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The U.S. Army wants to add pace to the development of the Bell MV-75 Future Long-Range Assault Aircraft and is willing to accept greater program risk to field the tiltrotor more quickly. Pentagon Editor Brian Everstine's report begins on page 40. Bell Helicopter Textron concept.

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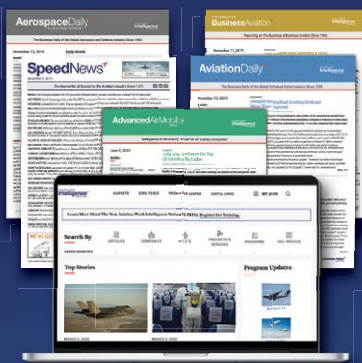
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LUNAR TRANSPORT

Moon rovers like those described in “Rugged Rover” (*Sept. 15-28, p. 34*) may help construct the first lunar bases. They may even be used locally in the medium term, for example, to move rocket fuel between bases and landing pads for a wide range of simpler, fast, rocket-propelled, semiautonomous and autonomous suborbital transports.

But time will be of the essence for human lunar explorers when they venture out of shelters that protect them from space radiation (possibly three times the level on the International Space Station) and contain centrifuges and exercise equipment, the frequent use of which will be essential to counter the adverse health effects of living in only 0.166g.

A “Moon rocket bus” may enable rapid travel over longer distances, such as between the fictional Clavius Crater base and Tycho Crater in “2001: A Space Odyssey.” During the planning for Apollo missions, a simple, personal rocket transport for local lunar travel was proposed by NASA scientist and engineer Paul R. Hill. It is illustrated in his book, *Unconventional Flying Objects: A Scientific Analysis*, published in 1995.

David Bartell, Felixstowe, England

SINO SYMBOLOGY

I have observed images from Chinese military parades, such as in “Chinese Victory Day Parade Spotlights New Weapon Priorities” (*Sept. 15-28, p. 24*), for quite a few years, and I have never understood why their vehicles and weapon systems often prominently display Western alphabet designators. Western nations do not use symbology from other languages, so why does China?

Roger Curtiss, La Conner, Washington

Aviation Week Network Military Fleets Data Manager Sam Archer replies: The consensus is that the Chinese do this for international recognition (to adversaries, friends or potential export customers who don't speak Mandarin), but the history of the practice is a bit hazy. It likely comes down to modern methods of typing Chinese on a computer keyboard. Modern data entry uses Hanyu Pinyin, the official system for romanizing Mandarin Chinese, from which we get romanized Chinese words that can then be abbrevi-



BEHIND THE SCENES

Senior Editor **Guy Norris** (second from right) spoke about the origins of CFM International, the aircraft engine manufacturing joint venture between GE Aerospace and Safran Aircraft Engines, at a special event at the French Embassy in Washington in early October marking the legacies of former U.S. President Richard Nixon and former French President Georges Pompidou.

ated as acronyms. This is where the “J” for fighter designations comes from, for example, as “J” is the first letter of the romanized Mandarin word for “fighter.”

ON AVIATIONWEEK.COM, in response to “Opinion: Is The Commercial Aerospace Business Model Broken?” (*Sept. 15-28, p. 58*), which states that “Boom is developing a supersonic airliner to fly at Mach 1.7 and carry 60-80 passengers up to 4,250 nm [and] has 130 purchase commitments from the likes of United Airlines, American Airlines and Japan Airlines,” **John L** writes: There are no such purchase commitments in American’s or United’s annual 10-K financial statement reports to the SEC. As publicly traded companies, they are required to disclose all purchase material commitments. They both list purchase commitments from Airbus and Boeing but none from Boom.

Boom tells Senior Editor Guy Norris: Boom characterizes them as orders and preorders. Orders come with nonrefundable deposits. American Airlines’ release, for instance, specifies that “American has paid a nonrefundable deposit on the initial 20 [Boom] aircraft.” It also states that they have “an option for an additional 40.”

This is the full statement on the Boom orderbook: “Boom’s commercial orderbook for Overture currently stands at 130 aircraft. In August 2022, American

Airlines placed a deposit on up to 20 aircraft, with an option for 40 more. In June 2021, United Airlines ordered 15 Overture aircraft, with an option for 35 more. Japan Airlines made a pre-order for 20 aircraft in 2017.”

COMMENTING ON “U.S. Air Force Efforts Give Stealthy, Agile Tankers New Momentum” (*Oct. 13-26, p. 24*), **ROGERTHAT** states:

U.S. Air Force aircraft have needed stealth only in the destruction of an airspace’s aerial defenses. These air vehicles would have but one mission: to destroy the defenses of that defended airspace. Once this mission was accomplished, stealth air vehicles were no longer necessary. A corollary to this fundamental doctrine was that stealth should not be wasted on aircraft or air operations where an airspace has had its air defenses destroyed.

When designing or developing an air vehicle, you give it an extended range so that logistics functions (such as refueling) can be undertaken in undefended airspace areas. Instead of wasting money on providing stealth for aerial refueling tankers, you spend money on designing a more extended range for combat aircraft, their weapons and their systems (i.e., their engines’ fuel economy). That’s a better way to spend the money—on the combat aircraft, not on the tanker. ☒

Address letters to the Editor-in-Chief, *Aviation Week & Space Technology*, 2121 K Street, NW, Suite 210, Washington, DC, 20037 or send via email to: awstletters@aviationweek.com Letters may be edited for length and clarity; a verifiable address and daytime telephone number are required.



Jonathan Cirtain has been named CEO of *Axiom Space*, adding to the position as president he has held since June. He succeeds Tejpal Bhatia, who was named CEO

in April. Before joining the company, he spent eight years in senior positions at BWX Technologies, including leading its nuclear medical and advanced technology businesses. He also led programs at NASA's Marshall Space Flight Center.

American Airlines has appointed **Nathaniel Pieper** chief commercial officer, effective Nov. 3. He was CEO of the Oneworld alliance and brings experience from senior positions at Alaska Airlines, Delta Air Lines and Northwest Airlines.

Saska Gerasimova has been named group CEO of global air charter specialist *Chapman Freeborn*.

She succeeds **Eric Erbacher**, who becomes chair of the board of directors.

Gerasimova was senior supply chain manager at Amazon Air Europe, and worked for 10 years before that at SmartWings as fleet director and leasing manager. Erbacher had been CEO since 2020, with past positions at Car-golux Airlines and Lufthansa Cargo.

Susan Sirois has joined orbital logistics and space infrastructure provider *Space Ocean* as chief human resources officer. She was vice president of people operations at Credit Union West, and previously worked at American Water and the Water Quality Association.

Northrop Grumman has promoted **Greg Simer** to chief technology officer from vice president and hired **Chantal Sice-Sweger** as vice president of supply chain. Simer has worked at the company for over 20 years, and before that was at Yafo Networks. Sice-Sweger joins from L3Harris Technologies, where she was also vice president of supply chain, and previously spent 10 years at Raytheon Missiles and Defense.



Wesley Bush has joined the board of directors at *GE Aerospace*, succeeding Steve Angel, effective Dec. 1. He is the former chairman and CEO of Northrop Grumman, where he was also chief operating officer and chief financial officer.

Corneel Koster has been named to succeed Shai Weiss as CEO of *Virgin Atlantic* effective Jan. 1. Koster is now chief customer and operating officer; he rejoined the carrier in 2019 as chief customer officer after serving as senior vice president for Europe, the Middle East, Africa and India at Delta Air Lines and before that as chief operating officer at Aeromexico.

Britten-Norman has hired **Ben Smith** as head of aftermarket. He joins from Garmin, where he was aviation associate and services sales manager for Europe, the Middle East and Africa. His previous employers include Powervamp and Red-line Aviation Security.

Winston Beauchamp has joined *Boeing Defense, Space and Security* as vice president of intelligence systems. He was director of security, special program oversight and information protection and previously deputy chief information officer in the U.S. Department of the Air Force. In addition, he worked in the Office of the Director of National Intelligence and the National Geospatial-Intelligence Agency.

Michael Kaplan has rejoined *StandardAero* as chief legal officer, succeeding Steve Sinquefield. He was senior counsel at Norton Rose Fulbright, with past positions at MDC Holdings and Red Robin. When last at StandardAero, he was general counsel and chief security officer.

Aftermarket services provider *FCAH Aerospace* has hired **Fred Sontag** as vice president of its First Class Air Support brand. He was vice president of distribution and Americas sales at



GA Telesis, and has worked in sales, distribution and business development at AAR, Unison and Wesco Aircraft.

Jacob Grob has joined Earth observation company *Near Space Labs* as vice president of sales. He was a sales executive at Origami Risk and previously a chief revenue officer at Tensorflight, with past senior positions at Maprisk and Corelogic.

Anduril has hired **Brett Darcey** as vice president of engineering. He was a technical fellow and previously executive vice president and head of product at Shield AI, which acquired his prior employer, Heron Systems.

Rich Pournelle has joined advanced propulsion developer *New Frontier Aerospace* as director of business development. He was business development manager at Benchmark Space Systems and previously oversaw business development at Nanoracks and XCOR Aerospace.

Cutter Aviation has hired **Patrick Cote** as regional sales manager for Tecnam in Arizona and California. He is a recent graduate from the University of North Dakota, where he was a certified flight instructor, as well as a sales and marketing intern at Piper Aircraft.

Wendy Schoppert has joined the board of directors at *Sun Country Airlines*. She is also board chair at Office Depot and a board member at DaVita and Fossil. As an executive, she was chief financial officer and previously chief information officer at Sleep Number, with past roles at U.S. Bank and America West Airlines.

SES has appointed **Joseph Cohen** to its board of directors. He is a co-founding partner at Trilantic Europe and previously spent over 20 years at Lehman Brothers, with over half of that as European co-head of Lehman Brothers Merchant Banking. ☞



To submit information for the Who's Where column, send Word or attached text files (no PDFs) and photos to: whoswhere@aviationweek.com For additional information on companies and individuals listed in this column, please refer to the Aviation Week Intelligence Network at AviationWeek.com/awin For information on ordering, telephone U.S.:

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See Wei Cong, ST Engineering

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Defense Trade Press Statement on Media Restrictions at the Pentagon

FOR DECADES, the defense trade media has been a trusted source of news and insight about U.S. Defense Department programs, budgets and strategy. Ethical, accurate and timely reporting makes that possible. The public, industry and indeed the department itself benefit from granting credentialed defense reporters access to unclassified areas in the Pentagon and from the trust engendered by that access.

DANIEL SLIM/GETTY IMAGES



The Pentagon has been seeking to impose unprecedented restrictions on journalists' ability to cover the military for several months. Having restricted where unescorted media may go in the Pentagon—such that even visiting the public affairs offices of the military services now requires an escort—department leaders are asking reporters to sign a document acknowledging a vague new policy that, on its face, appears to contravene the First Amendment. This policy threatens to punish reporters who ask legitimate questions in the course of their daily work and to impose material harm on our news organizations for factual reporting.

Journalists from the undersigned defense trade publications will not sign this new policy. Our newsrooms will continue to cover topics of military, defense and national security fairly and independently.

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Breaking Defense
Defense Daily
Defense News
Defense One
Inside Defense
Military Times
USNI News

FIRST TAKE

For the latest, go to
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DEFENSE

Shield AI has unveiled the X-Bat, a fighter-

size, jet-powered, tailsitting vertical-takeoff-and-landing autonomous combat aircraft, and anticipates first flight in 2026.



The European Commission is proposing four flagship programs to bolster its defenses—the European Drone Defense Initiative, Eastern Flank Watch, European Air Shield and European Space Shield.

Ukrainian President Volodymyr Zelenskyy signed a letter of intent on Oct. 22 with the Swedish government to acquire up to 150 Saab Gripen fighters over the next 10-15 years.

Boeing has unveiled the high-speed vertical-takeoff-and-landing uncrewed tiltrotor CxR concept for the U.S. Army, focused initially on strike and reconnaissance.

The Netherlands has signed a letter of intent to join the U.S. Air Force's Collaborative Combat Aircraft program to enhance the effectiveness of its Lockheed Martin F-35 fleet.

Germany has formally placed an order for 20 more Tranche 5 Eurofighters, just days after securing budgetary approval for the purchase.

Boeing and Leonardo have teamed up

VIEW FROM WASHINGTON

Competition To Spur Return to Moon

The Trump administration plans to reopen its Artemis III Human Landing System (HLS) contract awarded to SpaceX in a bid to speed the U.S. return to the Moon.

"The problem is [SpaceX] is behind . . . and we are in a race against China," acting NASA Administrator Sean Duffy told CNBC. "Whatever one can get us there first to the Moon, we're going to take." Duffy is open to contracting two companies to perform the lunar mission. "I feel pretty confident that with this competition we are going to beat the Chinese," he added on Fox News.

In 2021, NASA awarded SpaceX a \$2.89 billion contract for a version of its Starship launch vehicle to land astronauts on the Moon's south pole. Blue Origin challenged the award but lost.

Test failures have delayed development of the Starship reusable heavy launch system. SpaceX has yet to demonstrate Starship refueling in Earth orbit, which is required to reach the Moon.

Before Artemis III, SpaceX must fly at least one uncrewed mission that lands the Starship HLS on the lunar surface and demonstrates that it meets the requirements for crew safety, NASA says.

Blue Origin is due to fly its Mark I lunar lander early next year, a prototype for its HLS-class Mark II, but this architecture involves refueling in lunar orbit.

SpaceX CEO Elon Musk dismissed his rival's capabilities. "Blue Origin has never delivered a [useful] payload to orbit, let alone the Moon," he wrote on social media. "Starship will end up doing the whole Moon mission. Mark my words."

to offer the AW119T/TH-73 for the U.S. Army's future helicopter training program to replace the UH-72 Lakota fleet.

Denmark is to grow its F-35 fleet by 16 to 43 aircraft as part of procurements to boost its defense capability in Greenland and the Arctic.

Switzerland plans to spend 850 million francs (\$1.1 billion) over 12 years to expand its military space capacity to field capabilities including counter-space.

COMMERCIAL AVIATION

The FAA has cleared Boeing to increase 737 MAX production to 42 aircraft per month from the cap of 38 imposed in early 2024, in the aftermath of the Alaska Airlines door plug blowout (page 11).

A Boeing 747 freighter operated by AirACT skidded off the runway while landing at Hong Kong International Airport early Oct. 20, hitting a ground vehicle and crashing over a sea wall.

South American airline group Abra has fortified its Airbus orderbook with 50 A320neos and up to seven A330neo widebodies.

The European Commission has approved Boeing's acquisition of Spirit AeroSystems, provided they comply with commitments to divest businesses supplying Airbus (page 39).

Airbus has opened second final assembly lines for the A320neo family in Mobile, Alabama, and Tianjin, China, as it strives to boost production to 75 per month.

A second final assembly line for CFM Leap-1A turbopfans is expected to start operations in Casablanca, Morocco, in 2028, Safran says (page 64).

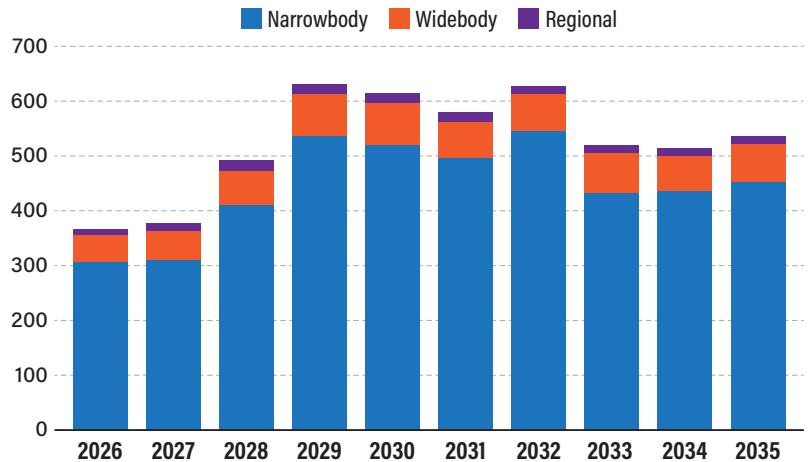
China's long-delayed AVIC MA700 70-seat regional turboprop, reengined with a domestically developed powerplant, has begun high-speed taxi trials.

Lessor TrueNoord has ordered 20 Embraer 195-E2s, with purchase rights for up to 20 more plus 10 E175-E1s.

Korean Air has selected Archer Aviation as its electric vertical-takeoff-and-landing air taxi partner in South Korea, with purchase rights for 100 aircraft. 🌐

DATA SPOTLIGHT

European Forecast Deliveries, 2026-35



Source: Aviation Week Network 2026 Commercial Fleet & MRO Forecast

The recently released Aviation Week Network 2026 Commercial Fleet & MRO Forecast (page 22) gives insight into future deliveries to European operators. Airlines in the region have almost 4,000 aircraft on order, and more than 5,000 deliveries are forecast. Those deliveries are projected to remain consistent through 2028 and then increase in the early 2030s. Airbus is forecast to lead, with almost 60% of all deliveries—the A321 alone should account for over 35%. Boeing is forecast to make 37% of the deliveries; the 737 MAX 8 will represent a little more than 20% of the deliveries forecast. Narrowbodies are projected to continue to dominate the European market and most regions of the world.



For more about the Aviation Week Network 2026 Commercial Fleet & MRO Forecast and other Aviation Week data products, go to: [Aviationweek.com/Com-Forecast](https://aviationweek.com/Com-Forecast)

40 YEARS AGO IN AVIATION WEEK

Built over three years by Rockwell International in Palmdale, California, space shuttle Atlantis made its flight debut from the Kennedy Space Center in October 1985, joining NASA's three other spaceworthy orbiters, Columbia, Challenger and Discovery. The liftoff was featured on our cover a few weeks later, but there were few details inside the magazine. The reason: Atlantis was on a classified mission for the U.S. Defense Department. Aviation Week editors, sourcing documents released four years earlier by the U.S. Air Force, surmised that Atlantis had probably deployed the first two General Electric-built Defense Satellite Communications System spacecraft. Atlantis would make 33 trips to space over 26 years before being retired in 2011. The orbiter is now on display at Kennedy's visitor center. To this day, NASA's website lists little information on its first mission.



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UP FRONT

RICHARD ABoulAFIA



JET ENGINES HAVE SOME OF THE highest entry barriers of any industry, since there are only 3.5 big engine primes. Yet four new entrants are devel-

oping their first products, and their success or failure will have a significant impact on the market.

The new hopefuls are a diverse group. China wants to go from building military engines (many, if not all, of which owe their lineage to Russian designs) to producing civil engines, starting with the AECC Commercial Aircraft Engines CJ-1000A for Comac's C919 jetliner.

South Korea also seeks to eliminate dependence on the U.S.—Hanwha Aerospace is developing a General Electric F414-class engine for Korea Aerospace Industries' KF-21 Boramae fighter.

In Turkey, Tusas Engine Industries is developing the TF35000 to replace the General Electric F110 on Turkish Aerospace Industries' Kaan fighter. As its designation suggests, the TF35000 is expected to provide 35,000 lb. of thrust, meaning the twinjet Kaan would have roughly the same engine power as Lockheed Martin's F-22.

These new engines reflect ambitions for self-sufficiency. But in the U.S., Boom Supersonic, working with Kratos' Florida Turbine Technologies unit and other companies, is designing the 40,000-lb.-thrust Symphony engine for the Overture supersonic jetliner.

These aspirations stand in stark contrast to historical experience. As the jet age began in the 1950s, three and a half manufacturers made commercial or military jet engines: GE, Pratt & Whitney, Rolls-Royce and Snecma. The latter counted as one-half, since it built only fighter engines. The Soviet Union produced its own engines. Seventy years later, the industry still has just these players, although Safran has taken Snecma's role and grown it through the CFM partnership with GE. Post-Soviet Russia's engine capabilities have deteriorated markedly.

Some companies have attempted to join the club, and several have wisely walked away from such efforts. India's Gas Turbine Research Establishment worked on the Kaveri, an unsuccessful GE F404-size engine for the Hindustan Aeronautics Ltd. Tejas fighter. Safran worked on the failed Silvercrest business jet engine and, with Russia, on the slightly less disastrous PowerJet SaM146 regional jet engine. Japan has developed a variety of small jet engines but built few

in significant numbers, and, except for a limited number of programs such as IHI's XF9-1, it has declined to build its own commercial and fighter engines. Honeywell, despite its track record with small business-jet engines, never developed anything larger than the 7,000-8,000-lb.-thrust HTF7000 series, but the company still aims to increase the engine's thrust to 10,000 lb. Major turbine suppliers and partners, such as IHI, MTU Aero Engines, GKN Aerospace and ITP Aero, generally stick to their subordinate roles.

Yet the four new turbine hopefuls and their government and financial backers are acting as though design-

ing and manufacturing a new jet engine is just like developing another component, as opposed to the experience-dependent black art it has been. Some argue that if they can design an aircraft, they can design an engine. Others, like Boom, argue that new design technologies are leveling the playing field with the complacent legacy engine primes.

There are implications for the success of any of the four new entrants. For Turkey and South Korea, it would mean a much higher level of military sovereignty, and it

would permit them to export a high-end weapon system without fear of being cut off by the U.S., UK or France.

For Boom, a successful engine would eliminate a major barrier to creating a supersonic jetliner. No engine manufacturer agreed to create a powerplant for Boom. In fact, no company has developed a commercial supersonic engine since Rolls-Royce and Snecma built the Concorde's Olympus, which was initially built for the Avro Vulcan bomber. Thus, Boom's would be the world's first bespoke commercial supersonic engine.

Most of all, a successful Chinese engine would eliminate one of the few obstacles to China's self-sufficiency in air transport. Perhaps, if the engines are up to Western standards, the country's jetliners could achieve global commercial competitiveness. At the very least, as Russia falls prey to corruption and isolation, China is likely to take Russia's place as a supplier to key allied nations.

We will soon find out whether the very high entry barriers around jet engines have diminished and what impact that will have for countries that seek a higher level of civil or military self-sufficiency. ☪

Contributing columnist Richard Aboulafia is managing director at AeroDynamic Advisory.

High Barriers

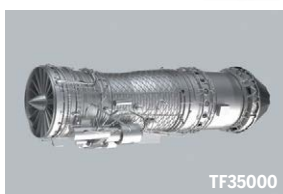
Is the jet engine market accessible to new entrants?



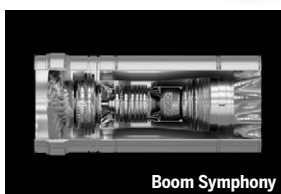
CJ-1000A



Hanwha KF-21 engine



TF35000



Boom Symphony

CLOCKWISE FROM TOP LEFT: CHINESE MINISTRY OF INDUSTRY AND INFORMATION TECHNOLOGY, MARK WAGNER/AVIATION-IMAGES, BOOM SUPERSONIC, TUSAS ENGINE INDUSTRIES.



GOING CONCERNS MICHAEL BRUNO

THE LONG INTERNATIONAL NIGHT-mare is over: The commercial aviation manufacturing upcycle is finally happening.

For the past five years, commercial aerospace production has been haunted by false starts, irrational exuberance, supply chain breakdown and the comeuppance of air transport OEMs and their regulators. Year after year, eye-popping production forecasts were issued around January, only to be revised down almost quarterly. In the end, the dual crises of the COVID-19 pandemic and Boeing's 737 MAX scandal wiped away hundreds of billions of dollars in manufacturing revenue and set back fleet planning by hundreds if not thousands of unbuilt airliners (AW&ST May 6-19, 2024, p. 11).

But the Oct. 17 announcement that the FAA has approved Boeing's request to increase 737 MAX production to 42 aircraft per month is greenlighting industry players to say the quiet part out loud: Things are finally getting better, *reliably*, and for the long term. Even before that good news, advisors and analysts sensed the pivot was happening.

"For the first time in years, aircraft delivery estimates have arguably bottomed, and in Boeing's case, they're actually moving higher," Melius Research aerospace analyst Scott Mikus told his investor clients earlier on Oct. 17. Delivery estimates for Airbus also have stabilized over the past year. "The early phase of the OEM upcycle is increasingly being recognized by [Wall] Street, setting the stage for a further step up in deliveries and earnings momentum into 2026," he said.

AeroDynamic Advisory Managing Director Richard Aboulafia—also an AW&ST guest columnist—sees manufacturing business going up and to the right for a long time. "We're not overbuilding," he said in an Oct. 15 webinar. "We're not at any risk at all of overcapacity. We're just going to keep going, and then I think we'll hit a nice plateau because . . . supply and demand will only reach equilibrium toward sometime in the early years of the next decade."

"Is it a supercycle, or is it a cycle that couldn't quite live up to the expectations and potential of producers and customers in the early years and ultimately will catch up?" Aboulafia asked during his annual fall market update to *Aerospace Manufacturing and Design*. The question may be academic, he explained: "Because of this massive chunk of undelivered capacity, we've got some really good times ahead."

Aerospace executives believe it, too, according to Accenture's latest Commercial Aerospace Insight Report, which includes results from an exclusive survey of industry managers in August. "This is the first time that I remember having all nine indicators green," John Schmidt, aerospace and defense global lead at Accenture, tells Aviation Week. "It's been a while coming."

According to the report, global commercial aerospace revenue this year is expected to be up 12% over 2024, with maintenance, repair and overhaul spending likely 14% better. The improvements are driven by production increases, including 25% growth in narrowbody and widebody deliveries, as well as "strong" aftermarket demand and rising confidence in the supply chain.

To that effect, supplier confidence among surveyed respondents rebounded to 92% within 12 months and 97% within 24 months—back to the all-time high under the Insight history, despite near-term tariff and parts pressure.

As many experts have observed in recent years, this upcycle could turn into one of the longest, most prosperous in the history of aircraft-making. As Aboulafia suggested, the irony is that this upcycle's painfully slow beginning be-

came a key ingredient for its likely protracted duration. In the early days coming out of the pandemic, he half-jokingly called it the worst recovery ever, but that is the case if you look at it like any other recovery. It is not.

Historically, commercial aerospace cycles ran through seven-year episodic paths. But if you assume, for argument's sake, that a next-generation air transport replacement will not enter service until 2035 at the soonest, that means there are 10 more years in this cycle and at least 15 years since it began. Chances are that a real next-generation replacement will not enter service until 2040 or beyond.

This has huge implications for suppliers. If you are an established, certified, trusted provider now, you are sitting in the catbird seat. The OEMs are less able to shake you down for inclusion on the next program because it is so far away as to be irrelevant, even for your next long-term agreement negotiation.

Of course, a black swan event can always derail this blue-skying. But assuming that does not happen, wouldn't you like to have known that a once-in-a-lifetime productivity upswing was really beginning? Industry executives think it has. Wall Street is waking up to the investment thesis, and the FAA just gave it a green light. Here we go. 🟢

Here We Go

The commercial upcycle is **finally** here



JENNIFER BUCHANAN/THE SEATTLE TIMES POOL PHOTO



INSIDE BUSINESS AVIATION

WILLIAM GARVEY

THE CONCEPT THAT MORE FUEL delivers more range is obvious, but delivering on it can require engineering ingenuity. And while transoceanic narrowbody transports exist today, they did not five decades ago.

That is when Harvey Patrick, an enterprising engineer with experience at Pratt & Whitney and Butler Aviation, set off to serve the upper end of the business aviation market. Among his first products were auxiliary power units for business jets. But his company, PATS Inc., gained wide notice when it began fitting privately operated transport aircraft with auxiliary fuel tank systems that extended range considerably.

A VIP Boeing 727 was the first aircraft equipped with PATS aux tanks. Tom Gollicker, an aviation pal of Patrick's familiar with the project, described the technical solutions as "creative." And that has remained a key element of the company's DNA.

PATS ownership changed several times, and the company's products and services expanded so much over the years that in 2015 it rebranded as Aloft AeroArchitects to reflect that evolution.

Based at Delaware Coastal Airport in Georgetown, Delaware, the company's campus (see photo) includes four hangars that can house seven narrowbody transports plus 42,000 ft.² of shop space along with a 35,000-ft.² manufacturing unit and a 90,000-ft.² ramp. There also are dedicated facilities for training, engineering and application of supplemental type certificates (STC)—it owns more than 350—and parts manufacturing. Those last two activities resulted from the FAA granting the company Organizational Designation Authorization (ODA) and Parts Manufacturer Approval (it owns 109 PMAs at last count).

Aloft AeroArchitects employs some 300 people, including maintenance, modification and avionics-electronics technicians, manufacturing personnel and scores of engineers. Its main lines of business are maintenance, modification and completions work; systems and equipment manufacture; and ODA design, engineering and approval services. Accordingly, it boasts the ability to "design, build, install and certify virtually any solution for our customers."

Those hangars are typically occupied with transport-size aircraft being serviced, modified with new systems and avionics, or whose cabins are being outfitted with custom interiors and passenger electronics.

Aloft is a Class 4 FAA Part 145 Repair Station and

a Boeing Business Jet (BBJ) Service Center. Indeed, every new BBJ 737—that is approaching 200 green machines—comes to Georgetown to have a complete PATS aux fuel system installed. CEO Scott Meyer notes, "We're what make it a BBJ."

Some 30 of those—including a BBJ MAX 8—have been outfitted by Aloft with high-end interiors, including 10 for heads of state. Other aircraft outfitted by Aloft include the Bombardier CRJ200 and Embraer Lineage 1000.

Do-It-All Shop

Committed to "design, build, install and certify"



ALOFT AEROARCHITECTS

Two years ago, Boeing named Aloft, in collaboration with Greenpoint Technologies, the key installer for BBJ Select. The program enables buyers to choose among 144 predesigned, modular cabin combinations at a fixed price to accelerate delivery.

Over the decades, Aloft produced STCs for aux tank installation in the Boeing 737NG, 757, 767, Airbus A220, Fokker 100, McDonnell Douglas MD-87, and Bombardier Challenger 850 and CRJ200, among others. The company has delivered more than 1,000 aux tanks and 250 fueling systems.

Its manufacturing output also includes the Hollingsead

International lines of racks, trays, hardware extractors and hold-downs used for avionics installation.

That kind of diversity, talent and authorization has attracted a clientele of leading aerospace customers, such as Airbus, FedEx, Lockheed Martin, Northrop Grumman, Raytheon, Sikorsky and the U.S. Air Force as well as American Airlines, All Nippon Airways, Korean Air and other airlines.

The company will celebrate its 50th anniversary next year and has launched the Aloft Academy to ensure a robust talent pipeline for the future. The 16-week program is intended to develop "local, high-aptitude, mechanically inclined students" into Aloft technicians.

The subjects include structures, avionics, mechanical systems, interiors, regulations, safety and documentation. On Day 1, students are made full-time Aloft employees.

Meyer, who was the keynote speaker at the inaugural class' graduation ceremony, declared the program "is paying dividends already."

To help mark its golden anniversary, Aloft plans to host an international gathering Sept. 22-24, 2026, of custom aircraft completion pros to share ideas, experiences, assessments and fuel—for discussion, that is. ☐

William Garvey was editor-in-chief of Business & Commercial Aviation from 2000 to 2020.

AIRLINE INTEL

SEAN BRODERICK



THE AVIATION INDUSTRY HAS A carry-on bag problem.

Airline policies and passengers' desire to avoid a few extra minutes of wait time upon arrival lead to more demand for carry-on space than supply on most flights. And in the rare instances when things go wrong, the temptation to stop and grab a bag before proceeding to the nearest available emergency exit proves too tantalizing for many to avoid.

That leads to longer evacuation times. And—egregious bag fees and related money-first policies notwithstanding—that is the problem.

Smartphones and social media have amplified the issue, but it is not new. The NTSB's 2016 probe of an American Airlines engine failure prompted the board to recommend that the FAA quantify the risk and take action.

The FAA's action came via a safety alert for operators (SAFO) issued in mid-September of this year that urges airlines to review their outreach—from cabin crew briefings to gate signage—and fill any gaps. "Consider communication methods to highlight consequences of non-compliance with crew-member commands regarding retrieval of personal items during an evacuation," the SAFO recommends.

As for the analysis that led to the SAFO? It turns out that the risk of grabbing a bag in the midst of an emergency evacuation—which should not need much evidence to quantify—is more dangerous than many might expect.

An FAA-sponsored University of Greenwich study examined the issue as part of the agency's response to the NTSB's recommendations. In the study, completed in 2024 and published with little fanfare, researchers from the UK school built a model to simulate evacuations. They selected a 180-seat narrowbody with a full cabin staffed with two pilots and three cabin crew.

The model followed FAA regulatory standards that call for evacuations within 90 sec. with half of the available exits unavailable. It added a real-world wrinkle, making only the front pair of Type C exits and left pair of Type III (overwing) exits available—and none in the rear. This matches two famous fatal disasters involving post-crash fires: the 1985 British Airtours Boeing

737-200 accident at Manchester, England, and the 2019 Aeroflot Sukhoi Superjet 100 accident at Moscow's Sheremetyevo Airport.

Four scenarios were developed using variables to reflect real-world evacuation and luggage-retrieval observations. In the base case, no passengers retrieved luggage. In the three other cases, 25%, 50% and 75% of passengers, respectively, attempted to grab belongings. Each scenario was run 1,000 times.

The big-picture takeaways? Even in the base case of everyone leaving belongings behind, the median total

evacuation time (TET)—121 sec.—exceeded the regulatory requirement of 90 sec. The results showed an average of 38 passengers still onboard at that critical 90-sec. mark when everyone is supposed to be gone (fodder for a separate risk evaluation, perhaps).

In the worst-case scenario, the TET averaged 199 sec., and an average of 63 virtual passengers were still onboard after 90 sec.

Within each luggage-retrieving scenario, the random distribution of retrievers in the cabin had a measurable effect on outcomes. The exit configuration selected meant that passengers

in the rear of the cabin—designated as Zone 5—were most at risk in any scenario.

"In the event of a serious post-crash cabin fire, increasing the number of luggage retrievers will increase average dwell times, which, in turn, is likely to decrease the survivability of passengers, particularly in Zone 05, by increasing their exposure to hazardous fire products," the study states. "Furthermore, the increased exposure to toxic fire products, heat and the obscuration effects of smoke will adversely impact the ability of exposed passengers to evacuate, further increasing their dwell time in Zone 05 and, hence, their exposure to severe fire hazards. This downward spiral is likely to result in a significant increase in the expected number of fatalities."

The authors caution that the study has many limitations, such as including certain assumptions in scenarios out of necessity. More work is needed—examining other exit availability scenarios, for example—to draw any firm conclusions, they add.

Still, the results are eye-opening. And they should prompt industry follow-up. 🧳

Carry-On Chaos

Grabbing a bag during evacuation—how bad could it be?



AL DRAGO/GETTY IMAGES

THE DEW LINE

STEVE TRIMBLE



THIS IS HOW THREE-FOURTHS of the Ukrainian military buys drones: An acquisition bureaucracy vets offerings to list them in an approved online

marketplace, and front-line troops pick what they want, paying for them with points gained from how well their units have performed.

That is how Mykhailo Fedorov, Ukraine's deputy prime minister, described the "Army of Drones" acquisition process during the Defense Tech Valley Summit in Lviv, Ukraine, on Sept. 17. About 75% of the Ukrainian units participate in the points-driven acquisition process, and scores are tabulated based on tactical priorities set by headquarters, he said.

The units' funding for drones depends partly on how well they use them in combat. Hitting a target with a drone rewards the responsible unit with points based on the value of the target that the drone hits.

Damaging a tank earns a unit 20 points. Destroying a tank results in 40 points. Blowing up a Grad multiple launch rocket system nets 50 points.

The points can be adjusted as operational priorities change. Killing a Russian soldier with a drone originally was worth only two points. That was when Ukraine prioritized hitting Russian vehicles.

With so few Russian vehicles now within range of Ukrainian drones, Kyiv adjusted the points system. Now killing a Russian soldier with a drone strike is worth six points. As soon as the point adjustment was made, Ukraine's count of Russian personnel losses doubled the next month, according to Ukrainian officials.

Since May, the system has also started rewarding Ukrainian units for laying mines, weapons that are ideal for blunting the speed of a Russian break through the Ukrainian defenses.

As Ukrainian units rack up points, they can cash them in to "buy" new drones. The units can shop for the drones in the online marketplace, as if they were browsing Amazon.com. The drones are divided into categories, with dozens of options available in each.

A 7-in., first-person view (FPV) drone costs a unit 1.5 points. If it is controlled by a fiber-optic cable instead of a radio frequency link, the same size drone costs 2.5 points. Multiuse bombers, such as the Sky-

Fall Vampire hexarotor (also known as "Baba Yaga") that can carry a 5-kg (33-lb.) payload, cost 38 points.

The top drone unit in August—the 414th Separate Brigade of Unmanned Strike Aviation—tallied 34,171 points with drone strikes in 31 days. That was enough points for them to buy 600 daytime FPV drones; 720 fiber-optic FPV drones; 400 Vampire bombers; 70 intelligence, surveillance and reconnaissance payloads; and 10 electronic warfare systems.

One purpose of the point system is to create a self-

selecting process that distributes the most relevant drones to units that have proved most effective. It also creates a competition among units to achieve the best scores. Finally, it creates a feedback loop as units test new drones, capabilities and tactics on a fast-changing battlefield.

"It allows you to make quality decisions based on data," Fedorov said. "Many, many things we invented for the first time in the world in order to make decisions quickly and win."

The marketplace goes beyond drones. It includes electronic warfare devices and land robotic vehicles among the roughly 159 items offered there, Arsen Zhumadilov, director of the

country's defense procurement agency said at the DSEI expo in London in early September. That list is set to grow next year to include, for instance, a wider variety of uncrewed systems, warheads for their use and interceptor drones to counter adversary systems.

To get into the marketplace, equipment undergoes some checks for functionality. The manufacturers also are audited by Zhumadilov's agency for their financial health and to ensure they have no ties to sanctioned countries, such as Russia, North Korea, Belarus and Iran.

The process takes about 2-3 weeks. Zhumadilov said the barrier for inclusion is not very high. Items for which there is only one supplier typically will not be listed because they would not present a true marketplace.

The purchasing model has resonated with some Western militaries that are looking to Ukraine for ideas about improving their processes and fielding equipment expeditiously. But there are barriers to implementing the concept in many places, including funding such purchases and providing the requisite approval authorities to empower front-line troops to make their own buying decisions. 🌐

Point System

Ukraine's drone marketplace evokes in-game purchasing model



UKRAINE DEFENSE MINISTRY



THE LAUNCHPAD

IRENE KLOTZ

THE FIRST OF A NEW GENERATION

of cargo ships for Earth orbit—and possibly beyond—is poised for a debut run to the International Space Station, a

mission also geared to demonstrate Japan's growing space capabilities.

While the U.S. and Russia fly the bulk of the resupply runs to the International Space Station (ISS), the European and Japanese space agencies buttressed the 15-nation partnership by operating independent cargo lines to the station between 2008 and 2020.

Expanding the Fleet

A trio of new spacecraft is being eyed for ISS cargo runs

The European Space Agency's (ESA) Automated Transfer Vehicle (ATV) flew five missions before the vehicle was retired in 2014. ESA and its contractors parlayed ATV technologies, hardware and operational experience into a lead role in the U.S.-led Artemis lunar program. NASA is using ATV-derived service modules for its deep-space Orion capsule.

The Japan Aerospace Exploration Agency (JAXA) started flying its H-II Transfer Vehicle (HTV) to the station in 2009 and conducted nine missions over the next 11 years.

After a 5.5-year hiatus, JAXA was poised to debut the expanded, redesigned HTV-X spacecraft, which can carry some 6.5 tons of cargo—about 1.5 times more than the predecessor HTV ships. Launch aboard a Mitsubishi Heavy Industries' H3 rocket is expected before Nov. 30 from Japan's Tanegashima Space Center.

The HTV-X, which was developed for 60% less than the HTV, can haul 1.2 times more cargo than a Northrop Grumman Cygnus XL, 1.8 times more than a SpaceX Cargo Dragon and 2.3 times more than a Russian Progress MS freighter.

Other upgrades include:

- Capability to supply power to experimental equipment and other devices.
- Option to load cargo as late as 24 hr. before launch, compared with 80 hr. for the HTV.
- Post-ISS mission options lasting up to 1.5 years. A three-month demonstration mission is planned for the first HTV-X flight.

Beyond ISS missions, JAXA is looking to provide HTV-X cargo flights to NASA's planned lunar-orbiting Gateway and to support possible commercial stations in low Earth orbit (LEO).

Meanwhile, Colorado-based Sierra Space says it con-

tinues to work toward a free-flying demonstration mission of its Dream Chaser spacecraft, which was sidelined in September from a planned visit to the ISS.

NASA modified its Commercial Resupply Services contract with Sierra Space, which originally included six Dream Chaser missions to the ISS. However, technical issues have delayed the ship's debut. NASA said it will continue to work with Sierra Space to mature the Dream Chaser; but its supply runs to the ISS are to be determined. Sierra Space hopes to conduct the demonstration mission by late 2026.

Also angling to join the ISS fleet is The Exploration Co., a European-based startup developing cargo—and eventually crewed—spacecraft. The company is working toward a 2028 flight test of its Nyx spacecraft to the ISS under a program backed by ESA.



Japan's H-II Transfer Vehicle-9 docked to the ISS in June 2020.

BOB BENNETT/NASA

The Exploration Co. has twice flown prototypes to develop technologies for the Nyx, but neither mission was entirely successful. The latest launched June 23 on a SpaceX Falcon 9 rideshare flight. The test satellite powered on its payloads, stabilized its orbit, reentered the atmosphere and reestablished communications. A few minutes before splashdown, however, communications were lost.

The company's first test capsule launched on the inaugural Ariane 6 flight in 2024 but was unable to conduct its mission due to a problem with the rocket's upper-stage engine.

Since assembly of the ISS began in December 1998, 288 vehicles have visited the station: 93 Russian Progress ships, 71 crewed Soyuz capsules, 50 cargo and crew SpaceX Dragons, 37 NASA space shuttles, 22 Northrop Grumman Cygnus spacecraft, nine HTVs, five ATVs and one Boeing CST-100 Starliner.

The station is expected to be decommissioned in 2030, and U.S. and partner microgravity research and technology demonstration missions are to transition to one or more planned commercial LEO platforms. 🌐

ELECTRICAL BREAKDOWN



> ADVANCED AIR MOBILITY BOOM IS SHOWING SIGNS OF GOING BUST

> THE INVESTMENT ENVIRONMENT HAS DRIED UP FOR MOST COMPANIES

> CONSOLIDATION IS QUIETLY MAKING HEADWAY IN THE SECTOR

SUPERNAL

Ben Goldstein Boston

This has been a breakthrough year for the nascent advanced air mobility industry, as the leading producers of electric vertical-takeoff-and-landing vehicles make continued progress toward type certification.

But beneath the headlines, the industry is quietly consolidating, and failures are piling up. While market leaders like Archer Aviation, Beta Technologies and Joby Aviation have raised billions of dollars and are flight-testing full-scale, preproduction prototypes, a growing cohort of companies that did not gain traction are going dark—part of a rising tide of insolvencies that shows no sign of abating.

Below is a partial list of notable company failures in 2024-25. It excludes many companies that never got off the ground—figuratively and literally—and numerous others that

are believed to be hanging by a thread. It also omits a growing roster of companies that have scaled back their initial visions for passenger-carrying aircraft into lower-risk cargo and non-passenger uncrewed air vehicles.

In almost all cases, the programs were bedeviled by a lack of funds that ultimately slowed progress, as well as strategic missteps that caused them to fall behind in an unforgiving investment environment for aerospace startups.

More failures are coming. CEOs of numerous other companies have told Aviation Week that they are in dire straits amid a tight market that has

Supernal sacked its C suite and its planned S-A2 tiltrotor air taxi in September.

increasingly consolidated around a small number of startups.

“The majority of the money is basically going to a handful of companies,” says Sergio Cecutta, founder and partner at SMG Consulting, who closely tracks the advanced air mobility (AAM) industry. “I think we’re getting to the point where it is difficult for smaller companies to make any progress.”

2025 COMPANY FAILURES

Airbus The European airframer was developing the CityAirbus NextGen four-seat electric vertical-takeoff-and-landing (eVTOL) air taxi at a dedicated test center in Donauwörth, Germany. Featuring eight propellers

mounted on a 12-m (39-ft.) wing and V-tail in a lift-plus-cruise configuration, the company built a prototype that made first liftoff in November 2024. But Airbus doubted the program's commercial and technical viability. Airbus Helicopters announced a decision in January to pause development of the program, citing concerns about the maturity of existing battery technology and the readiness of the urban air mobility ecosystem.

APUS Zero Emission Based in Strausberg, Germany, APUS Zero Emission set out to develop a hydrogen fuel-cell-powered four-seat aircraft called the APUS i-2. The company rolled out the clean-sheet, twin-engine i-2 in September 2024 with plans to fly in 2025, targeting European Union Aviation Safety Agency certification in 2027 and market launch in 2028. With a maximum takeoff weight of 2,200 kg (4,850 lb.), the i-2 was to have had a range of 500 nm (575 mi.) and cruise speed of 160 kt. But the company entered into provisional insolvency proceedings in March, citing "severe financial pressure," and has failed to secure an investor to continue funding its program. Its majority assets were later acquired by FTI Engineering.

Crisalion Mobility Originally called Umiles Next, Spanish startup Crisalion Mobility was developing a multiprop eVTOL called the Integrity. The aircraft featured a unique propulsion system called FlyFree, with four boom-suspended pods that each housed four sets of electric motors and propellers—16 in total—which the company likened to separate quadcopters that control the aircraft using differential thrust. But it failed to secure a €150 million (\$170 million) investment from the charging company Movalisa this year, and talks with other potential investors collapsed; a court-imposed deadline to negotiate with creditors passed in September.

Cuberg/Northvolt Spun out of Stanford University in 2016, Cuberg was a U.S. battery startup developing lithium-metal anode cells for high-energy applications including aviation. Swedish battery developer Northvolt acquired the company in 2021, but several issues emerged around stability, cost and safety margins. Northvolt announced in August 2024 that it

would shut down Cuberg's operations in California, lay off nearly 200 employees and concentrate operations at its main R&D hub in Sweden. Northvolt filed for bankruptcy in March.

Eviation Founded in 2015 in Israel and later relocated to Washington state, Eviation was developing the nine-passenger, all-electric Alice commuter aircraft. The first prototype was damaged in a fire in 2020, and the second made its first and only flight in September 2022, a roughly 8-min. sortie from its base at Moses Lake, Washington. The company boasted more than 600 conditional orders worth an estimated \$5 billion, but an internal rift between its co-founders and majority investor, Clermont Group, led to a decision to pause the program in February.

Guardian Agriculture Massachusetts startup Guardian Agriculture developed a large autonomous drone called the SC1, capable of carrying up to 200 lb. of fertilizer and pesticide and covering up to 60 acres per hour. While the company raised more than \$50 million across five funding rounds, it failed to secure sufficient follow-on investment due to issues ranging from competition from China to an unclear regulatory environment. While the startup said it had \$100 million in orders, it had reportedly built only eight drones before it closed operations in August.

Overair A spinoff of Karem Aircraft, Overair was a startup in Santa Ana, California, developing a five-passenger tiltrotor eVTOL called the Butterfly. The aircraft was notable for its 20-ft.-dia. rotors—roughly twice the size of most other eVTOL models—and its proprietary Optimum Speed Tiltrotor and Individual Blade Control technologies. The company raised some \$145 million in June 2022 from its largest investor, South Korean conglomerate Hanwha Aerospace, and completed assembly of its first full-scale prototype in late 2023. But it ran low on cash, and Hanwha pulled the plug after recording a loss of about \$100 million on its investment in 2024. While Overair never formally called it quits, the company's C suite has mostly resigned, and there is no sign that its program is still active.

Supernal Hyundai subsidiary Supernal burst onto the scene with the debut

of its S-A2 tiltrotor eVTOL concept at the CES 2024 show in Las Vegas in January. It rolled out an engineering demonstrator, but that was not designed to a production configuration and was never intended to fly. The company consolidated its operations from South Korea to Irvine, California, in late 2024. But amid reports from former employees of a dysfunctional management culture, the startup sacked most of its C suite, including CEO and NASA alum Jaiwon Shin in August. It also announced a strategic pause—essentially scrapping its S-A2 design and going back to the drawing board. Along the way, Supernal is believed to have burned through \$1-1.5 billion, according to SMG Consulting.

Textron eAviation Textron eAviation was a subsidiary of Textron Aviation dedicated to electric aviation and AAM. The unit was developing the Nexus four-passenger tiltrotor eVTOL as well as the Nuuva V300 hybrid VTOL cargo drone. But the company announced a decision to pause work on the Nexus in October amid a corporate reshuffling that incorporates the Nuuva under its Textron Systems division alongside other uncrewed aircraft like the small Aerosonde and Shadow Tactical drone. Slovenian electric aircraft-maker Pipistrel will be rolled into the broader Textron Aviation.

2024 COMPANY FAILURES

Lilium The failure of this German startup in late 2024 became something of a cause celebre in the tight-knit AAM community. A publicly traded company that raised close to \$1.5 billion, Lilium had a team of nearly 1,300 employees at its peak in 2024, with an executive team drawn heavily from Airbus and other legacy aerospace companies. The startup's flagship product, the seven-seat Lilium Jet, featured an array of small electric ducted fans that controlled the aircraft with vectored thrust. A crewed prototype was planned to fly in early 2025. But the company was constantly low on cash, and toward the end of its lifetime became dependent on the possibility of subsidies from the German federal and Bavarian state governments that never materialized. In a strange twist, Lilium was saved in late 2024 by a consortium of investors—but the promised funds never came. A second, last-ditch rescue attempt fizzled out in February.

AIRBUS



Airbus paused development of its CityAirbus NextGen in January.

Alongside Lilium, the startup's battery supplier, CustomCells, also went bust. Archer acquired some of Lilium's key patents in October, effectively ending the saga—although in some ways, the damage to the industry's reputation never fully recovered from the debacle.

Volocopter This German company was viewed as recently as last year as the Western OEM most likely to certify first. Its two-seat Volocopter multicopter was improbable as a commercial

success due to its questionable economics, but it was expected to help establish a toehold in the market for the larger VoloRegion lift-plus-cruise aircraft. Signs of trouble emerged when the company's plans to fly at the Paris Air Show in the summer of 2024 backfired, which harmed its reputation alongside the broader industry's. Expected certification was pushed back from mid-2024 to late 2024, and the company's cash runway came under pressure. Despite raising more than \$700 million, Volocopter ultimately made the painful decision to sell to China's Wanfeng Diamond for just

\$15 million. The company continues to develop its aircraft out of the limelight, but little is known about its progress.

Universal Hydrogen Founded in 2020 by former Airbus and United Technologies Chief Technology Officer Paul Eremenko, California-based Universal Hydrogen was in the advanced stages of developing a hydrogen-fuel-cell propulsion and related fuel logistics system targeted at regional airliners. At the time of its failure, the company was actively preparing for the next phase of a flight-test campaign for its 1-megawatt hydrogen-electric demonstrator system on a De Havilland Canada Dash 8-300 testbed. But the startup was forced to liquidate in July 2024, after repeated attempts to secure equity or debt financing failed. Its intellectual property and key assets were later acquired by French startup Beyond Aero.

Rolls-Royce Electrical Rolls Royce set up an initial electric propulsion unit in 2018 and expanded the effort after acquiring technologies and facilities from Siemens in Germany and Hungary. By 2022, the business was spun off as its own entity. But a companywide restructuring under CEO Tufan Erginbilgic, announced in November 2023, was intended to sell off the business along with other noncore assets. After failing to find a buyer, Rolls-Royce Electrical was shut down one year later. 📌

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Chinese eVTOL Market Lifts Off as Startups Achieve Milestones

> DOMESTIC COMPANIES ENJOY REGULATORY FLEXIBILITY FOR SERVICE ENTRY

> OEMs HAVE ACCESS TO FULLY NATIVE SUPPLY CHAINS

Ben Goldstein Boston

While the U.S. electric vertical-takeoff-and-landing leaders continue to progress on the long road to type certification, an uncomfortable realization is setting in for many stakeholders of the nascent industry. Despite their impressive progress, they may be falling behind their Chinese counterparts.

The Chinese electric vertical-takeoff-and-landing (eVTOL) industry is robust. With strong backing from the Beijing central government through its Low-Altitude Economy (LAE) initiative for drones and advanced air mobility (AAM) aircraft operating below 1,000 m (3,280 ft.), a sturdy domestic supply chain and deep well of engineering talent, the country is seeking to replicate its lead in consumer drones and electric vehicles (EV) in the new eVTOL industry.

Although Western analysts have called into question the safety credentials of the Civil Aviation Administration of China's (CAAC) type certification process, it has become clear that Chinese companies are being held to a rigorous standard that is essentially on par with that of the U.S. FAA and European Union Aviation Safety Agency—with the added caveat that the Chinese OEMs enjoy a greater degree of flexibility. They can certify 10^{-5} for cargo, 10^{-7} for rural operations and 10^{-8} for urban operations. Many next-generation aircraft are also being designed to 10^{-9} —or one chance of catastrophic failure in a billion flight hours—the same level of safety required by commercial airliners.

The upshot is that while Chinese startups can secure a toehold in the market without the cost and workload of certifying to the highest standard (an estimated 90% of which relates to compliance verification), Western companies face more of a binary, all-or-nothing approach from regulators.

“For like-to-like airplanes, they will be certified to the same level of safety [as in the West],” says Sergio Cecutta,

founder and CEO of SMG Consulting. “But the difference is they have the ability to start gaining revenue through lower-risk operations, while in the West you can either fly over people or you can’t.”

The LAE initiative also pits provinces against each other in a competition to provide the most financial backing and regulatory support to the new industry. China’s top economic

“They don’t have to go abroad to source components; every single piece of the airplane can be made domestically,” Cecutta says. “They don’t have to rely on the whims of export controls and geopolitics.”

To be sure, Chinese OEMs will likely struggle to gain a foothold in the U.S. due to geopolitical constraints, but their domestic market is massive. Chinese cities are sprawling—and most of the country’s population of more than 1.4 billion resides in or near coastal metropolises. Domestic demand for urban air mobility is huge. They also can tap into large markets in East Asia, India, the Middle East and perhaps even Europe—where Chinese EV manufacturers like BYD are already outselling U.S. companies like Tesla with high-performing vehicles that boast a lower price tag.



EHang's autonomous VT-35 is an intercity complement to its EH216-S urban air mobility aircraft.

planner even set up a special department devoted to managing the LAE, housed within the National Development and Reform Commission. There are more than 50,000 enterprises engaged in business related to the sector; according to an English language web page of the State Council of the People's Republic of China.

“There is really nothing like it in the West,” Cecutta says.

China’s industry also can source nearly all components domestically and at a far lower price point than U.S. or European companies. Volant Aerotech, for example, has sourced almost its entire airplane—fuselage, avionics, batteries, flight controls and motors—from domestic suppliers.

Louis Liu, CEO of Dap Technologies and a close follower of the Chinese AAM industry, says China’s advantage also reflects a cultural difference in Beijing’s approach to technology development. “The Chinese can pursue projects with a 1-5% success rate, but the West will only do something with a 10-30% rate,” he observes. “The Chinese can support 50-100 OEMs to make one carmaker like BYD a success, but the West can’t do that. The EV situation is already happening in the AAM sector; and Chinese companies will be going to the international market soon to compete head-to-head with U.S. OEMs.”

Perhaps controversially, Liu also says there is a growing delta of engineering talent compared with the

West. “China can produce a huge number of engineers per year—more than the U.S. and Europe combined,” Liu says. “The engineer pool is arguably of a higher quality and much lower cost—maybe 30-50% cheaper than the U.S. or EU.”

As a testament to China’s booming eVTOL industry, at least 13 companies have flown full-scale prototypes, Cecutta says, compared with just seven in the U.S.

China already has certified the EH216-S multicopter from EHang and the CarryAll V2000CG lift-plus-cruise cargo aircraft from AutoFlight. Meanwhile, the first U.S.-made eVTOLs from such companies as Archer, Beta Technologies and Joby Aviation will not be certified until late 2026 at the earliest and possibly 2027 or later.

CONTINUED PROGRESS

In the month of October, Chinese companies continued to achieve milestones related to technology development, certification and commercialization.

VOLANT AEROTECH

Shanghai-based Volant Aerotech completed the first series of crewed flight trials in its VE25-100 lift-plus-cruise eVTOL in mid-October. The testing took place at the Zigong air base in Sichuan province. Volant says it marked the first time a Chinese company had conducted piloted flights in an eVTOL weighing more than 2 tons, as well as the country’s first piloted flight in an eVTOL with large wings.

Weighing in at 2.6 tons and featuring a 16-m (52-ft.) wingspan, the VE25-100 seats a pilot and up to five passengers with a design range of 200-400 km (190-250 mi.) and top speed of 249 kph (155 mph). It features eight dedicated lift props on four booms and two aft-mounted pusher props. It is being marketed for passenger transport, emergency medical services, cargo and logistics, and aerial tourism and sightseeing.

Volant expects certification of the VE25-100 in 2027.

EHANG

On Oct. 13, EHang rolled out the first prototype VT35, a long-range, autonomous eVTOL intended for intercity flying and performed a flight in view of a host of spectators.

Building on its VT30 prototype, the enhanced VT35 is designed to

carry two passengers up to 200 km in a pilotless configuration, serving as a longer-range complement to the Hefei-based startup’s EH216-S short-range urban air mobility multicopter.

The CAAC accepted EHang’s type certification application for the VT35 in March, and the aircraft is undergoing airworthiness certification, with internal testing and experimental flight testing “progressing steadily,” the company says.

“bridge,” “embodying the company’s founding purpose of connecting sky and earth by delivering a future where flying is as easy as driving.”

A wholly owned subsidiary of Chinese EV manufacturer XPeng, the newly renamed Aridge has developed the Land Aircraft Carrier, a modular vehicle combining a hybrid SUV called Mothership with a detachable, optionally piloted multicopter air module called the X3-F. The hybrid-



Aerofugia rolled out a full-scale prototype of its AE200-100 lift-plus-cruise aircraft in October.

EHang has set an official price of 6.5 million yuan (\$914,000) for the Chinese market.

AEROFUGIA

Aerofugia rolled out the first AE200-100 eVTOL air taxi off its production line in Chengdu on Oct. 10, bringing the startup closer to the beginning of piloted flight testing. The Geely subsidiary is developing the AE200-100 hybrid tiltprop eVTOL, a piloted air taxi capable of carrying four passengers or a 500-kg (1,100-lb.) payload up to 200 km at a cruise speed of 248 kph.

The startup says it has formally entered the “final stretch” toward airworthiness certification and the beginning of the preproduction phase of its development program, paving the way for the onset of certification flight testing with the CAAC.

ARIDGE

Chinese hybrid eVTOL startup XPeng AeroHT in October rebranded itself to Aridge and announced scores of new orders from customers in the Middle East.

The startup says the new Aridge moniker combines the words “air” and

electric Mothership seats four passengers and features six wheels in an all-wheel drive configuration, while the two-seat, six-rotor air module is housed in a rear bay and can be recharged up to six times before the EV itself needs to be recharged.

Aridge also announced the successful completion of its first crewed flight in Dubai and up to 600 conditional orders from a host of operators in the Middle East.

TCAB TECH

Shanghai-based TCab Tech completed a full flight in a piloted configuration with the startup’s founder and CEO, Huang Yongwei, sitting in the cabin—still a rare feat in an industry in which passenger flights are few and far between. The company said it marked the first time a “fully configured” eVTOL, as well as a tiltrotor eVTOL, had completed a flight in the country. It is not clear, however, whether the aircraft performed a complete transition between hover and cruise.

The E20 tiltrotor eVTOL is a four-passenger aircraft with a range of 200 km, cruise speed of 260 kph and weight of 450 kg. 🛩️

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Aviation Week's 2026 Forecast Predicts Slower Production Ramp-Up

> SUPPLY CHAIN CHALLENGES STIFLE AIRFRAMERS' MONTHLY RATE GOALS

> MORE RETIREMENTS DELAYED TO CLOSE THE GAP

Dan Williams London and Jens Flottau Frankfurt

Aviation Week's 2026 Commercial Fleet & MRO Forecast includes noticeable shifts in some key metrics, many driven by the same root cause: The number of deliveries over the next 10 years is likely to be slightly lower than expected, airlines are keeping aircraft in service longer, and, in consequence, maintenance spending is becoming an even bigger factor. But the commercial aviation fleet is expected to keep growing.

Combined commercial aircraft deliveries are not expected to recover to their 2018 level until 2027. The COVID-19 pandemic, Boeing 737 MAX production problems and the supply chain crisis cost the industry nearly a decade of growth. Deliveries are expected to plateau in the early 2030s.

The main issue is that aircraft manufacturers are still facing severe constraints in their supply chain, particularly the availability of new engines. And while both Airbus and Boeing are investing in in-house manufacturing capacity to allow higher production rates, ratcheting up output to meet demand will likely take years, barring a major crisis.

The commercial fleet has rebounded to its 2019 level, but real net growth started only this year. Growth should continue through 2035, though.

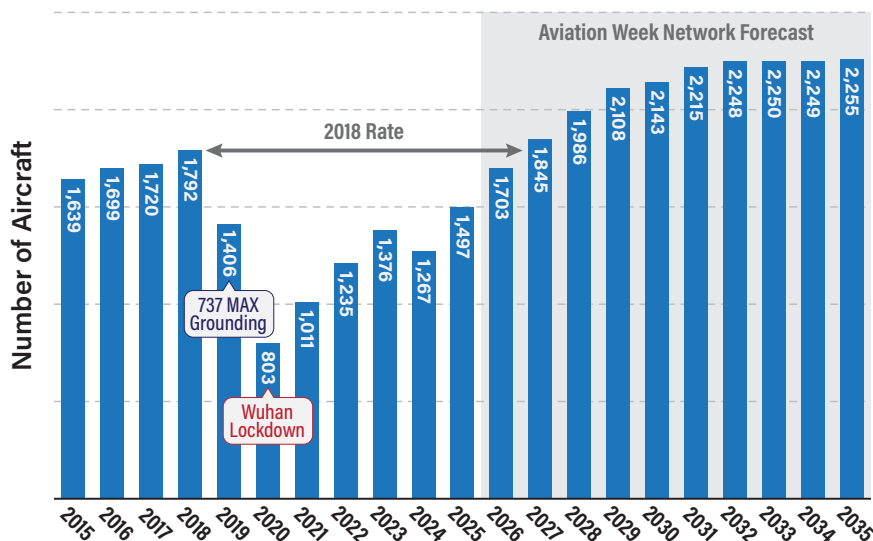
The in-service fleet will number just under 35,000 aircraft by the end of 2026, with a compound annual growth rate (CAGR) of 3% driving fleet expansion to more than 45,000 aircraft by the end of 2035, the forecast predicts. The trend illustrates the continuing demand for travel, which has shown resilience in spite of economic and political disruption over several years.

The forecast projects a little more than 21,000 new-build aircraft deliveries in 2026-35, reflecting a slight

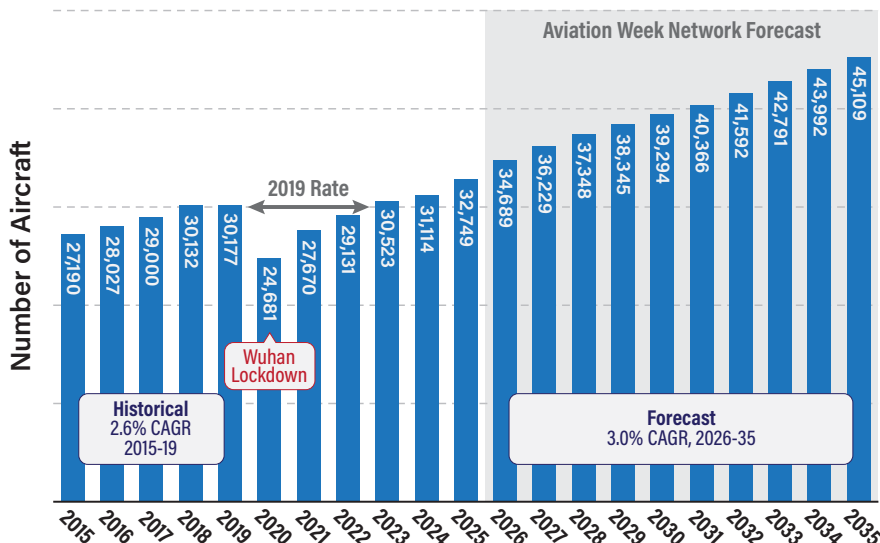
reduction compared with last year's forecast. The slower buildup of production also has provided a reprieve for older aircraft, such as the Boeing 737 Next Generation fleet and prior-generation Airbus A320s, which will remain in service longer than initially anticipated. That trend is also highly visible in the widebody market, where mainly Boeing 777-300ERs and Airbus A330s have benefited from the lack of replacement capacity.

The regional distribution of new-build deliveries highlights the dominance of North America (22%), Western Europe (21%) and the Asia-Pacific region (18%), which together account for approximately 60% of the total. China and India collectively represent just under 10% of deliveries. Latin America, Eastern Europe and Africa share the remainder. Narrowbody aircraft are projected to dominate the market, comprising three-quarters of all deliveries over the next decade. The A320neo family is expected to lead the charge with nearly 8,000 deliveries, and the 737

Historical and Forecast Commercial Deliveries

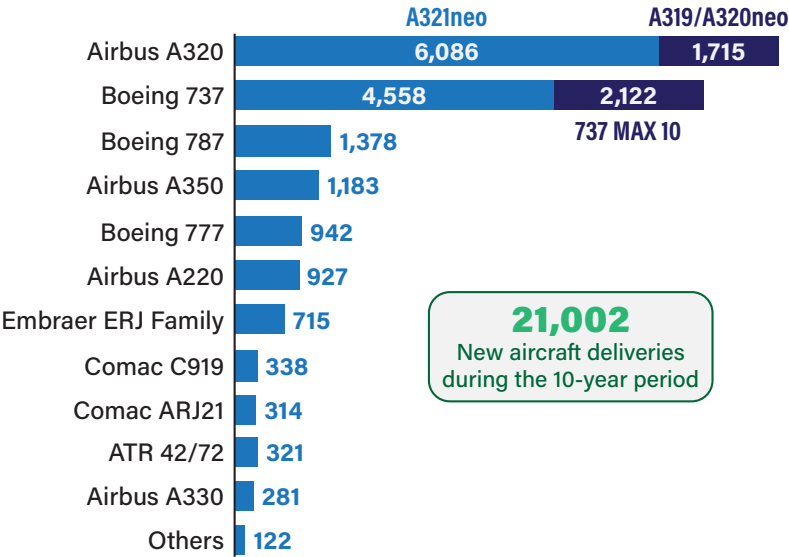


Forecast In-Service Commercial Aircraft Fleet



New-Build Aircraft Deliveries

2026-35



The Airbus A321neo looks set to be the dominant aircraft model delivered over the next decade. Its direct competitor, the Boeing 737 MAX 10, is forecast to capture only 35% of that segment.

MAX is projected to follow closely, with almost 7,000 units. Notably, the popular A321neo is slated to account for a quarter of all new-build deliveries.

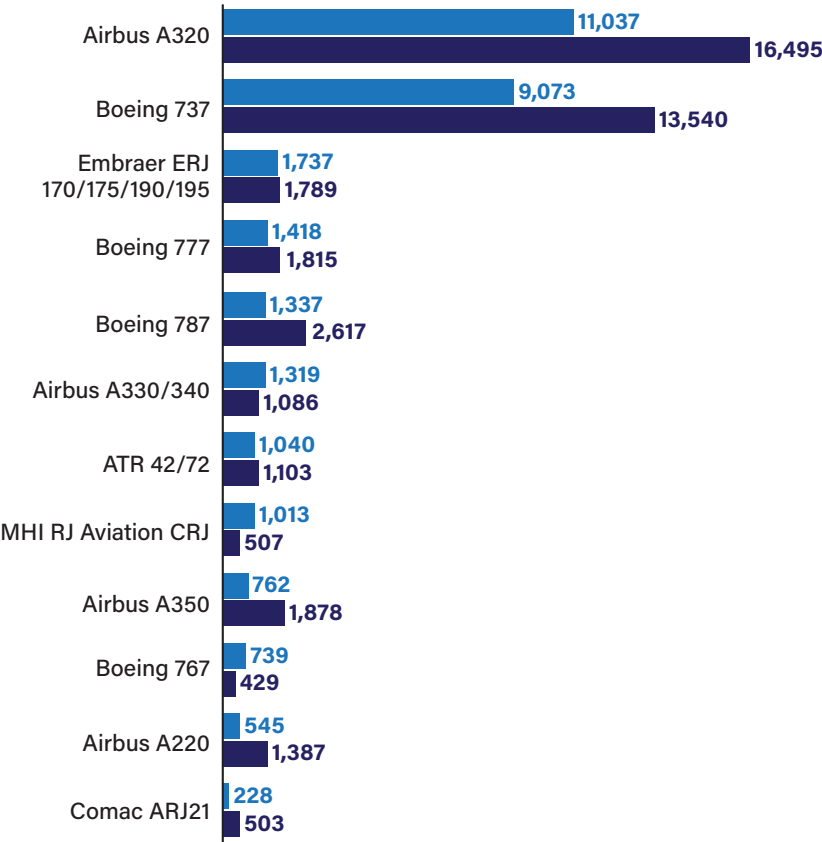
Airbus continues to command the largest share of delivery numbers, accounting for nearly 50% of the forecast total, with Boeing trailing at 43%. Comac and Embraer each contribute 3% to the overall delivery figures.

The extended service life of narrow-body aircraft also has affected retirement trends. Some 10,000 aircraft are expected to be retired over the next decade, fewer than forecast last year, reflecting the industry's efforts to keep older aircraft in operation. Historically low retirement rates have been observed in recent years, but as reliability

Forecast In-Service Fleet

By Aircraft Family

2026 2035



The market share of narrowbodies in the global fleet is forecast to rise in the next 10 years to 71% from 62%. Boeing 787s and Airbus A350s are projected to be the most popular widebodies.

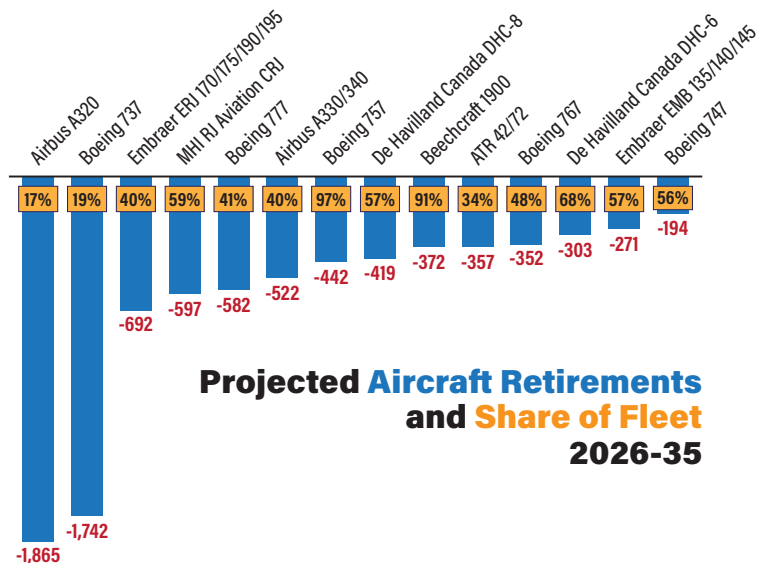
in new deliveries stabilizes, retirements are expected to return to a more consistent annual rate of around 2.5% of the in-service fleet—a figure that aligns with long-term historical averages.

The extended service life of older aircraft has driven a considerable increase in maintenance, repair and overhaul (MRO) spending. The forecast projects MRO expenditures to rise to \$1.6 trillion in 2026 from \$1.4 trillion in 2025. Engine maintenance remains the largest contributor, accounting for more than 50% of the total spend.

Components maintenance represents a little over 20%, while line maintenance accounts for 16%. Modifications and airframe heavy maintenance each contribute around 5%. Engine overhaul spending has seen a notable increase, rising 20% to \$677 billion in the 2026 forecast from \$557 billion in 2025. This surge is largely due to engines powering the narrowbody fleet, particularly the CFM International CFM56 and IAE V2500, which are undergoing more overhauls as operators keep aircraft equipped with them flying longer.

The forecast also sheds light on ongoing engine durability issues, particularly with Pratt & Whitney's PW1000G geared turbofan engines and CFM Leap engines.

Sources for all charts: Aviation Week Network 2026 Commercial Fleet & MRO Forecast and Fleet Discovery



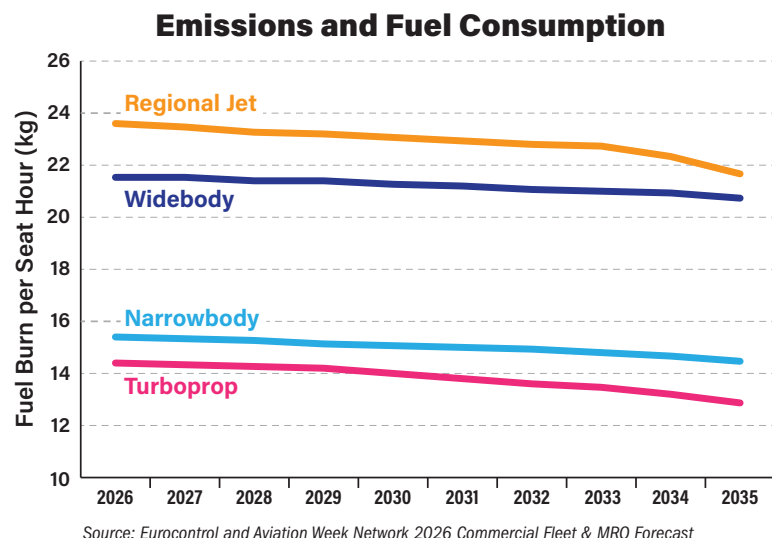
Sources: Aviation Week Network 2026 Commercial Fleet & MRO Forecast and Fleet Discovery

Projected Aircraft Retirements and Share of Fleet 2026-35

The Airbus A320 and Boeing 737 are forecast to be retired in the greatest numbers in 2026-35, but those will be relatively low percentages of their active fleets in 2026: 17% for the A320 and 19% for the 737.

The PW1000G continues to face challenges related to its combustion-heat exchanger and high-pressure turbine blade issues, while the Leap struggles with fuel nozzle and reverse bleed system problems. Aviation Week estimates that resolving these issues will cost \$5.1 billion and require more years of effort.

Another notable trend highlighted in the forecast is the decline in passenger-to-freighter (PTF) conversions. With passenger demand remaining high and new-build aircraft deliveries constrained, operators and



Source: Eurocontrol and Aviation Week Network 2026 Commercial Fleet & MRO Forecast

Aircraft will become more fuel efficient, but progress is going to be relatively slow.

lessors are prioritizing the retention of passenger-configured 737-800s in service. While widebody PTF conversions have remained relatively stable, the dwindling availability of Boeing 767s in passenger service has shifted feedstock to A330s and 777s, although supply remains tight as such airlines as Emirates are extending the use of their current widebodies as they wait for production of Boeing 787s and 777Xs to ramp up. ✈️

For more about the 2026 Commercial Fleet & MRO Forecast and other Aviation Week data products, go to: [Aviationweek.com/Com-Forecast](https://aviationweek.com/Com-Forecast)



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Southwest Embraces Cabin Changes in Ongoing Brand Evolution

> THE AIRLINE CONTINUES TO ROLL OUT NEW PRODUCTS

> WORK IS UNDERWAY TO PREPARE FOR POTENTIAL LAYOUT UPDATES

Christine Boynton Phoenix

Just over one year ago, Southwest Airlines found itself at a critical inflection point. The Dallas-based carrier was facing pressure from rising costs, shifting customer expectations and a vocal activist investor. At an investor day in September 2024, the company unveiled a three-year plan described as its “most transformational” yet, committing to curb growth, cut costs and evolve (*AW&ST* Nov. 25-Dec. 8, p. 28).

of the existing fleet, the carrier has begun to receive new Boeing 737 MAX aircraft with an updated cabin design, one that will be standard on all deliveries. Its refreshed interior includes new Recaro R2 seats, overhead bins that can accommodate 60% more bags, in-seat power ports and new lighting and carpet. Meanwhile, more than 52% of its current fleet have been equipped with the ELR, 40% with in-seat power and 20% with

design. “It is the new marker of our new product.”

As product rollouts continue, including the Oct. 24 launch of free in-flight Wi-Fi, the carrier has repeatedly teased more to come, such as the potential for long-haul flying and associated fleet changes (*AW&ST* Sept. 29-Oct. 12, p. 55). Meanwhile, it remains in negotiations with crew unions on contract changes required to expand beyond near-international routes for new transatlantic flying on its existing narrowbodies.

“We’re not stopping here,” CEO Bob Jordan said in September. “We’re already hard at work on the next strategy.” As part of that proactive approach, a techops team has been tasked with producing multiple “what-if” cabin layouts, considering certification lead times to prepare for what might come next. Roughly a dozen layouts of passenger accommodations (LOPA) are being worked internally with designs that range from multiple classes to multiple seat manufacturers.

Southwest plans to begin operating with assigned and premium seating in late January.

“The more LOPAs we can go out and get certified ahead of time, the faster we can do modifications—if you want to add a different class, a different seat—for things like that,” says Landon Nitschke, senior vice president of tech operations at Southwest. “We’ve looked at really everything, and we’re trying to go out and get ahead of what might be coming. Even though we don’t know, it would be better to be prepared. . . . We’re trying to really get out ahead of the next transformation for Southwest.”

Concurrently working to roll out changes while preparing for further moves, the carrier will continue to monitor consumer preferences to help steer its course.

“The technology foundation we’ve laid over the last few years brings us to be more industry standard, or at the leading edge of industry standard—so that provides us a lot of optionality,” Watterson says. “However we choose to evolve, our technology infrastructure will support it. We’re also continuing our incessant customer research, so we know exactly what it is customers want and we’re not blindsided by any changes in customer desires.”



Today, investments in technology and a streamlined corporate structure are among the factors enabling newfound agility to implement change as the brand pursues new customers and profit.

“This year is about us preparing the groundwork for what our new brand position will be next year,” Chief Commercial Officer Andrew Watterson said at a Phoenix event in mid-October, noting new destinations and offerings that the carrier has introduced this year as part of that effort. Southwest plans to enter the new year with more than half of its aircraft retrofitted with new Extra Legroom Seating (ELR). Assigned and premium seating are scheduled to begin Jan. 27—replacing a hallmark open-boarding policy and adding a tiered approach to what traditionally has been a single-class cabin.

In addition to ongoing retrofits

the larger bins. Work on older -700s will begin after the winter holidays, and certain modernizations will take retirements into account—the carrier aims to retire its 737NGs in favor of an all-MAX fleet by the end of 2031.

The new and refreshed cabins mark another step forward in Southwest’s multiyear transformation plan. Updated cabin elements are “based on extensive research covering customer and employee perceptions of color, comfort and aspirations for the overall onboard experience,” the company said.

The design makes material what Southwest envisions for its evolving brand. “If you think about all of the changes we’ve been making, especially to the cabin experience, this is the culmination of everything together,” Chief Customer and Brand Officer Tony Roach says of the new

Renewed Attempt Seeks To Return the Pan Am Brand to the Skies

➤ AVI8 AIR CAPITAL AND PAN AM BRANDS ARE BEHIND THE EFFORT

➤ PAN AM HAS FORMALLY INITIATED THE CERTIFICATION PROCESS WITH THE FAA

Christine Boynton Boston

A bid of 40.5 cents per pound for the U.S. air mail route between Key West, Florida, and Havana in 1927 launched Pan American Airways on a path to become one of the most iconic brands in airline history.

Having grown to achieve unofficial flag carrier status, Pan Am was operating some of the most advanced passenger jets of its day by 1966 and pushing for more—it placed a half-billion-dollar order that year to launch the Boeing 747 program.

“When Pan Am was founded 40 years ago, overseas travel as we know it today did not exist,” the airline’s 1966 Annual Report states. “Fast and comfortable service [now] links the United States and 81 lands throughout the world.”

Pan Am’s challenges began to mount as competition grew, and—hampered by rising costs, growing debt and an inability to adapt to post-deregulation years—the industry titan ceased operations in 1991 after selling assets throughout the 1980s (*AW&ST* Dec. 16-23, 1991, p. 28). Delta Air Lines purchased many of its transatlantic routes, and its famous logo and related assets sold for roughly \$1 million in 1993.

Now, nearly a century after its founding, a renewed attempt to restore the brand to the skies is underway.

In the decades since its dissolution, several attempts have surfaced. The first effort began just five years after it folded, when a reborn variant launched in September 1996 with leased Airbus A300-B4s initially operated from New York to Miami and Los Angeles. Backed by a group of investors and headed by a former vice chairman of the original carrier, the new Pan Am sought to be low-cost and long-haul (*AW&ST* Feb. 5, 1996, p. 38). Its return was lauded; descendants of founder Juan Trippe and of famed aviator and Pan Am pathfinder Charles Lindbergh helped celebrate the in-

augural new Pan Am flight (*AW&ST* Sept. 30, 1996, p. 39).

But just two years later, the successor filed for bankruptcy and suspended scheduled flights of the two Boeing 737-200s, seven 737-400s and five 727s that had been serving 14 cities. “Pan Am’s problem was never a load factor problem, but we had insufficient revenue from the traffic we were carrying,” an official said at the time (*AW&ST* March 9, 1998, p. 58). The brand would return briefly to airline service again in the late 1990s and early 2000s as its name, flight certificates and remaining assets changed hands.

The current attempt to restore the Pan Am name to scheduled airline service is marking a key milestone, having formally initiated the certification process with the FAA.

Avi8 Air Capital, an aviation merchant bank and strategic consultancy founded by longtime airline executive Ed Wegel, is helping to drive the effort in partnership with Pan Am Brands, a division of Pan Am Global Holdings. Avi8 also

counts industry veterans Nico Buchholz and Ray Sisson as partners. The two companies announced over the summer that they would jointly evaluate the feasibility of reintroducing Pan Am as a scheduled commercial airline.

Avi8 was tapped to assess current market dynamics, operational infrastructure and a fleet and financial strategy.

“Through this collaboration, we aim to assess a sustainable and forward-thinking approach to reintroducing scheduled commercial service under the Pan Am name—one that not only honors its legacy but also makes the Pan Am experience more accessible,” Craig Carter, CEO of Pan Am Global Holdings and Pan American World Airways, said in June.

Avi8 announced the step toward certification on Oct. 9 after completing a business plan for the potential relaunch. The company has assembled a team to lead the certification effort forward and said it “has received strong initial support from aircraft lessors and key

vendors.” If certification is achieved, Pan Am would be headquartered in Miami and plans to operate a fleet of Airbus aircraft.

The companies intend to share further updates about certification and other milestones in the coming months.

“Pan Am is more than just a brand—it represents the most iconic name in commercial aviation history,” Avi8 said in announcing the strategic partnership this summer. “Our team at Avi8 is honored to support Pan Am Brands in evaluating the best path forward for a modern, competitive and customer-focused airline that honors Pan Am’s historic legacy while embracing the future of aviation.” 🌐



Following several decades of industry dominance, Pan Am struggled to adapt to changing times and ultimately ceased operations in 1991.

Asia-Pacific Order Activity Remains High Despite Airline Growth Slowdown

> PENDING AIRCRAFT DEALS COULD MAINTAIN ORDER MOMENTUM

> THE REGION'S CAPACITY GAINS HAVE BEEN NARROWING

Adrian Schofield

While international capacity growth is cooling in the Asia-Pacific region this year, the continuing strong interest in new aircraft orders highlights airlines' confidence in their prospects for long-term expansion.

International capacity data for the region shows little increase since the start of 2025, in contrast to the post-pandemic surge in recent years. This trend is partly due to external constraints such as the supply chain crisis. Although yields are also easing, the good news is that airline profitability has generally remained robust, supporting airline efforts to refresh and grow their fleets.

There have been several significant fleet deals this year, and negotiations are underway for other major orders. While this year's activity is down from the wave of orders in 2023 and 2024, it still represents a healthy appetite for fleet investment.

Airbus and Boeing recorded a combined 1,358 orders from Asia-Pacific airlines in 2023, and 355 in 2024. The 2023 total was inflated by massive orders from Indian carriers, which accounted for most of the region's orders that year. In addition to the main manufacturers, Comac racked up more than 160 airline orders for its C919 in 2023, and 240 in 2024.

Boeing has reported 87 firm orders in 2025 through September, including major deals with Korean Air, Japan Airlines, China Airlines and Cathay Pacific. Airbus listed 107 orders through Sept. 30, the largest of which came from All Nippon Airways, Malaysia Airlines, Vietjet, Starlux Airlines and China Airlines. These totals include disclosed direct firm orders and exclude lessors.

Airbus also finalized an order for 30 A350s from IndiGo on Oct. 17.

More orders are on the radar, although they might not necessarily come to fruition by year-end. In some cases, these will exercise options that were part of earlier deals

or firm up tentative commitments.

Korean Air, for example, announced in August its intent to purchase another 103 Boeing aircraft following its firm order for 40 in March, including narrowbodies, widebodies and freighters. The timing for converting its latest announcement into firm orders has not yet been revealed.



Korean Air intends to boost its orders for Boeing 787-10s.

Thai government officials have said Thai Airways is negotiating an order with Boeing. This would likely include the conversion of the 35 Boeing 787 options the carrier holds.

Vietnam Airlines has been signaling an order for about 50 narrowbodies for the past several months, and in September it revealed that it is also seeking to add another 30 widebodies through leasing or ordering. Rival Vietjet signed a memorandum of understanding (MOU) with Airbus in June stating its intention to order 100 A321neos.

Malaysia Airlines has previously said it planned to launch negotiations for additional widebody orders this year. The carrier is seeking about 16 widebodies to replace its leased Airbus A350 long-haul fleet and provide for growth; it is also looking at widebody and narrowbody freighters.

Philippine Airlines is planning to

make decisions about replacements for its Airbus A330s by year-end, the carrier told Aviation Week (see page 29).

AirAsia signed an MOU in July for up to 70 A321XLRs that has yet to be firmed. The low-cost carrier is also assessing an order for smaller aircraft, likely to be either Airbus A220s or Embraer E2-family jets. The carrier has also hinted it is in talks with Comac regarding a C919 order.

Air India is considering further large orders for narrowbodies and widebodies, Reuters reports.

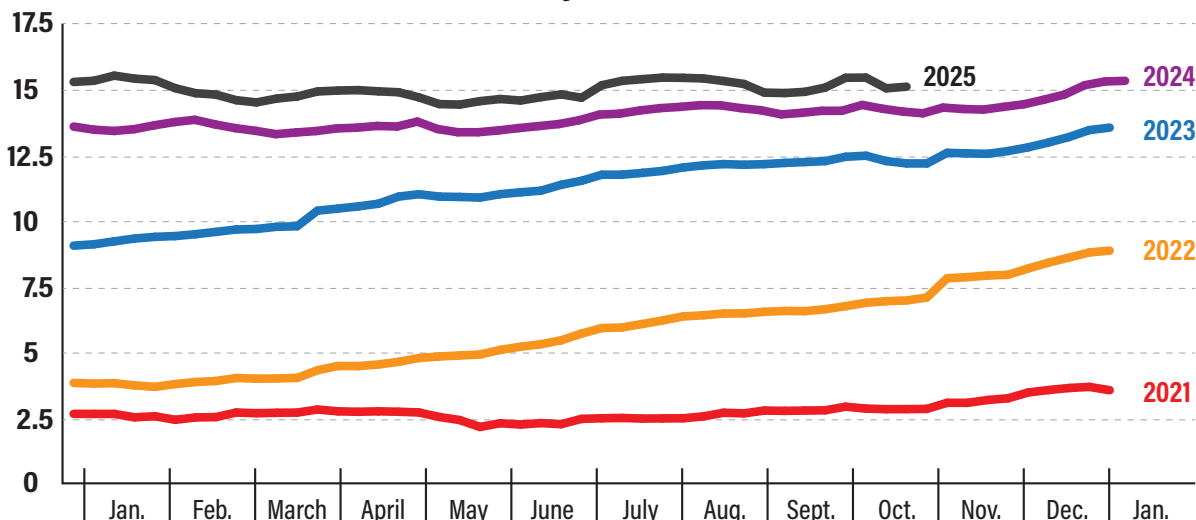
A potential deal between China and Boeing could top all these orders. U.S. officials signaled in September that such an agreement was in the final stages of negotiation, and Bloomberg

reported that the deal could cover about 500 aircraft to be allocated among Chinese airlines. However, the fluctuating political relationship between the U.S. and China makes timing predictions difficult.

A range of factors is motivating Asia-Pacific airlines to pursue aircraft orders. Some carriers are restarting investment that was put on hold while they regained financial health. And with medium-term delivery slots becoming more scarce, carriers are aware they need to lock in orders before delivery dates are pushed out even further.

Politics plays a part in a few cases, since buying aircraft from Boeing will help some countries reduce trade imbalances with the U.S. But this risks introducing outside variables into what should be purely a business decision. "These sorts of transactional politics can also skew the competitive

Asia-Pacific International Capacity, 2021-25 In Weekly Seats (millions)



Sources: CAPA – Centre for Aviation and OAG

environment,” notes Subhas Menon, director general of the Association of Asia Pacific Airlines (AAPA).

While many airlines see a degree of urgency in placing orders, others are still willing to wait. High demand for aircraft is limiting flexibility in pricing at the moment, notes Clark Johns, a director at Alton Aviation Consultancy. Some carriers are prepared to wait a few more years to see if there is a downturn or softening in the aircraft market that could affect bargaining power. They can also take an opportunistic approach if production slots become available.

Large legacy carriers might be in a better position to wait before ordering, Johns says. If they are focused on replacement more than growth, they often have flexibility to keep existing aircraft operating longer. However, low-cost carriers that have business plans predicated on growth may not have as much scope to hold off ordering.

Although the Asia-Pacific region's international capacity is still higher than in 2024, the growth rate has certainly slowed. Data from CAPA – Centre for Aviation and OAG shows international capacity for the region has remained relatively flat since the start of this year (see chart).

This means the year-over-year difference has generally been narrowing as the year progresses. For the week of Oct. 13, international seats were up by 6.6% versus the same week last year. In comparison, seat capacity was up by 13.5% year over year for the week of

Jan. 6, 10.4% for the week of March 31 and 7.1% for the week of June 23.

Year-over-year capacity growth rates were higher in 2024 and 2023, although the gaps have been getting progressively smaller.

In terms of recovery to pre-pandemic capacity, Asia-Pacific international seats were at 100% of 2019 levels for the week of Oct. 13. The region has hovered around the 100% mark since January. The Asia-Pacific recovery rate is well below the global average of 115% of 2019 levels.

year-over-year increase has generally been on a downward trend since the start of this year.

While demand has been strong overall in 2025, the growth rate is likely to moderate further as inflation takes effect, Menon tells Aviation Week. Monthly passenger growth will probably drop back to pre-pandemic rates of 5-8% in the last quarter and stay in that general range “for the foreseeable future,” he adds.

The imposition of tariffs is causing airline supplier costs to increase, which



Vietjet has stated its intention to order 100 more A321neos.

The supply chain crisis, delivery delays and engine heavy maintenance backlogs have undoubtedly played a role in constraining capacity. Many airlines have had to curb growth plans.

The AAPA reports that Asia-Pacific airlines carried 9.2% more international passengers in August than in the same month in 2024. The monthly

in turn is resulting in higher non-fuel unit costs, Menon says. At the same time, higher capacity is putting pressure on passenger yields, causing a “double whammy” for airlines, he notes.

All this means Asia-Pacific airlines might have passed the peak of the latest profit cycle. The region's airline industry should remain profitable, but mar-

gins will be much slimmer, Menon says.

The passenger demand growth rate is easing, although there are no signs that demand will start shrinking, says Alan Lim, a Singapore-based Alton director. One of the major reasons for the slowdown is an uncertain global economic outlook, and the higher cost of living is putting pressure on disposable income and leisure travel decisions, Lim says.

Airline profitability is definitely facing headwinds, Lim says. Carriers will "have their work cut out for them to try and maintain the same level of profitability," he notes. However, once again there are few signs that profits will reverse into widespread losses.

Airlines have many levers they can

pull to adjust to changing demand patterns, Lim says. The Qantas Group, for example, recently decided to close down its Singapore-based subsidiary Jetstar Asia and redeploy that narrow-body capacity to the better-performing Australian and New Zealand markets.

The vast size of the Asia-Pacific region results in significant variation, with some markets and traffic flows performing better than others.

International traffic has been slower to recover in the mainland China market. While inbound traveler demand to China is exceeding pre-pandemic levels, outbound demand from China to other countries is still at about 90%, Menon says.

International tourism to Thailand

was down 11.3% year over year in September, driven by a 32% drop in Chinese visitors to that country, CAPA data shows. This is mainly due to a few high-profile crimes against visitors this year and Thailand's conflict with Cambodia.

Travel demand from many Asia-Pacific markets to the U.S. has softened this year, Menon says. Nonstop capacity between the U.S. and China is particularly low, at less than 30% of 2019 levels, due to continuing restrictions on bilateral air services.

The Indian market has surged since the pandemic. Weekly international seats are up about 10% since the start of 2020, although even the Indian growth rate has flattened off this year. ☛

New Philippine Airlines President Plans Next Stages of Fleet Renewal

➤ THE CARRIER'S FIRST A350-1000 IS DUE BY EARLY DECEMBER

➤ ORDERING AIRCRAFT TO REPLACE ITS 11 AIRBUS A330s IS THE TOP PRIORITY, THE PRESIDENT SAYS

Adrian Schofield Manila, Philippines

Philippine Airlines will likely look back on 2025 as a pivotal year, with a leadership transition setting the stage for the arrival of new aircraft and major long-term fleet strategy decisions.

The carrier is due to receive its first Airbus A350-1000 this year, and it is preparing to resume deliveries of

Richard Nuttall, who took over the role in May.

Nuttall is a well-regarded airline industry veteran who was most recently CEO of SriLankan Airlines. He tells Aviation Week that his immediate mission at PAL is to maintain the airline's momentum since exiting Chapter 11 bankruptcy protection in 2022.

sure that we sustain profitability.

"But I think the longer-term [goal] is just to make the airline strategically as strong as it can be, so that we're not [just] talking about maintaining profitability for a year or two, but we're making sure that we have something that is set for the future [and have] a road map going forward," he added.

PAL will take a major step in upgrading its fleet with the arrival of the A350-1000s. The first aircraft is due in late November or early December, and another four are scheduled for delivery in 2026. PAL has a total of nine on order.

While the A350s will replace some of its 10 Boeing 777-300ERs, many of the 777s will probably remain in service for another 6-7 years, Nuttall says. The exact number of 777s to be kept will be part of the broader fleet strategy that is under discussion. PAL will likely undertake a retrofit program for the 777s it will retain.

The A350-1000s will give PAL better payload capacity on its longest flights from Manila to such destinations as Toronto and New York, Nuttall says. The -1000s also will bring improved cabin products, including an upgraded business class.

PAL already operates two A350-900s. The carrier had more of the -900s before the COVID-19 pandemic but returned four to lessors as part of its fleet restructuring.

On the narrowbody front, PAL has 13 Airbus A321neos remaining on order, which will join the eight it received before the pandemic. Deliv-

BAYNE STANLEY/ZUMA PRESS/ALAMY STOCK PHOTO



Philippine Airlines operates two A350-900s and has nine A350-1000s on order.

A321neos in 2026 after a long break. Further orders could follow as Philippine Airlines (PAL) looks ahead to the next phase of its fleet renewal and expansion. All these developments are occurring under a new president,

"Yields are getting squeezed, costs are still going up, and while the airline has been profitable for the last three years, it's getting harder to maintain that for [all airlines]," Nuttall says. "So the short-term [goal] is to make

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eries are set to restart next year.

The carrier also operates 30 A320ceo-family aircraft in its narrowbody fleet. It plans to lease a few more A320s to shore up domestic capacity, Nuttall says. Subsidiary PAL Express has seven A320ceos and 14 De Havilland Canada Dash 8-400 turboprops.

The upcoming deliveries will expand the group's fleet—including PAL Express—to 87 or 88 aircraft by the end of 2026, up from its current level of 79.

PAL is assessing its longer-term fleet needs, particularly given that the airline industry faces extensive lead times for new aircraft deliveries. The carrier soon will submit to its board its initial views on fleet strategy for the next 5-10 years, Nuttall says. PAL is aiming to make resulting aircraft replacement decisions by year-end.

The carrier's top priority will be ordering aircraft to replace its fleet of 11 Airbus A330s, Nuttall says. It also will need to place more orders for long-haul aircraft that will eventually replace those 777s that are being retained for the medium term. Narrowbody orders are also on the airline's radar.

PAL's most important international market is North America, where it mainly operates its 777s. The A350-1000s are to be deployed mostly in this market.

North American routes account for about a third of PAL's revenue, primarily due to the large Philippine population there. PAL serves four U.S. destinations and two in Canada, and the carrier is considering more routes to the region, Nuttall says. "We've got one or two places that are on our radar, [where we] might fly when the time is right."

PAL has not served Europe since suspending its regular London flights in 2020. Although the airline would "never say never" to a return to Europe, the time is not right at the moment, Nuttall says. He notes that there are many competing one-stop services between the Philippines and Europe.

Airport growth in the Manila metro area will be a key factor in PAL's fleet decisions. The city's main Ninoy Aquino International Airport has long been limited by congestion, but the airport plans improvements to boost hourly movements and terminal space. In the longer term, a new airport is under construction in Bulacan, to the north of the city. 📍

Lima's New Airport Comes at a Cost, Airlines Say

> TAXATION AND ACCESS CHALLENGES COULD "CHASE CUSTOMERS AWAY"

> KEY INFRASTRUCTURE PROJECTS ARE FALLING BEHIND

Lori Ranson Lima, Peru

A gleaming new terminal opened here in June, years after it was originally supposed to debut as a replacement for a structure that was bursting at the seams. Now airlines are warning that a planned tax for connecting passengers could dull the facility's luster.

"We're happy that finally we have a new airport," LATAM Airlines Group CEO Roberto Alvo said at the recent CAPA Airline Leader Summit Latin America & Caribbean here. "The plan was to have this airport being inaugurated in 2005, so it took 20 years."

"I think that this infrastructure is helpful, and it was badly needed," he said. But he added that "we're extremely concerned about the cost of operating at this airport," as "there's an intent" to levy a fee on connecting passengers. Not surprisingly, LATAM disapproves of a transit tax. "I think this has the potential to hinder the growth of Peru as an important center for tourism, which is a very important industry for this country," Alvo stated.

That is an important declaration from the head of Latin America's largest airline group. Affiliate LATAM Airlines Peru is the country's largest carrier, representing 63% of system departure frequencies, according to CAPA - Centre for Aviation. Lima's Jorge Chavez International Airport is the group's second-largest hub behind Sao Paulo Guarulhos International Airport in Brazil.

LATAM Airlines Peru is working with the government to create a tourist stopover offering in Lima. However, charging passengers who do not make the stop a \$25 connection fee "doesn't make sense if you want to attract more customers to Peru," CEO Manuel van Oordt told conference attendees, adding that building new infrastructure and charging more to use it "will just chase customers away."

But the airport's manager, Lima Airport Partners, seems unmoved by those arguments. "Yes, we are going to charge a connection fee—it's our right," CEO Juan José Salmón stated. "We have a contract with the government. We have invested \$2 billion in this terminal, and we have the right to recover from that investment." He explained that roughly 53% of Lima Airport Partners' gross income "goes directly to the government, and that is part of the contract condition that we took when we started these operations."

Peru's government has created a trust with the payments

from Lima Airport Partners. "They need to invest [that] in the regional airports" where upgrades have been delayed, Salmón said. If the government wants to reduce the amount of money it receives, "we are fine with that, as long as we are able to recover our investment," he noted.

Amid the connecting-fees debate, Peru is still chasing pre-pandemic tourist arrival numbers—roughly 4.5 million prior to the COVID-19 outbreak, and it expects to reach only 3.5 million this year, Salmón explained. There are many reasons for that lag, including riots stemming from political unrest in 2022-23 and the comparatively late reopening of Peru's borders as the pandemic receded.

Airlines also stressed that taxation distorts the trend of falling airfares in Peru. Van Oordt explained that during the past 15 years, average airfares in the country have dropped 30%, "but the fees have doubled, so the impact on the consumer is far less."

Aside from the controversial fees, infrastructure headwinds also are creating challenges at the new airport. Van Oordt said there are fewer jet bridges at the airport than at the old facility. "We need to finish those," he explained.

Airlines warn that passenger connecting fees at the new Lima airport could chase customers away.



"We need to work together to have those problems solved and be able to build infrastructure and have customers use it in the right way."

Some progress is being made in infrastructure. Refurbishment of the airport's old runway is underway, Salmón said, noting: "We will have a two-runway system starting in January."

But critical projects for airport access remain delayed, including a bridge to the terminal over a river, a planned highway to the facility and development of a metro station to serve the airport. "The train that was built was built to the old terminal," Peter Cerda, regional vice president for the Americas at the International Air Transport Association and CEO of Latin American and Caribbean Air Transport Association, said at the event. "The governments have to take a much more involved, collaborative role. It cannot only be the industry—it cannot only be the airport doing the work."

Calls for more collaboration come as Latin America's growth potential remains robust. If current trends in Peru continue, van Oordt observed, the country's passenger levels could reach 140 million by 2040, compared with roughly 30 million this year. "Infrastructure is key," he said—not only for Lima's new airport, but for airports across the country. ✎

RIGHTSIZING EXE

- > LEASING SECTOR CONSOLIDATION TO CONTINUE
- > SMBC'S TAKEOVER OF AIR LEASE CORP. IS LIKELY TO TRIGGER MORE MERGERS AND ACQUISITIONS
- > LESSORS BELIEVE BIGGER IS BETTER

Jens Flottau Prague

SMBC Aviation Capital's plan to take over Air Lease Corp. with a group of investors would create a second giant in the global aircraft leasing industry. Following regulatory approval, the new company would substantially narrow the gap with AerCap, the current market leader. Industry watchers agree the ripple effects would be profound and long-lasting.



Under CEO Peter Barrett, SMBC has become the second-largest lessor globally.

The transaction is "part of a trend," said James Kelly, KPMG's head of aviation finance. "There will be a slow consolidation of the leasing sector," he told Aviation Week on the sidelines of the recent International Society of Transport Aircraft Trading Eu-

rope, Middle East and Africa (ISTAT EMEA) conference here.

"There will more consolidation; the big can still get bigger," Dubai Aerospace Enterprise (DAE) CEO Firoz Tarapore said.

Aviation Capital Group (ACG) CEO

Tom Baker agreed: "If you want to compete, you need scale."

Alton Aviation Consultancy Managing Director Denis Hogan added, "People like Avolon and DAE will want to grow."

Although the industry has performed well over the past several years, finding ways to grow has been complicated. Airbus and Boeing backlogs are so big that deliveries for orders placed now would happen in the early 2030s, which is a concerning premise for lessors that are weighing financial risk every step of the way. Attractive sale-and-leaseback transactions are rare with OEM production growth way behind plans. Because airlines are doing reasonably well financially, many do not need the cash infusions generated by the popular transactions anyway. That leads to hypercompetition for the relatively few deals that are available—and returns on them that are not so great.

Aircraft trading and portfolio transactions are often zero-sum games, as lessors adjust their fleets along exposure factors such as aircraft types, geographies and customer risk profiles.

That leaves mergers and acquisitions as the only real option for fast and substantial growth. Market leader AerCap has bought International Lease Finance Corp. (ILFC) and GE Capital Aviation services over the past dozen years. Many others have been active at a lower scale or in smaller steps.

SMBC's deal to purchase Air Lease Corp. (ALC), and rename it Sumisho Air Lease, has reset the scene (*AW&ST* Sept. 15-28, p. 38). Tarapore said DAE has worked on the assumption that growing to a fleet of around 800 owned, managed and committed aircraft on order will give the company enough scale, even though AerCap is already far larger. Now, with SMBC moving up to a fleet of roughly 1,500 units, things have changed.

"All of us in positions [No. 3 to No. 10] in the market have to ask the question: Are we left behind?" Tarapore said. "Size does offer incredible benefits; it becomes more and more important." Tarapore has tasked him-

RCISE

self and his team with determining whether 800 remains the optimal fleet size or if the target should be closer to 1,000. It is easy to guess what the answer is, but at the same time he said that trying to match SMBC or AerCap is not necessary or even desirable.

“Where is that demarcation?” Tarapore asked, pointing to the mark where diseconomies of scale—becoming slow and highly exposed with big fleets at some customers—eat up the advantages of size. “We struggle a lot” with the answer, he conceded.

One industry observer at ISTAT EMEA quipped that “DAE will buy anything just to grow.” The company bought Nordic Aviation Capital in May, which included a small order-book for seven Airbus A220-300s and eight A321neos and moved it into a dominant position in the ATR market niche. DAE also divested 49 Embraer EJs in the process.

The Dubai-based lessor is not the only one that must answer questions about what size is right. Avolon, owned by Bohai Leasing and Orix Corp., is in the same camp—as are companies like BOC Aviation, ICBC Aviation Leasing, Babcock & Brown Aircraft Management (BBAM), and Baker’s ACG, which has just under 500 aircraft. The pressure is still more intense on somewhat smaller players like Macquarie AirFinance and CDB Aviation. Macquarie, which just ordered 30 Boeing 737-8s, has been rumored to be up for sale for some time now, although Alton Aviation’s Hogan noted that “ultimately, everybody is for sale.”

KPMG’s Kelly said he expects the leasing industry to split into three camps over time: big consolidators like AerCap, SMBC and probably others; specialists that focus on specific parts of the industry, such as regional aircraft (Azorra, Falko), midlife or end-of-life fleets, and engines; and “pure-play financial investors.”

Baker agrees that a segmented market is likely ahead for the leasing industry. “If you want to compete, you need scale,” he said. “On the other hand, own a niche and understand it better than anyone else—you can gen-

erate success then. Generalists need to get bigger, and specialists need to get smaller.”

Azorra, one such specialist, is growing fast instead. It picked up the 49 EJs sold by DAE. “We want to expand our E1 operator base,” Azorra Chief Business Officer Damon D’Agostino said. “There is a lot of life left in the EJs.” Also, many of the airlines not hampered by U.S. scope clauses may later move to the more modern E2s.

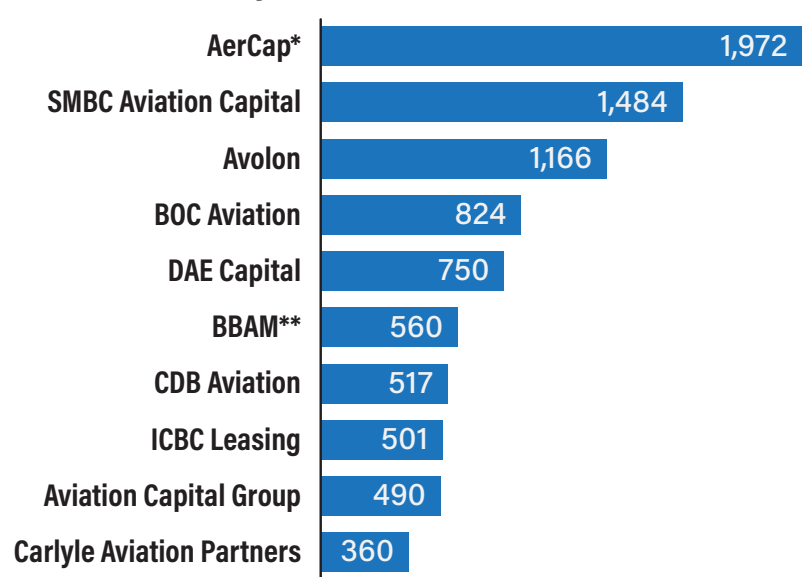
The rearrangement of the industry comes as figures who have helped to create and grow the sector, such as

likes to stay in the background and is much more focused on the finance part than airline relationships, people who know him well say.

However, Hogan adds that “down the value chain, it is still an industry where there are opportunities for entrepreneurs, particularly with managing older aircraft and engines through their life cycle.”

As for SMBC: “This transaction is transformational for our business and the leasing landscape,” Barrett said Sept. 2 when the deal was announced. “Investing in Sumisho Air

Top 10 Aircraft Lessors by number of aircraft



*Excluding helicopters and engines.
**As of Dec. 31, 2024.

Source: Company reports as of June 30
and Aviation Week Network Fleet Discovery

ALC Chairman Steven Udvar-Házy, are about to exit. Of course, that is assuming that at 79 years old, Udvar-Házy will not set up another company like ILFC or ALC.

But “the volume end of leasing has gone from an entrepreneurial enterprise to a more conservatively managed financial institutional industry,” Hogan asserted. “That trend is likely to continue.”

That development is best illustrated by the likely departure of the ultimate dealmaker, Udvar-Házy, which frees up SMBC CEO Peter Barrett to manage the ALC portfolio, orderbook and customers that the founder put together over the past 15 years. Barrett

Lease, purchasing their orderbook and becoming servicer to the substantial majority of Sumisho Air Lease’s portfolio will enable us to deploy our financial scale and strength to meet the evolving needs of our customers and take a strategic lead in reshaping our sector.

“In our sector, economies of scale matter,” he added. “Our industry is evolving at pace and requires significant and diverse pools of capital so that our airline and investor customers can be provided with the products and services they need.”

One of the interesting sidenotes of the deal is the fact that SMBC will for the first time move into the widebody

space in a marked way through the ALC fleet and orderbook. “They have to manage that for the first time,” Hogan said. “The risk profile is different, transitions [from one airline to another] can cost tens of millions. That is why there are fewer players in the widebody leasing space, including SMBC, to date.”

As for the future industry structure, Hogan said “there is room for more consolidation and a third big player.” A major question is whether that player could come from China. The sector saw a host of new players arrive from China in the mid-2010s, when aircraft leasing was identified by Beijing as a key investment target. Dozens of new platforms emerged and placed orders with Airbus and Boeing.



AerCap CEO Aengus Kelly is facing strengthened competition from a larger SMBC.

Since then, strategic priorities in China appear to have shifted, but the various companies still exist. “What is going to happen to all these Chinese leasing companies?” Hogan asked. “They all have separate platforms doing the same thing; they are ultimately owned by the same people. Logic would point to potential consolidation among these companies.”

Avolon, which is based in Ireland but partially owned by Chinese entities, is by far the largest of these platforms and could play a pivotal role in consolidation. So, too, could BOC Aviation, the Bank of China subsidiary based on the former Singapore Aircraft Leasing Enterprise and now run by its former longtime chief financial officer, Steve Townend. 

Europe's Airports Face Up to Noise Scrutiny

➤ AMSTERDAM SCHIPHOL CASE IS KEEPING THE ISSUE IN THE SPOTLIGHT

➤ PARIS AIRPORT EXPANSION PLAN SPARKS CRITICISM FROM LOCAL RESIDENTS

Helen Massy-Beresford Paris

A government-imposed flight cap that finally will come into force at Amsterdam Airport Schiphol in late October highlights the environmental and social pressures that airports around Europe are facing.

Air passenger growth remains strong—in Europe, airports are forecast to reach more than 2.5 billion passen-

gers in 2025, a 3.6% year-over-year increase, according to airports group ACI World.

But airport expansion plans are increasingly under scrutiny for both their environmental impact and their effects on local residents, including quality of life, sleep and health.

While airports tout the tourism, economic and connectivity-linked benefits of expansion—and note that aircraft are becoming quieter as airlines renew their fleets—research is increasingly underscoring how airport noise is a detriment to the health of people who live near them.

In the Netherlands, Schiphol's future capacity remains uncertain, even though a Dutch government spokesperson confirmed that the flight cap—478,000 flight movements per year, down from 500,000—will come into force with the International Air Transport Association's winter season on Oct. 26.

The industry is still challenging the Airport Traffic Decree (LVB) through the Dutch Council of State, but any change to the flight cap will not happen in the short term.

Airlines had sought to suspend the LVb while the case was pending, but once it became clear that all historic slots would be allocated for the winter season, they rescinded the request.

Schiphol is limited to 478,000 flight movements per year as of the winter flying season.

The main case seeking to overturn the flight cap in the longer term is ongoing.

While the Schiphol case is a high-profile example of a government seeking to redress the balance of air traffic growth and economic benefits with environmental concerns and public health, Schiphol is not the only airport caught in that debate.

Paris airport operator Groupe ADP presented results in early October of a three-month public consultation about the 2035-50



ARTHUR VAN DER KOOIJ/ANP/AFP/GETTY IMAGES

strategy for Paris-Charles de Gaulle, the French capital's biggest airport, which processed 70.3 million passengers in 2024. While Groupe ADP highlighted key strategic priorities, including development of a major multimodal station, optimization of freight activities and creation of a low-carbon energy hub, many of the 17,000 people who participated focused on noise reduction and air quality improvements.

Local residents' associations as well as nongovernmental organizations (NGO) including Stay Grounded protested at the results presentation.

"The legitimate concerns expressed during the consultation were not heard," said Françoise Brochot, president of Advocnar, an NGO focused on defending the interest of citizens bothered by air traffic noise. "We fear that ADP will persist with this outdated project, when it is necessary to plan and organize the reduction of air traffic."

Charlène Fleury, a coordinator at NGO Stay Grounded, added: "The group presents the extension as 'green,' announcing emission reductions based solely on imaginary promises of technological solutions that are not mature on an industrial scale, such as [sustainable aviation fuel]."

The harmful effects of France's largest airport will only increase with projected traffic growth, she said, citing noise and air pollution. The groups are considering their next steps as the Charles de Gaulle project moves forward.

Elsewhere in Europe, other airports are being scrutinized. A local Irish residents' group commissioned consultancy PMCA to conduct a study on noise at Dublin Airport

this year. The study found a €770 million (\$896 million) annual health cost from noise exposure in 2023.

Airport operator the DAA resubmitted its "no-build" request to increase capacity to 36 million from 32 million passengers per year, saying the increase would boost tourism, connectivity and the country's economy.

Airports group ACI Europe has been keen to highlight the importance of governments following the Balanced Approach procedure, which European member states are obliged to observe when seeking to reduce airport noise.

ACI Europe says the Balanced Approach procedure is a "proportionate and evidence-based approach," and it "ensures that restrictions are not only tailored to the local noise situation but also cost-effective, safeguarding both environmental protection and air connectivity along with its economic and social benefits."

The protocol requires operating restrictions to be considered only as a last resort after exploring other measures, such as land-use planning, noise abatement operational procedures and fleet renewal to replace older, noisier aircraft with newer, quieter ones.

The Dutch government initially failed to follow that process at Schiphol, before an appeal from the industry forced it to change tack, which has made for a high-profile and long-running legal saga. The unresolved Schiphol noise controversy and ongoing litigation have brought increased attention to broader discussions about the future of airports across Europe. 



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Top Manufacturers Boost Supply Chain Readiness Efforts

> SUPPLY CHAIN CONSTRAINTS PERSIST

> OEMs ARE CHANGING TACTICS, BUT MORE SUPPLIERS ARE NEEDED

Sean Broderick London

Top-tier manufacturers accustomed to leveraging largely passive tactics to reap commercial aftermarket benefits are incorporating more active strategies to meet strong demand for older products as they push many of the same suppliers to meet new aircraft commitments.

The airframer also is working to position its spares more strategically. “We’re making an investment not only in inventory, but there’s a huge [localization] push for us,” William Ampofo, senior vice president of parts and distribution and supply chain, said during a panel at the Aviation Week

AIRBUS



Production ramp-ups amid strong demand from the in-service fleet mean suppliers face added pressure to keep up.

Aircraft- and engine-makers are adept at selling spare parts and licensing repairs to eager customers and repair shops. But supply chain bottlenecks have created material shortages in key areas. The issues are part of the reason new aircraft deliveries have fallen short of OEMs’ projections—and customer expectations—for several years.

One ramification is that older aircraft are flying more. That boosts demand for spare parts, which puts more pressure on already-strained suppliers.

The overlap is prompting industry’s biggest players to become more involved in their own aftermarket support. Boeing is increasing its used serviceable material (USM) involvement to put more high-demand spares on its shelves. Under a recent deal with Unical Aviation subsidiary Ecube, the supplier will tear down retired aircraft consigned to Boeing for part-out.

Network’s MRO Europe conference here. “We’ve got a warehouse and distribution network all over the world. We just recently opened a warehouse in Cologne, [Germany,] in response to the customer saying, ‘I need faster turnaround times, and I don’t want to go back to the [U.S.] to get something that I need in Europe.’”

Engine manufacturers have more advanced aftermarket operations than their airframe and component counterparts, anchored by extensive overhaul networks and USM strategies. But even for them, strategies are changing.

CFM International and its co-owners, GE Aerospace and Safran, are leaning heavily into repair development to augment increased new parts production. The two-prong effort is necessary to meet material demand on both CFM56 and Leap narrowbody engine families.

The joint venture has developed more than 1,000 CFM56-5B/-7B-series repairs since the variants entered service more than 30 years ago. Recently, CFM has focused on getting more of these repairs into shops. About 400 repair industrializations—instances of introducing a specific repair at a single facility—have been done since 2023, when the latest variant of its CFM56 performance improvement program engine blade was introduced, the company says.

One example is an automated laser welding process for older high-pressure turbine blades that replaces a manual procedure. The new process, performed in GE Aerospace’s Singapore facility, keeps more parts in service and reduces turnaround times by about one-third, the company says.

“That’s going to give us more throughput, reduced turn time as well as [make it easier] for operators to do the repairs,” Jacey Welsh, GE Aerospace’s general manager for CFM56 engines and services, tells Aviation Week. “If we’re thinking about delivering value for our customers, cost of ownership is always a key one that comes to the forefront for them. Continuing investment in the repairs is key. Our customers obviously would choose repair over new if available, and at every overhaul, we’re really having that dialog.”

Besides lowering operators’ new part costs, investing in repairs pays dividends on the USM side. “The more parts we can repair, the fewer spare parts customers need,” CFM International President and CEO Gaël Méheust said in a statement. “This lowers overhaul cost and lessens demand for new material in the supply chain. The new repairs are also helping build an inventory of used serviceable material, another tool customers can use to ensure competitive cost of ownership.”

The increase in repairs comes alongside a boost in turbine blade production output at GE Aerospace’s factory in Greenville, South Carolina.

Demand for both the CFM56 PIP and previous-iteration Tech Insertion blades remains strong as operators lean heavily on CFM56-powered narrowbodies amid years of new aircraft delivery delays and durability issues on current-generation engines. The broader trend is generating more shop visits for CFM56s and their main competitor, the IAE V2500.

While repairs and increased volume from current suppliers are helping, an enlarged pool of providers seems inevitable. “With the supply base, I do think there’s going to have to be capacity added,” Ampofo said. “New entrants are going to have to be stood up.”

Materials shortages are evident in various areas, Ampofo said. Items on Boeing’s “pain parts” list range from standard materials such as fasteners to more complex, purpose-built components. “We’re looking across our structural components, our actuation,” he said. “Those are a couple of areas that are top of mind for us.”

Launching a new company is always challenging; establishing a provider of highly regulated parts is even harder, Richard Stoddart, head of material services at Airbus and CEO of subsidiary Satair, said on the MRO Europe panel.

“The challenges in certification and the huge investment that’s needed to develop some of these complex systems—gear, flight controls—it’s not an easy business,” he said. “It’s a huge investment that’s made, and we need it.”

Manufacturers can help by sharing as much information as possible with suppliers about new and aftermarket demand. That will help bolster investment cases, Stoddart stated.

“It’s about us turning our industry from a rearward-facing mirror of forecasting what happened in the past to try and be more predictable about what’s going to happen in the future,” he said. “[Determine] why people are ordering what they’re ordering, and give that visibility to the supply chain to make the investment.

“If you’re going to encourage the supply base to grow . . . in this economic world now, the bottom of the spreadsheet is what drives a lot of decisions in boardrooms,” he added. “The investment thesis is the key to unlocking that problem.”

In the meantime, operators should brace for more and longer delays—and perhaps added frustration—in their aftermarket queues.

“Lead times are stretching, but more importantly for me is the service delivery,” British Airways Chief Technology Officer Andy Best told MRO Europe attendees in his keynote speech. “It’s inconsistent and way short of what’s needed, never mind contractually. I’m painting [with a broad] brush because we’ve

got some people that clearly do step up, but we’ve got a bunch of people that don’t.”

Metrics from the carrier’s massive A380 refurbishment project illustrate Best’s point. British Airways recently began a major interiors revamp and routine maintenance program to keep the 12-aircraft fleet—averaging 12 years old, Aviation Week Network’s Fleet Discovery shows—as a long-haul cornerstone for another decade or more. But progress has been slow and frustrating.

“We have a lot of providers” on the A380 rework effort, Best said. “Ninety-three percent of those contract providers failed to deliver [on their contractual obligations], from small providers to OEMs.”

On the powerplant front, “our main engine providers have not provided a single engine on time per the agreement in 2025,” he said. “Not one.”

British Airways’ aftermarket headaches have prompted some supplier changes. Most visible was the selection of GE Aerospace GENx engines in its July 2024 order for 38 Boeing 787-10s. The carrier’s other 42 787s—including 12 787-10s—are powered by Rolls-Royce Trent 1000 engines.

The Trent 1000 has been plagued by years of part durability issues and

related unscheduled overhauls that have grounded some affected aircraft for months at a time. Rolls-Royce also supplies and supports Trent 900s for British Airways’ A380s.

While issues with the Trent 1000 and Pratt & Whitney PW1000G are program-specific, broader aftermarket trends suggest service providers will continue to struggle in the near term. A recent RBC Capital Markets survey of more than 50 maintenance, repair and overhaul (MRO) providers revealed 60% consider spare parts availability and lead times as the largest factors that drive aftermarket performance improvement.

“Although we believe the supply chain issues continue to improve, demand is still outpacing supply,” RBC’s Ken Herbert wrote in an Oct. 10 research note analyzing the survey results. “We also asked MROs about their material lead times for parts from OEMs and distributors. On a weighted average, MROs are seeing [about] 19% increase in lead times, which we found to be much higher than we expected.” 🎥

Video *Aviation Week editors and analysts break down Europe’s MRO market:*
[AviationWeek.com/MRO-podcast-London](https://www.aviationweek.com/MRO-podcast-London)



IATA Report Underscores the Stressed Supply Chain’s Cost for Airlines

➤ PASSENGER DEMAND GREW FASTER THAN CAPACITY IN 2024, PUSHING UP INDUSTRYWIDE LOAD FACTORS

➤ THE REPORT RECOMMENDS MORE INDUSTRY COOPERATION

Helen Massy-Beresford Paris

Airlines are missing growth opportunities and face higher fuel bills as the more fuel-efficient aircraft they have ordered are delayed by persistent supply chain challenges, according to a new report that suggests greater industry cooperation could mitigate some of the effects.

Supply chain issues could cost airlines more than \$11 billion this year, says a study published by the International Air Transport Association (IATA) and management consultancy Oliver Wyman.

The report focuses on delays in production of new aircraft and parts

that are prompting airlines to reassess their fleet plans; in many cases, they are flying older aircraft longer. The delays also prevent airlines from keeping up with growing demand for passenger travel, the study says.

Ryanair has trimmed its growth projections several times because of delays to the delivery schedule of its Boeing 737 MAX aircraft, and Norwegian in May reduced its 2025 growth outlook to 3% from 4%, citing Boeing delivery delays.

Industrywide, a 10.4% increase in passenger demand in 2024 exceeded capacity expansion of 8.7%, which

pushed load factors up to a record 83.5%, IATA reported.

The worldwide commercial backlog reached a historic high of more than 17,000 aircraft in 2024, considerably higher than the 2010-19 backlog of about 13,000 aircraft per year, IATA and Oliver Wyman said in the study.

The report's authors acknowledge there is no immediate solution, but they suggest increased collaboration to improve schedule stability and give early insight into supply chain problems as well as development of early warning and joint contingency planning for specific risk areas.

to supply chain threats, while ramping up efficiency and driving down costs over the long term."

"We see an opportunity to catalyze an improvement in supply chain performance that will benefit everyone, but this will require collective steps to reshape the structure of the aerospace industry and work together on transparency and talent," said Matthew Poitras, a partner in Oliver Wyman's Transportation and Advanced Industries practice.

Improved supply chain insight through end-to-end supply chain mapping and visibility, revealing potential bottlenecks and hidden risks, would build a clear picture and also help drive better collaboration and innovation, including the use of digital tools for real-time tracking and tracing.

The authors of the report assert that the industry should make better use of inventory and maintenance data: "Airlines possess a wealth of data, and through open industry forums, etc., could leverage it for virtual 'parts pooling' to optimize parts access and inventory as well as to develop predictive tools," the report states. "This also could include central repositories for aircraft maintenance data to serve as a shared knowledge base."

Initiatives to boost the workforce could also help: "The five generations now in the workforce have different learning styles, technology exposure and work-life values—workforce programs and outreach efforts need to recognize this," the report notes.

The study also suggests expanding maintenance and parts supply by increasing the ability to repair materials, which would free up production capacity to focus on critical parts that are in short supply.

The authors call for an overhaul of the aftermarket that would support providers and enable them to become less constrained by manufacturer-driven commercial licensing models and encourage the rise of new independent maintenance, repair and overhaul programs.

"Opening the aftermarket would help by giving airlines greater choice and access to parts and services," IATA Director General Willie Walsh said. "In parallel, greater transparency on the state of the supply chain would give airlines the data they need to plan around blockages while helping OEMs to ease underlying bottlenecks." ❁

JOE PIESAVANT/NET



After years in which delays to aircraft production and upheaval within the supply chain caused daily headaches for manufacturers, suppliers and operators alike—while lessors enjoyed strong demand for leased aircraft—many industry players report that the worst of the post-COVID-19 pandemic supply chain disruption seems to be easing.

But the study underscores ongoing and potentially damaging issues. It also suggests constructive solutions and stresses that cooperation is absolutely vital.

"The aircraft market has not quite fully recovered to its pre-pandemic size but is on track to do so by 2027," the report states. "The problem? The highly consolidated, tiered structure of the commercial aircraft industry has found it difficult to absorb multiple recent and overlapping market shocks—from the disarray caused by the COVID-19 pandemic to geopolitical conflict-driven material shortages and tight labor markets. As a result, airlines are waiting for new aircraft with lower fuel consumption while facing higher maintenance and repair costs for an aging fleet."

Industry players are already working together to combat supply chain issues. French industry group GIFAS established the AAP1 fund in the wake of the pandemic to strengthen the sector's resilience. Its successor, AAP2, continues the initiatives aimed at supporting and reinforcing the supply chain while ensuring a ramp-up in production.

GIFAS also launched the Aero Excellence program in early 2024 that provides a shared assessment standard for companies in the sector. The initiative is now used by all the prime contractors and supports improvement in industrial performance; 111 companies and 164 industrial sites have joined. The program is broadening out as Aero Excellence International, with the UK and Germany on board, and intends to become a global standard.

But more cooperation, and on a bigger scale, could achieve further results. "We believe that present commercial aerospace supply chain challenges are not intractable," the report says. "A broader, united industry response that is more proactive, flexible and strategic could help all participants better prepare for and be ready to respond

Goodbye, Large Independent Aerostructure Companies

> EUROPEAN COMMISSION GRANTS CONDITIONAL APPROVAL TO BOEING'S ACQUISITION OF SPIRIT

> PROPOSED TIE-UP MOVES TOWARD FINISH, MARKING END OF AN ERA

Helen Massy-Beresford Paris and **Michael Bruno** Washington

One of aerospace manufacturing's worst experiments so far this century could finally come to an end in the coming weeks or months if Boeing closes its acquisition of most of Spirit AeroSystems, the aerostructure giant based in Wichita.

What comes next for Boeing and Spirit has yet to be revealed, but clues could emerge Oct. 29 when Boeing leaders report their third-quarter financial results and take questions from stock analysts. Regardless of what is announced in the coming months, one thing is certain: The era of large, independent aerostructure providers is over because they are not sustainable businesses.

"This is why we can't have nice aerostructure companies," quips Richard Aboulafia, managing director of Aero-Dynamic Advisory and an *AW&ST* guest columnist. "They need to become a cost center and not a [profit and loss business], and that means being reabsorbed back into Boeing and other companies."

The deal, revealed in March 2024 and once expected to close by the second quarter of this year, received important clearance on Oct. 14 when the European Commission (EC) said it approved Boeing's proposed acquisition of Spirit.

"We had concerns that by acquiring Spirit, Boeing would have an incentive to . . . limit supplies to its competitor, Airbus," said Teresa Ribera, the EC's executive vice president for clean, just and competitive transition. "This could [drive] up prices and make large commercial aircraft parts harder to find, meaning that European passengers could face higher ticket costs."

U.S. and UK regulators already approved the acquisition. But it is not immediately clear whether regulators in China or elsewhere still must do the same, or whether the deal remains hung up on such approval as trade wars rage between the U.S. and other countries.

Terms of the all-stock deal were

announced in July 2024. At the time, representatives said the deal had an equity value of \$4.7 billion and an enterprise value of \$8.3 billion, including Spirit's then-net debt, which remains



SPIRIT AEROSYSTEMS

The end of Spirit AeroSystems will mark a return to a time when OEMs made their own aerostructures.

around \$4 billion. However, Boeing also has agreed to pay Airbus \$439 million to acquire its work packages at Spirit, and Spirit still technically owes Boeing \$1 billion under customer financing agreements extended in 2023-24.

The EC said a straight merger between Boeing and Spirit would have the ability and incentive to stop supplying aerostructures to manufacturers of large commercial aircraft—in particular Airbus—or at least deteriorate the supply conditions. Additionally, the tie-up with Spirit could allow Boeing to gain access to commercially sensitive information relating to Airbus that Boeing could use to its advantage. To address the EC's preliminary competition concerns, Boeing offered to divest Spirit businesses with Airbus aerostructures to Airbus. Boeing also has agreed to part with its site in Malaysia that supplies Airbus with aerostructures—among others—to Composites Technology Research Malaysia Sdn. Bhd. (CTRM).

Airbus signed a definitive takeover agreement for its parts of the Spirit business this year. Airbus' part includes the manufacturing of Airbus A220 wings and midfuselages, which is

carried out in Belfast, Northern Ireland.

"These structural commitments fully address the competition concerns identified by the commission," the EC said. "They will enable Airbus to integrate Spirit's businesses that currently supply aerostructures to Airbus into Airbus' own operations, and hence, secure its supply chain. Also, they will allow a new competitive force, CTRM, to enter the market for aerostructures."

The EC said that the decision is conditioned upon full compliance with the commitments and added that, under its supervision, an independent trustee will monitor their implementation.

Both Airbus and Boeing are believed to be eager to close their acquisitions of Spirit so that they can put its respective production systems fully in order to support higher narrowbody and widebody monthly build rates. Boeing, which currently finishes 737s at a rate of 38 per month, is looking to go to a rate of 42 as soon as the end of this year, and then to rate 47 and later to a rate in the 50s. Spirit never reliably delivered 737 shipsets at rate 50 or above, so Boeing will have to marshal more resources to help Wichita achieve such rates. The companies have not yet discussed post-acquisition plans for doing so.

The end of Spirit, which was originally spun out of Boeing in 2005, comes after the demise of other peer competitors, including GKN Aerospace and Triumph Group. Both of those were bought by private equity owners, and many aerostructure assets have been sold off or closed in recent years. To be sure, smaller rivals have since emerged, including Montana Aerospace in Switzerland. But at a market capitalization of \$4.53 billion, publicly traded Spirit was the largest, and its passing marks the end of an era. 🛩

The U.S. Army Makes Risky Move To Speed Up FLRAA

> THE SERVICE SHIFTS FUNDING TO BUILD EARLY

> FIRST FLRAA PROTOTYPE IS EXPECTED BY THE END OF 2026

Brian Everstine and **Steve Trimble** Washington

The U.S. Army and Bell are aggressively pushing to speed up fielding of the MV-75 tiltrotor by shifting acquisition milestones, moving funding up and concurrently designing and building initial aircraft.

It is a plan that adds pressure to the Army's biggest acquisition program, but the service says it is worth the risk.

"We're kind of doing two things at once: We're doing the design, and we're building at the same time," says Col. Jeffrey Poquette, the Army's Future Long-Range Assault

ter plan, integrated master schedule and the test and evaluation plan. Those documents take a long time to produce and are meant to keep visibility through development.

The Army has embedded engineers with Bell to watch over the design work, and in doing so, it has handed over critical design review authority for subsystems. This development helps move the program along quickly, ahead of the overall weapon system critical design review set for March.

"We needed to give more ability for Bell to move fast and to give them quick feedback," Poquette says.

Bell is building parts for initial aircraft before the design is fully set. More than 3,000 engineering drawings have been released, about 90% of the total, and upward of 5,000 purchase orders have been signed with more than 360 suppliers.

Bell's approach to building the MV-75 is largely vertically integrated, including the decision last year to remove Spirit AeroSystems as the aircraft's fuselage supplier and take the work in-house.

The company is manufacturing rotor blades, the yoke, drive system, fuselage and other major components at locations including its new advanced composites center in Fort Worth.

There, an automated fiber placement machine is laying down wing skins and spars. All of this is being done before the full weapon system critical design review and as engineering releases come amid manufacturing, says Ryan Ehinger, Bell's MV-75 FLRAA program director and senior vice president. The components will be shipped to nearby Amarillo, Texas, where Bell will do final assembly work.

"We're really kind of moving things in parallel, where previously you might see them a little bit more serial," Ehinger says. That is part of the acceleration, he notes. "So we got active, finishing up a lot of the critical design review activity in the midst of fabricating components and starting some of that initial assembly work on the fuselage."

The Army's goal is to have about

20 aircraft built before a Milestone C decision, which is expected in 2028.

While the process introduces risk for rework, Poquette asserts that a few factors build confidence. The first is Bell's V-280 demonstrator, which first flew in 2017 as part of the Joint Multi-Role Technology Demonstrator phase of the program and eventually accrued 214 flight hours. Another factor is the extensive use of digital engineering and modeling intended to keep the Army informed on the evolution of the design. Instead of handing over designs intermittently, the service at any moment can look at how the aircraft is coming together.

That design approach and transparency is key to compressing a typical 10-year traditional development cycle down to four or five years. The 10-year approach typically takes into account a major aspect of the design going wrong, which in turn could affect testing or change the weight and shape of an aircraft.



Bell is working to deliver the first MV-75 prototype next year under U.S. Army pressure.

Aircraft (FLRAA) program manager. "If you're doing that, there's the risk of having to do some rework along the way. You're not going to get perfection every time, but that's a risk the Army is willing to take."

Under direction from new Army leadership, the partners in the program are compressing a nine-year timeline to deliver the first operational FLRAA unit within 18 months. New Army Secretary Dan Driscoll has ordered delivery of the first prototype by the end of next year, while Army Chief of Staff Gen. Randy George has called for operational capability sooner than originally planned—in other words, the program is now calling for the first unit to be equipped in 2030.

The plan relies on multiple steps that are all different from traditional new-aircraft acquisition programs. The Army is looking to defer the need to have technical information handed over under normal acquisition procedures, which could include documents such as the integrated mas-

BELL HELICOPTER TEXTRON

"With the digital engineering, we're not going to have big things," Poquette says. "That's the theory, that you won't have a big, expensive thing go wrong in test that you have to then fix. It's little things, and the little things can either be dealt with or we can accept them early on."

If there are "little things" that make initial aircraft imperfect, those tiltrotors could be used only for training while the Army delivers perfected aircraft for operational use, Poquette says.

"The imperfections are something that the Army believes they can deal with and use and still have good capability, and we'll get to great down the line," he says.

To allow for the acceleration, the Army has shifted its planned funding for the FLRAA program. The service is moving low-rate initial production ahead of a traditional

Milestone C decision, and early procurement is planned for fiscal 2027. As part of a reevaluated five-year spending plan, the Army is moving production of 24 aircraft up by 18 months for the first company and moving up the first battalion-size fleet of 48 aircraft by 18 months. The Army and Bell want to increase production 50% year over year on the way to a full rate of 48 tiltrotors per year.

These developments are all taking shape for an initial increment of MV-75s before the introduction of new capabilities for special operations, medical evacuation and helmet-mounted displays for the cockpit. These updates are also slated to occur about 18 months earlier than originally planned, and the second version of the FLRAA tiltrotor is scheduled to enter service as early as fiscal 2032, says Brig. Gen. David Phillips, program executive officer for aviation. 

Punch and Pace Capture Army Procurement Focus

➤ THE SERVICE REVIVES INTEREST IN NEW AIR DEFENSE INTERCEPTOR

➤ NEXT PRECISION STRIKE MISSILE NEARS

Steve Trimble and **Brian Everstine** Washington and **Robert Wall** London

If an army truly marches on its stomach, then the U.S. Army has, in modernization terms, developed a ravenous appetite for fast food—and lots of it.

The service is ramping up production of Lockheed Martin Patriot Advanced Capability-3 (PAC-3) missiles, eyeing fast procurement of a follow-on system and looking to expedite the introduction of deep-strike weapons, among other items on its acquisition plate.

The Army's fielding plan for acquiring and delivering Launched Effects-Short Range (LE-SR) air vehicles underpins that newfound sense of urgency. The service aims to equip every division by the end of next year.

The move follows a three-week demonstration in August by the 7th Infantry Division at Joint Base Lewis-McChord in Washington state, which involved the Aevex Aerospace Atlas, Anduril Altius-600 and RTX Coyote Block 3. The demonstration assigned LE-SR vehicles to an infantry unit, a Stryker armored fighting vehicle unit and an aviation unit, Brig. Gen. Cain Baker, director of the Future Vertical Lift Cross Functional Team, said during a panel discussion at an event related to the Association of the U.S. Army's (AUSA) annual conference in Washington. "We learned a ton," Baker said.

The launched effects concept, which includes medium- and long-range variants, augments ground and air units with affordable and expendable systems. Depending on the mission and available payloads, the vehicles could be sent forward into dangerous areas to sense enemy targets, spoof or jam emitters at close range

or destroy the targets. To attack targets, the weapons could deploy small munitions or crash into them.

Army aviation officials briefed service leaders in early October on the acquisition plan for the LE-SR program, and they plan to act very soon, Baker said during the panel discussion organized by Defense News. The Army also is creating a plan to field a family of Launched Effects-Long Range air vehicles by the end of fiscal 2026, he added.

A similar sense of urgency underpins the service's renewed interest in fielding a PAC-3 missile follow-on a year after the Army appeared to turn its back on the so-called Lower-Tier Future Interceptor program.

"I believe that we will get support for the program," Maj. Gen. Frank Lozano, the service's program executive officer for missile and space, said at the AUSA symposium. "I may be in a position this time next year to begin 'program of record' execution."



The U.S. Army experimented with the Aevex Aerospace Atlas (pictured) and other systems to assess the utility of launched effects munitions.

The service is trying to define the requirements for such a system as well as the acquisition strategy. Lozano signaled interest in pursuing one of the newer procurement approaches the Pentagon has embraced to speed fielding of

U.S. DEFENSE DEPARTMENT

equipment—in particular, the middle tier of the acquisition path to develop fieldable prototypes rapidly. The goal is to put a minimally viable system into users' hands in 3-5 years, Lozano said, and then evolve the system from there.

The U.S. Army is ramping up output of the Patriot PAC-3 missile while also exploring follow-on options.



U.S. DEFENSE DEPARTMENT

"We are going to cast a wide net," he said, noting that "there are a lot of new market entrants into this space."

Even as the Army considers what will come after PAC-3, it is pushing industry to ramp up output. Boeing said on Oct. 14 that it received a \$2.7 billion contract to provide more than 3,000 PAC-3 Missile Segment Enhancement (MSE) seekers at a rate of up to 750 per year through 2030, up from 700 by year-end.

Jim Bryan, executive director of Boeing Integrated Air & Missile Defense, says the company has been increasing its capacity, including with a new production facility in Huntsville, Alabama, expected to open in the coming months. The Patriot has shown its capability in recent years, notably in Ukraine and the Middle East, which drives a continued rise in demand.

the production increase. Lockheed Martin and the Missile Defense Agency are now seeking second suppliers for Lockheed's Terminal High-Altitude Area Defense system, which was not designed for second sources from the outset.

Reynolds says Lockheed Martin is prioritizing parts that have been failing at a higher rate or have faced quality issues, but he would not specifically identify them.

Paula Hartley, who runs Lockheed Martin's tactical missile programs, says output increases are happening across the board. Last year, the company delivered 10,000 missiles and launchers. This year, the number is around 15,000. The company builds a guided multilaunch rocket system missile every 10 min., she notes.

The Army also is looking to move with speed to field the next iteration of the Lockheed Martin Precision Strike Missile (PrSM). The service expects to receive two Increment 2 missiles from Lockheed Martin before year-end that are due to go to White Sands Missile Range, New Mexico, for testing between January and March, Lozano said.

"If those are successful, we are going to produce the first 10 Increment 2 missiles immediately after that," he said. Contract award could come by May or June, he added, although the timeline could be affected by the government shutdown.

The baseline PrSM—with a range of more than 400 km (250 mi.) that augments the Army Tactical Missile System—reached its early operational capability and passed its production go-ahead in July. The initial operational test and evaluation of Increment 1 missiles has just been completed, Lozano said. The Increment 2 features a seeker that is able to strike mobile and naval targets.

The service expects to replicate the Increment 1 process of ramping up production even as testing continues, aiming to expedite delivery to customers. "We have to be aggressive," Lozano said. "We have to accept risk. We have got to be able to go into production as quickly as possible."

Production of Increment 1 missiles is now at a rate of around 120 missiles per year and rising. Lozano added that the plan is to increase to 400 missiles a year.



STEVE TRIMBLE/AW&ST

Lockheed Martin, prime contractor for the PAC-3 missile, has been ramping up production to 650 and plans to go far beyond, says Jason Reynolds, the company's vice president and general manager of integrated air and missile defense.

But the ongoing government shutdown may have an impact, he says. The Army's Contract Command furloughed most of its employees on the PAC-3 program, which has put a hold on some work contracting actions to underpin the production increase. If the shutdown extends for a long period of time, "it could have adverse effects," Reynolds says.

The companies have been able to find second sources for most of the components of PAC-3 MSE to allow for

Lockheed Martin unveiled its design for a long-range PrSM.

Lockheed Martin also used the event to unveil its PrSM Increment 4 design that features a ramjet with a solid rocket motor, forming a combined-cycle propulsion system to extend the range to 1,000 km. A ventral air scoop is positioned forward, slightly behind the nose cone, feeding air to a ramjet to supplement a solid rocket motor.

The Army also plans to test the Blackbeard missile designed by Castalion, a defense startup, as a low-cost alternative to the PrSM Increment 4. According to budget documents, the Blackbeard is being designed to reach 80% of Increment 4's range at a fraction of its cost. ☛

U.S. Army Aviation Leaders Seek Collaborative Combat Aircraft

➤ BOEING AND SIKORSKY UNVEIL VTOL CCA CONCEPTS

➤ ARMY AVIATION BRANCH FACES DEEP PERSONNEL CUTS

Steve Trimble Washington

The shrinking U.S. Army Aviation Branch is looking at the emerging class of collaborative combat aircraft as a potential way to offset the effect of planned troop cuts.

During the Association of the U.S. Army's (AUSA) annual convention in mid-October, the branch's leaders welcomed vertical-take-off-and-landing (VTOL) concepts unveiled by Boeing and Sikorsky for a possible Army version of the Collaborative Combat Aircraft (CCA) that are entering development within the Air Force, Marine Corps and Navy.

"It comes down to a discussion of mass," said Brig. Gen. Cain Baker, director of the Future Vertical Lift Cross-Functional Team. "A platform—a loyal wingman or a CCA—allows you to have mass while also reducing the amount of aviation [personnel]."

The concept adds to the Army's plans to start fielding a diverse family of autonomous launched effects (LE) air vehicles next year (page 41). The LE vehicles are expected to be relatively small, low-cost and expendable, in contrast to the CCA approach focused on reusable vehicles that can fly alongside crewed rotorcraft with similar range and speed.

The Army Transformation Initiative that launched on May 1 seeks to cut the aviation branch by about 6,500 active duty personnel to free up money for other modernization priorities.

But Army Aviation officials started searching for options to fill the personnel gap months before. Maj. Gen. Clair Gill, the commander of the Army Aviation Center of Excellence, told reporters at AUSA that the Army quietly

sent out a call last fall for companies to submit ideas for a VTOL CCA.

A year later, Boeing unveiled the Collaborative Transformational Rotorcraft (CxR) on the eve of the 2025 AUSA conference. Boeing revealed a 5,000-7,000-lb. VTOL aircraft design with attack and logistics

Long-Range Assault Aircraft (FLRAA), a Future Attack Reconnaissance Aircraft (FARA) and an Advanced Unmanned Aircraft System (AUAS).

The Army selected Bell to develop the MV-75 in 2023 for the FLRAA requirement, but canceled the FARA program later that year, citing cost constraints. The AUAS program was shelved in 2020, allowing the Army's aviation acquisition system to focus their resources on executing the FLRAA and FARA.

The Army is still refining requirements for a possible CCA program. At the same time, the aviation branch also is looking at options for autonomous aircraft to solve problems in a



Boeing's Collaborative Combat Rotorcraft is one adaptation of the company's Collaborative Transformational Rotorcraft, a modular, uncrewed, multimission, autonomous tiltrotor concept.

BOEING CONCEPT

variants. A week earlier, Sikorsky unveiled the Nomad concept, leveraging the company's rotor-blown-wing technology to create a VTOL aircraft. The Army received other designs, which remain secret.

"It might not look like some of the things we've seen on the floor today," said Brig. Gen. David Phillips, the Army's program executive officer for aviation. "But I can tell you, we received a very robust response from industry."

The Army's interest in CCA also revives one of the original priorities for the Future Vertical Lift (FVL) program. When the Army first unveiled the concept in 2018, the aviation branch defined requirements for a Future

combat scenario with contested logistics. In addition to Boeing's logistics CxR variant, Sikorsky unveiled an autonomous version of the UH-60 Black Hawk featuring clamshell doors.

Such autonomous aircraft could be used to augment the Army's crewed rotorcraft as well as address the speed and range requirements imposed by the Indo-Pacific operational area, Baker said.

The Army remains early in the process of drafting requirements for CCAs, Baker added.

The concept relies on the development of a Next-Generation Command and Control architecture, which is now in progress. ☛

U.S. Army Outlines Real-World Test Plan for New Surveillance Fleet

> THE PROGRAM IS ATTRACTING INTEREST ABROAD

> THE SERVICE HAS SELECTED NORTHROP SELF-PROTECTION SYSTEM

Brian Everstine Hagerstown, Maryland

The U.S. Army for the past five years has built a program for a new high-altitude surveillance fleet through a unique approach: flying contractor-owned aircraft on real-world missions to set requirements. Now the service plans a similar approach to deploying those first operational aircraft.

The Army's ME-11B High-Accuracy Detection and Exploitation System (HADES) will be a fleet of Bombardier

"They are performing exceptionally well from an aircraft standpoint, but maybe more importantly . . . they're unlocking new collection areas for us," says Andrew Evans, director of the Strategy and Transformation Office within the office of the Army's Deputy Chief of Staff for Intelligence. "They're unlocking new collection insights in terms of places that we've been able to range, some of the targets we've been

HADES fleet are coming into focus. The Army this year outlined plans to have the business jet launch smaller aircraft, which are being called Ultra-Long-Range Launched Effects. The Global 6500s have hardpoints that will be used to carry systems with a planned range of 1,000 nm, Evans says. The service plans to conduct a ground-launched demonstration next year to determine which systems could then be integrated onto the aircraft.

SNC says its production of the two Athena platforms is laying the groundwork to move quickly on HADES. Although the mission equipment will be different—Northrop Grumman Long-Range Radars are being used on the Athena aircraft while the ASARS are on HADES, for example—the aircraft are otherwise almost identical.

"We've learned a lot as far as manufacturing and making these things," says Tim Harper, SNC vice president of business development. "It's then taken forward into HADES 1 and HADES 2."

The Army is also prioritizing self-defense for HADES, Aviation Week has learned. The service is the second customer for Northrop Grumman's ALQ-257 Integrated Viper Electronic Warfare Suite (IVEWS), which detects and counters radio frequency threats. The company was only recently able to confirm that IVEWS was not just for Lockheed Martin F-16s but also designed for business-jet-type platforms like HADES.

The Army's disclosed mission for HADES is to operate before conflict and stay away from the threat. But given the current nature of threats, particularly in the Pacific, the mission makes that role unpredictable.

"Our threat environment has changed a lot," says Jim Conroy, Northrop Grumman's vice president of electronic warfare and targeting. "We used to know: These were the threat rings, and we could fly around those. That has changed now."

While not speaking specifically about the systems on HADES, Evans says aircraft need a mix of capabilities for self-protection.

"You don't want to go into an operating environment and just assume that I have nothing—no self-protection, no ability to detect a threat against my own capital asset because I think that I'm never going to be shot at like that," Evans says. "That could be a \$250 million mistake." ☛

Sierra Nevada Corp. is integrating mission payloads onto the first two HADES prototypes, expected to be delivered next year.



SNC

Global 6500s integrated by the Sierra Nevada Corp. (SNC) and equipped with several sensors and radars to track targets deep behind enemy lines. HADES started in 2020 with a series of prototypes deployed downrange beginning to set requirements while attempting to fill a major gap in surveillance for U.S. forces.

The two first HADES aircraft are coming together at SNC's facility in Hagerstown, Maryland. The Global 6500s will be outfitted with the Advanced Synthetic Aperture Radar System (ASARS) from the U.S. Air Force's retiring Lockheed U-2 Dragon Lady fleet along with signals intelligence and electronic intelligence systems. SNC is also finalizing production of its two prototypes of the Army Theater-Level High-Altitude Expeditionary Next Airborne (Athena) aircraft that is slated to deploy in November, following two other Athena prototypes built by L3Harris Technologies and MAG Aerospace that deployed this year.

able to sense. So it's literally changing the paradigm of how we do sensing and collection, in [the Pacific] particularly."

While the Army prepares to deploy HADES, it is facing uncertainty for the overall fleet of Global 6500s. The service planned to field 14 of the aircraft, but the proposed fleet was cut to six in the spring under a broader transformation order. Evans and other key stakeholders say it is not set in stone yet, but they hope the broader military will see the fleet's value for surveillance.

"Our senior leaders are going to let the threat lead that, and the threat will determine how we prioritize funds against this," Evans says.

In the meantime, the Army also is creating a Foreign Military Sales case for the ME-11B, and Evans says Morocco has emerged as a strong potential customer. While some mission equipment might be restricted by International Traffic in Arms Regulations, the aircraft can be customized.

Additional specifics about the

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Global Bidders Weigh In on UK RAF Next-Gen Trainer Need

> THE ROYAL AIR FORCE WANTS TO REPLACE BOTH HAWK VERSIONS THROUGH A SINGLE FLEET PROCUREMENT

> T2 ENGINE PROBLEMS HINDER THE FIGHTER TRAINING PIPELINE

Tony Osborne London

Airframers are gearing up to provide the UK with a new fleet of advanced jet trainers to replace the BAE Systems Hawk, but timelines are tight if the Royal Air Force wants to begin fleet replacement by the end of the decade.

used to prepare future pilots for the service's Eurofighter Typhoons and Lockheed Martin F-35s were supposed to be in service until 2040, but a series of issues has plagued operations—most recently with the Hawk's Rolls-Royce/Turbomeca Adour engine.

IVAN LEWIS/UK ROYAL AIR FORCE



As British as Buckingham Palace or fish and chips, the Red Arrows have been displaying the Hawk T1 at air shows since 1980. They are expected to fly a different type by the summer of 2030.

Boeing and Leonardo are the first to throw their hats into the ring as the Royal Air Force (RAF) seeks a replacement for both of its remaining Hawk fleets—the T1s, flown by the Red Arrows aerobatic team, and the T2s, used for advanced fighter training.

The service wants a single fleet of aircraft, but the need to replace the 28 T2s is likely to drive the system requirements, officials close to the plans say.

A timeline to transition the aircraft flown by the Red Arrows has been set in stone for several years; the T1 is due to be out by April 2030. The 28 T2s

These problems prompted calls from service chiefs to accelerate the T2 withdrawal.

Former UK Chief of the Air Staff, Air Chief Marshal Richard Knighton—now Chief of the Defense Staff—stated in November 2024 that he would like to see the Hawk T2 replaced well before 2040 (*AW&ST* Dec. 9-22, 2024, p. 33).

Hawk T2 availability has improved over the last 12-18 months as their engines have been repaired. However, the problems severely affected the UK's fighter-pilot-training pipeline, forcing the service to send student pilots overseas to Italy, Qatar and

the U.S. at a cost of about £40 million (\$53 million) annually. This complication compounds the heavy labor costs associated with maintenance, repair and overhaul of the increasingly obsolescent T2 fleet.

The UK Strategic Defense Review published in June recommended that both variants of the Hawk “be replaced with a cost-effective fast jet trainer” and that training arrangements be “urgently revised to optimize capacity, building in maximum use of contractors and provision for training overseas students.”

Studies on a potential replacement for the Hawk have been underway for years, but Aviation Week has been told that teams in the RAF's Rapid Capabilities Office and the UK Defense Ministry's Defense Equipment and Support materiel agency are now being set up to prepare a strategic outline case—one of the first steps in laying the foundations for a major procurement. The requirement is likely to feature in the defense investment plan expected to be published by year-end. A single procurement would deliver buying power, officials with knowledge of the plans say.

Initial deliveries would enable the Red Arrows to transition to the new type without a gap, a key consideration, given the political sensitivity around the aerobatic team. Even the notion that the team might be disbanded or put into abeyance has spurred politically damaging front-page newspaper headlines and campaigns to save it.

The Red Arrows would likely need aircraft to enter service by the end of 2029 at the latest to be ready for displays in the summer of 2030, depending on the type. One option for managing the transition would involve temporarily transplanting personnel into other air forces with existing display teams to gain experience. The team would require only minor aircraft modifications, such as installing a diesel smoke generator to create their distinctive red, white and blue smoke trails.

Keeping the Red Arrows as a nine-ship formation would call for 12-15 aircraft. For the advanced jet trainer role, the RAF is expected to need 22-25, resulting in a total requirement of about 40.

Several OEMs are actively promoting their aircraft as candidates: Leonardo is offering the M-346 Block 20

and Boeing the T-7 Red Hawk.

Tommaso Pani, senior vice president of marketing and sales at Leonardo Aeronautics, tells Aviation Week that the company preferred to “compete together with BAE Systems,” but it would still compete without partnering.

“We really believe that the M-346 is the right solution for the UK and the logical choice, as there are several collaborations between Italy and the UK,” Pani explains.

Leonardo has begun lightly marketing the aircraft to the UK, including taking its M-346 Block 20 simulator to the DSEI defense exhibition here in September. UK students have been flying the aircraft at the Italian Air Force’s International Flight Training School in Sardinia for more than two years. Production lines for the aircraft are flowing, and Leonardo is actively marketing it as a trainer for the Global Combat Air Program, targeting sales in Japan as a potential replacement for the Kawasaki T-4. Leonardo says the UK could lean on its efforts to develop a variant of the M-346 for Italy’s own aerobatic team, the Frece Tricolori (AW&ST Oct. 14-27, 2024, p. 56).

Dominic Lyons, Boeing UK’s business development and strategy head, said the company is waiting for the RAF to reveal its requirements before considering how the T-7 might fit but believed the aircraft was in a strong position. “With the platform being designed for that fifth- and sixth-generation environment and having that future flexibility and growth, we think it is a really good fit for the RAF,” Lyons said.

The T-7, however, is not yet in full-rate production, and production slots could be limited by the need to deliver for U.S. Air Force training needs first.

There are no details yet about the UK’s offset needs or whether the country will demand that both the trainer and associated training system have a significant amount of domestically manufactured content. Increased UK specification and components could drive up price and complexity, delaying service entry. Both the M-346 and T-7 have limited UK content.

Lyons says Boeing is in active discussions with existing suppliers, and he points out the establishment of training and maintenance facilities in the UK in support of other Boeing platforms purchased by the country, such



as the AH-64 Apache.

Pano says Leonardo could go as far as assembling the aircraft in the UK if required and would explore increasing its UK content.

Incumbent BAE Systems has not yet said how it might approach the trainer program.

Other possible contenders could include the Korea Aerospace Industries (KAI) T-50 Golden Eagle, already in

“KAI has proved that it can rapidly deliver straight off its hot production line,

having delivered aircraft to Poland just over a year after they were first ordered.”

widespread service, and the Turkish Aerospace Industries (TAI) Hurjet, of which two prototypes are flying. Lockheed Martin, which partnered with KAI on the T-50 development, presented a model of the T-50 in Red Arrows-like colors at DSEI. KAI has proved that it can rapidly deliver straight off its hot production line, having delivered aircraft to Poland just over a year after they were first ordered. The company has a road map for modernization of the T-50 as well.

The Hurjet is the least mature of the set, but this has not put off Spain. The Spanish government is pushing ahead with procurement of that aircraft in conjunction with Airbus as

Lockheed Martin displayed this FA-50 model wearing notional Red Arrows colors at the DSEI defense show in September.

a replacement for its Northrop SF-5 lead-in fighter trainers.

Knighton and other senior officials are familiar with the Hurjet. Indeed, when TAI presented a model of the aircraft to Knighton at the IDEF defense exhibition in Istanbul in July, TAI CEO Mehmet Demiroglu jokingly said: “This is the first delivery [of the Hurjet] to the UK.”

Several outlying options include Aero Vodochody’s L-39NG Skyfox and Pilatus’ PC-21 turboprop trainer. Both are undergoing further development along with their associated synthetic training systems to enable an easier training path to the F-35.

Aeralis says its proposed modular jet platform could provide a cost-effective, UK-made aircraft with export potential, but the company has not yet built one and appears unlikely to be able to meet the current timelines.

Whichever aircraft is selected for the UK need might appeal to Hawk users elsewhere, since others are expected to follow the UK in retiring the type. Australia is bringing forward plans to replace its Mk. 127 by 2033, and the Royal Malaysian Air Force intends to withdraw its Mk. 108/208s starting in 2027. The U.S. Navy, too, wants to replace its Hawk-derived T-45 Goshawks. 🇬🇧

Iron Beam Milestone Moves High-Energy Lasers Into Mainstream

➤ ISRAELI AIR DEFENSE COMMAND IS POISED TO DECLARE THE SYSTEM OPERATIONAL

➤ CAPACITOR SUPPLY WILL BE TAILORED BASED ON OPERATOR NEED

Steve Trimble Washington

The terms “experimental,” “demonstrator” and “prototype” have defined the status of weaponized high-energy lasers in military arsenals for more than half a century, but that is changing.

Israel is expected to declare in the coming weeks or months that a family of Rafael-made lasers, ranging from 10 to 100 kW, is operational, joining the country’s multilayer air and missile defense system with multiple batteries deployed.

The pending announcement would fulfill Israel’s nearly 30-year-old circuitous path to produce and deploy high-energy lasers at scale, and it marks a major step in the evolution of the technology globally.

The operational milestone for the Iron Beam system—also known as Or

Eitan within Israel—follows a months-long trial under fire in the past year. As Israel faces sustained attacks from drones, rockets, cruise missiles and ballistic missiles, a family of Rafael-made high-energy lasers formed a new defensive layer below the kinetic, counter-rocket Iron Dome system. The Iron Beam shot down dozens of aircraft and munitions with a “high” rate of success, according to Israel’s Defense Ministry.

Since the operational trial ended in the summer, the state-owned defense company has taken back the units deployed for the demonstration, which were the first to roll off an assembly line built for mass production, Rafael CEO Yoav Turgeman said.

“We fixed all the scratches, etc., and are delivering [them back] to the air

force,” Turgeman told Aviation Week at the Association of the U.S. Army’s annual convention in mid-October. “They will decide when to [declare the system operational].”

Israel first started pursuing high-energy lasers for air and missile defense in 1996. At the time, Prime Minister Shimon Peres signed an agreement with U.S. President Bill Clinton to launch the Tactical High-Energy Laser (THEL) program, which the Israelis named the Nautilus project. The Northrop Grumman-led program called for producing a chemically based deuterium-fluoride laser capable of generating a beam with tens of kilowatts of radiated power. The THEL technology proved the feasibility of such a weapon in a 2000 demonstration that shot down 28 Katyusha rockets and five 152mm artillery shells.

But interest in the THEL program waned amid the complexities of converting a chemical laser with toxic ingredients into a viable operational system. The U.S. and Israel agreed to cancel THEL in 2005.

By then, Israel had become interested in alternatives to lasers for intercepting rockets, artillery and other small munitions. In 2007, a year after a Hamas barrage of 4,000 rockets killed 44 Israelis, the defense ministry selected Rafael to develop the Iron Dome system, featuring the Tamir

Israel Defense Forces deployed early production models of all three versions of the short-range Iron Beam system in 2024, claiming a high rate of successful hits on incoming drones and rockets.



ISRAELI DEFENSE MINISTRY

interceptor missile. The Iron Dome system became a successful part of a larger defensive architecture that includes the Rafael/RTX Stunner missile in the David's Sling system that shoots down cruise missiles and the Israel Aerospace Industries-Boeing Arrow missile family that intercepts ballistic missiles inside and above the atmosphere.

Despite the shift to kinetic interceptor systems, Israel continued working at a low level on nonkinetic options. Rafael was ready to unveil the Iron Beam concept at the 2014 Singapore Airshow. The announcement revealed an internal switch from chemically based lasers to solid-state laser technology. In this case, Rafael selected the coherent beam combining approach, which merges multiple high-energy laser beams into a high-energy ray. At that time, Rafael executives shared that a proof-of-concept demonstration of the technology had resulted in a hit rate of 90%.

But work on the Iron Beam proceeded slowly as Israel faced competing budget priorities, including the rollout of a national network of Iron Dome batteries. The defense ministry announced in April 2022 that the system should be ready for operations within two years. The U.S. government joined the program later that year, pledging to invest \$1 billion to establish coproduction facilities. Rafael owns the intellectual property for the Iron Beam, but the agreement adds Lockheed as a coproducer.

"We will split the work between us and them," Turgeman said. "So they will do some of the components; we will do some components."

The U.S. involvement comes as the Pentagon continues to search for a viable high-energy laser for mass production. Israel's entire military, including reserves, compares roughly with the size of the active duty U.S. Army. So production costs for the high-energy lasers represent an up-front challenge. The U.S. Army launched the Enduring High-Energy Laser program this year, seeking to find an affordable, mass-producible defensive system in the 50-kW class.

To offset the limited magazine depth of kinetic interceptors, high-energy lasers are sought for their seemingly inexhaustible capacity. However, Turgeman acknowledges that systems such as the Iron Beam still come with

duty cycle limitations. To intercept a target, the Iron Beam system must maintain energy on a precise spot as the drone or munition continues flying for an undisclosed length of time. The power for the laser comes from a capacitor that stores energy from

a generator or a power grid. As the capacitor becomes depleted, it must be refilled before the laser can be used again.

"Each customer will ask for a specific [capacitor size], and we will tailor a solution," Turgeman said. ☒

Turkey Accelerates Development of Air and Missile Defense Umbrella

- STEEL DOME WOULD PROVIDE UNIFIED AIR SURVEILLANCE SYSTEM
 - COMMAND-AND-CONTROL WILL USE ARTIFICIAL INTELLIGENCE FOR DECISION SUPPORT IN AERIAL ENGAGEMENTS
-

Tony Osborne Ankara, Turkey, and London

Air and missile defense has become the pressing issue for NATO nations and especially for Turkey.

The country sits in the middle of a geopolitically volatile neighborhood. To the north just across the Black Sea, Russia and Ukraine are exchanging one-way attack drones and cruise and ballistic missiles. Similar tactics have been adopted by neighboring Iran and its proxies against Israel.

With the slow pace of NATO-integrated air and missile defense modernization, Ankara has decided to press ahead and rely on domestic capabilities to develop its own multilayer air defense umbrella, called Steel Dome. The goal is to link advanced sensors, platforms and effectors across Turkey's Air Force, Army and Navy into a unified air surveillance system and create layers of protection for cities and critical infrastructure.

Turkish President Recep Tayyip Erdoğan said in August that development of such air defense capabilities defines whether a nation "sat at the table or ended up on the menu."

Leaders approved plans for the multibillion-dollar project in the summer of 2024, and prime contractor Aselsan, a Turkish defense electronics concern, handed the system's first elements to the military in August. The company is developing Steel Dome's backbone: the command-and-control systems, data links and redundant communications systems. In addition to producing the sensors for radars, electronic warfare systems and electro-optical cameras,

its infrared and radio frequency seekers are to equip the missiles that will hunt down incoming threats. Other companies involved include missile producer Roketsan and MKE, a munitions manufacturer.

Aselsan officials will not disclose development or operational timelines, but the company has received a €1.6 billion (\$1.9 billion) contract from the Turkish Defense Industry Agency for deliveries of Steel Dome-related equipment in 2027-31, with more likely to follow.

Each of the company's six divisions has a role to play in Steel Dome, Aselsan CEO Ahmet Akylol told Aviation Week in September.

The program is anticipated to transform the scale and fortunes of the 50-year-old firm. "Steel Dome will be a long-term, live journey for Aselsan," he said. "The threat is very dynamic, and at the same time we are trying to add new features at both the sensing and intercept point."

The system aims to address all air threats against Turkey, from swarms of fiber-optic multicopter drones to ballistic and hypersonic missiles.

Threat evaluation algorithms and artificial intelligence decision support will assist commanders, Aselsan officials told Aviation Week during company press briefings in October. "Air defense has become all about budgeting, because you simply cannot use a missile for every threat," an official said. The decision-support mechanisms are intended to help decision-makers prioritize threats. Rather than intercepting low-cost drones

The Aselsan-Roketsan Hisar short-range air defense system is one of several missile systems in the Steel Dome construct.



ASELSAN

with expensive missiles, the system might suggest holding fire until the threat closes in on its target, where it can be destroyed by less costly anti-aircraft guns or soft-kill jammers.

All the elements of Steel Dome are designed to be mobile, which could reinforce regions that face an increased

threat, and redundancy will allow one system to take command if another becomes unserviceable or is taken out. At short ranges, threats would be engaged by Aselsan's family of Korkut self-propelled anti-aircraft guns, Hisar short-range surface-to-air missile systems and a range of laser systems under

development. Longer-range and more complex targets, such as ballistic and hypersonic missiles, would be addressed by evolutions of the Roketsan Siper missile system, a Turkish analog to the U.S. Standard or the European Aster missile. The Siper Block 3 is due to add an anti-ballistic missile capability around 2027.

The brain of the Steel Dome system is composed of Hakim, the command-and-control system; Radnet, which fuses the various radar images together to provide a coherent picture; and T-Link, a dedicated data link with broadband connectivity and satellite links that networks the system together.

Aselsan does not rule out the addition of foreign-produced effectors and sensors, stating that Steel Dome has been designed to be fully interoperable with NATO systems. Erdoğan raised the prospect of acquiring Raytheon's Patriot air defense system, a system long desired by Ankara, with U.S. President Donald Trump in September. Aselsan officials note that it would be easy to link the Patriot with Steel Dome. Adding Turkey's controversial Russian-supplied S-400 air defense system, however, is not in the cards.

Aselsan is preparing for Steel Dome's full-scale implementation by constructing massive facilities for radar development, production and integration at its Golbasi campus near Ankara. These facilities will increase production capacity 40%, supporting both domestic deployment and potential exports. Research and development facilities also are being erected, and Akyol says they will be the largest facilities in Europe dedicated to air defense development. 🇹🇷

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Commercial Firms Make the Case for a U.S. Space-Based Logistics Layer

> THE PENTAGON DEBATES THE VALUE OF IN-SPACE SERVICING

> VENDORS EYE LUCRATIVE GOLDEN DOME OPPORTUNITIES

Vivienne Machi Huntsville, Alabama, and Los Angeles

Military leaders have long extolled the value of logistics across physical domains—except in space. As the Pentagon refines requirements for a space-based missile defense shield under the Golden Dome initiative, space servicing companies are pitching a logistics layer.

Keeping U.S. space assets operating beyond the early stages of conflict and maintaining an edge over adversaries will require “the right mix” of capabilities, including responsive launch, on-orbit maneuvering and logistics, U.S. Space Command Commander Gen. Stephen Whiting said Aug. 5 at the Space and Missile Defense Symposium in Huntsville, Alabama. Mission areas such as on-orbit refueling or repairs will become as critical as filling up a tank or changing a flat tire in a self-driving car, he said.

Since President Donald Trump formally announced the Golden Dome initiative in May, technology companies across capability areas have scrambled to participate. The White House says the endeavor would cost \$175 billion and take three years to build, although independent analysts estimate the cost could run into the trillions.

A key component of Golden Dome is space-based, including new interceptors for boost-phase missile interdiction and missile warning/tracking sensors. As the U.S. Space Force embraces commercial technology, in-space servicing companies are urging the Pentagon to consider a logistics layer.

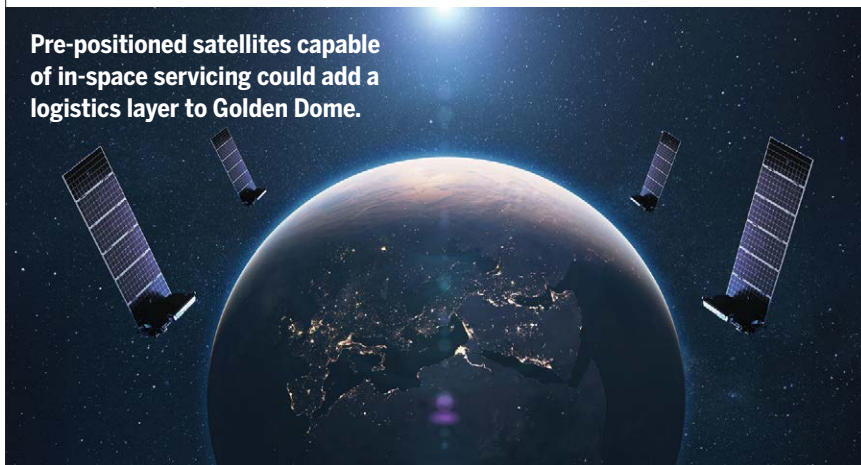
The Defense Department is planning several demonstrations next year related to on-orbit refueling and in-space servicing. In one effort, it is partnering with Astroscale U.S. to develop a 300-kg (660-lb.) satellite to refuel two Space Force assets in geostationary orbit. It is slated to launch next summer.

As on-orbit assets grow more vulnerable to attacks, companies like Astroscale U.S. see opportunities to support Golden Dome and other space-based assets, says company

President Ron Lopez, a former U.S. Air Force intelligence officer.

“We’re at a stage right now where the national security domain of space is the only domain of operations that isn’t backed up and supported by a logistics tail,” he tells Aviation Week.

Pre-positioned satellites capable of in-space servicing could add a logistics layer to Golden Dome.



A potential logistics layer would include five capability areas, Lopez says: inspection, maneuver and orbital transfer, refueling and life extension, removal and deorbiting, and on-orbit storage and pre-positioning of space-based assets.

Since Space Force Gen. Michael Guetlein’s confirmation as the Golden Dome acquisition czar in July, the Pentagon has limited public statements about the program, but it has released a handful of solicitations. None have specifically mentioned a logistics layer. However, the possibility is “not difficult to imagine,” says Dallas Kasaboski, principal analyst at Analysis Mason.

“Unofficially, trends are moving in that direction, and it wouldn’t surprise me that these capabilities will be required,” he adds.

Kasaboski says a “huge disconnect” remains between the investment needed to develop such commercial capabilities, what a Golden Dome might require and how the program is now budgeted.

The acquisition process has always

lagged behind the introduction of novel mission areas, Lopez says. Pentagon offices, including the Air Force Research Laboratory and DARPA, are partnering more frequently with commercial companies to hone new technology, and those businesses need follow-on contracts, he notes. “We need to make sure that these [demonstrations] don’t just become one-off cool technology development programs,” he says.

While Golden Dome is not the only major opportunity in town, “it is a very large game with a large amount of funding behind it and likely to have more funding,” Kasaboski says.

A broader issue is how to secure military funding for in-space servicing. Some Space Force leaders favor a proliferated architecture that can be rapidly launched and replaced, thanks to declining launch costs. They argue that it is now more cost-effective to replenish a satellite constellation than to repair individual spacecraft.

Defense contractor Anduril is aware of both arguments, as it develops technologies for rendezvous and proximity operations that could support an on-orbit logistics layer, says Adam Thurn, chief engineer for space missions. While declining to provide specifics, Thurn tells Aviation Week that Golden Dome offers opportunities for “tactically responsive capabilities” that allow the U.S. military to pre-stage logistics support differently.

That could mean positioning on Earth satellites and launch vehicles that are ready to launch at a moment’s notice, or on-orbit capabilities “that have a day job [and are] ready to perform a second job when called upon,” he says. ☛

CHROMORANGE/ALAMY STOCK PHOTO

Apex Scales Up With Ambitions To Become Premier Satellite Builder

➤ ON-ORBIT INTERCEPTOR DEMO PLANNED FOR 2026

➤ BUS MANUFACTURING MARKET REMAINS LARGELY CLOSED

Vivienne Machi Los Angeles

Three years and one month ago, Apex did not exist. Now the company says it is ready to produce 200 satellite buses per year for defense and commercial customers, and to demonstrate space-based interceptor technology.

support more than 500 kg. All Apex satellites are optimized for low Earth orbit (LEO), and the company offers an Aries variant for high-maneuverability and geostationary missions.

Apex has made no secret of its ambitions to become the space industry's

Trump administration's proposed Golden Dome missile defense architecture, providing buses and components for new technology like interceptors and missile warning-missile tracking satellites. On Oct. 22, Apex announced plans to demonstrate space-based interceptor (SBI) capabilities within the next year under an effort it calls Project Shadow.

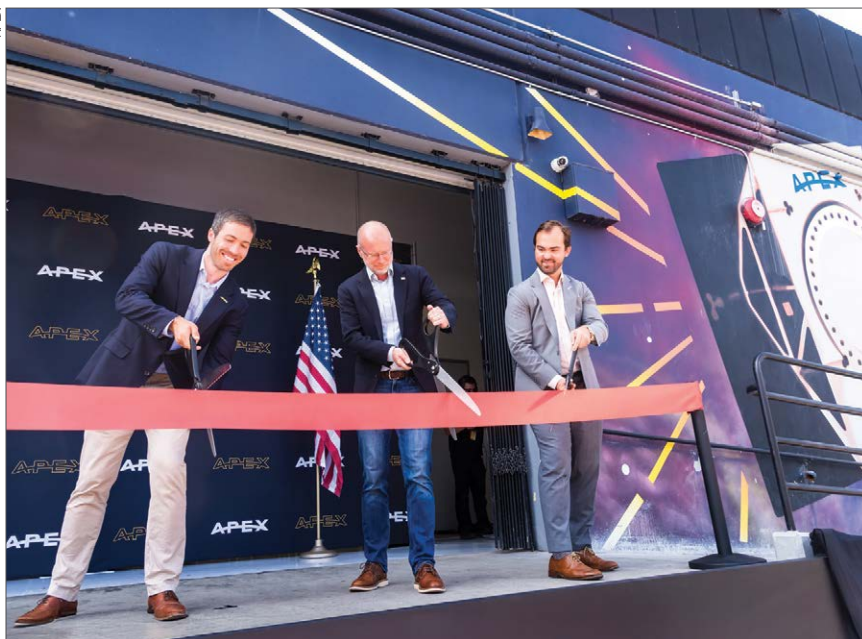
The company intends to launch its first Nova spacecraft to LEO in June and use the spacecraft to host, deploy and fire two demonstration SBIs as well as test other relevant capabilities. Apex is spending \$15 million on Project Shadow to mature the core technology needed for SBIs ahead of a constellation-scale deployment by 2028, Cinnamon told Aviation Week. The White House has said it wants to reach an initial operating capability for Golden Dome by 2029.

"We're not going to go intercept anything or cause space debris," he said. "But let's go prove that all of the pieces . . . can actually talk to one another, and it can get you to a functional space-based interceptor."

Few Apex customers are publicly known. Anduril and Booz Allen Hamilton provided payloads for the Aries SN1, and Apex says it has built satellites for multiple Tier 1 defense primes as well as the U.S. Space Development Agency, NASA and allied partners. About 20% of its business is direct-to-government; the remaining 80% is evenly split between supply system integrators and commercial companies, Cinnamon said.

A recent \$200 million Series D financing round boosted the startup's valuation to more than \$1 billion. The company has more than \$350 million in the bank to keep scaling and investing in new technology, Cinnamon said while hosting a Factory One tour for Federal Communications Commission Chairman Brendan Carr prior to the Oct. 6 ceremony. To remain independent, Apex is focused on streamlining its products and keeping costs low enough to profit on each satellite sale.

With Factory One online, Apex plans to become almost entirely vertically integrated—building flight computers, reactor wheels, ethernet switches and avionics in-house. Since the Aries SN1 launch, the company has increased internal production markedly. That satellite was made with about 60% purchased parts and



FCC Chairman Brendan Carr (center) participated in Apex's ribbon-cutting ceremony on Oct. 6 in Los Angeles, flanked by company co-founders Ian Cinnamon (left) and Maximilian Benassi.

The satellite manufacturing startup officially opened its Factory One production facility on Oct. 6 in the Los Angeles neighborhood of Playa Vista, where Howard Hughes' private airfield and aircraft factory once stood.

The facility spans more than 100,000 ft.² across two buildings; the first is open now for production and testing. An expansion scheduled to open by mid-2026 will support subassembly and integration. Factory One is expected to house production of Apex's full satellite line—ranging from the Aries bus with a 150-kg (330-lb.) payload capacity to the Nova, capable of carrying up to 300 kg in its base configuration, and the Comet, which can

default bus manufacturer, drawing inspiration from Henry Ford's streamlined assembly line. CEO Ian Cinnamon and Chief Technology Officer Maximilian Benassi co-founded the company in September 2022. The company launched its first operational satellite, the Aries SN1, 18 months later with customer payloads and an internal software testbed. A little more than three years after its founding, Apex is producing one satellite per month and has about a dozen Aries spacecraft for undisclosed customers awaiting launch "very soon," Cinnamon said at the event.

The company wants to play a key role in the space-based layer of the

40% in-house components, Cinnamon said.

Meanwhile, about 70% of the parts for the Nova spacecraft that will support Project Shadow are slated to be produced in-house. Apex expects 90% of its satellite components to be manufactured in-house within the next 18 months, he said.

The company also is scouting locations worldwide for a second facility, Factory Two, that could open in the coming years near payload developers and launch sites. Cape Canaveral and international sites that would benefit allied nations are being considered, Cinnamon said.

Factory One is scaling production annually, but Apex could build as many as 200 satellites per year within 12 months of receiving orders, depending on launch availability. "We try to marry how many we're producing with what the market will actually take," he said.

Launching an independent satellite bus company has been tried before. A wave of manufacturing startups en-

tered the market in the past 5-10 years chasing demand from new commercial constellations, says Caleb Henry, director of research at Quilty Space. Many were eventually acquired by major contractors: Terran Orbital, Millennium Space Systems and Blue Canyon Technologies were bought by Lockheed Martin, Boeing and RTX, respectively.

Payload developers are increasingly choosing to build their own buses to control costs and offer full-stack systems, Henry notes, citing remote-sensing companies, such as Planet, Umbra and Iceye. To stand out in a crowded market, Apex needs to "build a lot of satellites—and quickly," he says.

Novaspace, a space consulting company, projects that 43,000 satellites will be launched by 2034, most destined for five megaconstellations planned by the U.S., China, SpaceX and Amazon. Defense remains a key driver, accounting for 48% of manufacturing and launch value over the next decade.

Still, the manufacturing market remains largely closed. Novaspace estimates that just 7% of the market is fully open to any supplier.

As humanity looks beyond Earth, Apex aims to play a role by providing the satellite buses that enable critical communications, military support and other services needed in orbit, Cinnamon said. Looking ahead 20 years, he envisions applying efficiencies in Apex's production model to support orbital data centers and satellite mesh networks, the way SpaceX's operational efficiencies have transformed space-based technology.

In the long term, Cinnamon said he wants Apex to become "the backbone of space infrastructure for many, many generations." Cinnamon sold his first company, a dual-use artificial intelligence startup called Synapse Technology Corp., to Palantir, but he asserts that mergers and acquisitions are not in Apex's plans.

"If we ever get purchased or merged with a prime, . . . we have failed," he said. ☪

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Next Up: Starship Take 3

> SPACEX FINISHES STARSHIP-SUPER HEAVY VERSION 2 TEST SERIES

> TILES WERE REMOVED FOR HEAT SHIELD TEST



After dispatching a Starship into a near-orbital trajectory, the fifth and final Super Heavy Version 2 booster made a hypersonic return to Earth and hovered in position before splashing into the ocean.

SPACEX

Irene Klotz Cape Canaveral

SpaceX had a rough start with its Starship Version 2. Propellant leaks and hardware issues felled the first three vehicles minutes into planned hour-long, suborbital flights. A fourth ship was destroyed during fueling for a routine Raptor static engine hot-fire before launch.

The fifth Starship Version 2 (V2) spacecraft put SpaceX back in the game when its Aug. 26 flight test fulfilled all planned objectives, including the first demonstration of a Starlink satellite deployment system for Starship. The flight ended as intended in the Indian Ocean, with the Starship splashing down fewer than 10 ft. from its target.

SpaceX repeated the feat on Oct. 13, demonstrating that Flight 10's success was not a fluke. Flight 11 marked SpaceX's latest effort to develop an easily reusable, highly reliable, low-cost transportation service for Earth orbit and beyond.

Flight 11 also provided more operational data about Starship's thermal protection system, which is designed to withstand repeated exposures to hypersonic atmospheric reentry heating up to 3,000F.

In addition, the mission tested a flight profile that SpaceX plans to use to return Starships back to the launch site for landing, a milestone expected next year. SpaceX first demonstrated its unique launch tower grapple system on Oct. 13, 2024, with the returning Super Heavy booster from Flight 5

(*AW&ST* Oct. 28-Nov. 10, 2024, p. 26). The tower's chopstick-like arms later captured Super Heavy boosters launched for Flights 7 and 8 on Jan. 16 and March 6, respectively. Those stages were reflown on Flights 9 and 11.

SpaceX is incorporating lessons learned from a 10-month, five-flight Starship V2 program as it readies a next-generation Starship-Super Heavy system for a trial run next year. With Starship V3, SpaceX intends to test docking and in-space fuel transfer operations needed for crew lunar transport and other deep-space missions.

"Version 3 has built into it the kind of long-duration capabilities that we need," Stephen Creech, assistant deputy associate administrator for NASA's Moon to Mars Program Office, said at the International Astronautical Congress on Sept. 29.

SpaceX is contracted to provide transportation and lunar habitation services as part of NASA's Artemis III mission, currently targeted for 2027 but likely delayed to at least 2028. The Starship Human Landing System (HLS) is designed to carry two astronauts from lunar orbit to the surface of the Moon for a weeklong stay. The HLS would then fly the astronauts back to their Orion spacecraft in low lunar orbit, where they would reunite with their crew and return to Earth. NASA also bought Starship HLS services for Artemis IV. A second HLS, in development by Blue Origin, is baselined for Artemis V.

NASA acting Administrator Sean Duffy said on Oct. 19 that he intends to reopen the HLS competition for Artemis III to see if industry has any offerings that will produce a lander more quickly than SpaceX.

SpaceX's Starship HLS for NASA missions will be derived from Starship V3. "We're actively building multiple, next-generation V3 Starship and Super Heavy vehicles in the factory," Communications Manager Dan Huot said during SpaceX's Flight 11 webcast.

In addition to in-space refueling demonstrations and other orbital operations, SpaceX plans to fly up to 60 next-generation Starlink broadband satellites on upcoming Starship V3 missions.

Version 3 features higher-thrust Raptor engines made with far fewer parts. The ship has docking adapters that can be used to bring two Starships together for fuel-transfer demonstrations. SpaceX estimates about 10 tanker flights will be needed to refuel the Starship HLS in low Earth orbit before it heads to the Moon to support NASA's Artemis III mission.

Super Heavy V3 changes include an integrated hot-staging ring and a redesigned fuel transfer tube, which is about the same size as a Falcon 9 first stage. The tube can channel propellants to the booster's 33 engines simultaneously, improving thrust at liftoff, control authority and operational margins.

The new Super Heavy is outfitted with three grid fins that are much

stronger and 50% larger than the current four-fin design. In addition to providing aerodynamic control, the upgrade fins will be used for vehicle lift and for catches by the launch tower landing system.

Beginning next year, SpaceX will shift launches to a new pad at its facility in Starbase, Texas, near Brownsville. The current launch complex will be outfitted with a new orbital launch mount, a flame trench system and upgraded chopsticks.

Flight 11 began at 7:23 p.m. EDT/6:23 p.m. local time on Oct. 13 with the last Super Heavy V2 booster firing up its 33 Raptor engines to lift the 404-ft.-tall stack out over the Gulf of Mexico. The cluster fired for 2 min. 37 sec., then all but three engines shut down while six Raptors on the Starship upper stage ignited to push the ship off the booster, a technique known as hot-staging.

The Super Heavy, which was flying for the second time, then flipped and conducted the first of two burns to set the stage for a controlled splashdown in the Gulf. Twelve of the booster's

inner 13 engines ignited for a 49-sec. boostback burn, followed by the jettisoning of the vehicle's hot-stage ring. Version 3 boosters have built-in hot-stage steel rings designed for reuse.

For the final landing burn, SpaceX demonstrated the flight profile planned for upcoming V3 booster returns to the launch site. The sequence began with a 13-engine burn, then transitioned to a five- and then three-engine configuration that allowed the booster to hover momentarily at an altitude of about 650 ft. before crashing down into the ocean.

The Starship upper stage meanwhile completed a 6-min. 19-sec. burn to reach a near-orbital speed of 16,460 mph. After coasting about 10 min., the Starship tested its Starlink payload deployment system by dispatching eight mass simulator dummy satellites. The deployment system was first demonstrated during Flight 10.

The Starship also demonstrated a Raptor engine relight, a test that will pave the way for in-space maneuvers and deorbit burns.

To prepare for future Starship launch tower returns, the vehicle conducted banking maneuvers at supersonic and hypersonic speeds during its return through the atmosphere, followed by an aggressive turn at the start of subsonic flight as the ship repositioned belly down. "That's essentially the approach that we would do on a return-to-launch site and the tower catch," Huot said.

Despite the turns, the ship splashed down as planned in the same position in the Indian Ocean where Flight 10 ended in August.

SpaceX modified the ship's heat shield in some places to continue to test operational capabilities. For example, on the leading edge of one steering flap, SpaceX removed some tiles completely.

"We're really trying to stress some of the most sensitive areas around Starship where, basically, if you lose a tile, it's the worst possible spot," Huot said. "If we're able to make it through this, that tells us quite a bit about just how resilient this vehicle is." 🚀

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- > JAPAN'S INTERSTELLAR TECHNOLOGIES PLANS TO TAKE A SLICE OF SPACEX'S BUSINESS
- > THE LAUNCH VEHICLE DEVELOPER SEES AN UNTAPPED NICHE IN THE ASIA-PACIFIC REGION
- > THE COMPANY IS CONDUCTING R&D ON AN AMBITIOUS MICROSATELLITE CONSTELLATION

Garrett Reim Taiki, Japan

PART TWO AMID STABLES FOR 1,400 DAIRY COWS, A tanker truck empties its load: a liquid stream of manure that pours out, flows into a trough, then into a pipe that leads to a giant bubbling vat. Eventually, this will become the element that propels hopes and dreams—otherwise known as rocket fuel.

The startup is fueling its rocket engines with liquid methane.

Interstellar Technologies, a startup launch vehicle developer, has earned its fair share of punny news headlines for its plans to off-gas and refine cow manure into liquid methane rocket fuel. “To the Moo-n,” “Cow dung set to poo-sh Japan to space” and an “Udder-ly New Space Chapter!” declare a few.

But the company, based on the northern Japanese island of Hokkaido, is a serious venture. Interstellar says it has received ¥42 billion (\$279 million) in funding, including from venture capital, debt financing and government subsidies. Toyota Motor Corp. has also signed a strategic manufacturing partnership with the startup. Interstellar decided to source biomethane from a nearby cow farm not as a gimmick but as a matter of pragmatism.

“We needed to transport methane to Hokkaido, [but] it costs a lot,” Keiji Atsuta, Interstellar Technologies’ chief operating officer, told Aviation



INTERSTELLAR TECHNOLOGIES PHOTOS

NTAGE

Week here about the difficulty of moving methane from Japan's main island. "Why don't we use biomethane for fuel? We didn't even think about it."

Interstellar Technologies is emerging as one of Japan's leading attempts to develop a homegrown launch vehicle company that one day might be able to take a slice of business from dominant SpaceX. Like the pioneering American aerospace manufacturer, the Japanese company's plans include a reusable rocket and a constellation of thousands of communications satellites. Vertical integration—the practice of building most parts in-house—is also part of the plan, of course.

Japan already has a reliable launch vehicle. But that rocket, Mitsubishi Heavy Industries' medium-lift H3, carries mostly Japan Aerospace Exploration Agency (JAXA) and defense ministry payloads. Launches of the expendable H3 are scheduled only about six times per year.

The Japanese government wants homegrown rocket capacity to reach 30 launches per year. Interstellar is aiming for its in-development Zero small launch vehicle to loft commercial and government payloads from Japan and across the Asia-Pacific region 10 times annually.

The Zero is expendable, but the technology and components, such as the methane-propellant system, eventually will be adapted to Deca, a partially reusable, heavy launch vehicle that the company aims to send into space in the 2030s. The two-stage Deca is designed to have a reusable first stage, Interstellar says. However, renderings posted online by the company suggest the vehicle would return with its payload faring to land on an elevated stand on the ground.

The Deca is key to the company's ambitious Our Stars communications satellite constellation, an effort the company has described as operating picosatellites—potentially "pingpong-ball-size"—in precise formations in low Earth orbit (LEO). The microsatellite swarms would essentially create a giant phased array transmitting direct-to-device high-speed broadband data that would be resilient and con-

tinue to operate even if some individual satellites were lost. Our Stars is still in the R&D phase, but commercialization is planned for the early 2030s.

SMALL BEGINNINGS

Interstellar debuted in 2019 with its suborbital Momo sounding rocket, a vehicle that the company says was Japan's first private rocket to reach space. It launched successfully three times between 2019 and 2021; four other attempts were unsuccessful.

The company's closest rival in Japan is perhaps Honda Motor, which in June surprised the industry when it launched a small reusable rocket to an

repeatedly said that small launch vehicles are a difficult business. His company is developing a partially reusable Neutron medium launch vehicle and an ever-expanding satellite component manufacturing business.

Interstellar aims to carve out a niche in the Asia-Pacific region by using the local Hokkaido Spaceport, positioned on the rural east coast of the island. As Aviation Week drove to and from the remote site, red foxes, deer and a bear crossed the road.

"One of the good parts of Hokkaido is you can make noise," Atsuta says. "We need to, of course, negotiate with farmers and fishing communities."



Interstellar aims to provide dedicated rides to small satellites.

altitude of 271 m (890 ft.) and landed it back on the ground at its facility in Taiki. The rocket had been developed in secret after a brief press announcement in 2021 about the effort.

Interstellar hopes to make its mark on the space market with the Zero's relatively larger payload. The expendable rocket is designed to loft up to 1,000 kg (2,200 lb.) to LEO compared with Rocket Lab's highly successful small launch vehicle, the Electron, which has a payload capacity of 300 kg to LEO. The first launch of the Zero is planned for 2027.

Of course, lofting a small launch vehicle is a serious engineering challenge; some companies, such as ABL Space Systems, Gilmour Space and Isar Aerospace, failed to reach orbit in the past two years. Peter Beck, Rocket Lab founder and chief executive, has

The mayor of Taiki is enthusiastic about the space industry, seeing it as a means to revitalize the farming community, which has lost about half its population in the past 75 years. "No one wants to be farmers," Atsuta says. "They tend to move to Sapporo, maybe Osaka or Tokyo—big cities. Taiki needed to do something."

The Hokkaido Spaceport hosts a variety of suborbital sounding rocket launches from student groups, JAXA and Taiwan's TiSpace.

The launchpad for the Zero was still under construction when Aviation Week visited in July. The concrete flame trench had just been completed amid coastal sand dunes covered in succulents, grass and thickets of knotweed.

The beach below Interstellar's launch site is covered in a long line of stacked tetrapods, thousands of giant

concrete jacks that form a breakwater to absorb and scatter wave energy from tsunamis. From here, the company will launch the Zero eastward over the Pacific Ocean to inclinations between 42.2 deg. and Sun synchronous orbit. Those LEO orbits are ideal for Earth observation and broadband internet satellites.

Atsuta says the company would like to peel away customers from SpaceX's Bandwagon rideshare program, which drops off dozens of small satellites at a midinclination LEO destination typically twice per year. Japanese and Asia-Pacific customers could benefit from more frequent launches to custom orbits. For nearby nations—for instance, the governments of Indonesia and Singapore—launching closer to home would bypass the need to ship their satellites across the Pacific Ocean for launch by SpaceX, he adds.

JAXA's space industry catalog advertises Interstellar's launch services as free from International Traffic in Arms Regulations, noting that the lack of U.S. restrictions "simplifies international partnerships."

Interstellar announced its first customers in August for its initial operational launch of the Zero in 2027. Clients from Osaka Metropolitan University, Tokyo City University, the U.S. and Singapore purchased rides for 1U and 2U cubesats.

AUTOMOTIVE EXPERTISE

Before Interstellar can launch, it must of course manufacture its Zero. The company is hoping to get a boost from its strategic partnership with Toyota. In addition to investing ¥7 billion into the startup, the automaker is lending 20 employees.

The partnership is similar to the Toyota alliance with Joby Aviation, the U.S.-based electric vertical-takeoff-and-landing aircraft startup, Atsuta says. Toyota will help develop and manufacture key components for the Zero's rocket engine, the Cosmos, including the combustion chamber and turbopump. The automaker also is to help develop a production system for the Zero vehicle.

Toyota's Formula One race car team's experience in developing

high-revving, turbocharged engines that can withstand extreme temperatures and pressures could prove valuable. "Exhaust manifold for Toyota Formula One engine parts—those are Inconel," Atsuta says.

Interstellar also has recruited a considerable number of former Honda employees, Atsuta notes. Engineering training and job experience in Japan is heavily focused on the automotive sector, so the rocket startup has no choice but to recruit from car manufacturers, he says.

The automotive supply base in Japan, concerned that electric cars might render certain components obsolete, is also interested in working with Interstellar.

A wall plaque at Interstellar's manufacturing plant lists some of its partners that pay a minimum of \$30,000 per year to be listed as a sponsor. The partnerships are a marketing strategy—akin to sponsoring a hometown baseball team—for companies that want to associate with the space sector, Atsuta says. Such collaborations are a business opportunity to get a foot in the door and peer into Japan's growing space industry. ☛

Toyota is helping to develop a production system for the Zero launch vehicle.



INTERSTELLAR TECHNOLOGIES

Japan Pushes Major Tests of HAPS Capabilities for 2026

- > CONCERNS ABOUT CHINA DRIVE GEO LASER RELAY SATELLITE DEMO
- > HIGH-ALTITUDE PSEUDO-SATS AND LASER RELAY SATELLITES ARE PLANNED TO COMPLEMENT MEGACONSTELLATIONS

Garrett Reim Tokyo

While companies in China, Europe and the U.S. are racing to launch constellations of thousands of satellites into orbit, leading Japanese telecommunications companies are pursuing a strategy that is a bit more down to Earth.

Space Compass and SoftBank Corp. are developing rival efforts to transmit cellular data from high-altitude pseudo-satellites (HAPS) flying within the atmosphere, albeit at stratospheric heights of 60,000-70,000 ft.

Space Compass and SoftBank Corp. are bullish about transmitted 5G connectivity from HAPS.

Both companies aim to start broadcasting connectivity to mobile phones in 2026 from solar-powered vehicles as part of pilot programs in Japan, and they anticipate full commercial rollout in the years following.

Space Compass, a joint venture between telecommunications company NTT and satellite communications company SKY Perfect JSAT, is using the Zephyr HAPS. That uncrewed solar-electric, fixed-wing aircraft is operated by Aalto HAPS, an Airbus subsidiary into which a Japanese consortium including NTT Docomo and Space Compass agreed to invest \$100 million in 2024.

For its part, telecom SoftBank Corp. plans to use U.S.-based Skeye's solar-powered airship next year. It has also worked with U.S. company AeroVironment's Sun glider uncrewed solar-electric, fixed-wing aircraft.

Space Compass and SoftBank Corp.'s HAPS plans contrast starkly with SpaceX's Starlink, Amazon's Project Kuiper and multiple state-backed efforts in China that are duking it out for world domination and deploying thousands of broadband communications satellites into low Earth orbit (LEO). The Japanese companies see opportunity serving a home market.

"We understand our strategy is

a bit disadvantaged in terms of the coverage," Space Compass co-CEO Shigehiro Hori tells Aviation Week. "But if our infrastructure covers a certain area, we want to provide more robust and economical connectivity to the customers. That's our basic idea of how to compete and survive."



SPACE COMPASS

Japan is a mountainous country, spread across more than 14,000 islands. And the nation is prone to large-scale disasters such as earthquakes and tsunamis. Aircraft that can quickly launch and provide dedicated coverage to hard-to-reach areas are welcome.

Carrying a direct-to-device communications payload, the Zephyr can provide coverage over about 7,500 km² (2,900 mi.²) of the Earth's surface, about the same as 250 conventional ground cellular towers, Aalto says.

The company explains that because the aircraft flies close to Earth, at least relative to LEO satellites, 5G latency from the HAPS is less than 10 millisecond. That compares with SpaceX Starlink's median peak-hour latency of about 26 millisecond.

Aalto declared a world record for the longest continuous flight in May,

after the Zephyr flew for 67 days continuously in the stratosphere. The pilot program for Space Compass' Zephyr-based communications network is planned to take place over an undisclosed location in southern Japan, Hori says.

Space Compass' HAPS project fits into a larger Japanese strategy, which seems to translate into "if our rivals zig, we zag." The country is avoiding head-to-head competition with international rivals and instead looking for home field advantages, especially ones that fill gaps in the market and create complementary systems.

Consider Space Compass' other big initiative, SkyCompass-1, an effort to develop and launch a geostationary-

orbit (GEO) laser communications relay satellite in 2027 or 2028. That satellite is designed to receive data from Earth-observation satellites flying below it in LEO and then quickly radio downlink that information back to ground stations.

Earth-observation satellites typically must wait to pass over a ground station to downlink the data they have captured, creating delays and limiting the amount of information that can be radioed back to Earth at once.

But a single laser relay satellite in GEO could gather data from rapidly orbiting Earth-observation satellites as well as uncrewed air vehicles operating anywhere in the U.S. Indo-Pacific Command's area of responsibility and then transmit information back to the ground in seconds, Space Compass noted in an October 2024 white paper. Two GEO relays could cover

the entire world, the company stated, adding that one system would handle data rates up to 10 Gbps.

Fears about neighboring China are driving interest in Tokyo. “The Japanese government, they published their vision to prepare for some event happening in the near future,” Hori says. “It’s regarding the Taiwan issues.”

In April, Space Compass signed a contract with the Japanese Defense Ministry to demonstrate use of a GEO relay satellite to transmit space domain awareness data “about activities in geostationary orbit,” a realm in

which Chinese spacecraft are known to stalk and surveil the satellites of other countries.

Additionally, Japan’s New Energy and Industrial Technology Development Organization in 2023 contracted Space Compass to lead development of a LEO laser communications relay network, dubbed Laiden, that would connect with its GEO relay.

In March, Space Compass signed a memorandum of intent with the European Space Agency to study the feasibility of connecting Laiden to the High-Throughput Optical Network,

Europe’s multi-orbit laser communications network.

Hori says Space Compass is researching how it might eventually make its communications relay satellites part of a larger network that includes third-party satellites, Zephyr HAPS and terrestrial networks. The strategy differs from more closed, stand-alone megaconstellations, such as Elon Musk’s Starlink.

“I hope the future of space optical data should be integrated like the internet, not just dominated by one guy,” Hori says. ☪

Astroscale Plans Demos for Multiple New Space Services

- > ADRAS-J SPACECRAFT CAME WITHIN 15 M OF DERELICT UPPER STAGE
- > THE COMPANY IS PLANNING NEARLY A DOZEN DEMONSTRATIONS, INCLUDING OVERSEAS

Garrett Reim Tokyo

The Japanese are world-renowned for their cleanliness. Walk the streets of Tokyo, and there is not a loose piece of trash in sight. After major sporting events, Japanese fans stay and bag garbage. So it fits the stereotype that the country

would lead the world in cleaning up space junk.

Astroscale, Japan’s leading space debris removal company, has found that the technologies underpinning its on-orbit service make for a tidy business—potentially several busi-

nesses, in fact. The Tokyo company was founded in 2013 with the sole stated aim of cleaning up the growing mess of derelict rocket bodies, dead satellites and other debris orbiting Earth. It dubbed its employees “space sweepers.”

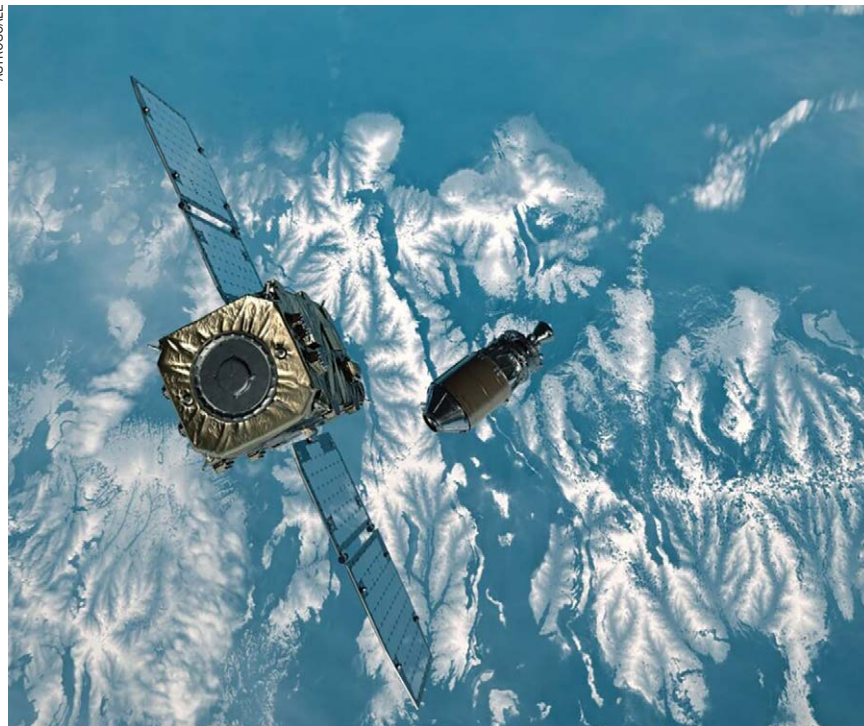
The company sent its Active Debris Removal by Astroscale-Japan (ADRAS-J) spacecraft to approach and maneuver alongside an abandoned H-IIA upper-stage rocket body in low Earth orbit (LEO) in 2024. Astroscale has yet to remove debris from space, but it is getting close. The ADRAS-J came within 15 m (50 ft.) of the derelict upper stage. That year, the Japan Aerospace Exploration Agency also awarded the company a follow-on mission, scheduled for launch in 2027, to use a larger ADRAS-J2 spacecraft to remove and return the H-IIA rocket body from space.

After demonstrating that it can fly close to another object in space—rendezvous and proximity operations, in industry parlance—Astroscale has been on something of a tear. This year alone, the company has announced

Technologies developed for the 2024 ADRAS-J mission are being repurposed for new services.

multiple new demonstrations in in-space servicing, on-orbit refueling and military space domain awareness.

Many of Astroscale’s missions use similar rendezvous and proximity operations technologies, including sensors and guidance, navigation and control, as well as techniques honed from ADRAS-J’s mission. Three spacecraft that Astroscale is developing for Japanese government-funded missions use



ASTROSCALE

the same bus structure: ADRAS-J2, In-situ Space Situational Awareness-Japan 1 (ISSA-J1) and Refueling for Extension and Flexibility-Japan (Reflex-J1).

“Naturally, we try to maximize the commonization among the satellites in design and selection of hardware,” Eddie Kato, president and managing director of Astroscale Japan, tells Aviation Week.

The ISSA-J1 mission is anticipated for launch in 2027. The spacecraft is expected to diagnose and inspect two large pieces of satellite debris in two different orbits. The Reflex-J1’s mission is scheduled for launch in 2028. The company plans for that spacecraft to use a robotic arm to demonstrate chemical propellant refueling in LEO.

The ability to get a close-up look at another spacecraft is increasingly piquing the interest of world militaries, including the Japanese Defense Ministry, which in recent years has seen its budget balloon as concerns about China grow.

The ministry contracted Astroscale in February to develop and fly a “responsive space system demonstration satellite prototype” in geostationary orbit (GEO). As part of the demonstration, the spacecraft—which is considerably smaller than other vehicles under development for the Japanese government—would be equipped with a laser communications terminal so that it could transfer space domain awareness data quickly to a laser relay satellite in GEO made by Space Compass of Tokyo.

Kato anticipates the Japanese government will fund in-space manufacturing demonstrations soon, presenting an opportunity for Astroscale to use its robotic spacecraft in yet another application. Astroscale is interested in collaborating with companies that have in-space welding technology; Kato points out a Japanese startup, Space Quarters, that is developing electron-beam welding systems for assembling large structures in orbit and on the lunar surface.

Astroscale has set up subsidiaries in France, Israel, the UK and the U.S., where its local entities are pursuing development and demonstration work with national governments. Astroscale UK has a long relationship with Eutelsat OneWeb and the UK government, including demonstrating satellite docking technologies. The company was awarded £5.15 million (\$6.9 mil-

lion) by the UK government in June to develop two formation-flying cubesats that will collect data on space weather.

Sharing intellectual property across international subsidiaries is tricky, however. National governments are not keen to have technologies that were developed in their countries—and at their citizens’ expense—transferred abroad, Kato says. “These en-

tities are independently operated with a minimum collaborative relationship,” he explains.

But as Astroscale is running nearly a dozen spacecraft demonstrations, some with overlapping missions, Kato says the company is moving into a new phase: assessing what can be shared and repurposed across the larger international business. ☛

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CFM Reveals Adaptive Engine Technology for Open Fan

> VARIABLE BYPASS ENABLES SMALLER FAN

> THIRD STREAM CENTRIFUGES OUT DUST

Guy Norris Colorado Springs

Adaptive engines traditionally have been associated with military propulsion. But as CFM International digs deeper into next-generation propulsion technology, the engine-maker is turning to the idea for its future commercial powerplant.

Like the U.S. military adaptive engines in development, the application of a form of variable cycle in the open fan study under the Revolutionary Innovation for Sustainable Engines (RISE) initiative is based on control and manipulation of a third stream of airflow outside the conventional core and bypass flows.

However, while the overall principle is similar in both military and civil engines, the reasons for adopting the concept for the open fan are notably different, the GE Aerospace-Safran Aircraft Engines joint venture says. Unlike its military counterpart, in which the third stream is varied to increase either combat power or cruise efficiency, the RISE design aims to use the third flow to make the engine more durable and easier to install.

In a military adaptive engine, the added airflow is used to boost either mass core flow for greater acceleration or bypass ratio for greater range. In RISE, the third stream is intended to increase effective bypass ratio, and therefore efficiency, without a large expansion in fan diameter, making installation simpler. At the same time, it is designed to enable lower core operating temperatures and reduce dust ingestion, both of which should lead to greater overall durability.

"It's something we've been working toward all along as one of the benefits of the open fan architecture," says Arjan Hegeman, vice president for future of flight at GE Aerospace. Now that tests of the system have quantified the expected benefits, he adds, "we can start talking about it more publicly."

In the open fan design, the third stream enters the inlet behind the single-stage fan and passes through the intermediate section containing the fan gear system and on which the variable guide vanes are mounted before exiting the engine and merging with the external fan bypass stream. Although further details have not been revealed, it is likely that a splitter in the inlet would be used to divert flow into the fan bypass or core as needed.

"I can make the bypass larger or smaller," Hegeman says. "The larger I make the bypass, the higher the fuel efficiency, but you get a little less thrust responsiveness. So for takeoff, when you want a more rapid thrust response, we make the core flow larger and the bypass flow smaller by manipulating that third stream. If you don't do it with a third stream, the only other way to do it is with a larger fan."

The adaptive approach "allows for a smaller fan size, and you still get the right thrust responsiveness when you need

The third stream enhances particle separation while providing variable bypass.

it without giving up any efficiency," Hegeman says. Ducting more airflow through the core at higher power settings increases mass flow and fan pressure ratio. Conversely, as the third stream is mixed with the fan bypass, the effective bypass ratio increases while the fan pressure ratio decreases.

The design helps improve durability—a key parameter for the open fan. "Clearly, for next-generation engines, durability and maintainability are going to be as important as fuel burn," Hegeman says. "If you hit your high fuel burn efficiency target, but it doesn't meet the durability target, then from an overall operations cost perspective, you still haven't gained anything for the operator."

The adaptive approach helps bolster durability in two main ways. First, by improving the overall propulsive efficiency, it reduces the imperative to rely solely on boosting thermodynamic performance in the core with higher temperatures and pressures. Although the push to higher overall pressure ratios and turbine inlet temperatures in recent high-bypass turbofans has helped drive down fuel burn, the extreme operating conditions—particularly in challenging environments—have exposed vulnerabilities to turbine blade and nozzle erosion, among other durability issues.

Second, the additional flow acts as a "fantastic centrifugal filter," reducing ingestion of dust and particulates into the core, Hegeman explains. "It filters out so much dust and debris that normally get sucked into that high-pressure, high-temperature part of the engine, and that really is a durability challenge," he says. "All that gets filtered out and expelled out of the engine before it gets into the core and it goes into the bypass. The data we have now suggest that we should be able to get operators in harsh environments to be close to the same experience as today's operators in neutral environments."

Having recently completed critical design review for the open fan, CFM is "much more converged on what that is going to look like for both the demonstrator as well as a product that we would do afterward," Hegeman notes. "So with those flows much better defined, you can really start quantifying how much filtering of ingested dust you really get. The number is higher than what I was expecting. So that's the good news and the new finding."

One benefit of the third stream that the open fan shares with its military engine counterpart is additional cooling. As part of RISE, CFM is studying incorporating in the engine a hybrid-electric system, which is undergoing tests using a modified GE Aerospace Passport engine.

"It is an extremely effective heat sink," Hegeman notes. "You recover the thrust out of the heat that you dump into the third stream. Everything in this architecture is driving toward efficiency, so when we add hybrid electric into that, you need



CFM INTERNATIONAL IMAGES

to manage the heat loads that come with that. This means instead of just wasting the heat, you are recovering thrust out of it by having heat exchangers in that third stream.”

CFM’s acknowledgment of the adaptive design feature comes as it begins key dust ingestion tests on the new high-pressure turbine blades and nozzles at the center of the future small-core design. Tests are being conducted with a specially adapted GE Aerospace F110 military engine at a company site at Edwards AFB, California.

The evaluation targets improved durability in harsh operating environments and involves injecting a bespoke mix of sand and other particles developed by GE into the inlet. Building on similar durability tests developed for other CFM and GE commercial engines—including the Leap-1, GEnx-1B and GE9X—the ingestion work evaluates the interaction of molten particles of a calcium-magnesium-aluminosilicate (CMAS) mix with the thermal barrier coatings (TBC) that protect the turbine blades and nozzles.

TBC are key to enabling the engine to operate at temperatures up to 1,200C (2,200F). CMAS issues can degrade coating performance, leading to blade erosion and—in the worst cases—component failure.

The dust tests follow more than 3,000 endurance cycles on the high-pressure turbine completed this year, as well as an earlier series of tests to validate thermal, mechanical and system performance. Endurance tests of the turbine and nozzle components included simulated high-thrust takeoff and climb to see how parts would withstand flight condi-



Dust ingestion durability tests of advanced high-pressure turbine blades for the compact RISE core are underway using an F110 engine.

tions. CFM has conducted more than 350 tests to date under the RISE initiative. 🔄

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Safran Doubles Down On Leap-1A Final Assembly Site Diversification

> CFM PARTNER PRIORITIZES RESILIENCE OVER PRODUCTION COSTS TO ENSURE CONTINUITY OF OPERATIONS

> FACTORIES TO OPEN IN MEXICO IN 2026 AND MOROCCO IN 2028

Thierry Dubois Lyon

Reducing costs, including in production, is generally a priority for engine-makers. But with demand and backlogs strong amid uncertainty in international trade, resilience is trumping cost-cutting. Some manufacturers prefer to guarantee continuity of operations, despite the price.

and Morocco in the industrial setup of major OEMs. After starting with low-value-added work, the countries now contribute to complex manufacturing, including final assembly of commercial aircraft engines.

Safran has followed a dual-source strategy since the Leap program began.

Now that assembly will occur in more than one place, if a major industrial issue arises at the Villaroche site near Paris, for instance, the Queretaro and Casablanca lines can continue to produce Leap-1As, Cueille says.

As secondary sources, they are expected to produce about 35% of all Leap-1As. By the end of 2026, Queretaro is planned to start serving Airbus' production line in Mobile, Alabama, eventually shipping about 100 engines per year from a conventional production line using assembly rigs.

Villaroche and Casablanca will be sister facilities. Both are to rely on pulse lines—three in Villaroche and one in Casablanca—where in-progress engines move at a regular pace. The two sites will use the same production methods, Cueille says. Operations are planned to start in 2028 and reach full capacity—about 350 engines per year—at an unspecified time.

Safran has produced all CFM engines powering the Airbus A320 family at its Villaroche site near Paris to date.

Building in Morocco is more expensive than expanding in Villaroche, but creates geographic diversity, Cueille notes. Moreover, the new Leap maintenance, repair and overhaul (MRO) site in Casablanca needs a testbed, equipment that is too expensive to justify for a single aftermarket shop. But a testbed also used for production would be worth the expense, and production and MRO activities would benefit from logistic synergy in receiving Leap-1A components.

Thanks to its long-established presence in Morocco, with 4,900 employees, the company is confident in local skills, he adds. Safran Nacelles already assembles 60% of its final products in the country.

Queretaro was an option for the new pulse line, but its distance from Airbus production sites in Europe would not have made sense logistically or in terms of CO₂ emissions, Cueille explains.

GE has had interests in Queretaro, too. Since 2016, the site has led engineering design and produced components for the CF34 regional jet engine. And in 2022, GE partnered with the Aeronautical University of Queretaro to open the Sustainable Aerospace Technology Innovation Lab. 🌱

—With Guy Norris in Colorado Springs



ADRIEN DASTÈ / SAFRAN

Safran is doing precisely that in adding final assembly lines for the CFM International Leap-1A turbofan in Casablanca, Morocco, and Queretaro, Mexico. Together, the two facilities will put the final touch on the company's resilience strategy for the Leap-1A, which powers most new Airbus A320s.

The factories are to support the Leap-1A production ramp-up, which has become an issue between Airbus and CFM. The engine-maker has struggled to keep up with demand, and Airbus CEO Guillaume Faury once reproached it as prioritizing airlines in need of spare engines. Safran has yet to catch up on Leap-1A deliveries, but it is following an agreed-upon plan with Airbus, Safran Aircraft Engines CEO Stéphane Cueille says.

The new final assembly lines mark the growing importance of Mexico

The company is in charge of Leap-1A final assembly—and therefore deliveries—while its partner in CFM International, GE Aerospace, is responsible for the Leap-1B, which powers the Boeing 737 MAX. Safran also handles the Comac C919's Leap-1C, but that version, almost identical to the -1A, accounts for a small proportion of deliveries.

Safran also briefly assembled Leap-1Bs to help GE meet demand before the COVID-19 pandemic and two deadly crashes hit the 737 MAX program. CFM expects to deliver 2,500 Leap-1A/B/C engines per year beginning in 2028.

Dual-sourcing will give Safran at least two suppliers for each engine component for which it is responsible. The OEM has extended the arrangement to parts it manufactures itself. Three facilities in France, Mexico and the U.S. produce Leap fan blades.

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Maintaining the U.S. Lead in Aerospace

By **Alex Krutz**

From Day 1, the goals of President Donald J. Trump's America First Trade Policy have been clear: revitalize the American industrial base, reestablish U.S. manufacturing dominance and ensure economic and national security. The International Trade Administration's Manufacturing Office within the U.S. Department of Commerce is hyperfocused on these missions, including for the U.S. aerospace industry.

The aerospace sector is a pillar of the U.S. economy and an example of domestic manufacturing at its best. The aerospace industry's trade surplus began more than 70 years ago, and it reached \$73.9 billion in 2024, according to the Aerospace Industries Association. U.S. aerospace exports totaled \$138.7 billion in 2024, the association reported, touching almost every country in the world. In 2022, the FAA reported that civil aviation supported 9.4 million direct and indirect jobs—a figure that is likely higher today.

The International Trade Administration's Manufacturing Office intends to leverage these successes to help the aerospace industry further increase its global competitiveness, including in advanced manufacturing technologies and artificial intelligence (AI) infrastructure essential to reclaiming leadership in the new industrial era.

Advanced Manufacturing

Manufacturing economies around the world are grappling with existential threats to their industrial bases from dwindling skilled workforces and disrupted supply chains to rising costs and global competition. The U.S. faces these same challenges, but what sets it apart is its leadership in advanced manufacturing—a suite of technologies critical to improving efficiency, resilience and competitiveness on the factory floor. Nearly every manufacturing sector is investing in and accelerating adoption of these technologies to close gaps in production and workforce capacity while boosting productivity and output. Today, a manufacturer's competitiveness increasingly hinges on the ability to integrate advanced technologies into its operations.

Digital transformation is at the core of this shift. The digitalization of manufacturing assets, powered by AI, enables the creation of digital twins (virtual replicas of the factory floor or equipment) and digital threads that track and optimize every step of the production process. These tools, coupled with simulation capabilities, allow companies to streamline operations, reduce waste and shorten development cycles. The U.S. is also leading in the deployment of next-generation robotics, prioritizing ease of use so that workers can be trained quickly to program, troubleshoot and collaborate with robotic systems. American innovations in additive manufacturing, including advanced design, material science and printing methods, are opening new possibil-

ities for industries that depend on fragile supply chains or require fast turnaround for custom or complex parts.

The International Trade Administration's Manufacturing Office is at the forefront of advanced manufacturing. We are engaging industry to reshore the critical equipment needed for U.S. manufacturing. We are focused on bringing back to the U.S. robotics, machinery and tooling once made here through incentives to expand companies' machinery manufacturing or through foreign direct investment for companies based in other countries to set up U.S. manufacturing operations.

AI Infrastructure

The Trump administration's commitment to revitalizing U.S. manufacturing is exemplified in its ambitious drive to expand national AI infrastructure, sparking a historic wave of industry and public investment. The president's AI Action Plan, coupled with a suite of targeted executive orders, has mobilized the federal government's capacity to accelerate permitting, unlock financial incentives and streamline export controls to expand critical data center capacity rapidly. Industry has responded with unprecedented commitment, notably through the launch of the \$500 billion Stargate Project and multi-billion-dollar expansions announced by tech leaders at the Pennsylvania Energy and Innovation Summit. This surge is further fueled by growing international demand for U.S. AI infrastructure and exports, driven by high-profile partnerships abroad that are opening global markets for American-made AI products and technologies.

The growth of AI infrastructure highlights the urgent need to reshore and expand high-value manufacturing for critical AI components, ensuring essential technologies are produced domestically to protect supply chains and national security. For example, priority investment must include revitalizing domestic manufacturing of printed circuit boards, the building blocks for all electronics. The International Trade Administration's Manufacturing Office is at the center of this work, translating AI infrastructure investments into tangible gains for U.S. manufacturing. By leveraging strategic investments, effective policy and coordination, and focused industry engagement, we are fostering high-tech manufacturing ecosystems and positioning the U.S. to lead the global AI-driven industrial era.

The Trump administration is committed to strengthening the domestic development, adoption and production of advanced manufacturing technologies and AI infrastructure, which will ensure the U.S. remains the global leader in the aerospace sector and the broader industrial base. ☪

Alex Krutz is the deputy assistant secretary for manufacturing at the International Trade Administration within the Department of Commerce.

**"THE GROWTH OF AI
INFRASTRUCTURE
HIGHLIGHTS THE URGENT
NEED TO RESHORE AND
EXPAND HIGH-VALUE
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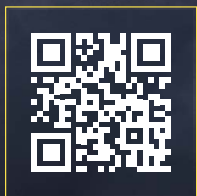
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