

Issue

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# FLIGHT DAILY NEWS

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Celebrating the deal: (l-r) Glenn Chai and KW Chang from Starlux, Airbus's Christian Scherer, Ewan McDonald of Rolls-Royce, and Benoit de Saint-Exupery of Airbus

## Five-star freighter

Another Asian customer for A350F as Taiwanese start-up puts faith in Airbus cargo variant

**Alfred Chua**

**A**irbus landed another Asia-Pacific customer for its A350F on day two of the show as Taiwan's Starlux Airlines signed a firm order for five freighters and took options on a further five.

Starlux, which already operates A350 and A330-900 passenger aircraft, also signed for three more A330neos.

Airbus says the additional

A330neos are set for delivery in 2025 and 2026, while the A350 freighters will follow "a little bit later".

The order marks the first dedicated cargo aircraft for Starlux and continues its rapid expansion since launching services in 2020.

Starlux chief executive Glenn Chai says: "With this order, Starlux will become the first Taiwanese airline to operate the next-generation A350F widebody freighter."

Launched in July 2021, the A350F is expected to enter service in 2026 and has so far gained 50 orders

from airlines including Asia-Pacific operators Cathay Pacific and Singapore Airlines.

"The three new A330neos will strengthen our fleet advantage and provide greater flexibility for passenger operations," Chai adds.

Cirium fleets data shows Starlux operates four A350-900s and four A330neos, alongside 13 A321neos. It held outstanding orders for 14 A350s - including eight -1000s - before today's announcement.

Earlier in the day Latin American low-cost carrier JetSmart become

the latest customer to disclose a follow-on engine selection for A320neo-family jets.

JetSmart selected Pratt & Whitney PW1100G engines to power 35 Airbus A320neo-family aircraft it has on order.

That came after lessor China Aircraft Leasing Group placed a repeat order for CFM International Leap-1A engines to power a batch of 20 more Airbus A320neo-family jets and Cebu Pacific signed for more P&W GTFs on 15 Neos.

**See story P14**

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# Cake is big enough for Comac too: Airbus boss

Flight Daily News reporters

Comac's stepped-up presence at this week's Singapore air show has garnered plenty of attention as the Chinese aircraft manufacturer bids to break the Airbus and Boeing narrowbody duopoly.

After a long development process, the C919 entered service with China Eastern Airlines in May 2023 and is making its international debut at the show. The positive momentum was further bolstered with a firm commitment from Tibet Airlines for both the C919 - for which it will be launch customer of the high-altitude variant - and Comac's ARJ21 regional jet.

While Airbus commercial aircraft chief executive Christian Scherer does not

see the new twinjet taking significant market share from Airbus and Boeing in the short-term, he says the airframer "must not stick its head in the sand" as the Chinese manufacturer ramps up its marketing efforts for the single-aisle.

"Far be it from us to have an attitude that dismisses Comac - that would be a mistake," he said during a media briefing.

But Scherer notes that the C919 is an aircraft that "looks very much like one that Airbus or Boeing are offering to the market today".

CFM International Leap-1C engines power the C919, while the Leap-1A is an option on the Airbus A320neo and the -1B the exclusive powerplant on the Boeing 737 Max.

Scherer argues that the Chinese jet is not "bringing any product differentiation"



Scherer says Airbus must not stick head in sand about C919

to the market and "that is why we are not anticipating that the C919 is going to rock the boat in a significant way from a strategic perspective."

However, he thinks there is room for all three narrowbodies the given the rapid expansion of the market in the Asia-Pacific: "The cake is growing suffi-

ciently for Comac to want to compete," he says.

Speaking during a panel debate at the show, Peter Bellew, chief operating officer of emerging Saudi Arabian carrier Riyadh Air, and a former chief executive of Malaysia Airlines, welcomed the Chinese company's growth as a healthy

market diversification. "It's great for the industry to have another force out there," he said. "I wouldn't underestimate Comac for a minute."

Separately, one of the US government's top military aircraft buyers expressed scepticism of the Chinese jet's merits.

Andrew Hunter, the civilian official who oversees procurement for the US Air Force, says: "A lot of times you take a look at a design you're like, oh, that looks like a really cutting-edge design sometime back, and not necessarily cutting edge by today's standards."

However, he concedes the Chinese narrowbody may be able to find a "competitive niche" in the global market for passenger jets, noting customers will have the final say. "Welcome to an interesting market," he adds.



The XWB-97 engine powers the A350-1000, which is taking part in the flying display

# Rolls-Royce tweaks Trents

Rolls-Royce will over the next five years introduce a series of performance upgrades across its Trent widebody engine family designed to improve fuel-burn and durability.

Part of an over £1 billion (\$1.26 billion) product development programme, the UK propulsion specialist will insert advanced coatings and high-temperature materials into the in-production engines, says chief customer officer Ewen McDonald.

Durability concerns related to operations in hot and dusty environments have dogged the higher-thrust XWB-97 for the Airbus A350-1000 in recent years, with Emirates Airline president Sir Tim Clark particularly outspoken on the issue.

McDonald says the engine maker plans a series of technology insertions for the powerplant running through until 2028 which "will double the time on wing in the harshest environments".

Even operators in "benign" environments, will see a 50% improvement in time on wing, he adds.

While later steps will focus on higher-temperature materials and improved cooling technologies, the initial enhancement will see the introduction of so-called CMAS-resistant coatings to the turbine blades, designed to better withstand operations in sandy environments.

An improvement programme for the XWB-84 is already in progress that should deliver a 1% fuel-burn

reduction when it rolls out in 2025.

A durability enhancement to double the time on wing of the Trent 7000 for the Airbus A330neo entered service in August 2022, and operational feedback suggests the engine is performing as planned.

A second turbine blade improvement package is now in the works, says McDonald, which will increase time on wing by a further 30%.

Operators of the Trent 1000, meanwhile, are still waiting for an upgrade programme to be approved by regulators, a milestone McDonald expects later this year.

But that engine, an option on the Boeing 787, will also benefit from the same enhancement as its sister powerplant.

# Saab eyes global Gripen chances

Swedish airframer Saab is looking to expand the customer base for its Gripen fighter, pursuing sales opportunities around the world.

While orders from Brazil and the company's home country of Sweden are anchoring the programme, Saab is also in discussions with militaries elsewhere in Europe, South America and Asia regarding the latest Gripen E variant.

Saab officials, speaking yesterday, revealed the airframer is in talks with governments in Peru, Colombia, Thailand, the Philippines and Austria to offer the Gripen E as a replacement for existing fighter fleets.

The Swedish manufacturer is also pursuing life-cycle extension and sustainment opportunities for legacy Gripen operators including the Czech Republic, Hungary and South Africa.

Brazil also appears likely to add to its current order of 36 Gripen E/Fs, particularly following the 2023 launch of an Embraer-partnered Gripen assembly plant in Gavião Peixoto.

"Their requirement is much more than 36," says Mikael Franzen, Saab's chief marketing officer for the Gripen programme.

Worldwide there are currently 21 operational Gripen Es, including test models. The single-seat fighters are split between Brazil and Sweden - the only operators of the type at present.

BillyPik



# Class act

Murdo Morrison

Italy's Avio Interiors has the distinction of being the only aircraft seating supplier exhibiting at the show. However, director of sales and marketing Christian Battisti believes

the effort will pay off as it searches for its first customer in Asia. "We are looking to close some deals," he says. The Latina-based company - which with a 52-year heritage is one of the oldest seating manufacturers - specialises in the retrofit

market but is working to get back into line-fit after moving out of that segment some years ago, notes Battisti. Although it is smaller than some of its rivals, Battisti believes that gives Avio Interiors an edge because "we can deliver 11

or 12 months after an order is placed, compared with much longer for our competitors". It is also one of the few seating firms - other than the giants of the sector Safran, Recaro, and Collins - that offer economy, premium economy, and

business-class products, all of which are on display at Singapore. Its Allegra HD lie-flat is designed for long-range narrowbodies such as the Airbus A321XLR. Pictured on the two-abreast seat are Battisti and sales manager Elena Zizzi.

# Fold-fashioned quality

Japanese precision parts manufacturer Misashi is enticing passing traffic to its stand with an impressive display of traditional origami birds.

The Hiroshima- and Kanagawa-based company - which was founded in 1938 and builds military jet engine parts for IHI and Kawasaki among others - believes the miniature paper cranes, one of which is held by Hitoshi Koike, section chief at Misashi's manufacturing group, illustrate both its Japanese culture and its attention to detail and quality manufacturing.



# All FOD cons

Singapore's N8XT (pronounced "next") Aerospace is locking sights on the Asia-Pacific market for its twin-camera foreign object debris (FOD) detection system for airports.

The kit includes a thermal and a visual camera, which the company says allows maximum efficiency in all weather conditions and times of the day.

The latest version of its product - with 4K cameras - was released two years ago and 11 units are in use on one 4,000m runway at Hong Kong International airport, with an older, HD-camera version from the company deployed on its other two.

Phoebe Chew, executive director and design engineer (pictured), says N8XT has had "good discussions" with potential customers at the show.



# Water great fire fighter

Although it does not have a customer signed up yet, Kencoa Aerospace hopes to interest the South Korean military and other countries' armed forces in an octocopter drone that can be adapted to a lightweight firefighter for maritime environments.

The 230kg (507lb) aircraft - a one-tenth scale model of which is on display on its stand - can be fitted with a 60kg fire extinguishing module on

its belly. The aircraft is buoyant and waterproof, which makes it ideal for seaborne operations such as tackling blazes on ships, says business development manager Zoe Yoon.

The Sancheon-based aerostructures and materials supplier, which also has a subsidiary in Georgia, USA, was founded 11 years ago and has grown to a revenue of \$80 million.

# Business model

Murdo Morrison

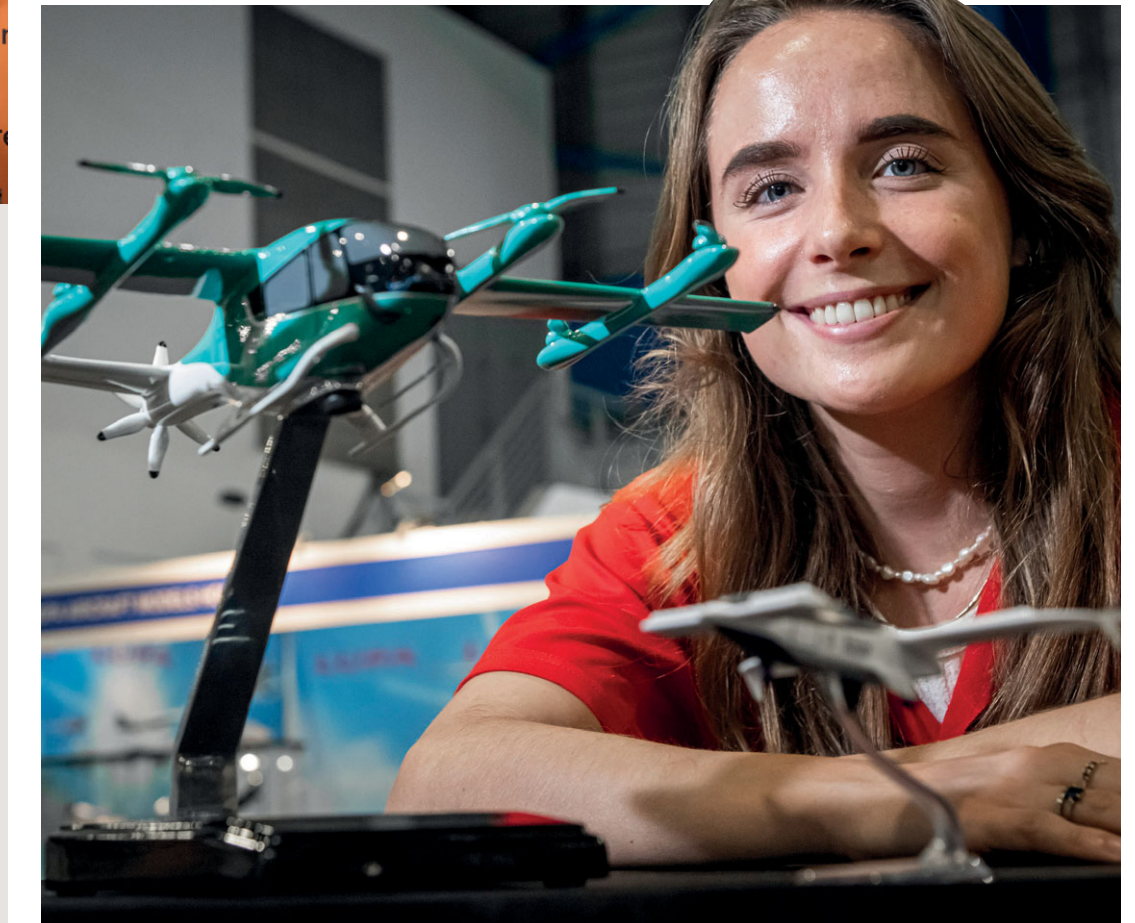
One of the industry's best-known aircraft modelers is back at the show with a new line of business.

Dutch aircraft replica specialist Lupa is branching into the electric vertical take-off and landing (eVTOL) market with an Eve model that the Embraer spin-off is displaying on its own exhibit at Singapore. "It's a growing area for us," says the Haar-

lem-based company's Edwin de Wolf. "We are seeing lots of demand."

Lupa, which has been producing models for 30 years, does not sell its plastic models directly to the public through hobby shops. Instead, it works exclusively for manufacturers and airlines, says de Wolf. Its client base includes Boeing, Embraer and Lockheed Martin.

Company representative Floor de Wolf displays two of the eVTOL models on the Lupa stand.



# Heaven scent



You can follow your nose to MScents, the Singapore start-up that is the official scent partner to the show.

It has supplied many of the fragrances that you detect as you walk through the aisles.

The company, which was established in 2007, is exhibiting here for the first time as it looks to broaden its market from hospitality, galleries, and offices into aviation.

"It is a market that we want to get into," says founder Magdalene Ang (pictured). "We travel a lot and when you board a plane, or use the lavatory, it doesn't always smell its best."

Singapore has a long tradition of "scenting up", she says. The company formulates all its fragrances in the city, sourcing raw ingredients from all over the world.

Although it supplies the consumer market through e-commerce, most of its customers are businesses.

Photography: Billy Pix



Hermes 650 boasts 260kg payload capacity

## G700 set for business

Gulfstream has high hopes in the region for its G700, which is making its Singapore debut after a six-year absence from the show for the US airframer.

It comes as the Savannah-based firm waits for regulators to green light its largest business jet, with certification held up because of staff shortages at a Federal Aviation Administration (FAA) preoccupied with investigating a series of issues at Boeing.

"We are very close to certification. All flight testing has been finished and it's now in the hands of the FAA," says Scott Neal, senior vice-president, worldwide sales.

The experimental example on the static is one of two fully outfitted demonstrators Gulfstream has been displaying at air shows around the world. Five other aircraft were involved in the flight-test campaign.

Neal says the G700, and its larger sibling the G800 – currently in flight-testing and due to replace the G650 – gives Gulfstream "an aircraft for every mission".

"Because of our product line-up, we are growing in strength in this region with customers both from competitor brands and first-time buyers [in business aviation]," he says.



## Elbit Sparks interest in wide-speed range UAV

Greg Waldron

Elbit Systems has a launched a new model in its Hermes series of unmanned air vehicles, called the 650 Spark.

Unveiled at the show yesterday, the Spark breaks from previous variants of the family and features an engine in the nose rather than a pusher-propeller configuration in the tail.

Ziv Avni, head of market-

ing and business development at the Israeli firm, says it has already secured an undisclosed launch customer for the Hermes 650.

Primarily designed for intelligence, surveillance and reconnaissance (ISR) missions, the Spark is not currently due to be armed, says Avni.

Boasting a maximum take-off weight of 650kg (1,430lb), the Hermes 650 can carry a 260kg payload.

Elbit claims an endurance of 24h, and the aircraft can

travel at speeds of 55-120kt (101-222km/h).

Avni says that this wide speed range allows the aircraft to quickly reach its mission area and then loiter for an extended period.

Some ISR payloads have already been integrated with the platform and Elbit is ready to begin production.

Key considerations in the design of the Hermes 650 include a high level of autonomy, as well as the ability to operate from short airfields.

## USAF readies for F-15EXs

Boeing is preparing to deliver the first combat-configured F-15EX Eagle II fighters to its US Air Force (USAF) customer.

The US airframer has already handed over six F-15EXs – the latest variant of the 1970s-era multi-role fighter – to the USAF, the type's first and so far only customer.

However, those jets, built at Boeing's St Louis plant, were all configured for operational testing, currently under way at Eglin AFB with USAF test pilots.

But tail numbers seven and eight are fully operational combat aircraft. They will be received by the air force in the coming days.

"Those are on the ramp in St Louis," says Rob Novotny, director of F-15 business development at Boeing. Those fighters will be assigned to an Air National Guard squadron in Portland, Oregon.

## Red all over



Our instantly recognisable red-suited *Flight Daily News* team, which has been delivering your favourite show read this week, poses in front of the stand of distribution supporter RTX

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HOW TO CONTACT US

We are located in C-G106

Editor

Murdo Morrison  
murdo.morrison@flightglobal.com

Executive Editor, Flightglobal

Graham Dunn  
graham.dunn@flightglobal.com

News Editor

Dominic Perry  
dominic.perry@flightglobal.com

Reporting team

Alfred Chua, Ryan Finnerty, Howard Hardee, Greg Waldron

Production Louise Murrell

Designer Sarah Eversfield

Picture editor James Robbins

Photography Tom Gordon, Law Kian Yan

Distribution Stuart Burgess, Dawn Hartwell, Beatrice Olsen

Divisional Director,

FlightGlobal Sophie Wild

Printers Times Printers, Singapore



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In brief...

**GE gets smart with its Singapore MRO**

GE Aerospace is investing \$11 million to revamp its engine MRO facilities in Singapore into a "smart factory", incorporating advanced technologies such as automation and digitalisation. The firm will also expand the site's additive manufacturing capabilities to supply GE's family of commercial engines, starting with the GENx, followed by the LEAP powerplants produced by the CFM International joint venture. GE will introduce automated inspection systems, and digitalisation to its Seletar facility, before rolling these out to its two other facilities in Singapore. GE Aerospace president of commercial engines and services Russell Stokes says: "This facility will support the government's broader economic goal of job creation while driving our innovation and competitiveness in the global MRO market to a new level."

**Supernal strikes deals to develop AAM here**

Hyundai subsidiary Supernal has signed agreements with two Singaporean agencies to develop the advanced air mobility sector in Singapore and Asia-Pacific, as it looks to tap into the region's "growing prominence". The partnerships - with the Singapore Economic Development Board and Civil Aviation Administration of Singapore - cover research and development, safety information exchange, as well as public engagement efforts.

# AirFish makes a splash

Alfred Chua

ST Engineering has secured a launch customer for its in-development AirFish wing-in-ground effect craft, with Turkish start-up Eurasia Mobility Solutions (EMS) signing a letter of intent for up to 10 examples. Under the agreement, ST Engineering will customise and deliver 10 examples of the AirFish 8 craft to EMS from 2025. The AirFish 8 can carry up to eight passengers plus two crew members, or about 1t of cargo. A test craft is on display here at the show, and ST Engineering hopes to have it certificated and entering service in 2025.

The craft, which is being developed by joint venture ST Engineering AirX, uses aerodynamic forces and air pressure generated between the craft and water surface to reduce drag and create high travel speed of up to 90kt (166km/h). ST Engineering envisages the AirFish to be an alternative to ferries, helicopters and seaplanes. It states: "Designed to take off and land on water, AirFish avoids the need for infrastructure such as an airfield, making it a more



convenient option not only for maritime public transport, but also the delivery of parapublic and logistics services as well as potential military applications in littoral waters." Eurasia Mobility Solutions is a Turkish start-up that hopes to use the AirFish for tourism and private transportation purposes. Founder Kubilay Ilgin says:

"As an alternative mode of transportation, AirFish 8 offers a safe, sustainable and faster solution to conveniently reach places without any port or runway. Faster than existing air and marine travel options, this new technology will change the rules of marine transportation and create new trends in Turkey." ST Engineering commercial

aerospace president Jeffrey Lam adds: "This is a significant milestone for ST Engineering's commercial aerospace business as we scale up our engineering and original manufacturing capabilities to develop more innovative and sustainable solutions that connect people and goods along some of the earth's vast coastal areas."

**Flying start for Alpha Aviation in Indonesia**

Philippines training specialist Alpha Aviation Group (AAG) has signed a memorandum of understanding with FlyBest Flight Academy under which the partners will establish a new flight training organisation in Indonesia. AAG says the partnership will transform it into an international pilot training institution. The joint venture with FlyBest will involve the replacement of ageing training aircraft, as well building new facilities to support the enlarged business. AAG also yesterday announced the purchase of a new A320 full-flight simulator for its Philippine training centre, having late last year upgraded its A330 simulator to include upset prevention and recovery training. AAG Philippines general manager Cristopher Magdangal says: "Through a combination of upgrading our Philippines facilities and striking a partnership with FlyBest Flight Academy, we are confident we will be able to better support the aviation industry in both the Philippines and Indonesian regions."

# Waldron's a winner

FlightGlobal's Asia managing Editor Greg Waldron (pictured) has won an Outstanding Achievement award at the Aerospace Media Awards Asia event. An industry judging panel recognised Waldron's broad coverage of the Asia-Pacific aerospace sector in the last two years, citing his concise writing style, industry knowledge, and commitment to journalistic accuracy. This is Waldron's second Outstanding Achievement award, having won in 2020. At the 2023 Paris air show, Waldron was named the Aerospace Reporter of the Year at the global Aerospace Media Awards. Asia air transport editor Alfred Chua was shortlisted for the prestigious Best New Aerospace Journalist award, as well as for an Advanced Air Mobility award. In addition, Waldron's 2023 feature story about how changes in China are impacting western aerospace firms was shortlisted for the Best Asian Aviation Analysis award.



## When combat engagements take place beyond small arms range, an IAI VTOL precision strike system offers ground troops a ready solution



Point-Blank enhances ground forces' capabilities, providing indirect fire capability at long range, beyond the line of sight

# Point-Blank - transforming the battlefield dynamics

As modern warfare continues to evolve, the asymmetry of the battlefield presents unique challenges and demands agility in how combat forces operate. Recent conflicts have highlighted the necessity to enhance the multi-dimensional strike capability at all operational levels. This agility counters the emerging threats posed by peer and near-peer adversaries, enabling forces to act without the delays inherent in coordinating non-organic support from higher operational levels. Engagements often occur beyond the effective range of the squad's small arms, necessitating a small unit to have the capacity for organic firepower that is not limited by line of sight and which provides a solution to their wide tactical combat ranges. Moreover, Special Forces can leverage such weapons to enhance their efficiency and survivability by employing their firepower independently, deep within enemy territory, far from supporting troops. Israel Aerospace Industries (IAI) has introduced a formidable solution to this tactical requirement with the Point-Blank weapon system. This hand-launched, VTOL (vertical takeoff & landing) precision strike missile enhances ground forces' capabilities, providing indirect fire capability at long range, beyond the line of sight. It boasts hovering abilities for superior observation in complex terrains, allowing for precise target acquisition and immediate attack, as the weapon is switched from ISR to strike by a flip of a switch. Operating with the soldier-in-the-loop, the system ensures that decisions to engage are

deliberate and controlled. If the user decides NOT to engage a target or doesn't find one, he can safely return the Point-Blank back to his hands and reuse it, showcasing its advanced 'back home' retrieval capability. The weapon is ideal for the unpredictable nature of asymmetric warfare. With the Point Blank, deployment is simplified and versatile, suitable for use on land or at sea against both mobile and stationary targets, including personnel in open or in buildings and light unarmored vehicles. The system's dimensions and weight - approximately one meter in length and 10kg - facilitate ease of transport; a team of four soldiers can carry six units, ready for rapid deployment in two to four minutes. In flight, the Point-Blank flies at an altitude of around 500 meters, with a maximum speed of 80 meters per second. Propelled by ducted rotors, it is almost inaudible. Its loitering feature helps verify the target's nature and precise location before engagement. The electro-optical system provides real-time surveillance and target validation, paired with an advanced warhead for effective target neutralization. Point-Blank represents a leap forward in organic precision strike capabilities for ground forces. It is lightweight, compact, and easily deployed, enabling high readiness and responsiveness on the modern asymmetric battlefield. IAI, a global leader in defense and aerospace, is at the forefront of pioneering innovations across multiple domains: space, air, land, sea, and homeland security. IAI innovation leverages Israel's "Start-up nation" ethos to bring groundbreaking solutions to the modern battlefield. With extensive experience in defense technology, IAI specializes in developing cutting-edge systems designed to meet the multifaceted demands of contemporary combat environments. Among its wide array of defense products, IAI's unmanned aerial vehicles and precision strike capabilities stand out - exemplified by the innovative Point-Blank missile system. This system underscores IAI's commitment to providing agile, precise, and tactical solutions that empower the modern military force. ■



The VTOL boasts hovering abilities for superior observation in complex terrains



Targeting local markets: Berry (right) and Lindaur

## MD talks up TH530's quick-change potential

Greg Waldron

MD Helicopters sees opportunities in the Asia-Pacific for its TH530 trainer, which can be quickly reconfigured for combat missions. Howard Berry, who

heads Asia-Pacific sales for the US manufacturer, says potential markets include Indonesia, Malaysia, the Philippines, Thailand, and Vietnam. He cites the type's ruggedness and sustainability as key selling points for military and parapublic forces.

The TH530 is based on the company's popular MD530 light-single but comes with a range of enhancements that enable the helicopter to be quickly reconfigured to an AH530 light-attack/scout standard, or a more heavily armed AH530 Block II.

In its baseline guise the TH530 includes heavy landing gear, provision for an electro-optical/infrared sensor, a military interior, an emergency locator transmitter, and other relevant systems.

These features are the base for the helicopter to be reconfigured into the armed variants. The AH530 light-attack/scout features items such as a well-protected fuel system, ballistic cockpit armour, and the provision for guns and rockets.

The Block II configuration builds on this, incorporating a range of more advanced features, including the ability to carry Lockheed Martin AGM-114 Hellfire anti-tank missiles.

"It's a small aircraft with a big punch," says Jason Lindaur, vice-president sales and marketing at MD Helicopters. "Now that we have the capability of Hellfire from the military side, it's a full package."

MD Helicopters is focused on highlighting the type's multi-role adaptability. "You're basically getting one platform that can expand," Lindaur says.

## Singapore academy boosts capacity

The Singapore Aviation Academy, the training unit of the Civil Aviation Authority of Singapore (CAAS), has begun a review of its curriculum, as part of a broader revamp that will also see an increase in capacity.

The academy will undergo a S\$120 million (\$89.2 million) expansion over the next two years, allowing it to increase capacity by 20%, it announced at the show. Work is expected to commence in April and be completed in 2026.

The CAAS says it will refresh the current curriculum "to better equip aviation professionals with new competencies to help them navigate the post-Covid world". Among key changes include a consolidation of its specialised schools into three entities, with the appointment of a senior professional staff to head them.

The three schools cover topics in aviation management, aviation safety and security, as well as air traffic services.

CAAS director-general Han Kok Juan says: "Demands of the aviation sector have changed significantly after the Covid-19 pandemic. CAAS is conducting a sector-wide manpower study to establish what Singapore needs. [The academy's] enhancement will support this to ensure that the Singapore air hub has a strong pipeline of highly-qualified, highly-trained aviation professionals with deep expertise."

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Cady: Recycling circular materials will help cut emissions

# Second life for composites

Alfred Chua

Singaporean start-up Nandina REM will begin producing aerospace-grade carbonfibre from materials reclaimed from retired aircraft, a move it believes will help cut emissions from the production process.

Nandina says it is looking to “bridge the gap between unused materials from retired aircraft and the growing demand from manufacturing industries for high-quality resources”.

It believes its “novel approach” to reclaiming carbonfibre “addresses the long-standing” challenge of ensuring material integrity and quality, given that, unlike metals, the composite cannot simply be melted down and reformed.

“By reclaiming high-value materials from end-of-life aircraft, markets have access to new sources of ultra-low-emission, high-quality carbonfibre composites that are comparable in quality to virgin materials, and cost less,” Nandina states.

It is working with Singapore public sector research agency A\*Star and is a member of the body’s Advanced Remanufacturing and Technology Centre. Under the partnership, Nandina and A\*Star will work on profiling aircraft undergoing disassembly, as well as

separating materials into different “resource streams” and facilitating the recovery of high-grade fibres.

“These high-quality materials will be accessible to manufacturers for a variety of products, including aircraft cabin galleys and seats. This availability enables emissions reductions from the production process, compared to virgin carbonfibre materials,” it says, claiming the process could eliminate 1 gigatonne of greenhouse gas emissions from the global supply chain by 2030.

Chief executive Karina Cady says: “Reclaiming high-quality circular materials from end-of-life aircraft is a key industry achievement which will unlock a multitude of possibilities for both aviation and advanced manufacturing.”

Nandina sees the number of aircraft decommissioned globally as a large opportunity, noting that the Asia Pacific region generates the largest share of retirements. The company announced in October 2023 plans to also recycle aluminium from aircraft into high-grade ‘low-carbon’ aluminium.

The announcement comes amid ongoing research into the recycling of aircraft carbon composites at the end-of-service. Boeing, for instance, is working with universities and private-sector companies to find ways to recycle aerospace-grade composite waste.

## Airbus picks up pace on A350F

Airbus is ramping up development activity on its A350 freighter as the airframer works towards final assembly and first flight milestones in 2025.

“We are really in that industrialisation process now,” says Crawford Hamilton, Airbus head of freighter marketing. “We have got parts heading towards sections and we are ready to start final assembly next year [with] first flight in 2025.”

Two of the region’s biggest airlines – Cathay Pacific and Singapore Airlines – are among the variant’s early customers. Parts currently produced include the lower fuselage skin and wing-box feet, he told reporters at the show on 20 February.

In addition, around 30 “large test rigs” have been commissioned to assess

individual systems and components, including the environmental control system and cargo loading system (CLS) controls.

A further ground-test rig for the CLS itself will be built at Airbus’s California-based supplier, alongside another example inside a “full contoured” shell, dubbed “Cargo One”, at the airframer’s Hamburg plant, says Hamilton.

Based around a new design, although incorporating existing components, the powered CLS will then be tested aboard the programme’s two development aircraft, he adds.

Launched in July 2021, the A350F is expected to enter service in 2026. It will be capable of flying 4,700nm (8,700km) with a payload of 109t, or 4,550nm with a maximum 111t load on board.

A five-frame, 3.2m (125in) shrink of the A350-1000 passenger aircraft, and using the same Rolls-Royce Trent XWB-97 engines, the new freighter features what Airbus claims is the largest main deck cargo door in the industry – 15% wider than the competition – and a segregated fresh air crew area.

To date, the twinjet – officially designated the A350-1000F – has gained 50 orders from nine identified airlines and lessors, plus one undisclosed customer.

Included in that total are Cathay Pacific (six) and Singapore Airlines (seven) and Airbus forecasts a requirement for 145 large widebody freighters in the region in the period to 2042.

But Airbus does not have the market to itself: Boeing is also developing, for 2027

service entry, a new freighter based on its developmental 777-8 widebody, which has so far accumulated 55 orders from carriers such as Qatar Airways, Cargolux and All Nippon Airways.

Meanwhile, despite its poor sales record over the years, registering just 38 orders, Airbus continues to offer the older-generation A330-200 freighter to customers.

But how much longer remains for the twinjet is up for debate, says Hamilton: “I think that the fact that it’s a [current engine option] means its time is probably drawing to a close in terms of building new ones.”

Instead, he thinks, A330 passenger to freighter conversions will prove increasingly popular for that segment of the market “with a much lower capital cost”.

## Ametek records new deal

Honeywell has named Ametek MRO Singapore an authorised repair centre for solid-state flight-data and cockpit-voice recorders on a string of Airbus and Boeing types.

The five-year agreement covers full test and repair capability on the Honeywell recorders for Airbus A320s, A330s and A340s and on Boeing 737s and 777s.

Ametek Singapore divisional vice-president and general manager David Corish, says: “This agreement expands our long-standing relationship with Honeywell and strengthens our presence in the market.”



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# Lighting up the skies

Despite low clouds, the rain held off as an array of display teams, military aircraft, and commercial jets wowed the crowds in the show's famous daily aerial bonanza

SAF-powered A350-1000 takes flight



Fabulous four:  
Indonesia's Jupiter  
display team



Turning heads: RSAF F-15SG



Warrior: A RSAF Boeing AH-64 Apache



Photography: Billy Pix

Still in production half a century after its unplanned first flight in prototype guise, the F-16 continues to punch above its weight for 25 nations, with service entry also drawing near for Ukraine's air force

# Prize fighter



Active global inventory stands at more than 2,850 jets, with US Air Force having 948

**Craig Hoyle**

In late January, Lockheed Martin marked a major anniversary in the astonishing history of its F-16 programme: 50 years since the first flight of a prototype developed for the US Air Force (USAF). It is no exaggeration to say that the YF-16's debut outing from Edwards AFB in California on 20 January 1974 represented an unplanned and bumpy start for what was to become today's most widely-flown fighter, as test pilot Phil Oestricher recalled during a 2012 interview.

"I had intended all the way along to put a little bit of daylight under the wheels, maybe a foot or two, fly it about 1,000 feet down the runway and land it, in the meantime checking out the lateral or roll response sensitivity," he said of what had officially been planned as a first high-speed taxi test. "I started the run - the airplane accelerated very smartly, of course - and pulled the power back... [but] we had a wiring problem in the airplane where the exhaust nozzle would not open up, thus killing thrust. "The airplane was very sensitive

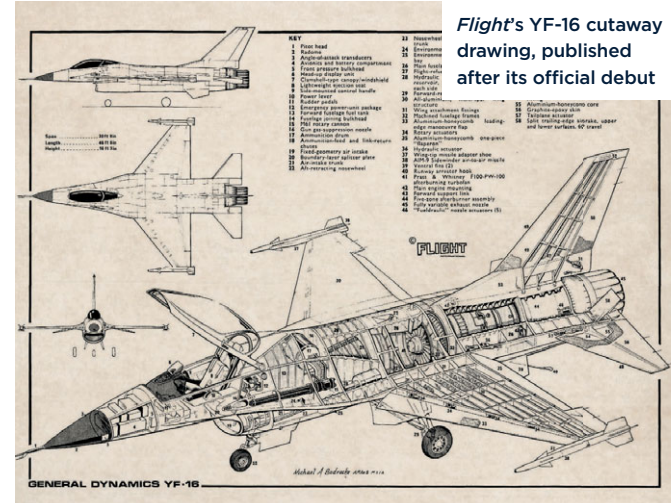
in roll: it rolled violently left, I countered with an equally violent right command, then we were instantly in a pilot-induced oscillation, with the airplane rolling back and forth very quickly." With the fighter only feet off the ground and turning sharply left, Oestricher had to act instantly. "I could see it was going to go out into the dirt, so I just powered it up and let go of the controls and let it fly away. I made a rather extended turn to the downwind, came around and landed. Most of the flight was done with me barely touching the stick, if at all."

The surprise debut resulted in light damage, with the aircraft's starboard horizontal tailplane and port wingtip missile rail found to have struck the ground after it became airborne at about 135kt (250km/h). Barely two weeks later, Oestricher put the same YF-16 through its first official outing, on 2 February completing a 90min sortie from Edwards. This included taking the fighter to 350kt (647km/h), 30,000ft and manoeuvring at a maximum of 3g. "The F-16's maiden flight in 1974 marked a watershed moment. It introduced a highly agile and

**F-16 global fleet**

Country	Active	Ordered	On option
Bahrain	24	14	
Belgium	52		
Bulgaria		8	8
Chile	46		
Denmark	43		
Egypt	218		
Greece	154		
Indonesia	32		
Iraq	34		
Israel	224		
Jordan	59		12
Morocco	23	24	
The Netherlands	31		
Oman	23		
Pakistan	75		
The Philippines			12
Poland	48		
Portugal	25		
Romania	20	32*	
Singapore	25		
Slovakia	1	13	
South Korea	167		
Taiwan	139	66	
Thailand	49		
Turkey	243		
Ukraine		61*	
United Arab Emirates	78		
USA (Air Force)	948**		
USA (Navy)	21		
Venezuela	15		
<b>Total</b>	<b>2,852</b>	<b>125</b>	<b>32</b>

Source: Cirium fleets data/Lockheed Martin Notes: \*Sec-ondhand \*\*Includes 62 QF-16 target drones



Flight's YF-16 cutaway drawing, published after its official debut



Dutch F-16s saw combat in Afghanistan - now surplus examples will help to defend Ukraine



Full-scale development assets gained enlarged control surfaces and air-to-surface weapons

lift and control. Fly-by-wire flight controls improved response time and replaced heavy hydro-mechanical systems with lighter and smaller electronic systems. "A side-mounted throttle and stick, head-up display, 30° seat back angle, hands-on controls, and bubble canopy improved the pilot's g-tolerance and situational awareness. The YF-16 was the first to incorporate all of them into a producible design."

**Bubble vision**  
Referring to the use of a bubble canopy, which gives the pilot 360° vision in the upper hemisphere, *Flight's* report noted: "There is a substantial supersonic drag penalty associated with this type of canopy, but General Dynamics points out that visibility in combat was the requirement, and by far the greater part of dogfighting takes place at speeds below Mach 1." Following a short flight-test campaign, the USAF selected the F-16 as the winner of its formal Air Combat Fighter requirement in January 1975. Its decision was driven by a "Hi-Lo" operating concept, which would

employ the type in partnership with the larger and more expensive F-15. Lockheed hails the vision of a so-called 'Lightweight Fighter Mafia' group in the USAF and US Department of Defense, which "favoured simple and small fighter designs that could change direction and speed faster than their potential adversaries - designs that were harder to detect, and inexpensive to produce, operate and maintain." *Flight's* coverage after the selection's confirmation noted strong opposition from some parties who had favoured a twin-engine solution - including the US Navy (USN) - stating: "The decision ignores the strenuous efforts made in recent months to ensure that the selected aircraft would be as attractive as possible to known and expected overseas customers." Such concerns were to prove ill-founded, even though the defeated YF-17 would evolve into the also highly successful F-18, first flown in November 1978. Produced by McDonnell Douglas and later Boeing, the type was sold to the USN and US Marine Corps, plus

export customers Australia, Canada, Finland, Kuwait, Malaysia, Spain and Switzerland. Production of the current F/A-18E/F Super Hornet will end in 2025. With its selection made, the USAF funded General Dynamics to start work on eight full-scale development (FSD) aircraft, which featured major, but mostly internal design changes. "The YF-16 validated the aerodynamics, propulsion, and handling qualities of the aircraft's basic design. With the major design issues out of the way, engineers concentrated on internal details, such as the electrical system, hydraulics, and avionics, with the FSD aircraft," Lockheed says. "The evolution of the production F-16 became a balancing act between adding and improving capabilities and maintaining the original design's optimised performance." Changes meant the fighter gained an extra 13in in length, and its nose "acquired a slight droop to accommodate the Westinghouse APG-66 multimode radar". "To respond to the need for larger air-to-ground [weapon] payloads, the wing and tail surfaces were enlarged to carry the extra weight," Lockheed says. Wing area was increased to 27.8sq m (300sq ft), from 26sq m, the horizontal tail and ventral fins by about 15%, and flaperons and speed brakes by roughly 10%. The airframe was also strengthened, enabling an additional two hardpoints to be added under its wing, boosting its total count to nine. Its canopy was improved, to withstand impact by a 1.8kg (3.9lb) bird at 350kt. Combined, the enhancements meant that the fighter would be capable of an unrivalled 9g performance with a full internal fuel load. A first production F-16A built for the USAF made its debut flight in December 1976, and its first operational examples arrived at Hill AFB in Utah in January 1979. The service officially named the model the Fighting Falcon, although it is widely also nicknamed the Viper. European Partner Air Forces Belgium, Denmark, the Netherlands and Norway had also ordered a combined 348 of the type, with their aircraft to be assembled in Belgium and the Netherlands.

**Capability updates**  
Multi-role capability followed from 1981, when the enhanced C/D model - with a maximum take-off weight (MTOW) of 17,000kg - achieved initial operational capability.



Test pilot Phil Oestricher was at the controls for both 'first' flights involving prototype YF-16



Official 90min debut on 2 February 1974 took lightweight fighter to 350kt and 30,000ft



Cockpit configuration is optimised for high-g dogfighting, including 30° seat back angle

Further updates to the type, which is powered by either an F100 or GE Aerospace F110, were declared in service by the USAF in 1989 as the Block 40/42 version and 1994 for the Block 50/52.

The USAF notes that during Operation Desert Storm in 1991, its F-16s flew "more sorties than any other aircraft" and struck "airfields, military production facilities, Scud missile sites and a variety of other targets". The region also provided the first air-to-air kill for an F-16: a successful 'no-fly' zone engagement of an Iraqi air force MiG-25 using a Raytheon AIM-120 AMRAAM, during the subsequent Operation Southern Watch.

Shortly afterwards, Lockheed in 1993 acquired General Dynamics' tactical military aircraft business, including the F-16's Fort Worth final assembly line in Texas. This grew to be a mile long, and now hosts completion of Lockheed's F-35 stealth fighter. The last F-16 delivery from the site was made in 2017, with the aircraft bound for service with the Iraqi air force.

In 2023, first shipments were completed from a new production facility in Greenville, South Carolina.

Some 4,591 F-16s had been built as of mid-December, with the global fleet having recorded over 13 million sorties and 19.5 million flight hours. Lockheed notes that over the life of the programme, around 140 versions have been produced, through various blocks, models and national-specific adaptations.

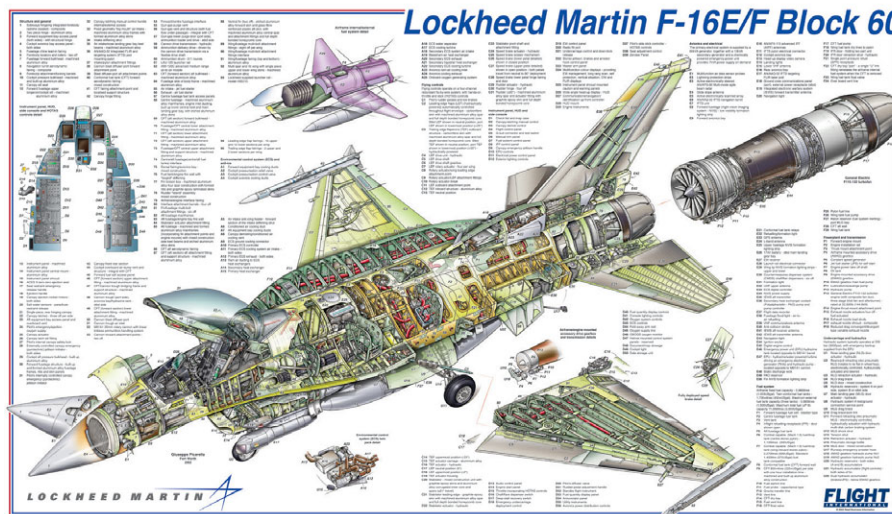
Today, F-16s are in frontline use in 25 nations, with Slovakia and Bulgaria to follow and Ukraine in 2024 to begin fielding at least 61 examples which F-35 buyers Belgium, Denmark, the Netherlands and Norway will transfer from surplus stocks. Partially in support of the pending equipment transfer to Kyiv, Lockheed in late 2023 established a new European F-16 training centre at Fetesti air base in Romania.

Cirium fleets data indicates that the current active F-16 inventory totals 2,852 military aircraft, with another 327 recorded as currently in storage.

Lead operator the USAF has progressively reduced its active F-16 fleet to slightly below the four-figure mark: some 948 were in use as of mid-December. The service's frontline C/Ds are aged between 18 and 41 years, while its fleet total also includes 62 A/C-model examples modified by Boeing into QF-16 target drones, and examples used by the Thunderbirds aerobatic display team.



Royal Bahraini Air Force was the first to receive a Greenville-built Block 70, followed by Slovakia



We marked the United Arab Emirates' introduction of the Block 60 F-16E/F with cutaway poster treatment in 2003

The three leading users behind the USAF are the air forces of Turkey (243), Israel (224) and Egypt (218). Other notable users include the United Arab Emirates, which flies 78 E/F-model examples in the advanced Block 60 standard, which introduced an active electronically scanned array (AESA) radar with the type.

US adversary training provider Top Aces, meanwhile, has become the first such operator to field F-16s, with 10 N-registered examples - nine As and one B - in use, aged up to 43 years.

**Non-military users**

Other non-military users are listed as Lockheed, with two, and single examples are with Calspan, Israel Aerospace Industries and NASA.

In terms of engine choice, Cirium

records a fairly even split: of all F-16s currently flying, 53% are F100-powered, while the remainder use the F110.

By December 2023, Lockheed had handed over three Greenville-built aircraft in the F-16's latest Block 70 standard. Initially to be employed in support of pilot training in the USA, these include the first two of 16 examples for Bahrain and one of 14 ordered by Slovakia.

New capabilities embedded with the Block 70/72 standard include Northrop Grumman's APG-83 AESA radar, plus "advanced avionics, a modernised cockpit with new safety features, advanced weapons, conformal fuel tanks [CFTs], an improved-performance engine, and an extended structural service life of 12,000h" - equivalent to at least 40 years of operational use.

MTOW also climbs to almost 21,800kg, with engine thrust in the 29,000lb (129kN) class.

Lockheed notes that the CFTs - which increase internal fuel capacity by almost 1,360kg - provide extended range "without sacrificing the aerodynamic performance of the jet".

The company also notes that its automatic ground collision avoidance system has saved the lives of 13 USAF personnel since its introduction in late 2014.

"There are currently 125 F-16s for five countries in the production backlog," Lockheed says: its other customers are Bulgaria (8), Morocco (24) and Taiwan (66). To date, the majority of buyers for the enhanced version have selected GE's F110

engine: only Morocco's examples will have the F100.

Bulgaria plans to boost its acquisition by another eight jets, and Jordan intends to buy 12. And in 2023, the Philippines emerged as another potential future customer, with a need for a dozen advanced fighters.

Lockheed notes that its current production activity is supported by roughly 470 suppliers globally, with "major components produced in eight countries".

Deliveries will run through at least late this decade, but the company has previously said that it expects to secure additional orders in "Europe, Asia and Africa". Opportunities include an Indian air force requirement for which Lockheed is offering a rebadged F-21, to be produced in the country if selected.

"We leverage emerging technologies to advance F-16 performance for future production as well as upgrades and modernisation activities," the airframer says. Greece, South Korea and Taiwan - which fly a combined 460 examples - plus another undisclosed operator are in the process of updating their fleets with the APG-83 radar, a high-resolution centre pedestal display and replacement modular mission computer, it notes.

**Defending Ukraine**

2024 will again see much focus placed on the F-16, as the type bolsters the capabilities of the war-depleted Ukrainian air force. Its 50th anniversary will also be one of the show themes for the 19-21 July Royal International Air Tattoo in the UK, with multiple nations due to proudly exhibit their aircraft.

Describing the jet as "the most dominant and capable fourth-generation fighter ever produced", Lockheed says: "This foundation of innovation, versatility and affordability has been integral to the F-16's enduring global success over the past five decades. The jet stands as one of the most iconic fighters in history. It is a symbol of enduring partnerships, industrial collaboration and security."

"The fundamental strengths of the original design remain," it adds. "At the heart of every Fighting Falcon is the lightweight fighter concept championed by Colonel John Boyd and the other members of the Lightweight Fighter Mafia." ▶



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Lou-Ann Seet believes that the biggest challenge facing women who want a career in aviation is the lack of a network, a problem she is working to address through the Singapore chapter of Women in Aviation International (WAI)

# Breaking barriers

Greg Waldron

From a young age Lou-Ann Seet had a passion for flight. She recalls a childhood of travelling with her mother, who spent decades working with both Singapore Airlines and Cathay Pacific. At the age of 16, Seet decided on a career in aviation.

Initially she trained to be a pilot, and even obtained a private pilot's licence, but ended up working on the corporate side of the industry, initially with private jet charter firm Hongkong Jet, Collins Aerospace, and now its flight tracking subsidiary FlightAware. During her career Seet has also been involved with the Asian Business Aviation Association.

FlightAware, says Seet, offers the opportunity to engage with a range of players in the aviation sector. Moreover, it supports the aeronautical aspirations of employees who happen to be pilots. "The biggest perk is that being a flight tracking company they really allow employees to further our ratings and our flying experiences," she says.

"Beyond that, FlightAware does have a good number of mentors. So I get a very different slice of leadership styles and learning that can help me during my career here in the Asia-Pacific. It's a flexible, nimble company with a good brand."

Seet is also the second president of the Singapore chapter of Women in Aviation International (WAI), which she founded in 2021 with Marie Louise Philippe, the chapter's first president.

Seet and Philippe had known each other from other associations, but felt something was lacking. They decided that Singapore needed a forum where women interested in aviation could network, and also help those who wanted to join the industry to break down barriers.

Just three years after its founding, the association has 200 individual members and 13 corporate members. The membership is split between 90% women and 10% men.

"The biggest obstacle for women entering the industry is not having that network," says Seet. "Not having anyone to ask about aviation, not having that connection to a friend or a senior professional who is in the industry."

Seet has met women from sectors



Singapore as a country is very supportive of women in aviation roles, says Seet

such as finance and technology who are interested in aviation, but unsure about how to enter.

"They find the barriers to be quite intimidating, and believe that they need to be something like a pilot or engineer or somebody quite technical."

Despite its young age, the Singapore chapter of WAI is very active, with several programmes to help women and girls.

One is a programme that pairs mentors – both male and female – with female aviation professionals. The programme's objective is to build the confidence and leadership skills of mentees and offer exposure to different career paths. As for the mentors, they get the opportunity to help shape the sector's future leaders.

The programme is run by human resources consultants and involves the establishment of goals, as well as regular meetings between mentors and mentees.

"Women and a lot of professionals

we see do not have the mentorship and coaching guidance to help them understand what the industry is like, what their blind spots are, and to listen to their challenges," says Seet.

The chapter also hosts an annual 'Girls in Aviation Day'. This sees girls aged between 8 and 17 years get more exposure to career possibilities as well as female role models in the industry. The activity, which enlists the support of WAI's corporate partners, also sees girls get tours of industry locations such as engine shops and simulator centres.

Also supporting young women is a scholarship programme that was established in October 2023. This will see the chapter provide scholarships to students who are passionate about aviation and studying in a related field, such as engineering or technology.

While the chapter receives some funding from corporate members and the nominal fees it charges members, a big fundraiser

is its annual gala dinner, where the chapter sells seats to help raise funds. The event attracts a number of prominent players in the Singapore aerospace scene.

Seet says that Singapore is very supportive of women in aviation roles, with senior government and corporate figures supporting the chapter's local events.

She observes that women are gaining increasing prominence in Singapore's aviation sector, noting that JoAnn Tan became the chief financial officer of Singapore Airlines in 2023.

Asked for advice about how girls and young women might approach entering aviation, Seet suggests joining a network such as WAI.

"Without any commitment of a full-time career, this is the best way to know and connect with different people and members in our group, and get a sense of what the roles are like and the responsibilities," she says.



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