved efficiencies. Can you discuss how this has helped airline customers in the region?

A Rolls-Royce pioneered engine health monitoring (EHM) in the early 1980s to indicate engine health and predict when maintenance will be necessary; we have continued to develop this capability over time. New generation engines, such as the Trent XWB, Trent 1000 and Trent 7000, are able to capture more parameters across the engine and at higher sampling frequency. We have moved from about 30 parameters being scanned three times per flight to hundreds of parameters being recorded every second. The additional data, coupled with rapidly advancing computing capacity and analytical techniques, enables more potential faults to be detected, and for these faults to be detected earlier and with more confidence (ie, fewer false alerts). So we are able to recommend appropriate maintenance action in plenty of time for our customers to avoid disruption to their operation.

More data has enabled us to implement lifing insight to extend the useable life of life limited parts (LLPs). Previously, operators had to assume that every flight was a worst-possible case. Now, we treat every engine as an individual, using data from each flight to calculate how arduous that flight is, and how much life is consumed on LLPs as a result. Lifing insight increases engine time on wing by up to 40% in some less-arduous operations, with the lives of some modules doubling before they require overhaul. This reduces maintenance for airlines and increases the residual value of engines.

Comprehensive data showing how the engines are actually used allows us to recommend operational changes to minimise fuel burn and CO2 emissions, and extend to engine life. The Rolls-Royce efficiency management service combines engine data with other contextual data from the airline and third parties to give deep insight.

Performance data is increasingly being used in combination with digital twins built on the Rolls-Royce IntelligentEngine platform. These enable the life of individual components to be modelled in accordance with the data recorded by each individual engine. This allows Rolls-Royce and our customers to plan and forecast with increased accuracy – so we have the right parts, people and overhaul capacity in place when they are needed.

Rolls-Royce is taking part in Singapore's drive for innovation, giving it access to bespole skills

Rolls-Royce

Q Singapore is keen to develop itself as a hub of innovation. As a global aerospace leader, what is Rolls-Royce doing locally to help Singapore achieve this aim? How does Rolls-Royce benefit?

A Singapore is committed to continuing its innovation push by building up a skilled workforce, innovative firms and a vibrant economy. Rolls-Royce has participated in all aspects of this strategy.

We are active partners in Singapore's open innovation models, supported by the Economic Development Board, the National Research Foundation, the Agency for Science, Technology and Research (A*STAR) and the Nanyang Technological University (NTU). This has resulted in our Smart Manufacturing Joint Lab investment in A*STAR's Advanced Remanufacturing and Technology Centre (ARTC) and Rolls-Royce@NTU Corporate Lab, a S$75 million ($55 million) partnership with NTU, one of the top universities in the world.

The Joint Lab gives us the platform to work with researchers as well as local enterprises, offering them the opportunities to contribute to large-scale technology projects. This allows them to develop their competencies and become more innovative. To date, this initiative has opened up pathways for about 40 local companies.

For Rolls-Royce, this means that we have access to specialist resources and bespoke skills that are not typically available in our ranks to help solve our problems. Thanks to the lab's positive results, Rolls-Royce and A*STAR recently invested another S$8 million into the programme, bringing the total investment to nearly S$70 million. ■

Singapore Airshow 2020

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FLEXIBLE FRIEND

CHRISTOPHE POTOCKI, ATR's head of Asia Pacific talks about the airframer's future prospects, as well as potential challenges to the brand's hegemony in the segment

Q Southeast Asia is the biggest market for ATR. What are the factors behind this?

A One reason is because Southeast Asia is a fast-developing region where airport infrastructure development has yet to keep up with the fast pace of growth. It means there are many airports in Southeast Asia that have too short a runway to support jet aircraft.

Also, unlike North America and parts of Europe, regional jet aircraft have largely failed to take off in Asia Pacific. This is due to pure economics.

The ATR has a lower trip cost than jet aircraft and the airlines in Asia-Pacific recognise this. They also see that the turboprop aircraft product has evolved and now offers a very comfortable passenger cabin.

Lower trip costs are important, as passengers in Asia-Pacific are very savvy and price conscious. As a consequence of this, airlines need to be price competitive.

Q Can you discuss progress with the short take-off and landing version of the ATR?

A We have officially launched the programme with commitments for 20 aircraft from various customers. Irish lessor Elix Aviation Capital has already signed a letter of intent for 10 aircraft.

Even though Elix is based in Europe, many of the ATR 42-600S aircraft it orders, I envisage, will actually be for airlines in Asia and the Pacific islands. The airline launch customer is Air Tahiti, with a firm order for two.

Q Does the STOL version have applications in the Asia-Pacific?

We see a big market for the ATR 42-600S in our region. Particularly, the Pacific islands and parts of Southeast Asia, such as Papua, where there are airports with short runways.

The ATR 42-600S is designed to take off and land from runways as short as 800m. Having a super short take-off and landing version of the ATR gives airlines a lot of flexibility.

We have forecast that the ATR 42-600S will allow ATR operators to access 500 new airports worldwide that were previously only accessible by 19-seat aircraft. Nearly a third of those airports are in Asia-Pacific.

Q Airlines sometimes say that smaller aircraft such as ATRs and regional jets are not the most efficient use of slots at busy hubs such as Bangkok and Jakarta. What is your response?

A It is very important that governments, civil aviation regulators and airport operators understand the importance that regional aircraft can bring to the local economy and local communities.

If you do away with regional aircraft, it means many local communities will no longer have an air service. This is because there are some destinations where the passenger volumes are too low or the runway too short to support larger aircraft.

There is also a very direct correlation between regional connectivity and local economic development and living standards. The ATR regional air service helps to drive local economic growth and improve people's living standards by, for example: facilitating business and trade; helping to develop tourism in a sustainable way; facilitating cultural exchange; and providing people with better access to essential services such as healthcare and education.

Q Embraer has said that it may move ahead with a new turboprop. Can you offer some thoughts on how ATR would respond to a competitive challenge such as this?

A We are watching the market closely. The interest from new entrants demonstrates the growing significance and importance of the regional turboprop market.

Our position in the market is very strong. ATR is the market leader in our segment. Our aircraft burn 40% less fuel and have 40% less CO_2 emissions than regional jets of the same size.

ATR aircraft have lower trip costs as well as better performance capability on short airfields and in 'hot and high' flying conditions. ATR has remained number one by continually improving its product and customer service network.

Q In the past two years Singapore has shifted turboprop operations from Changi to Seletar. Can you discuss how this will impact the development of turboprop operations into and out of Singapore? So far, only Firefly operates its ATRs to Seletar.

A We see the decision, by the Singapore authorities, to shift all commercial turboprop operations to Seletar Airport as an opportunity. Singapore has reportedly spent S$80 million ($58 million) on the new passenger terminal at Seletar.

It is an outstanding terminal that provides airline passengers with a very convenient and comfortable experience. The terminal feels more like a VIP terminal, which is not surprising considering business jet operators also share the building.

It only takes two minutes to get from the terminal front door to your gate. We see that being at Seletar is a competitive advantage.

Developing city airports, using turboprops, such as Seletar airport in Singapore, Subang airport in Kuala Lumpur, Sangley airport in Manila and Indonesia's Bandung airport contributes to economic development.

These city airports were previously under-utilised. Also, the new turboprop services from these city airports are often to under-served smaller cities and towns in the country.

Q ATR is also active in the freighter market. With cargo demand down in 2019, can you discuss how this business is faring? What is your forecast for additional ATR freighter sales?

A ATR is the only regional aircraft manufacturer offering a straight-from-factory dedicated regional aircraft freighter. It's the ATR 72-600F and our launch customer is FedEx. There is growing demand for ATR freighters in Asia-Pacific, which is partly driven by the growth of e-commerce.

Philippine carrier Cebu Pacific Air has just converted two of its ATR 72-500s to dedicated freighters. Cebu Pacific's ATR freighters transport cargo in ULD containers, the same containers that its widebodies use. Cebu Pacific sees opportunity to transport goods from smaller cities and towns in the Philippines to Manila where the goods are then transferred to the belly-hold of widebodies for export.

In the Philippines, just as with other markets around the world, there is an expansion in e-commerce. E-commerce is growing 19% a year globally. And when people order goods online, they increasingly expect next-day delivery. Therefore, air freight is crucial for that.

In some other countries in Asia, such as Indonesia, we are also seeing the national government actively encouraging the launch of air cargo services to smaller cities and towns.

Indonesia has the 'air bridge' programme, which is likely to lead to the development of more air cargo services in eastern Indonesia – and this will be using turboprops.

Q Can you offer some insights into the discussions you'll be having with customers at the Singapore air show? Specifically, what products will you be promoting?

A Southeast Asia is our biggest market globally and the ATR stand is always very busy at the show. ATR operators and potential new operators love to come to our stand to meet with our management and sales team.

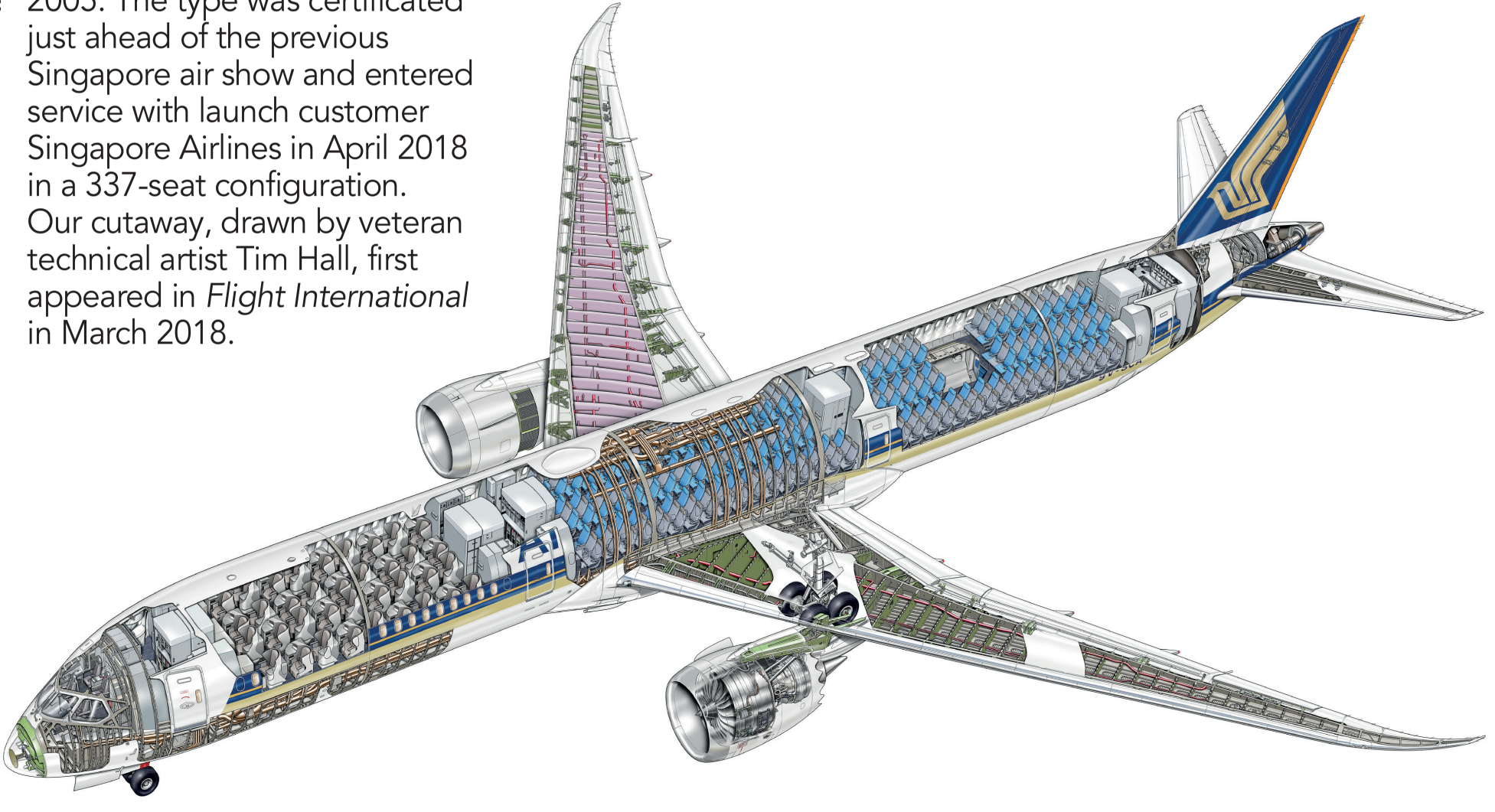
We encourage that. ATR continues to support the show because we really value the opportunity to meet with our customers, and potential new customers, face-to-face.

We have a Bangkok Airways ATR 72-600 on static display at the show this year. We're also promoting the ATR 42-600S at the show, as well as new product innovations such as ClearVision, which is a new vision system that combines enhanced vision with synthetic vision, for better situational awareness at night or in poor weather conditions. ■

Cebu Pacific is one of a growing number of ATR operators in the region

BOEING 787-10

The 787-10 is the largest of the family announced by Boeing in 2005. The type was certificated just ahead of the previous Singapore air show and entered service with launch customer Singapore Airlines in April 2018 in a 337-seat configuration. Our cutaway, drawn by veteran technical artist Tim Hall, first appeared in *Flight International* in March 2018.



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