

Uncertainty Grips  
USAF's Next Fighter

GPS Interference  
on the Rise

China Samples  
Moon's Far Side

Blue Origin Joins  
Military Launch Club



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## & SPACE TECHNOLOGY



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we let them soar.

— We were meant to fly.



GE Aerospace





25

*NOAA seeks commercial space traffic management software to improve protection of its GEO-based satellite fleet.*



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*Airbus is expecting certification of its A321XLR imminently. The long-haul version of the A321neo, planned to be on display at this year's Farnborough International Airshow, has the potential to change route networks because it can make long-haul and smaller nonstop markets profitable to operate. Airbus has made significant design changes to make it compliant with European Union Aviation Safety Agency special conditions. Our report by Executive Editor for Commercial Aviation Jens Flottau begins on page 38. Airbus photo.*

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# INTELLIGENCE AND ANALYSIS OF KEY DEVELOPMENTS HAPPENING IN ADVANCED AIR MOBILITY

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## WHAT'S THE RUSH?

In sports, when a star player is struggling, he or she is told, "Let the game come to you." The airline industry's headlong doomsday approach to reducing its CO<sub>2</sub> impact needs to heed that advice. Kevin Michaels' "SAF Struggles" (*May 20-June 2, p. 10*) seems to argue that we must reduce CO<sub>2</sub> from airplanes, come hell or high water. Let us review current options being discussed in *AW&ST*.

Use cryogenic hydrogen as the fuel—but hydrogen comes from fossil fuel reforming (~95%). Grand ideas about green-energy-supported water hydrolysis plants are pie-in-the-sky. "Green" energy is so oversubscribed it is questionable if the energy is there to do the hydrolysis, let alone charge electric vehicles, heat/cool homes and run industry.

Next is electrically powered aircraft. Battery size and weight affect payload negatively, and recharge time forces

convoluted design and procedures to accomplish that in a reasonable time. The power density/weight issue is not favorable today for airplanes.

Finally, the topic of the article, sustainable aviation fuel (SAF), is 3-4 times more expensive than Jet A.

Solution: Have a government mandate. Given the inflationary climate, that just adds more fuel to the fire.

What is the rush? Let the technology mature, add some real system engineering to the overall energy problem and produce an overall cost-effective system solution. And convince China and India to stop building and using coal-fired power plants, which totally wipes out anything we do.

*Raymond F. Maddalone, Fishers, Indiana*

*Kevin Michaels responds:*

*I agree that the challenges for sustainable aviation are mind-bending! We face perhaps the greatest challenge of any industry, as we must take on physics, unique infrastructure and aviation regulation to bring new products to market.*

*In 2022, the International Civil Aviation Organization agreed to a goal to achieve net-zero carbon dioxide emissions from international aviation by 2050—a goal backed by the International Air Transport Association. My point is that if we are serious about making progress against this goal—if we intend to "walk the talk"—far more action and investment will be required, and that the best near-term lever to address emissions beyond fleet renewal is SAF.*

*Your point is that the goal itself is misguided and that we should slow down and let the technology develop. This is a different argument, and a topic worthy of further exploration. Personally, I don't believe we can get to zero emissions by 2050, and governments must move away from a "peanut butter" approach where they apply the same goal to every industry, regardless of cost-benefit or physics. At the same time, avi-*

*ation cannot be indifferent. We need to start our own decarbonization journey, and I believe that the expansion of SAF production is a critical element of this plan.*

## DIMINISHING RESPONSIBILITIES

The FAA is in the final stages of reassigning elements of air traffic control (ATC) services from the New York Terminal Radar Approach Control (Tracon) to the Philadelphia ATC facility. These operational responsibilities are for aircraft operating at Newark Liberty International Airport and its many "satellite" airports.

When commissioned, the New York Tracon was considered an operational and technological marvel. Integrating the control and "tracking" of aircraft at multiple major airports with a common technology platform was a true breakthrough. Over the years, pretty much every air navigation service provider (ANSP) emulated the New York Tracon's surveillance and flight data planning technological protocols.

The New York Tracon is located in Westbury, Long Island, New York, about 28 mi. east of Manhattan, and in recent years it has become a difficult commute for the three-shift-a-day operational staff. Accordingly, it has been a challenge to attract qualified personnel to transfer to Westbury. The FAA suggested moving it to a location much farther east on Long Island, where most employees reside, and had union and congressional support to do so. Those plans were canceled for logistical and financial reasons.

The Philadelphia move has been in the planning stages for several years and depends on some Westbury employees relocating to the Philadelphia area; at least 17 personnel are affected. There has been pushback from those employees, even after offers of \$100,000 plus relocation expenses.

"Breaking up" the tracon—vis-a-vis moving the Newark operations to Philadelphia—presents problems beyond the relocation of employees. The flight data and flight plan management platform and airspace "geometry" do not readily lend themselves to such a divestiture of responsibilities. In fact, ANSPs are moving toward greater integration of functionality, to include the blending of approach control airspace with low-level en-route sectors; they are referred to as Integrated Control Complex (ICC) facilities. To alter or diminish New York Tracon responsibilities clearly does not comport with this new approach to ATC service models. And FAA NextGen capabilities are imagined to support a greater integration of functionality, not a decentralization of control, as the Philadelphia move suggests.

The New York Tracon once stood as the gold standard of contemporary ATC service facilities. Where it stands today and tomorrow bears close observance.

*Dick Marakovits, Riverhead, New York*  
*Retired FAA air traffic manager, New York Center*

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](mailto:awstletters@aviationweek.com) Letters may be edited for length and clarity; a verifiable address and daytime telephone number are required.



UNITED AIRLINES



**Anna Wijkander** has been promoted to chief financial officer from deputy chief financial officer and head of corporate control at *Saab*, succeeding Christian

Luiga, effective Sept. 9. Before joining the defense prime, she worked at Ericsson, making her way up to head of corporate business control for sales.

*Airbus* has tapped **Victoria Coleman** as CEO of Acubed, the airframer's Silicon Valley innovation center, and *Airbus* head of research and technology in North America, effective July 15. She was chief scientist for the U.S. Air Force, before which she was director of DARPA.

**Irene Esteves** has been named chief financial officer of *Spirit AeroSystems*, succeeding Mark Suchinski as he steps down. She is a member of Spirit's board of directors and the former chief financial officer of Time Warner Cable.



*Booz Allen Hamilton* has hired **Bill Vass** as chief technology officer, succeeding Susan Penfield, who is retiring. He was vice president of engineering at Amazon Web Services. U.S. Army Lt. Gen. (ret.) **Scott Berrier** has also joined as senior vice president of the national security business. He was director of the Defense Intelligence Agency and has previously served as Army deputy chief of staff for intelligence.

*Turkish Aerospace Industries* has promoted **Mehmet Demiroglu** to CEO from head of helicopter programs, replacing Temel Kotil. Before joining the company, he worked with Tusa Engine Industries. In addition, **Omer Cihad Vardan** has been elected board chairman, replacing Rafet Bozdogan.

Sustainable fuel company *LanzaJet* has named **Doreen Pryor** chief financial officer. She was chief financial officer of North America at Siemens Gamesa, a wind turbine engineering subsidiary of Siemens, and has also worked on renewable energy at the parent company.

**Paul Croci** has been appointed chief financial officer at space launch company *Stoke Space*. He was managing

director and head of the aerospace and defense group at Wells Fargo, before which he worked with Honeywell and Barclays. U.S. Space Force Lt. Gen. (ret.) **John Shaw** also joins the board of directors, following a long career with the U.S. Air Force and U.S. Space Force that concluded with serving as deputy commander of Space Command.

**Jonathan Lunine** has been named chief scientist at *NASA Jet Propulsion Laboratory* as well as professor of planetary science with the geological and planetary sciences division at The California Institute of Technology. He joins from Cornell University, where he chaired the astronomy department and taught the physical sciences.



*Alaska Airlines* has promoted **Ann Ardizzone** to vice president of special projects from vice president of strategic sourcing and supply chain management, filling a new position to support the airline's planned merger with Hawaiian Airlines. **Justin Neff** succeeds her in her former role, leaving his position as president of *McGee Air Services*, a subsidiary of Alaska that provides aviation services. **Jeff Helfrick** replaces him as president there, joining from Hawaiian Airlines, where he



was vice president of airport operations.

**Jilinda Crowley** has been appointed chief financial officer at *Skydweller Aero*, a U.S.-Spanish developer of solar-powered autonomous aircraft. She held the same title at MagniX and before that at Electra.aero. Before entering the sustainable aircraft industry, she worked for 14 years at Rolls-Royce, culminating in her position as senior vice president of civil aerospace programs.

*JetBlue Airways* has hired **David Marcontell** as vice president of technical operations. He brings almost 40 years of experience in aviation, most recently working as an expert associate partner at McKinsey & Co. Before that, he was the founding chief operating officer at proposed carrier Connect Airlines, with 20 years at Oliver Wyman CAVOK.

Geostationary communications sat-

ellite developer *Astranis* has appointed **Matt Long** as general counsel. He held the same role at Palantir Technologies for over 12 years.

**Shawn Gregor** has been named president of the Americas at *SITA*. He was vice president and industry leader of travel and transportation at IBM, and previously worked at Infosys and Accenture.

**Brian McMenamy** has been appointed interim chief financial officer at *Spirit Airlines*, following Scott Haralson's departure. He was vice president and controller at the carrier, before which he worked at American Airlines for over 30 years.



**Celeste Heinonen** has been named chief financial officer of the *Ontario International Airport Authority* to support the Southern California airport's rapid growth. She was director of operating budget at the Massachusetts Port Authority, which oversees Boston Logan International Airport, Worcester Regional Airport and the state's other major points of entry.

**Elizabeth Schmid** has been promoted at *General Dynamics* to senior vice president of government relations and communications from vice president of government relations. Before General Dynamics, she was vice president of national security and acquisition policy at the Aerospace Industries Association, and previously worked as staff director for the Senate defense appropriations subcommittee.



The *Metropolitan Nashville Airport Authority* has announced a slate of appointments. **Robert Ramsey** has been promoted to chief development officer from chief operating officer, with **Adam Floyd** succeeding him, having been promoted from vice president of operations. **Eric Johnson** joins as chief revenue officer from the Metropolitan Airports Commission at Minneapolis-St. Paul International Airport, where he was director of commercial management and airline affairs. **Adam Bouchard** becomes vice president of operations, a title he also held at Tampa International Airport with the Hillsborough County Aviation



Authority. **Daniel Brown** has been promoted to vice president of facility management from assistant vice president, and **Ted Morrissey** to associate general counsel from assistant general counsel.

**Rosco Newsom** has joined *Alvarez & Marsal* as managing director of its aerospace, defense, aviation and space practice. He was principal and partner for advanced manufacturing and mobility at EY Parthenon, with past positions at Strategy&, Eaton and Northrop Grumman.

Leading airport consultancy *Paslay Group* has hired **Kris Vogt** as the inaugural director of operations for its executive program management division. Vogt has worked as program manager at Burns & McDonnell and AECOM, overseeing terminal modernization and improvement programs at Hollywood-Burbank Airport and Los Angeles International Airport.

*D-Fend Solutions* has expanded its U.S. team, bringing on **Gordon Kesting** as vice president of U.S. sales and business development, and **Glenn McArthur** as business development manager. Kesting was vice president of international military programs at Elbit Systems of America, where he worked for 15 years, and has Leonardo, BAE Systems and Northrop Grumman among his past employers. McArthur joins from the U.S. Border Patrol, where his 25-year career culminated in the role of assistant chief patrol agent. Before that, he worked with the



U.S. Drug Enforcement Administration.

**Julien Denat** has joined stratospheric exploration company *World View* as vice president of supply chain. He brings over

20 years of aerospace supply chain and program management experience, most recently from Radia, where he was head of supply chain. Before that, he worked with Airbus and Latecoere.

*Kuva Space*, a Finnish satellite technology startup, has hired **Andre Parris** as global head of business and development. He was regional sales manager for Southern Europe at BlackSky and brings an extensive geospatial



background with companies such as Bloomberg and Planet Apps.

U.S. Navy Vice Adm. (ret.) **Sean Buck** has been appointed president of the *National Training & Simulation Association*. He succeeds U.S. Navy Rear Adm. (ret.) James Robb, who passed away last year. Buck was superintendent of the U.S. Naval Academy, capping 40 years of service in the Navy.

*Tarmac Aerosave*, a joint venture between Airbus, Safran and Suez, has promoted **Jose Moliner** to site director in Teruel, Spain, from sales director. He initiated the group's move into Spain in 2013 and succeeds Pedro Saez, who has retired. Before joining the company, Moliner was director of the foreign investment department in the economic development agency for the regional government of the Aragón region of north-eastern Spain.

U.S. Air Force Lt.

Gen. (ret.) **Mary O'Brien** has been appointed to *Academy Securities'* advisory board and geopolitical intelligence group. She is also the principal owner at her consultancy. Before retiring from the public sector in 2023, she was director of the Joint Staff Directorate of Command, Control, Communications and Computers. She has also served as the Air Force's deputy chief of staff for intelligence, surveillance, reconnaissance and cybereffects operations.



U.S. Navy Adm. (ret.) **Jonathan Greenert** has been promoted to chair of the board of directors from board member at *BAE Systems Inc.*, the U.S.-based subsidiary of BAE Systems plc. He replaces Kelly Ayotte, who is stepping down to run for governor of New Hampshire. Greenert served in the U.S. Navy for 40 years, finishing his service as chief of naval operations and member of the Joint Chiefs of Staff. Before that, he was vice chief of naval operations.

*Daher Group* has named **Didier Kayat**

board chairman. Retaining his position as CEO, he succeeds Patrick Daher, who is retiring. **Olivier Genis**, who is also president of Eiffage Construction,



has been promoted to board vice president from board member.

**Tensie Axton** has been appointed to the board of directors at *XTI Aerospace* as well as chair of the company's nominating and corporate governance committee and as a member of the audit and compensation committees. She is a senior managing director at FTI Consulting, working in corporate finance.

*New Frontier Aerospace*, a startup developing advanced hypersonic propulsion for carbon-neutral aircraft, has appointed **Christopher Carney** to its board of advisors. He also works as a senior policy advisor at Nossaman. As representative of Pennsylvania's 10th congressional district in 2007-11, he chaired the House Homeland Security Committee's management, investigations and oversight subcommittee. He later worked with BAE Systems and the National Aviation Intelligence Integration Office.

## HONORS & ELECTIONS

**Joanna Geraghty**, CEO of JetBlue Airways Corp., will be awarded the Flight Safety Foundation's *Gloria Heath Trophy* on July 9, celebrating her achievements in



civil aviation. Geraghty is a 19-year veteran of JetBlue who took over as CEO in February after having served as the carrier's president and chief operating officer. She is being recognized for her commitment to the well-being and success of JetBlue's employees, including her leadership during the COVID-19 pandemic and for fostering an environment where personnel are empowered to report safety concerns. 🏆

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LEONARDO



## DEFENSE

**The Italian Army's Leonardo AW249** Fenice attack helicopter made its public debut at the June 17-21 Eurosatory defense show in Paris, with two in flight testing and two more ready to fly.

**South Korea has awarded initial production contracts** for 20 KF-21 fighters to Korea Aerospace Industries, engine supplier Hanwha Aerospace and radar developer Hanwha Systems.

**The U.S. State Department has approved** the sale to Taiwan of more than 1,000 loitering munitions from AeroVironment and Anduril, reflecting growing demand for such systems.

**MBDA has flown the Small Highly Adaptable Remote Carrier System** remotely piloted aircraft to demonstrate technologies for uncrewed wingmen for Europe's Future Combat Air System.

**Bell has begun flight-testing the first** Royal Canadian Air Force CH-146 Mk. II utility helicopter to receive upgrades under the \$584 million Griffon Limited Life Extension program.

**The U.S. Missile Defense Agency launched** the HTB-1 Hypersonic Testbed on June 12, a three-stage sounding rocket that boosts the Kratos Erinyes flyer to hypersonic speed.

**The Royal Australian Air Force (RAAF)** took delivery of the first of four Northrop Grumman MQ-4C Triton uncrewed aircraft systems on June 15 at RAAF Base Tindal in the Northern Territories.

**NHI Industries NH90 customer nations** Belgium, Germany, Italy and the Netherlands have launched a \$648 million upgrade program to boost the performance of the European utility helicopter.

**MTU and Safran have signed a cooperation agreement** to create a 50-50 joint venture, the European Military Rotorcraft Engine Alliance, to develop a powerplant for a future European military helicopter.

## COMMERCIAL

**Airbus no longer expects to reach its** target of producing 75 A320neo-family aircraft per month in 2026 and has cut back its delivery guidance for 2024 (page 30).

**The newest Lufthansa Group subsidiary,** Lufthansa City Airlines, debuted on June 26, with its first scheduled Airbus A320neo flight between Munich and Birmingham, England.

**South Korea's Air Incheon has been** selected as the preferred bidder for Asiana's freighter operation, an important step toward the proposed merger between Korean Air and Asiana.

**A severe workforce crunch is among** the key reasons for the fuel shortage at numerous Japanese airports, a public-private task force has found.

**At the request of the European Commission,** the European Union Aviation Safety Agency has formed a group of experts to provide technical advice on the non-CO<sub>2</sub> effects of aviation.

**Embraer has decided to focus concept studies** for its Energia family of sustainable regional aircraft on aircraft sized at around 50 seats, larger than the 19-30-seater previously studied (page 48).

**Qatar Airways has issued a request for** proposals to Airbus and Boeing as it considers additional orders of the Airbus A350 and Boeing 777X.

**A group involving Thales and Spire Global** is pursuing a 100-plus satellite constellation aimed at delivering air

## VIEW FROM BEIJING

### China Funds More Aircraft Research

China is doubling down on state support for its commercial aircraft industry with the creation of a joint fund for basic research on large aircraft, backed by the Ministry of Industry and Information Technology and National Natural Science Foundation of China.

Comac has long enjoyed considerable state support as China's flagship commercial aviation project. The Center for Strategic and International Studies in Washington estimated that, by late 2020, Beijing had used \$45-66 billion from the state coffers to support the company.

Chinese analysts estimate the new fund will be at least several billion yuan to start. A billion-yuan fund would be equivalent to almost \$700 million. While that is modest compared with what China has spent so far on the C919 narrowbody, it is likely just the beginning.

Details of the fund are sparse, but the Industry Ministry on June 14 said the focus is on "major national strategic needs . . . [and] forward-looking basic research to lay a solid foundation for the long-term development of the large aircraft industry." Areas identified include safety and sustainability.

As described, the fund sounds similar in intent to Europe's Clean Aviation public-private research program and NASA's Sustainable Flight National Partnership. Whether the fund will support Comac's next program, the widebody C929, or future projects across China's industry remains to be seen.



traffic management services beginning in 2027.

**China's AVIC conducted the first flight of its HH-100 uncrewed cargo aircraft on June 12 from Xian, Shaanxi. The 4,400-lb.-gross-weight aircraft is designed to carry a 1,500-lb. payload 320 mi.**

**Archer Aviation's uncrewed first prototype of the Midnight electric vertical-takeoff-and-landing air taxi completed its first full transition flight on June 8.**

**SPACE**  
**China's Chang'e 6 return module landed back on Earth on June 25 after a 53-day mission, bringing back the first lunar samples from the far side of the Moon (page 28).**

**DARPA has selected Redwire to be the prime integrator for the Otter project to fly an air-breathing spacecraft in very low Earth orbit using an electric propulsion system.**

**SpaceX is sidelining a Falcon 9 rocket for additional inspections following a rare launch abort at engine ignition on June 14 on a mission to orbit 22 Starlink satellites.**

**United Launch Alliance has dropped Sierra Space's Dream Chaser spaceplane from the second flight of its Vulcan rocket, citing schedule pressure to complete certification for national security launches.**

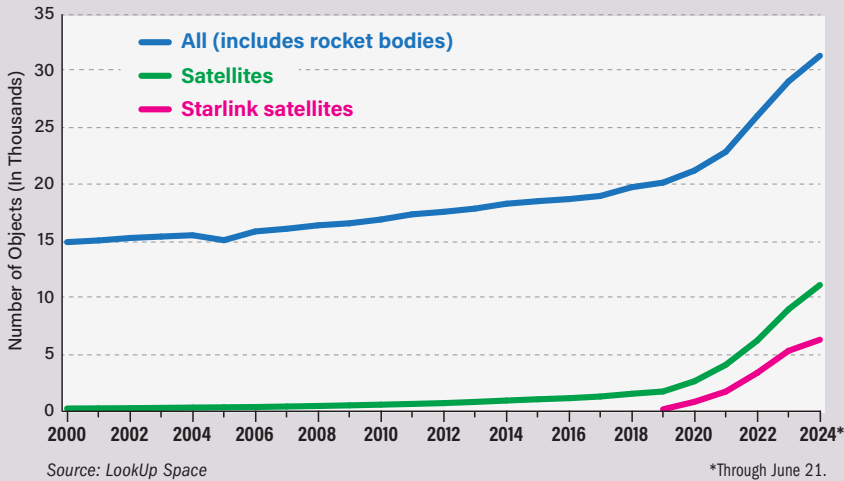
**The fourth and final member of the U.S. National Oceanic and Atmospheric Administration's (NOAA) GOES-R weather satellite constellation was launched by a SpaceX Falcon Heavy on June 25.**

**Lockheed Martin has won a \$2.27 billion contract to build at least three—and up to seven—satellites for NOAA's Geostationary Extended Observations (GeoXO) program.**

**SpaceX has won an \$843 million NASA contract to build a spacecraft to deorbit the International Space Station after it is decommissioned, which is expected no earlier than 2030.**

**Collins Aerospace is stopping work on a NASA contract to develop a next-generation spacesuit for spacewalking astronauts, leaving Axios as the sole performer.**

## Earth Orbit's Space Object Crowd Grows



The number of active satellites in Earth orbit has passed 10,000 for the first time, says LookUp Space, which operates a network of radars to detect and track objects in orbit. On June 19, the company counted 10,019 active satellites, two-thirds of which (6,646) belong to SpaceX's Starlink constellation. The majority (9,254) of these satellites are in low Earth orbit, mainly 400-1,200 km (250-750 mi.) from the Earth. LookUp Space also counted nearly 3,200 rocket stages and 13,326 pieces of debris orbiting the Earth, just a small fraction of the unaccounted for debris estimated at close to a million pieces measuring 1 cm (0.4 in.) or more in size.

## 65 YEARS AGO IN AVIATION WEEK

**Seventy-year-old Soviet aircraft designer Andrei Tupolev was aboard a Tu-114 when it flew a Soviet scientific delegation nonstop from Moscow to New York International Airport on June 28, 1959. Although it was a turboprop, the four-engine Tu-114 was designed to fly long distances at high subsonic speeds, making the trip to New York in 11 hr. and 6 min. at an average speed of 460 mph. Upon landing, Tupolev boasted that the Tu-114—a derivative of the Tu-95 strategic bomber—was the most economical airplane in service, though he “revealed few new technical details,” reported Aviation Week’s Erwin J. Bulban. U.S. Air Force pilot Maj. Augustine Puchrik, who was on the flight and given a turn to fly the aircraft, told Aviation Week he was very impressed with its features and handling. The autopilot, Puchrik said, “really works—better than some I’ve flown here.” But the flight was not perfect: The Tu-114’s first landing attempt was aborted, with “the pilot peeling off sharply as he made a go-around due to excessive speed on approach,” the magazine**



**Tu-114 Flies Moscow-New York in 11 Hr.**

By Erwin J. Bulban  
New York—(AP)—The Soviet Union's first long-range jet, the Tu-114, landed at New York International Airport on June 28, 1959, after a nonstop flight from Moscow. The aircraft, designed by Andrei Tupolev, was the first of its kind to fly from Moscow to New York. It was a four-engine turboprop, and it was the most economical airplane in service. The flight was not perfect, but it was a success. The aircraft was refueled at New York International Airport, and it was then flown to Washington, D.C. The flight was a major achievement for the Soviet Union, and it was a major achievement for the world. The flight was a major achievement for the Soviet Union, and it was a major achievement for the world. The flight was a major achievement for the Soviet Union, and it was a major achievement for the world.

reported. “On the second letdown, the airplane seemed excessively high . . . but touched down and completed a successful landing with room to spare, although the use of considerable brake was noticeable.”

Subscribers can access every issue of Aviation Week back to 1916 at: [archive.aviationweek.com](https://archive.aviationweek.com)

# UP FRONT

## BYRON CALLAN



### THE CURRENT CONSENSUS IS THAT

the 2024 race for the U.S. presidency is too close to call. Election Day is still months away, but it is worth assessing

what a Trump presidency in 2025-28 might mean for the defense sector. Policies can change. There are no leading candidates yet for defense positions in a Trump administration, including national security advisor and secretary of defense. The influence of Congress and its makeup also have to be considered.

One key source of insights on what former President Donald J. Trump could do is his campaign website, which has an “Agenda47” section that lists a number of plans and changes he would undertake if elected. Several are worth considering for their defense implications.

The first item on Agenda47: Trump “declares war on cartels.” It states that “the official policy of the United States [will be] to take down the drug cartels just as we took down [the Islamic State group].”

There are critical differences between a war against the Islamic State group (ISIS) in Iraq and Syria—which relied on U.S.-led coalition airpower and Iraqi forces—and one in Mexico and probably elsewhere in Latin America against drug cartels. Invoking the war against ISIS strongly implies the use of overt military force—likely in the form of precision strikes and special forces.

But Mexico and other nations may not be willing to join the U.S. war. While the ISIS was more or less isolated in Iraq and Syria and had no way of directly striking at the U.S., the cartels are sophisticated enough and have the resources to build submersible vessels to smuggle drugs to the U.S. They have used attack drones against one another and against Mexican authorities.

It would be naive to think the cartels would not attempt to strike back at the U.S., particularly with attacks on cities within 300 mi. of the U.S.-Mexico border. This could prompt more spending on air defenses against these threats. Converting narco-semi-submersible vessels to the types of naval weapons Ukraine has employed against Russia should be relatively easy.

Mexico is the largest U.S. trading partner. If trade is disrupted, it could have broader negative fiscal implications that might bear indirectly on defense. In addition, U.S. forces could be reassigned from missions in Europe to a war against the cartels, and the scale and scope of such a war could compete with resources for U.S. commitments in the Indo-Pacific. It is also conceivable that China, Iran, North Korea and Russia would aid cartels in order to keep U.S. forces engaged in the West.

“Rebuilding America’s depleted military” is another

item on Agenda47, but it provides no specifics on weapon programs, force size or what the military would do. It simply states that Trump would “address the military recruitment crisis.”

There is a trope that the U.S. military is not meeting its recruitment goals because of “woke” policies and the diversity, equity and inclusion movement. However, this is not remotely borne out by data the Defense Department collects. The latest report on the Pentagon’s Joint Advertising, Market Research & Studies website that surveys the willingness of young Americans to serve is from the

summer of 2023. That survey showed that the top three reasons people did not want to join the military were the possibility of physical injury or death, post-traumatic stress disorder and leaving family

and friends. “Possibility of sexual harassment” was cited by 30% of respondents. A move to “restore” military culture could worsen recruitment challenges, leading to more use of autonomous systems and private contractors.

The Trump campaign’s Agenda47 states that he would use “impoundment,” meaning that he would not obligate funds Congress has appropriated. That might not affect the Pentagon directly, but it raises

the threat of a more serious breach with Congress.

The campaign website also states that Trump plans to defeat “America Last warmongers in the Deep State, the Pentagon, the State Department and the national security industrial complex.” That could cut across a broad swath of the U.S. defense sector through programmatic effects that would have to be assessed when the policy is clarified.

Agenda47 asserts that Trump would “build a new missile defense shield.” Parts of Lockheed Martin, L3Harris, Northrop Grumman and RTX might benefit from this, as it implies a space-based sensor network and a significant expansion of ground-based interceptors. Without any arms control agreements with Russia and China, that could cause a weapons race as those countries build more strategic missiles to punch through a missile shield. The U.S. then might spend more on strategic weapons and the nuclear stockpile.

The campaign website agenda also calls for “immediate deescalation and peace” in Ukraine. That would likely put European defense spending growth on steroids and could also shape defense spending in Asia.

Of course, any, or all of these plans could change before or after Election Day 2024. But for now, Agenda47 is what analysts and planners have to work with and should continue to monitor. 📌

Contributing columnist Byron Callan is a managing director at Capital Alpha Partners.

## Military Agenda

Trump campaign defense proposals



JUSTIN SULLIVAN/GETTY IMAGES



# GOING CONCERNS MATTHEW FULCO



## BOMBARDIER HAS LONG HAD

outsize ambitions, best exemplified by its near-death experience in the mid-2010s following years of bruising competition with Boeing and Airbus in the commercial aviation segment. A timely bailout by the Quebec government was the first step on the long road to recovery.

Nearly a decade on, Bombardier has its mojo back. The company is consistently profitable, with strong demand for its business jets. It is on track to deliver 150-155 jets this year. Activity from the U.S. market remains strong, while the company is also seeing activity in the Middle East and Asia as well as signs of an uptick in Europe, CEO Eric Martel said during a first-quarter earnings call.

## Scoring on Defense

Will Bombardier's military work help it evolve into a **stronger competitor**?

In an April 15 report, National Bank of Canada Financial Market Research (NBCFM) said that even if new jet orders slow sharply, it still expects Bombardier's \$14.2 billion backlog to support a delivery ramp to 150-155 jets this year from 138 in 2023—with further increases possible in 2025. NBCFM observed that “activity on Bombardier model jets is running 7% higher [year-over-year], which we view as a solid leading indicator that order activity should remain solid.”

In the aftermarket, Bombardier is competing aggressively. It reached a 46% market share target for addressable maintenance services of its business jets in 2024, a year ahead of schedule, and will likely surpass 50% next year, with a goal of 70% by 2030. Of the major business jet manufacturers, only market leader Gulfstream has a bigger share.

Investors like what they see. Excluding pandemic-induced doldrums—which were more about an industrywide slump than Bombardier-specific missteps—the company's share price has generally performed well in recent years. Currently trading at \$62.77, it has risen 28% over the past year and 49.5% in the last five.

The question now is if Bombardier's growing defense foray will complement its existing business jet products. The company's leadership certainly thinks so. During the first-quarter earnings call, Martel described 2023 as “a banner year for Bombardier Defense.” He cited deliveries of modified Challenger 6000 aircraft to the U.S. Air Force as part of the U.S. Air Force Battlefield Airborne Communications Node program and to Saab as part of the defense prime's GlobalEye platform for the Swedish Air Force.

In December 2023, Bombardier Defense won a firm, fixed-price contract to supply at least one Global 6500 jet to the U.S. Army as a prototype airframe for a new spy plane program known as the High Accuracy Detec-

tion and Exploitation System (HADES). “This marks the first time the Army will use a large business jet for intelligence, surveillance and reconnaissance missions and represents a tremendous show of trust for Bombardier Defense,” Martel said.

Richard Aboulafia, managing director at AeroDynamic Advisory, sees Bombardier's interest in defense as “quite low-risk” as “it does not involve any up-front expense,” while basing the business in Wichita “gives them an American industry footprint.”



BOMBARDIER

In early June, Bombardier Defense and its German partners Hensoldt and Lufthansa Technik Defense announced that modification work done in Wichita to integrate the Persistent German Airborne Surveillance System (Pegasus) signals intelligence system on the Bombardier Global 6000 jet would be completed by the Canadian company in Hamburg, Germany.

“The rollout of the first structurally modified Global 6000 aircraft indeed marks a major milestone, not just as an important prerequisite for Lufthansa Technik Defense's Pegasus work packages, but for the overall progress of this pioneering signals intelligence aircraft project,” Michael von Puttkamer, vice president of special aircraft services at Lufthansa Technik, said in a news release.

In a March 2023 report, Aviation Week Network noted that most of Bombardier's competitors in the defense sector use composite structures in the wing and fuselage (*AW&ST* April 10-23, 2023, p. 28), which makes modification costlier for the antennas, pods and weapon stations needed for special missions. In contrast, the Global 6000/6500's metal airframe and wings, long-range performance and ample supply of onboard electric power have made the jet popular with military and government operators.

Since defense programs often take a long time to come to fruition, investors will have to be patient. These are still early days for Bombardier's defense expansion, but so far, they seem willing to take Martel at his word.

In a best-case scenario, Bombardier will evolve into a more diversified aircraft manufacturer better able to compete against its bigger and better-capitalized rivals. 🗞



## INSIDE BUSINESS AVIATION

# WILLIAM GARVEY

### JIM TAYLOR ARRIVED AT HIS

office one day last summer assuming the typical routine—until he became aware of unexpected activity. A group

of workers had gathered along with their equipment in a wooded area nearby. And then trees began falling.

To Taylor, the actions were surprising and concerning, even potentially alarming. He went to investigate and learned that the trees covering a 29-acre section of land were being cleared to make way for a high-density development of 274 private homes. Hearing that, he started telephoning.

The property had been annexed in 2005 by the coastal city of Georgetown, South Carolina—a key fact, since Taylor kept abreast of county activities, but less so of municipal matters. Consequently, he was unaware of the project and its approval by the city's planning commission, whose interim director was the recipient of Taylor's first call.

The problem, Taylor explained, was the site's location 2,500 ft. from—and directly under—the final approach to the end of Runway 23 at Georgetown County Airport, of which Taylor is the longtime manager. He adds that the work violated state ordinances and that the project would endanger aircraft and occupants, all within the development, and threaten the viability of the county-owned airport's 6,000-ft. primary runway. Taylor recalls the bureaucrat's response was an unenthusiastic “we'll look into it,” a too-familiar refrain to airport encroachment concerns.

Taylor's next call was to Gary Siegfried, executive director of the South Carolina Aeronautics Commission.

Whereas states commonly entrust zoning matters to local authorities, South Carolina has a special regard for its 58 public-use airports, which annually generate billions of dollars in economic impact and hundreds of millions in state tax revenues.

Accordingly, state law requires local planning officials to regulate densities around those airports and their approaches. State law also empowers the aeronautics commission to abate hazards to aviation including land uses, require local officials to consider aviation safety in land-use planning decisions near airports, and to notify the commission of any proposed changes to such locations, including zoning changes. The commission, in turn, determines whether the changes are compatible, need specific modifications or are incompatible with safe air operations. If the project proceeds despite a negative finding, the commission can take legal action.

While the federal government has long recognized the importance of compatible land use near airports—as was urged by a presidential commission led by aviation pioneer Jimmy Doolittle back in 1952—it was never made federal law. The FAA provides guidance instead. Meanwhile, the steady creep of “progress” out toward once remote airports continues with sometimes tragic and often expensive consequences.

Siegfried uses actual examples to underscore that threat, including a 2007 accident at Cantrell Field in Conway, Arkansas. A Citation 500 landed long on a wet

runway and attempted a go-around, but the pilot clipped a blast deflector, crashed through the perimeter fence, crossed a residential street and slammed into a house. He and a female resident were killed. A similar accident had occurred years before, and the community decided twice was too many. It took seven years and \$30 million, but the area is now served by Conway Regional Airport, located 7 mi. from the former in-town facility.

Then there's Ridgeland-Claude Dean Airport, a South Carolina facility dating back to 1938. Seven decades later—and before the full array of state statutes addressing such actions was in place—local leadership decided to build a public school across the street and directly in line with Runway 21. To help safeguard students and teachers, the airport eventually built a north-south runway and closed the old strip at a cost of \$22 million in federal, state and county funds.

After months of inaction by Georgetown and with the land prep continuing, Siegfried wrote to the city's recently installed director of planning, notifying him that the housing project needed commission review and failing that, legal action could follow. That halted further issuance of permits and a restart of the planning process.

Ultimately, Siegfried suspects the construction project will proceed, but with restrictions imposed to ensure safe operations. That, Taylor says, is absolute: “We have to protect our airport and our approaches.”

But airport supporters are resigned to another seeming absolute: As each new home is occupied, those new residents will come to regard activity at the 83-year-old facility next door to be so noisy and dangerous that it should be bulldozed to make way for more housing. ☛

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

## Houses on Short Final

South Carolina airport is confronting a high-density project



GEORGETOWN COUNTY AIRPORT



# QUANTUM LEAP

## GARRETT REIM



**DURING THE AGE OF DISCOVERY,** Portuguese and Spanish claims on territories in Africa, Asia and the Americas were mediated by the pope, negotiated across treaties and occasionally violently resolved via the dictum “*Might makes right.*”

As humanity ventures to the Moon and the planets beyond, NASA wants to ensure that the new age of exploration is not ruled by the law of the jungle. The space agency and the U.S. State Department are signing up the free and democratic world to a set of principles: the Artemis Accords.

The Artemis Accords establish a common political-economic understanding of the exploration and peaceful use of outer space, including resources on the Moon. The 43 signatories are mostly liberal democracies, signifying that geopolitical rifts on Earth are moving into space. China and Russia have established a rival 11-country bloc around plans for their International Lunar Research Station.

As with the first Age of Discovery, explorers and entrepreneurs are propelled into this new period by state sponsorship and the promise of riches. When Christopher Columbus sailed across the Atlantic Ocean in search of a shorter trade route to India, Spain had financed his journey and claimed the right to 10% of all revenue from lands discovered.

How property rights on the Moon would be enforced is not yet clear, but the nonbinding Artemis Accords sketch out a framework. Even before property rights are established, entrepreneurs hope to wildcat lunar resources by hitching rides to the Moon on spacecraft developed for NASA's related Artemis program and Commercial Lunar Payload Services initiative.

Case in point: Moon-mining startup Interlune of Seattle aims to collect small bottles of rare helium-3 from the lunar regolith and sell it to developers of quantum computers and nuclear fusion reactors (*AW&ST* March 25-April 7, p. 46). Interlune's mining prospect is a closely guarded secret but might support decades of excavation.

China is searching for resources on the Moon, too. Its Chang'e-6 lunar lander has touched down on the far side of the Moon, drilled into the lunar regolith and brought a sample to Earth.

Deconflicting Chinese claims on the Moon will be difficult—the country already does not respect claims in the South China Sea or high in the Himalayas on its border with India. However, deconflicting claims among like-minded Artemis Accords participants is a

start. Moreover, signatories have strength in numbers.

Although it is not clear how Artemis signatories would handle lunar claim jumping, the agreement emphasizes Outer Space Treaty articles forbidding claims of national sovereignty, making countries responsible for their actions in space and requiring registration of activities.

Noninterference is “hands down” the most important principle for the accords' signatories to implement, NASA Deputy Administrator Pam Melroy says. “We should do the obvious thing: Tell everybody where we're going.”

The gritty details are more complex. For example, lunar landers kick up moon dust during touchdown that can stay suspended, trashing nearby solar panels or sensitive instruments. NASA is studying plume surface interaction, Melroy says.

The agency is also trying to set precedent in space by buying lunar regolith from Japan's ispace on an upcoming lunar landing mission, where a robot will scoop and photograph the soil

## Staying in the Lead

Why the U.S. created a geopolitical space bloc with the Artemis Accords



to document the transfer of ownership to NASA.

As with the initial Age of Discovery, navigation, prospecting, communications, transportation and situational awareness technologies are important—and they have dual military-civilian uses. Instead of nations championing homegrown technologies, the accords emphasize interoperability, allowing joint expeditions to the Moon through standardized airlocks and spacesuits, for example. Standardization also lays the groundwork for a common space economy.

For its part, the Chinese-Russian-led space bloc is a who's who of autocracies, including Belarus, Pakistan and Venezuela. These countries have little in common except a shared suspicion of the outside world and form not so much a coalition but a galactic B-team of disaffected despots.

Most Artemis Accords signatories are party to overlapping security pacts, including alliances with the U.S. as well as AUKUS and NATO, making the accords essentially a U.S.-led cosmic coalition.

Joint missions also stretch NASA's budget and let it set the agenda, creating a gravitational pull toward U.S. industry. That strategy succeeded on the International Space Station and gave the U.S. commercial space sector primacy in low Earth orbit.

Despite an envious technology lead in space, the U.S. is not putting up political barriers but welcoming others to follow. That is a time-tested innovation strategy. The best way to stay in the lead is to lead. 🌕

# THE DEW LINE

## STEVE TRIMBLE



**LOCKHEED MARTIN F-35s WILL** become more expensive over the next four years, with flyaway prices rising 16-18% depending on the variant.

The trend prompted the CEOs of the stealth jet's biggest suppliers to start planning in June for a long-term cost-reduction campaign.

The rising cost estimates risk reversing a long-term trend of mostly falling or stable pricing for each F-35. Although suppliers fell short of the original goal to sell F-35As for the same or less than F-16s, flyaway pricing had been in a long-term decline since the first lot of production in fiscal 2007. The steadily falling costs came from the effect of a steady increase in order volume, maturing production systems on a stable configuration and two previous cost-reduction initiatives.

But pressure on the jet's price is increasing again as major upgrades are set to enter the production system. A long-term plan to hold the annual production rate at 156 per year could help a battered supply chain catch up, but it might come at the expense of a former favorite tactic of leveraging increasing annual orders to negotiate lower prices on each lot.

Pricing became a key topic during an F-35 Industry Summit in Fort Worth in early June. Lockheed Martin CEO Jim Taiclet huddled with four of his top suppliers: RTX CEO Christopher Calio, Northrop Grumman CEO Kathy Warden, BAE Systems CEO Tom Arseneault and L3Harris Technologies CEO Chris Kubasik.

"We committed to sharing additional data, improving test cycle times and defining a future Blueprint for Affordability (BFA) initiative," Taiclet wrote on LinkedIn after the summit.

Lockheed launched BFA Phase 1 in 2014, seeking to cut costs by \$4 billion overall across the program's life cycle. A follow-up Phase 2 in 2016 sought a more modest \$2 billion cost-reduction goal on a similar timeline. In 2018, program officials told reporters at the Farnborough Airshow that they had not decided whether to launch a third round of the affordability campaign.

Then Lockheed, engine supplier Pratt & Whitney and the Joint Program Office came to terms on a three-year pricing deal for Lots 11-14, with the cost of F-35As

ordered in fiscal 2022 reduced to less than \$78 million each. Notably, the program released that price commitment in the decade-old dollar value set in fiscal 2012, which was the baseline year for costs that the program used at that time. Adjusted for inflation, the U.S. Air Force paid \$85.8 million each for F-35As ordered in Lot 14. But that was the last year that an F-35A cost less than the year before.

Now the projected flyaway cost of a Lot 20 F-35A ordered by the Air Force in fiscal 2028 is estimated to cost 16% more than a Lot 16 jet contracted for this

year, according to the Defense Department's latest budget justification documents, released in March. The Marine Corps' estimated flyaway bill for the F-35B rises 17% over the same period, and the Navy projects an 18% jump for the F-35C.

As the price of the fiscal 2024 version of the F-35A leaps to \$109.4 million from \$94.1 million in four years, inflation is only partly to blame. Less than one-third of the \$15.3 million price difference over that period is attributed to inflation in the Pentagon's latest annual Green Book, which includes a deflator index for tracking the effect of inflation on budget data. That means most of the change by Lot 20 represents a real increase in the price of each aircraft.

A Lot 20 F-35A, however, is not the same as an \$85 million Lot 14 jet. The Air Force version comes with the new Northrop APG-85 active, electronically scanned array, replacing the original APG-81 radar. BAE is scheduled to install a more powerful version of the ASQ-239, raising the number of radio frequency receivers on the fighter by 67% to 20.

Pricing pressure could only continue to grow. The F-35 program is entering a midlife update period, which is being executed through a decade-long series of upgrades. The radar and electronic warfare improvements are arriving as part of the Block 4 program, which will also fund the integration of new weapons. Following Block 4, program officials are expected to introduce major upgrades to the engine and the power and thermal management system. More new capabilities are expected to come in a future Block 5 configuration. ☛

## Flyaway Prices

Pricing pinch prompts new F-35 affordability plans



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# FIGHT OR FLIGHT

> NGAD COULD FACE MORE BUDGET CUTS FROM U.S. AIR FORCE

> A CONTRACT AWARD HAS YET TO BE ANNOUNCED

> SECRETARY HINTS AT NIMBLER APPROACH AS THREATS LOOM



The U.S. Air Force might extend the tenure of F-22s and F-35s as its top combat aircraft while the service considers a budget change to Next-Generation Air Dominance plans.

KYLE LARSON/U.S. AIR FORCE

**Brian Everstine** Washington

**T**he U.S. Air Force is facing an internal budget fight as funding stressors and an understanding of emerging threats force it to consider decisions that would have been unthinkable previously. This includes a new approach to air dominance that could entail a cut to the service's planned future fighter.

Air Force Secretary Frank Kendall says decisions are needed soon, although he does not directly confirm if the service is considering cutbacks to the Next-Generation Air Dominance (NGAD) plan. The Air Force is about to submit a draft fiscal 2026 budget proposal to Defense Secretary Lloyd Austin for review, he says.

"We're wrestling with [fiscal 2026], right? Twenty-six is tough," Kendall tells Aviation Week. "There are a lot of things that we might not have contemplated a few years ago we're taking a hard look at. The need for air dominance, obviously, is not going to go away. But what mix of systems and how we do that is something we can take another look at."

Asked if he is considering a funding cut for NGAD, Kendall responds: "I don't want to get ahead of myself on any of this, OK? I'm just saying we're open-minded right now on the things we're looking at."

If the service reduces NGAD funding, it could be similar to the U.S. Navy's plan for its next-generation fighter, the F/A-XX. The Navy's fiscal 2025 budget request dramatically cut spending for the F/A-XX—calling for just \$453 million in 2025, almost 80% below the prior year's plan, which expected \$2.2 billion—opting instead to allocate funds to near-term, higher-priority issues like fleet readiness. The Navy is facing a budget crunch while keeping its current ships healthy amid

delays on new aircraft carriers, destroyers and submarines.

The Air Force fiscal 2025 budget request calls for \$2.75 billion in NGAD research and development, with the funding planned to climb to \$3.19 billion in fiscal 2026 toward a total of \$13.8 billion in fiscal 2025-28. This is a slight decrease from the prior year's plan.

Kendall says the budget planning is proceeding as the service also undertakes a congressionally mandated study to evaluate what the Air Force should look like in 2050. "Right now, we're very heavy on short-range capability and not as heavy on long-range capability," he says. "We have a relatively small bomber force. We're dependent upon runways and the forward-based air assets we have with our allies. And that's a problem for us."

To address that, the service has been trying to become more nimble under the Agile Combat Employment concept of dispensing small numbers of aircraft and personnel quickly to less dense locations to avoid becoming easy targets dependent on major bases.

"The degree to which we want to continue that dependency is an open question—the mix of munitions, the standoff versus shorter-range mission," Kendall says. "As we look at the joint operational concept, how we fit into that and what kind of things we want to do, both with the shorter-range tactical part of the Air Force and a longer-range, more strategic part, is something we've got to look at. So there's some pretty big issues on the table for us right now that we're working our way through."

Air Force Chief of Staff Gen. David Allvin told reporters June 14 that the service's consideration is "not dissimilar" to a 2020 plan by former acquisition boss Will Roper. He named the plan the Digital Century Series, referring to the Vietnam-era approach to building fighters quickly in response to emerging needs. Roper believed the service needed to adjust rapidly to threats and new technology instead of building one airframe to last decades.

Allvin said the Collaborative Combat Aircraft (CCA) program, which is evolving in multiple increments, is a pathfinder for other major programs.

"The idea is that we can shift to focus not on long-term, sustainable, perfect aircraft that are going to win every fight from now until 40 years from now," he said. "That's sort of a linear

worldview; we're not in a linear world." The Air Force cannot sustain an aircraft "forever" with related depot infrastructure, block upgrades and so on, Allvin asserted.

The service announced in May 2023 that it had released a classified solicitation for the engineering, manufacturing and development contract for NGAD; a contract award was expected by the end of the second quarter of fiscal 2024. While the Air Force has not identified the contenders, they are widely thought to be Boeing and Lockheed Martin. Northrop Grumman has said it will not compete as a prime.

The possibility of NGAD cutbacks likely is causing discontent among the competitors, which have spent years and invested heavily into creating designs and building facilities.

Kendall has said he expects NGAD to cost about \$300 million per aircraft—about three times the cost of a Lockheed Martin F-35A. The service has started its CCA effort to build uncrewed aircraft systems to fly alongside the NGAD platform and provide more capability in what the Air Force calls "affordable mass." Kendall says the Air Force is making it a high priority to field CCAs within the next five years.

The decision for NGAD comes as the Air Force and Pentagon face multiple cost pressures, even though the fiscal 2026 budget is expected to return to a rate of real growth following the current limit of \$849.8 billion mandated by the Fiscal Responsibility Act.

The Air Force, for example, must deal with dramatically growing costs for its massive LGM-35A Sentinel ICBM program. Costs have risen 37% over its baseline estimate, triggering a Nunn-McCurdy breach that requires the defense secretary to review the program and determine if it is critical to national security in order to continue. Air Force officials have said the service would do whatever it takes to keep it progressing, including taking funding from other programs. That review is to be completed in early July.

Kendall, who is recused from the program because of prior work with prime contractor Northrop Grumman, says his "biggest issue right now is resources" as he looks to modernize the Air Force and reshape it to counter China's growth—what he calls "reoptimizing for great power competition."

"The modernization is going to take significant funding, and we're trying to

get the cooperation of Congress—and in many areas we've had it—to divest some of our existing systems, which are increasingly obsolete or irrelevant to the China fight, to allocate those funds that would have gone to supporting those elements of the force structure into modernization," Kendall says.

If NGAD takes a budget hit, it would not be the program's first. The five-year plan outlined in the service's fiscal 2020 budget request called for \$6.1 billion for NGAD; its request from the year before called for \$13.2 billion. At the time, the Air Force justified the 50% cut by contending that the program was moving away from developing a single, monolithic fighter and toward a family-of-systems approach. That has played out with development of the CCA.

If a reduction is enacted and the planned NGAD fleet size shrinks, the program would face the same fate as the Lockheed Martin F-22 it is slated to replace. The Pentagon originally planned to field 750 of the fifth-generation stealth fighters before the buy dwindled to 179. This was primarily due to pressure from then-Defense Secretary Robert Gates, who deemed the F-22 largely unnecessary amid a focus on counterterrorism operations.

Kendall says the threat posed by China should drive increased spending to help the Air Force with the mandatory caps under the Fiscal Responsibility Act and the Biden administration's directive to stay under the required top line. "We were very fortunate in '23, '24 and '25 to get the resources we need to get moving," he says. "We're going to need more money in the out years. Twenty-five is very tight. And we had to make some hard choices there. But now we're building '26. And with the current guidance we have, '26 is a real challenge, but so are the next few years after that as we build our five-year plan."

"I don't know where budgets are going to be in the future," Kendall continues. "We obviously have an election coming up. The perception that China is a serious challenge to us is becoming more widely understood, and hopefully that'll help make an argument for more funding for the Air Force and Space Force. So overall, long-term, I'm more worried about resources than anything else." 🗣️

**Check 6** *Aviation Week* editors discuss NGAD and Everstine's interview with the USAF secretary: [AviationWeek.com/Check6](https://www.aviationweek.com/Check6)

## USAF Air Dominance Timeline

**2014** | DARPA completes the Air Dominance Initiative study, which concludes that "no single new technology or platform could deter and defeat the sophisticated and numerous adversary systems under development."

**October** | Frank Kendall, then the Pentagon's undersecretary of defense for acquisition, directs the Defense Science Board to study concepts to maintain air dominance. The study is completed in April 2016.

**2016** | DARPA launches the Aerospace Innovation Initiative to "develop and fly two X-plane prototypes that demonstrate advanced technologies for future aircraft."

The Air Force establishes a team to produce the Air Superiority 2030 Flight Plan, which reiterated the focus for a family of systems, stating no single capability "provides a silver bullet solution." The study states that the family will focus on a crewed fighter, called Penetrating Counter-Air, with an analysis of alternatives originally expected to be released by the end of 2017 but extended through 2019.

**2018 December** | A Congressional Budget Office projection of the Penetrating Counter-Air concept forecasts 414 aircraft to enter service in 2030 at a cost of about \$300 million each.

**2019 September** | Then-Air Force Chief of Staff Gen. David Goldfein says the NGAD program will focus on five key technologies. Only one, adaptive-cycle propulsion, has been publicly confirmed.

**October** | Will Roper, then Air Force assistant secretary for acquisition, outlines a new "Digital Century Series" approach aimed at using digital engineering to quickly build and field new capabilities for upcoming fighter aircraft.

**2020 July** | U.S. Air Force budget documents show GE Aviation and Pratt & Whitney have been selected to compete for the Next-Generation Adaptive Propulsion program to power NGAD.

**September** | Roper issues a surprise announcement that a full-scale NGAD flight demonstrator has flown.

**2021 May** | Then-Air Force Chief of Staff Gen. Charles Q. Brown, Jr., outlines his "4+1" fighter fleet plan, with NGAD replacing the F-22. The future fleet would be NGAD, the F-35, F-16 and F-15EX, with the short-term "plus one" of the A-10 until it is fully retired.

**2023 May** | The Air Force announces it has released a classified solicitation for the NGAD engineering and manufacturing development contract, with an award expected in 2024.

**July** | Northrop Grumman announces it will not compete for the NGAD program, leaving Boeing and Lockheed Martin as the expected finalists. 🗣️



# Congress Questions V-22 Program and Retains Flight Limitations

> THE TILTROTORS MUST FLY WITHIN 30 MIN. OF AN AIRFIELD

> LAWSUIT ALLEGES CONTRACTORS COVERED UP SAFETY ISSUES

**Brian Everstine** Washington

**A**gainst a backdrop of family members grasping framed photographs of their loved ones killed in recent crashes of the Bell Boeing V-22, U.S. Navy and Defense Department officials acknowledged that the Osprey is not yet suited for full operations as they emphasized the need for the system's speed and agility.

A mid-June hearing of the House Oversight Committee was convened following a series of high-profile Osprey crashes within the past two years that sparked a three-month grounding and a strict limitation of flight operations. The congressional hearing bore a striking similarity to another hearing held more than two decades ago across the Potomac River, when the Defense Department convened a blue-ribbon panel after the V-22 crashes that sparked an extended grounding. That March 2001 meeting included families of service members killed in the crashes who urged lawmakers to increase safety while the military expressed its need for the fleet. Following the panel's work, the Osprey eventually was cleared for full operations.

The Osprey's history has been dotted with periods of intense public scrutiny, including a 2009 meeting by the same committee in the same hearing room.

The tiltrotor fleet again finds itself in the spotlight as the Pentagon repeated its promises to improve the safety of the vital aircraft while family members and their attorneys expressed skepticism.

"You have my commitment, on behalf of the department, to continue to drive the safest outcomes . . . and try to work to reduce any mishaps in the future," Peter Belk, who is performing the duties of the assistant secretary of defense for readiness, told family members at the hearing.

The Navy cleared the fleet to fly in March but now says the Osprey will not return to unlimited operations until mid-2025. Vice Adm. Carl Chebi, commander of Naval Air Systems Command (Navair), told lawmakers that since the Osprey has returned to flight, there have been more than 7,000 flight hours without a notable mishap. Chebi said, however, that he will not certify the V-22 for the unrestricted flight operations until he is satisfied

that safety issues have been "sufficiently addressed." Navair also is conducting a comprehensive review of the overall program, expected to last another nine months. Air Force Special Operations Command says its review includes an overall focus on how the Osprey fits into the service's needs.

Four V-22 crashes in the past 2.5 years killed 20 service members. Two investigations—one regarding an MV-22 crash in Australia in August 2023 that killed three and another involving a CV-22 crash near Japan in November 2023 that killed eight—are expected to be released soon.

V-22 operations are severely limited currently. Ospreys cannot fly more than 30 min. from a divert field, but that limitation offers little consolation since the Australia crash happened just 15 min. after takeoff, as family members of those killed in the accident pointed out.

Each service is taking a different approach. U.S. Marine Corps MV-22s are deployed for exercises in Australia and Sweden. Meanwhile, a small number of U.S. Air Force CV-22s at one base is cleared to fly—and doing so sparingly. The Navy faces a unique shortfall in its operations and is still flying Grumman C-2As, which should be retired, to meet the carrier onboard delivery role. C-2As cannot transport spare Pratt & Whitney F135 engines for the carrier fleet, so Chebi says the service needs to plan to keep extra spares onboard carriers for now.

The exact causes of the Australian

**The U.S. Marine Corps has deployed V-22s to Australia for an exercise, despite limitations on their range due to safety concerns.**



CPL. ELTON TAYLOR/U.S. MARINE CORPS



and Japanese incidents are not yet publicly known, although the Japanese incident has been linked to a material failure. A June 2022 crash, which killed five Marines, was linked to a dual hard-clutch engagement (HCE) that in turn caused a failure of the Osprey's inter-connected drive system (ICDS). HCEs have been a known problem for the fleet since 2010, and the Pentagon is starting a new attempt at a redesign.

Gary Kurtz, Navair's program executive for air, antisubmarine warfare and special-mission programs, says the command is progressing on the new design; testing is expected in the next couple of months, and fielding is planned in mid-2025. The Navy's fiscal 2025 budget request calls for replacements in fiscal 2026 and plans to purge the aircraft of problematic thin-dense chrome. This chrome plating process has caused metal to chip into the Osprey's oil system and has been linked to serious problems. The budget calls for 45 kits to be procured in 2026; the full program will cost \$138 million for 328 kits.

Despite the planned changes, lawmakers and family members expressed doubt about the fleet's safety and operational viability. Rep. Stephen Lynch (D-Mass.) called on the Pentagon to keep the fleet grounded until the clutch replacement is cleared and installed, adding that if another V-22 crashes in the meantime, "your whole program is done."

Kurtz said no HCE problems have occurred since the command implemented a rule to change input quill assemblies (IQA) every 800 hr.

Multiple family members raised concerns about that approach. The Marine Corps said that since implementing the 800-hr. rule in early 2023, the possibility of an HCE error had been reduced by 99%. Navair, however, seemed to walk back from the 99% promise at the hearing, neither mentioning it nor publicly supporting it when pressed by families.

The HCE problem is a key focus of a new lawsuit filed in May on behalf of families of five Marines who died in the June 2022 crash. The lawsuit outlines allegations of known but undisclosed flaws and defects in the Osprey's drive system. Bell, Boeing and Rolls-Royce have declined to comment on the suit.

"Bell Boeing has been aware of hard-clutch engagement problems in the V-22 Ospreys since 2010," attorney Tim Loranger states in a press release.

"But here we are more than a dozen years later, and that knowledge hasn't resulted in a solution, and the malfunction has continued to cost lives."

Although the root cause of HCEs has not been determined, the Navy in March said it was honing in on a potential contributing factor: out-of-phase engagements in the gearbox's sprag clutches.

The lawsuit specifically highlights the Osprey's ICDS, which is designed to transfer power automatically from one engine to both propellers if the other engine fails. The press release states that although the ICDS is not unique to V-22s, the Osprey's is "flawed, unsafe and does not meet the government's specifications for safety and/or reliability."

"The Osprey's ICDS also lacks redundancy, contributes to catastrophic systems failure and grossly fails to meet specifications, because it allows an HCE on one side to initiate an HCE on the other side, which results in the assured loss of the aircraft and occupants with no corrective action available to the brave military pilots and crew, who are along for the ride to their deaths," the lawsuit says.

This legal action harkens back to the 2001 commission and the 2000 Arizona crash, when family members filed a wrongful death suit against Bell Boeing. That lawsuit eventually resulted in some of the family members settling before the case was dismissed. When asked about the differences between the current case and the past precedent, Loranger highlighted the specifics of the allegations and added "we will see" what will happen.

The families of the June 2022 Osprey crash, with the call sign Swift II, submitted a series of questions to which they want answers following the hearing; many families said they were not satisfied with the Pentagon's answers in testimony. They pressed for more explanations on the timing of the IQA replacements, plans to improve safety and the reasoning behind the Pentagon's claim of a 99% reduction in HCE incidents.

"We seek accountability, answers and change," the families said in their testimony. "Our goal isn't to see this platform removed; it's to know that someday we will be able to say: 'Their lives enabled others to live; knowing what happened to them won't ever be repeated.'" 🗣️

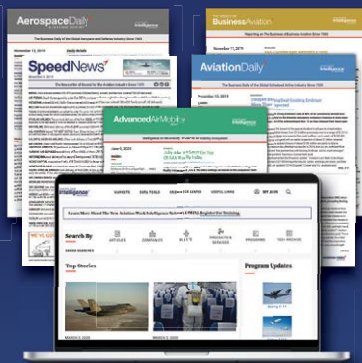
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## Embraer Looks to the U.S. and Other Markets for KC-390 Growth

- THE OEM IS ABOUT TO SIGN DEALS FOR THE MILITARY TRANSPORT AIRCRAFT WITH AUSTRIA AND THE NETHERLANDS
- SAUDI ARABIA AND INDIA SEEN AS BIGGEST EXPORT OPPORTUNITIES

**Jens Flottau** Sao Jose dos Campos, Brazil

**E**mbraer has had some success recently in securing export orders for its C-390 Millennium military transport aircraft and is about to sign a combined contract with Austria and the Netherlands for up to 15 more, including six options. But the goal remains to place the aircraft in much bigger export markets, and the U.S. is a key target.

"We are very aggressive in the U.S.," Embraer Defense CEO Bosco da Costa Junior says. "We would like to become a partner of the U.S. government." Embraer is building up its defense team in the U.S. to expand its presence and sees an opportunity for the C-390 in the Air Force, Navy and other services.

"The C-390 can help them a lot to improve the efficiency and productivity of the fleet," Embraer CEO Fran-

cisco Gomes Neto says. For the KC-390 tanker version of the aircraft, Embraer is willing to develop a boom, too, for the U.S. market.

Embraer has discontinued preliminary work with L3 Harris on a boom and is "exploring other opportunities" to introduce the aircraft and develop the boom, Gomes Neto says.

The KC-390 so far offers only a hose-and-drogue system for refueling, as required by its main customer, the Brazilian Air Force, and its current export customers. "If [the U.S.] has a requirement for a dedicated version, we are ready to develop with them that solution," da Costa says. "We are completely open."

Embraer so far has delivered seven C-390s, six to Brazil and one to Portugal. The Brazilian Air Force has accumulated 10,000 flight hours with

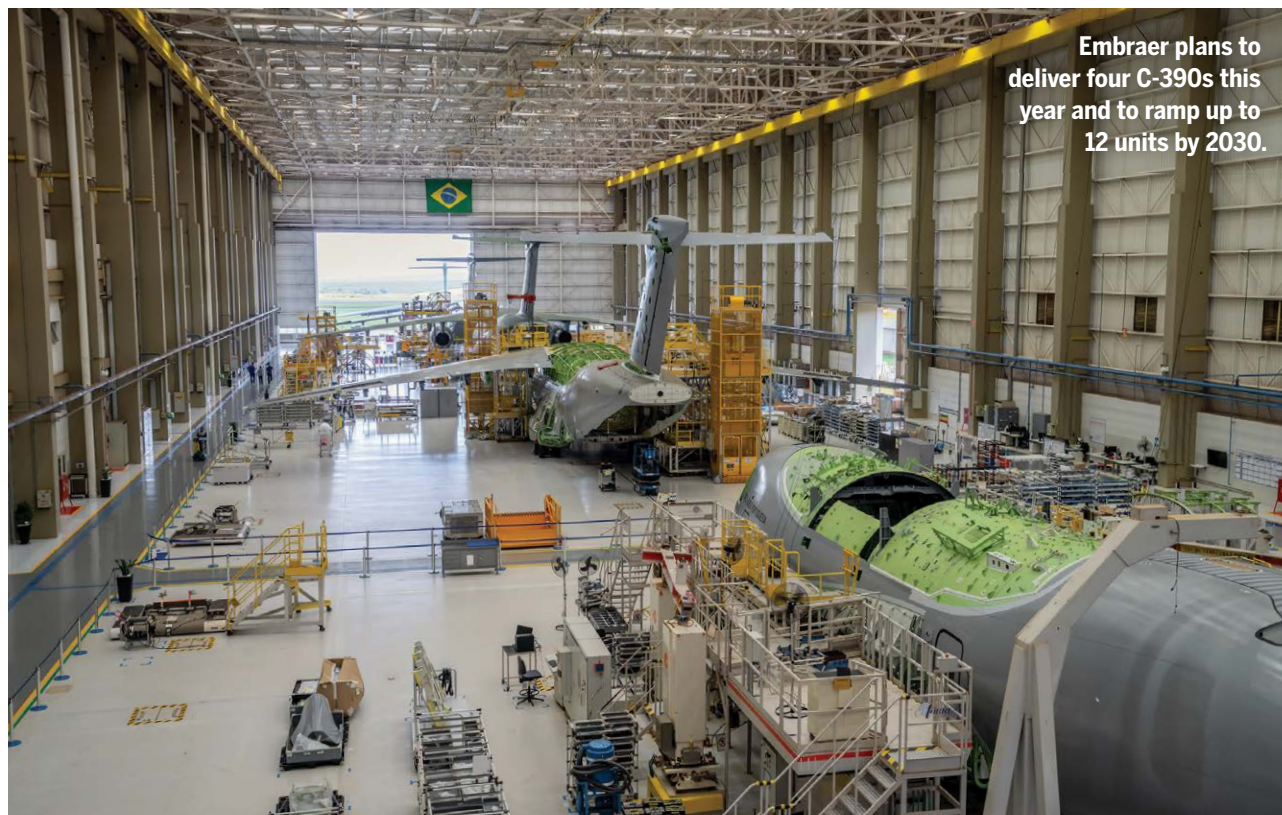
the aircraft; Portugal is at 650 hr. after six months. The manufacturer plans to hand over three more aircraft before year-end to Brazil, Hungary and Portugal.

The final assembly line at Embraer's site in Gavião Peixoto, Brazil, is capable of building 18 aircraft per year, far more than the four planned for 2024. Embraer aims to grow output to six units in 2025, seven in 2027 and 12 in 2030, still considerably short of the facility's capacity.

The company estimates there will be a market for around 490 units over the next 20 years just for replacements, as 260 aircraft used for similar missions are 45 years or older, da Costa notes. "We are ready to capture a good portion of that," he says. "We are 100% U.S.- and NATO-oriented," he stresses. Embraer is not seeking any Chinese defense business.

The NATO version of the C-390 was introduced in October. Embraer says it is "engaged" with several countries in Europe about the C-390, including some that do not have military transport aircraft now.

In Africa, Embraer sees opportunities in Algeria, Egypt, Morocco and South Africa. Several countries in the region are "in the final stages" of talks



Embraer plans to deliver four C-390s this year and to ramp up to 12 units by 2030.

EMBRAER



for the A-29 Super Tucano, particularly in the light attack aircraft role.

In the C-390 program, Brazil is the biggest customer so far, with 19 aircraft, cut back from an original agreement for 28. Da Costa says there are no discussions about the country reducing the commitment further. Portugal and the Netherlands will each take five, Austria has signed up for four, and Hungary and the Czech Republic have committed to two aircraft each. The size of South Korea's order is undisclosed. Da Costa says that "several [additional] campaigns are ongoing."

Most important among them are India and Saudi Arabia. India's Medium Transport Aircraft program is looking to procure up to 80 units to replace aging Antonov An-32s. Da Costa expects a decision in 2-4 years. Embraer has selected Mahindra as a local partner and is prepared to open a final assembly line for the C-390 in India if it wins the contract.

Saudi Arabia is looking to replace a fleet of 50 Lockheed Martin C-130 Hercules; da Costa believes the competition could be decided in a similar time frame. Unlike the efforts in India, which are primarily focused on the defense market, the Saudi engagement goes beyond the C-390. It also could include commercial and executive jets as well as advanced air mobility vehicles, a segment for which Embraer is developing the Eve electric vertical-takeoff-and-landing aircraft.

As for the C-390, "we have made a lot of market studies in Saudi Arabia with them as well, and we believe that [an order for] 20 C-390s is very reasonable," Gomes Neto says.

Two years ago, Embraer signed an agreement with Saab to support sales of the two companies' products in their respective home regions. The cooperation "is moving well," Gomes Neto says. Embraer is supposed to help sell Saab Gripen in countries such as Brazil or Colombia, while Saab is to assist with potential C-390 deals in Sweden and elsewhere in Europe. So far, none of them have come through.

Maritime patrol versions of existing aircraft are another avenue Embraer is exploring. Talks with the Brazilian Air Force are underway, and export sales could be built on that. The C-390 and the Embraer 190/195 commercial jets could serve as platforms, although da Costa points out that executive jets also could work in that role. ☛

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# Blue Origin Wins Spot on USSF Launch Vendor List

- > NO MIDSIZE LAUNCHERS MAKE LANE 1 FIRST CUT
- > LANE 2 AWARDS EXPECTED THIS FALL

**Vivienne Machi** Los Angeles and **Irene Klotz** Cape Canaveral

It took four years and a lawsuit for SpaceX to break United Launch Alliance’s monopoly on delivering the U.S. military’s most important and expensive spacecraft into orbit. A decade later, the vendor pool is expanding again, with a third contender invited to bid on national security space launches—and a half-dozen more companies waiting in the wings. Blue Origin joined incumbents United Launch Alliance (ULA) and SpaceX in winning the opening round of the U.S. Space Force’s National Security Space Launch (NSSL) Phase 3 program. The company, solely owned by Jeff Bezos, will become eligible to compete for a pool of missions worth a combined \$5.6 billion once it achieves a successful flight of its first orbital launch vehicle, New Glenn.

The Space Force selected the companies for a multiple-award, firm, fixed-price, indefinite-delivery/indefinite-quantity (IDIQ) contract, covering a minimum of 30 launches between 2024 and 2029, with an option to extend the agreement to 2034. In Phase 3, the service introduced a dual-lane acquisition strategy, dividing prospective missions and vendors into two pools. Lane 1 missions, which are open to launch providers with just one proven flight, can accept a higher risk of failure and include lighter-weight payloads going to less challenging orbits. Lane 2 is a direct follow-on to the ongoing Phase 2 program, serviced by ULA and SpaceX, with launch vehicle certification requirements and the ability to fulfill the full range of NSSL mission profiles. After reviewing seven proposals, the Space Force on June 13 announced it had chosen ULA, SpaceX and Blue

Origin as the initial vendor pool for Lane 1 missions. The same three companies—and only those three—also plan to offer launch services for the larger and more technically demanding Lane 2 missions. Launch providers were invited to submit bids for both lanes. “As we anticipated, the pool of awardees [in Lane 1] is small this year because many companies are still maturing their launch capabilities,” Space Force Brig. Gen. Kristin Panzenhagen, program executive officer for Assured Access



Following a tanking test in February, Blue Origin is preparing for the debut launch of the partly reusable New Glenn rocket this year.

BLUE ORIGIN

to Space, stated in a June 13 press release. “Our strategy accounted for this by allowing on-ramp opportunities every year, and we expect increasing competition and diversity as new providers and systems complete development.” The Space Force plans to reopen the Lane 1 solicitation annually to attract new launch service providers to the program; the next opportunity is coming in the fall of 2025. The government may order Lane 1 missions individually or in blocks, with task orders for launch services to be competed annually among all IDIQ awardees. Blue Origin’s invitation to bid on Lane 1 missions comes with a large prerequisite: a successful launch of the company’s first orbital-class rocket, New Glenn. “We’re readying the vehicle as we speak and preparing to fly later this year,” Blue Origin wrote in an email to Aviation Week.

The partly reusable rocket is due to be hot-fired this summer at Blue Origin’s Cape Canaveral SFS launchpad. Also this summer, the barge that will serve as the landing pad for the New Glenn reusable first stage is expected to arrive, the company added. Building on experience operating its reusable New Shepard suborbital launch system—flown 25 times since it debuted April 2015—Blue Origin plans to land the New Glenn rockets beginning with its first flight. The company also supplies engines for ULA’s heavy-lift Vulcan rocket, which had a successful debut on Jan. 8. A successful New Glenn launch would not only position Blue Origin to bid for Lane 1 missions, but also would count toward certification requirements for the larger, more lucrative Lane 2 program. In addition to Blue Origin, SpaceX and ULA,

## NSSL Program Evolution

		Vendors	Fiscal Year	Number of Launches
Phase 1/1A (EELV)		United Launch Alliance SpaceX	2014-24	46
Phase 2		United Launch Alliance SpaceX	2022-27	48
Phase 3	Lane 1	United Launch Alliance SpaceX Blue Origin	2025-29	~30
	Lane 2	Contract awards expected in the fall of 2024		~49

Source: U.S. Defense Department

the Space Force received Lane 1 proposals from Rocket Lab, Stoke Space and two other companies. Rocket Lab bid its in-development Neutron medium-lift reusable launcher, while Stoke Space offered Nova rocket flights. However, to qualify for this year's competition, launch vehicles either had to have flown or needed a "credible plan" to achieve first launch by Dec. 15, the Space Force said.

That put Rocket Lab outside of the qualification window, as the first Neutron launch is scheduled for mid-2025, said Morgan Connaughton, the company's vice president of communications. "Next year, there will be another opportunity to on-ramp," she told Aviation Week. A spokesperson for Stoke Space also confirmed plans to recompile Nova in the next Lane 1 cycle.

While only three bidders met the Lane 1 requirements this year, the pool of eligible contenders could expand significantly in 2025. In addition to Rocket Lab and Stoke Space, ABL Space Systems, Astra, Firefly Aerospace, Northrop Grumman and Relativity Space told Aviation Week they plan to submit bids to on-ramp their vehicles as soon as they are ready.

"The U.S. Space Force is absolutely interested in increasing resiliency through diversity of launch providers and systems," the service wrote in an email to Aviation Week. "That is one of the main objectives of our NSSL Phase 3 Lane 1 strategy because having a robust and diverse domestic launch base increases competition, innovation and resiliency. We have a growing commercial launch market, and Lane 1 is designed to tap into that market and onboard new launch providers or systems every year as they are ready."

Meanwhile, the next batch of Phase 3 contracts is expected this fall, when the Space Force is to select up to three vendors to handle launch services for about 49 Lane 2 missions throughout the five-year program. The companies selected for Lane 2 must meet full mission assurance with Space Systems Command-certified, high-performance launch vehicles and the ability to reach more stressing orbits.

With 79 launches expected in Phase 3, the Defense Department is making good on decisions taken over a decade ago to open to competition what was then known as the Evolved Expendable Launch Vehicle (EELV) program.

In 2013, the U.S. Air Force reintroduced competition into the EELV program for the first time since 1998, with a new acquisition strategy to award launches to qualified bidders beginning in fiscal 2015. That decision ended ULA's run as the sole provider of U.S. national security launch services from 2006 to 2015.

After declaring SpaceX's Falcon 9 launch vehicle capable of meeting national security space launch requirements, the Space Force in 2016 awarded the company its first firm, fixed-price, competitive contract for launch services. SpaceX had sued the Air Force in April 2014 to stop the awarding of an \$11 billion sole-source EELV contract to ULA. The suit was settled, with the service agreeing to put more missions up for competitive bidding.

The EELV program was officially renamed the National Security Space Launch program in the fiscal 2019 National Defense Authorization Act, reflecting the introduction of SpaceX's partly reusable Falcon 9 and Falcon Heavy

launch vehicles. That same year, the Space Force awarded Phase 2 contracts to ULA and SpaceX to support NSSL missions scheduled for launch in fiscal 2022-27, with ULA allotted 60% and the rest earmarked for SpaceX.

Beginning in 2020, geopolitical issues and an increasingly price-conscious competitive environment spurred the Pentagon to reconsider its NSSL acquisition strategy for continued, assured access to space.

As U.S.-Russian relations soured following Moscow's 2014 annexation of Crimea, Congress passed legislation banning future use of Russian-built engines on military space launch missions. The sanctions were the beginning of the end for ULA's workhorse Atlas V rockets, which are powered by imported Russian RD-180 engines.

Meanwhile, ULA's Delta IV rockets, which did not use Russian engines, quickly became economically unviable once SpaceX's cut-rate Falcon Heavy entered the market. ULA flew its last Delta IV Heavy in April and expects to retire the Atlas booster after 16 more missions. Vulcan boosters are replacing both rocket lines.

Phase 3's novel dual-lane approach is the latest in a series of experimental launch service acquisition strategies by the Space Force, alongside the Orbital Services Program meant to task small launch vehicle providers to carry experimental and prototype missions to low Earth orbit. In 2020, the nascent Space Force began to explore alternative acquisition mechanisms, such as awarding four Space Enterprise Consortium prototype project agreements to incentivize industry innovation and development of launch systems capabilities.



**Rocket Lab aims to on-ramp its Neutron medium-lift launch vehicle to the U.S. national security space launch program next year.**

The Phase 3 Lane 1 award includes task orders for each successful bidder to conduct an initial capabilities assessment and to explain how they will approach the program's tiered mission assurance structure. As a new provider, Blue Origin will receive \$5 million, while incumbent SpaceX and ULA receive \$1.5 million each, since the Space Force already understands the latter companies' launch systems and approaches to mission assurance.

In conjunction with the Lane 1 IDIQ awards, the Space Force in July expects to solicit proposals for two task orders: a block of seven launches for the Space Force's Space Development Agency and one for the National Reconnaissance Office. Blue Origin may be fighting the clock to compete for those, since a successful first flight is required prior to submitting its bid. 🚀

# U.S. Space Force Ponders MEO for Future Satellite Communications

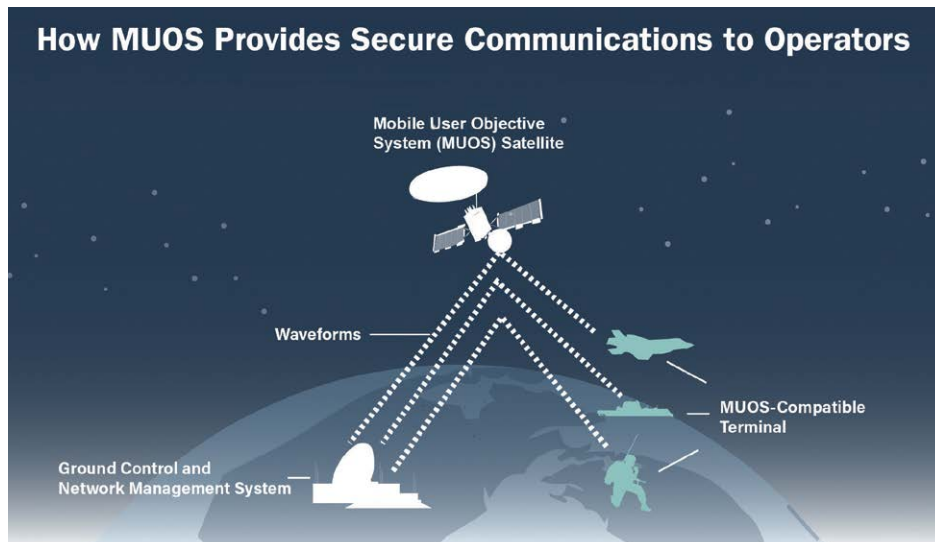
➤ DEBATE FEEDS INTO THE FORCE'S BROADER PLANS FOR A HYBRID SATCOM ARCHITECTURE

➤ BOEING AND LOCKHEED MARTIN VIE FOR FINAL TWO SATELLITES IN MUOS CONSTELLATION

**Vivienne Machi** Los Angeles

**T**he Pentagon is studying options to provide U.S. military operators and allies with smartphone-like communications from disparate resilient satellite constellations.

The U.S. Space Force has expressed interest in moving narrowband, beyond-line-of-sight and point-to-point communications services to medium Earth orbit (MEO) as it looks to transition away from the current Mobile User Objective System (MUOS) constellation within the next decade.



Source: GAO

As the earliest MUOS space vehicles approach the end of their service lives in geostationary orbit (GEO), the service is looking to build a system that delivers increased resilience, reduced life-cycle cost and shorter time frames for fielding new capabilities, according to a request for information (RFI) issued on May 29. The Space Force is particularly interested in a system that is compatible with existing user terminals but is moved from GEO into MEO.

The discussion is part of a wider reexamination within the Defense Department to build a more robust satellite communications capability in the face of growing great power competition.

"We are fundamentally transforming our military satellite communications and data transport architecture through a disaggregation, proliferation, capacity expansion, partnership with allies and with commercial, which will enhance our ability to fight in contested and degraded operational environments," Frank Calvelli, assistant secretary of the Air Force for space acquisition and integration, told lawmakers.

The U.S. military historically has used MEO for position, navigation and timing assets, such as the GPS constellation. But MEO generally has become an increasingly attractive orbit for operators that are looking for lower latency rates than GEO systems as well as a wider field of view and fewer satellites than needed for low-Earth-orbit constellations.

The U.S. Navy initiated the MUOS program in 2004 to replace the Ultra High Frequency Follow-On (UFO) system. Built by Lockheed Martin and launched between 2012 and 2019, it includes four orbiting satellites and one spare. Each satellite carries dual payloads: a legacy UHF payload and one carrying the commercial 3G cellular technology waveform known as Wideband Code Division Multiple Access (WCDMA), which vastly increases the capability and capacity of narrowband satcom.

The system had promised to supply a tenfold increase in communications for its users, but delays in deploying ground radio programs hampered the rollout of some of its advanced features. The Government Accountability Office in a 2021 report said that four years after the MUOS constellation became operational, the services had fielded only about 18% of their planned MUOS-compatible terminals.

The lack of compatible terminals means that users continue to rely on the vastly over-subscribed UFO constellation, even as MUOS satellites near the end of their lives.

The Space Force—which took over the narrowband satcom mission from the Navy—wants the capability to come online as soon as 2031 and would like it to provide continued support to existing WCDMA-capable user terminals, even from a MEO-based constellation. The Space Force also wants to make sure transitional services support a pathway to "resilient and modern (5G-like) services of the future," the RFI states.

The bridge to the future narrowband satcom architecture hinges on the Pentagon's creation of a MUOS Service Life Extension program, which would add two satellites to the constellation to keep it operational into the 2030s.

In January, the Space Force awarded Boeing and Lockheed Martin each a \$66 million technology-maturation and risk-reduction contract to design a prototype for those two satellites. The first phase of the contract, valued at \$46 million, will run through Feb. 1, 2025. A \$20 million option would run through Aug. 1, 2025, should the service choose to exercise it. The Space Force expects to select one of the suppliers to build the two final MUOS satellites in fiscal 2026.

Lockheed Martin and Boeing are drawing on decades of narrowband satcom experience in their submissions. Lockheed, as the MUOS prime contractor, plans to design the prototype to minimize risk, following the service's directive, says Justin Keller, director of advanced communications at Lockheed Martin Space.

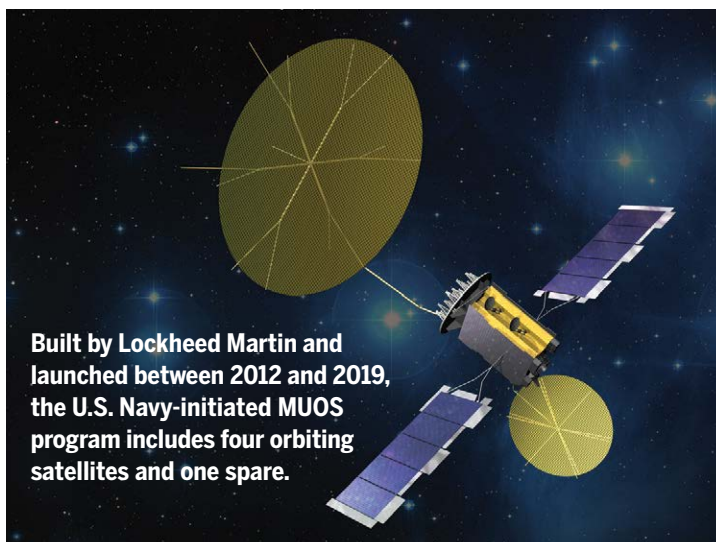
"The idea is they will fit seamlessly into the existing MUOS constellation with no impact to the users," he says.



"If there are changes, that would be design-specific between us and Boeing about what's the state of the art of the technology."

Boeing's experience building the legacy UHF payload that is part of the MUOS system informs its new prototype design, notes Ryan Reid, the company's executive director of space communications programs. The team completed the system requirements review in May, and early design review is slated for November.

Both bidders have experience building radiation-hardened satellites under the GPS program. Lockheed Martin manufactures the Block III satellites and is on contract to deliver their follow-on systems. Boeing builds the O3b mPower satellites for commercial satellite services provider SES. The Luxembourg-based company launched six of 13 planned satellites on orbit in MEO, and two more are set to launch this year. 📡



**Built by Lockheed Martin and launched between 2012 and 2019, the U.S. Navy-initiated MUOS program includes four orbiting satellites and one spare.**

LOCKHEED MARTIN

## NOAA Seeks Commercial Data To Fill Pentagon Space Debris Tracking Gaps

- SPACE IS TOO CONGESTED FOR DOD'S DEBRIS TRACKERS
- COMMERCIAL COLLISION AVOIDANCE SOFTWARE WILL HELP NOAA BETTER PROTECT ITS SATELLITES

**Vivienne Machi** Los Angeles

**T**he Pentagon's space monitoring capabilities do not have the bandwidth to keep the National Oceanic and Atmospheric Administration's satellites out of harm's way on their own, so the agency has turned to commercial providers to pick up the slack.

The National Oceanic and Atmo-

spheric Administration's (NOAA) Office of Satellite and Product Operations (OSPO) is seeking commercially derived space debris avoidance software to augment the free services that it receives from the U.S. military to help protect its satellites in geostationary orbit (GEO).

OSPO has historically used collision avoidance services provided by the Joint Space Operations Center (JSpOC) to monitor the health and safety of its satellites on orbit, including its four Geostationary Operational Environment Satellites (GOES). While the military center's space object cataloging is comprehensive, it has at times misidentified satellites and cannot provide all of the real-time or future-leaning data that satellite operators require, NOAA stated in a June 5 request for information (RFI).

"Augmented object catalogs that extend beyond what JSpOC provides are crucial to ensure satellite flight safety is maximized," the RFI states. Over several years of using commercial



**NOAA is looking to commercial space traffic management software to provide better protection for its GEO-based satellites, such as the GOES system depicted.**

LOCKHEED MARTIN CONCEPT

services alongside JSpOC's capability to support its GOES fleet, OSPO "experienced several situations requiring close attention or active intervention that would NOT have been identified by the JSpOC service alone," it adds.

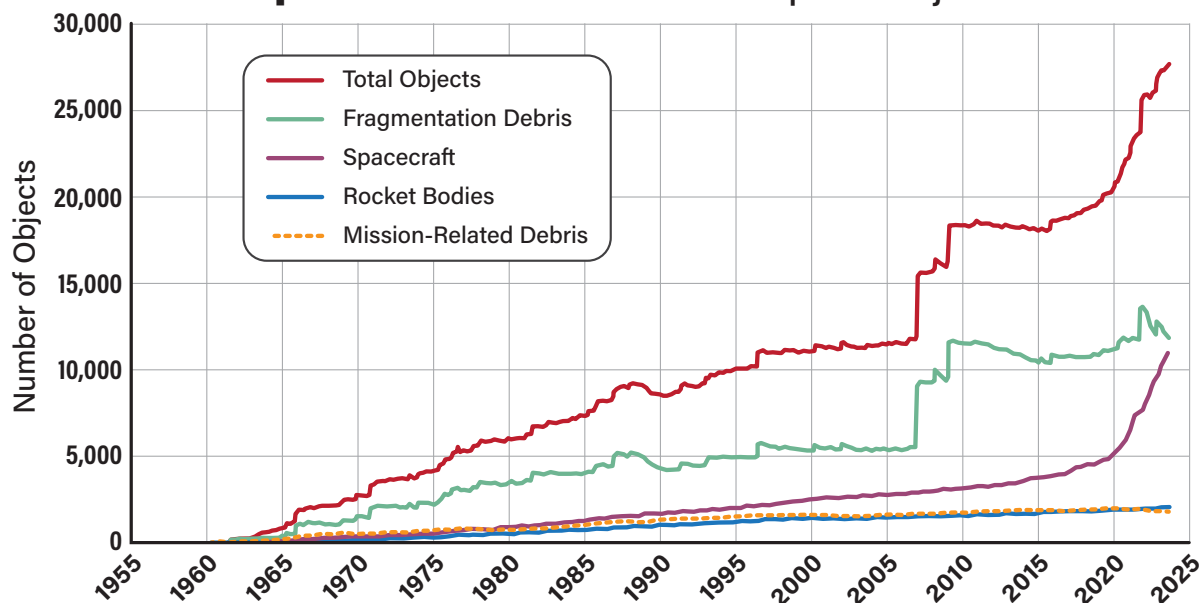
The JSpOC, which transitioned into the Combined Space Operations Center (CSpOC) in 2018, is headquartered at Vandenberg AFB, California. The center tasks a vast network of on-orbit sensors to collect space situational awareness (SSA) data, enabling lead-

2009, the Defense Department (DOD) became responsible for providing SSA services to satellite operators around the globe, including commercial and civil providers.

Since then, the amount of space objects has increased dramatically: NASA estimates the number to be nearing 30,000. The domain has grown vastly more contested, prompting the DOD to refocus its efforts on protecting and defending its on-orbit assets. The U.S. Space Force has called for

forts to explore testing and integrating commercial capabilities for government SSA needs in low Earth orbit (LEO). The Consolidated Pathfinder project, launched this past January and extended in May, has tasked five companies—Comspoc, Kayhan Space, Leo-Labs, Slingshot Aerospace and SpaceNav—to build and maintain a space object catalog that spans a majority of the LEO regime. The OSC in January also entered into a Cooperative Research and Development Agreement

## Exponential Growth Tracked Space Objects



Source: NASA

ers at U.S. Strategic Command and out in the field to integrate space power into global military operations.

Since 2010, the center has also provided collision avoidance notices to civil and commercial satellite operators as a free service. But as the number of objects in space has grown, the command has struggled to meet the real-time needs of operators like NOAA.

Every time an engineering and operations team needs to assemble to coordinate last-minute collision avoidance maneuvers on orbit due to incomplete prediction software, it costs the government money, NOAA warned in the RFI. U.S. Strategic Command and NOAA did not reply to requests for more detail.

NoAA's turn to commercial tracking has been 15 years in the making. After the Iridium-Cosmos collision in

increasing space domain awareness investments to support the military's overwhelmed monitoring systems.

The Trump administration in 2018 issued Space Policy Directive-3 in response to this new reality, directing NOAA's Office of Space Commerce (OSC) to take over the mission of providing basic SSA data and space traffic control for commercial and civil space operators. U.S. military offices like JSpOC could then focus on the national security missions they were established to support.

Civil satellite operators can still access the DOD's baseline data services, but they are now also leveraging new commercial data analysis and software capabilities for real-time satellite tracking.

Since taking over the space safety mission, OSC has funded several ef-

with SpaceX to assess the company's software for automating collision avoidance in satellite constellations.

The findings from these initiatives are expected to inform the OSC's development of the Traffic Coordination System for Space architecture. The forthcoming cloud-based system aims to provide basic SSA and space traffic coordination services to commercial and civil space operations in order to improve spaceflight safety, space sustainability and international cooperation.

Space Force Gen. Stephen Whiting, commander of U.S. Space Command, stated during a June webinar that military users will look to leverage the OSC's future investments in basic SSA to enhance its own operations. "We really do believe this is a synergistic opportunity," he said. 🌌



## Europe Gears Up for Ariane 6 Operations

> "WE ARE READY FOR LAUNCH," ESA SAYS

> TEN ARIANE 6 LAUNCHES EXPECTED IN 2027

**Robert Wall** London

**N**ine years after securing the go-ahead to develop a less expensive heavy-lift launcher to replace the Ariane 5, Europe is upbeat that the new Ariane 6 is emerging at a time when strong demand could boost its planned flight rate.

Days ahead of the Ariane 6's planned inaugural launch from Europe's spaceport in Kourou, French Guiana, rocket manufacturer ArianeGroup suggested that planned production rates could easily increase. "If we look at market demand, if we were able to produce much more, we would find customers," said Franck Huiban, head of civil programs at the Airbus-Safran joint venture. "It's a strong incentive to continue the ramp-up."

The first launch, planned for July 9, also effectively kicks off the ramp-up phase for the program, Huiban said at a European Space Agency (ESA) briefing June 25.

Arianespace, which sells the launcher and expects to take over operations with the second mission, plans to hold one more Ariane 6 launch before year-end, followed by six in 2025, said Caroline Arnoux, the launch service provider's head of the Ariane 6 program. The flight manifest is slated to increase to eight missions in 2026 and 10 in 2027. Huiban called that launch cadence "a first step."

Boosting production and flight rates is critical to bringing down launch costs in an increasingly competitive market dominated by the U.S., where SpaceX, United Launch Alliance and newcomer Blue Origin are based. In addition to restoring Europe's independent launch capacity, the Ariane 6 is intended to improve the launcher's financials over the predecessor Ariane 5 program, which required persistent government subsidies.

Customers have signed up for 30 Ariane 6 launches so far. About two-thirds of those missions are for commercial customers, including 18 for Amazon's upcoming Kuiper satellite internet service system. Arianespace declined to disclose launch dates for that customer, citing contractual sensitivity.

Program partners also would not discuss Ariane 6 launch costs, although Arnoux said the market uptake indicates customers are willing to pay its rate. Huiban added that compared with the Ariane 5, the Ariane 6's higher production rate and faster build process helped cut pricing for the new vehicle. The program goal is for the Ariane 6 to cost 40% less than its predecessor.

ESA has been pushing to reduce the Ariane 6 cost by 11%. Governments last year agreed to put €340 million (\$365 million) in extra funding into the project in return for the cost-cutting pledge. The agency is making "steady progress" in talks with industry to bring down the cost of the Ariane 6 rocket, said Toni Tolker-Nielsen, ESA director of space transportation.

A key milestone toward the inaugural mission took place June 20 at the launch site, where the rocket was fueled with 180 metric tons of liquid oxygen and liquid hydrogen—a process that took 3.5 hr.—and then drained.

ESA on June 25 was still analyzing data from the wet dress rehearsal but was confident enough to stick with the targeted July 9 launch date, which is about four years later than planned because of development setbacks. "We are ready for launch," Lucia Linares, the agency's head of strategy and institutional launches, said at the briefing.

The agency, which is involved in the launcher's development process, is the operator responsible for the first Ariane 6 flight. It is targeting liftoff between 2:00 and 5:00 p.m. EDT, or 3-6 p.m. at the launch site.



L. BOURGEOIS/ESA

**The Ariane 6 underwent a wet dress rehearsal on June 20 at the European spaceport in Kourou, French Guiana.**

The Ariane 6 will carry several experiments, two reentry capsules and nine cubesats or microsattellites. The satellites are expected to be deployed at an altitude of around 360 mi. The mission was designed, in part to ensure maximum connectivity with ground stations, said Michel Bonnet, ESA's inaugural flight principal.

The rocket's upper stage will undertake further tests to validate key subsystems and then deploy two reentry capsules, which are slated to fall into the Pacific Ocean. They will not be recovered. ArianeGroup provides the SpaceCase SC-X01 capsule to test heat-protection technology, while The Exploration Co. produced the 60-cm.-dia. (24-in.) Nyx Bikini to gather data on atmospheric reentry.

The new Vinci liquid hydrogen and liquid oxygen engine powering the Ariane 6 upper stage is scheduled to fire three times. The final burn is designed to deorbit the vehicle so it can burn up in the atmosphere.

For both missions planned this year, the Ariane 6 will fly with a pair of P120C solid boosters, enabling the rocket to carry nearly 10,000 lb. into geosynchronous transfer orbit and nearly 23,000 lb. into low Earth orbit. A four-booster variant for heavier payloads and higher orbits is likely to fly in mid-2025.

Arianespace closed out 27 years of Ariane 5 operations with a 117th and final flight on July 5, 2023. At one time, Arianespace dominated the global launch service industry, but the company lost its toehold around 2001 as competitors in the U.S., Russia and China matured. The biggest challenge, however, came from privately owned SpaceX, which overtook Arianespace as the world's commercial launch leader in 2017. 🌐



## Far-Side Moon Samples Set China's Future in Stone

- > SAMPLES WERE RETURNED FROM UNEXPLORED AITKEN BASIN
- > NEXT MISSION IS TO SURVEY LUNAR POLAR RESOURCES

China became the first country to return samples from the far side of the Moon on June 25. The Chang'e 6 sample canister landed in Inner Mongolia.



STRINGER/AFP/GETTY IMAGES

**Leonard David** Boulder, Colorado

**T**here is little doubt that the lunar rock and regolith samples returned by China's recently completed Chang'e 6 mission will yield invaluable information about the Moon's origin and its enigmatic, volcanic and cratered evolution.

Beyond the science bounty, the mission, which returned the first specimens gathered from the Moon's far side, not only broke new ground in China's space exploration capacity, it also is sparking a chain reaction in scientific and policymaking circles in the U.S.

Coming to a landing after a 53-day sojourn to the Moon and back, the Chang'e 6 return capsule—stuffed with its cache of lunar samples—parachuted into a preselected site within Siziwang Banner in north China's Inner Mongolia Autonomous Region on June 25.

The scientific “catch of the day” was a collection of samples from the unexplored southern mare plain of the Moon's Apollo basin interior, in the northeast interior of the far side's South Pole-Aitken Basin.

The Chang'e 6 lunar sample return mirrors the Chang'e 5 mission in December 2020 that brought to Earth

more than 60 oz. of snippets from the Moon's near side. Lunar researchers in China are eagerly awaiting the opportunity to put under the microscope another collection of extraterrestrial scoops and drilled samples.

Chang'e 6 is by far the most complex mission in China's lunar exploration program, and it is considered a steppingstone toward the country's major goal of placing a lunar research station on the Moon's south polar region. Breakthroughs along that path include the Chang'e 6's Long March 5 booster hitting a narrow launch window on May 3 as it departed from China's Wenchang Space Launch Site with its 8.3-ton payload.

Another advancement is in communications. The challenges of a far-side Moon landing were met by the nearly 1.2-metric-ton Queqiao-2 lunar communications relay satellite. It was launched March 19 on a Long March 8 rocket and later nudged into a select elliptical orbit around the Moon to enable signal linkage between controllers on Earth and the probe.

Chang'e 6 also showcased China's ability to perform autonomous and intelligent collection of lunar samples on task. The fast-paced, far-side gathering of Moon bits and pieces was com-

pleted within two days using two sampling techniques: a drill device that collected subsurface specimens and an outstretched robotic arm that snared topside lunar turf. China's earlier lunar mission, Chang'e 5, performed its sampling duties via a far-slower remote control-and-command approach.

After Chang'e 6 finished collecting lunar specimens, they were sealed in a container on the upper part of the spacecraft's ascender segment, which then lifted off from the lander. Once in lunar orbit, the ascender rendezvoused and docked with the orbiter-returner vehicle, moving the sample-toting container from the ascender into the returner.

As a final step, the orbiter-returner combination loitered in lunar orbit for 13 days before making its Moon-to-Earth transfer, in which the returner deployed the capsule-carrying specimens for atmospheric reentry and a parachute touchdown in Mongolia.

Beyond China's grab-and-go sample missions to the Moon, staging of a far larger lunar agenda is underway. “China is intent on going to the Moon, not only staying on the Moon by establishing a longer-term presence, but importantly, having a major voice in lunar governance and cislunar space

traffic management,” says Dean Cheng, a senior advisor on China for the U.S. Institute of Peace in Washington.

The Chinese methodically are undertaking a lunar exploratory program, including landings at the Moon’s south pole and far side, Cheng says. These are helping them not only to explore the desolate scenery there but to gain insights into where best to target robotic and crewed missions.

One exploration objective is ascertaining the availability and quantity of water ice, a potentially valuable resource residing in so-called cold traps, permanently shadowed areas at the Moon’s polar regions. The water ice could be processed into oxygen and water as well to produce rocket fuel.

“Insofar as China will likely establish a long-term presence on the Moon, it will then have at least reserved a voice in the setting of lunar governance terms, whether in terms of health and safety zones for landings or determining who will land near suspected sites of lunar ice,” Cheng notes.

The “first mover” is able to set many of the rules, Cheng adds, with China spouting “health and safety” reasons as it does not want massive clouds of dust generated by another party’s lander near its experiments or habitats.

James Head, a leading lunar expert and professor of geological sciences at Brown University, sees other implications stemming from China’s back-to-back Moon sample return successes.

“Each of the steps in the Chang’e 5 and Chang’e 6 sample return missions—launch, transit, orbit, landing, sampling ascent, rendezvous, transfer of samples to the orbiter and return to Earth—duplicate not only the key steps in human landings on the Moon, but also for sample return from Mars,” Head tells Aviation Week.

“Chinese scientists and engineers are actively considering detailed mission profiles and candidate Mars landing sites to follow up on their first Tianwen-1 mission to Mars and its Zhurong rover and to send a mission to return samples in the not-too-distant future,” explains Head, who has co-authored several scientific papers with Moon research colleagues in China.

China’s red planet success took place in May 2021, when the Tianwen-1 lander dispatched the rover within a preselected landing zone in the southern part of Mars’ Utopia Planitia.

“I am totally impressed with China’s

execution of their lunar mission,” says Greg Autry, who oversees a graduate program in space policy and business at Arizona State University. “Clearly, they are currently outperforming everyone, governmental and commercial.”

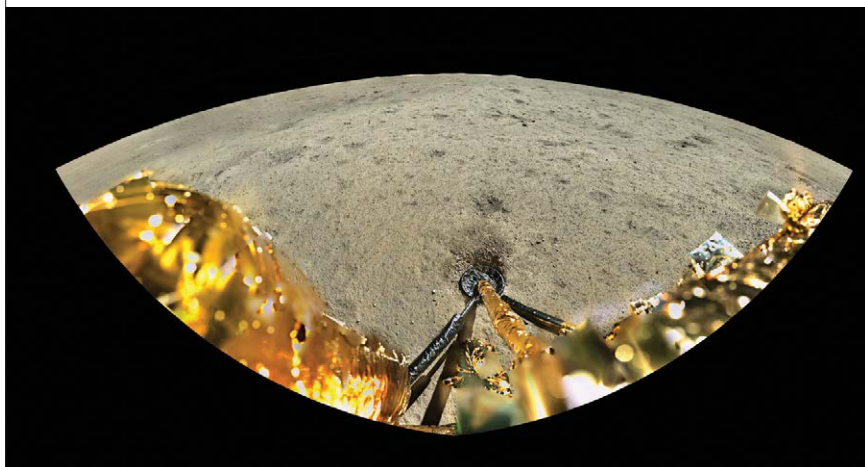
But Autry says he does not expect China to continue to outperform others. “America’s advantage in Space Race 2.0 is the ability of the entrepreneurial sector to work through failure and deliver market disrupting technologies,” he says. “China is still on a governmental program, and their commercial companies have a strategy of ‘copy whatever SpaceX has already done.’”

Autry says it is possible that China will maintain the lunar advantage for a few years and begin to tie up prime

An ILRS second phase is being touted as an expansion of the station, which is set for completion by 2045.

Meanwhile, China has been busily attracting other countries and organizations as partners. That mimics in many ways the Artemis Accords NASA and the U.S. State Department set in motion in 2020. The initiative calls for best practices and norms to promote sustainable civil space exploration with principles that are not legally binding.

On the heels of the Chang’e 6 mission, China is on track with the Chang’e 7 robotic lunar explorer in 2026. It is intended to be outfitted with resource-surveying equipment to investigate the lunar south pole region. Chang’e 8 is to follow in 2028 with a lander planned to conduct tests for the utilization of lunar resources.



**A panoramic camera aboard the Chang’e 6 lander captured images of the landing site on the far side of the Moon. The Chinese spacecraft touched down in the South Pole-Aitken Basin crater.**

natural resources locations with a barrage of nominally scientific missions. “There is also a serious chance they will beat [NASA’s] Artemis III in a human landing on the lunar surface with their much simpler architecture,” he adds.

Part of China’s strategic plan is orchestrating an International Lunar Research Station (ILRS) in partnership with Russia. While specifics are sparse, Chinese space officials have said that the first phase of the ILRS construction project is to culminate in the completion of a “basic station” by 2035 in the lunar south pole region. It is planned to constitute scientific facilities and be able to conduct experiments to develop and utilize local lunar resources on a limited scale.

“In this way, the Chang’e 7 and Chang’e 8 missions, and the entire fourth phase of the lunar exploration project, will make preliminary preparations for the establishment of a lunar scientific research station,” Wang Chi, an academician from the Chinese Academy of Sciences and principal investigator within China’s multiphase lunar exploration program, told the China Central Television Network recently.

All of this momentum by China is palpable, Cheng notes. “In reality, there is something of a renewed space race,” he says. Although the U.S. landed Apollo astronauts on the Moon in 1969, “China may well beat us to the Moon, get there before we can get back,” Cheng says “That’s as much our own fault as it is anything about China.”



# Commercial Aircraft Ramp-Up and Satellite Projects Challenge Airbus

- > SUPPLIER DELAYS CAUSE AIRBUS TO CUT 2024 PRODUCTION TARGET
- > EXECUTION, SUPPLY CHAIN AND COSTS RATTLE SPACE OPERATIONS

Jens Flottau Frankfurt and Robert Wall London

**A**s Airbus and the wider commercial aircraft industry headed into this year, the signs suggested that things were improving. The manufacturer had just announced 735 deliveries for 2023, a result that some thought impossible given the difficulties of restarting after the COVID-19 pandemic. But six

eral years. Customers have complained about routinely receiving A320neo-family aircraft several months late. The continuing and now aggravated scarcity of supply likely will further support the already high lease rates and could slow retirements even more as airlines operate aging aircraft longer than expected.

AIRBUS



Airbus suppliers cannot keep pace with production growth.

months later, many indicators point in a different direction. Supply chain problems have become more challenging, and Airbus is realizing that some of its satellite programs are in far worse shape than thought.

The aerospace giant shocked investors on June 24 when it disclosed that it no longer expects to reach its target of producing 75 A320neo-family aircraft per month in 2026, cut 2024 delivery guidance and slashed its earnings outlook for the year by more than \$1 billion. Shares slumped almost 11%.

Airbus now expects to reach rate 75 in 2027, having already pushed out the target once before because of supply chain issues. The company now aims to deliver 770 commercial aircraft this year, about 30 fewer than it had anticipated and a considerably slower growth than it had hoped.

For airlines and lessors, the latest news means more delays for many additional aircraft over the next sev-

The delay also means that Airbus cannot grow its share in the single-aisle market vis-a-vis Boeing as fast as planned in the coming three years. "For Boeing, tighter production constraints at Airbus could be marginally positive, as it may make timing of deliveries for new Airbus orders more challenging," Bernstein Research analyst Douglas Harned wrote.

"The continuation of supply chain issues in commercial aircraft goes against the narrative of gradual improvement," Vertical Research analyst Robert Stallard stated in a note for clients. "For even the super-conservative Airbus to have got this outlook wrong is emblematic of how challenging this supply chain situation is, and again calls into doubt the OEM ramp plans."

"We see that the operating environment is not getting better," Airbus CEO Guillaume Faury told reporters June 24. However, he said, the company remains "fully committed to the ramp-up toward a rate of 75 for the

A320neo. And as you know, demand is very strong, remains very strong and unquestioned. But the road to get there is complex, and we are slowed down by several items, and we continue to be paced by the supply chain."

The worsening delivery performance of its engine suppliers has caught Airbus by surprise. "The engine situation has degraded significantly in recent months," Faury admitted. "We find ourselves in a situation where we have missing engines for the single-aisles from both engine-makers. . . . It will be very difficult to recover by the end of this year, given the fact that it's two engine-makers and that the overall environment is tense."

The engine issues no longer affect only single-aisle programs but now include the A330neo, which has experienced late deliveries of its Rolls-Royce Trent 7000 powerplants.

Seats and interiors are also "a serious issue," Faury said. "Interiors remain difficult, particularly for business-class seats on new widebodies as they compete with high retrofit demand for RTX and Safran," Harned concurred in his note.

"We are spending far more time, energy and human resources on supply chain management post-COVID than we ever did previously, and not by a small amount," Faury said. "The supply chain—in the U.S., in Europe—is struggling to restore the skills, the know-how, the experienced workforce that it had before COVID. So many people left the industry, and it takes a lot of time to recover."

Airbus is also concerned about deliveries from Spirit AeroSystems, which builds the A220 wings and section 15 of the A350 fuselage. Spirit is "contributing to the degradation," Faury said. "Their situation is difficult from an industrial standpoint; this is not new. We've been facing their difficulties for a while."

"Spirit has lagged for some time on A350 production but had previously not affected Airbus deliveries due to buffers held by Airbus," Harned wrote. "That appears to be over."

However, the OEM has not disclosed any changes in the planned rates for the A220. That may be simply because its guidance for the type is already vague, with production to be grown to 14 aircraft per month by the middle of the decade.

Negotiations over splitting Spirit



into parts for Boeing and Airbus to take over are ongoing.

Issues in the cabin supply chain have worsened recently, industry sources say. Delays in deliveries and certification of seats have become a particularly serious problem, sometimes pushing back aircraft handovers by several weeks or months. Cabin monuments such as galleys and lavatories, as well as their parts, also have not arrived at the expected pace.

Airbus also is considering major changes to its space operations after a program review identified almost \$1 billion in higher costs on critical satellite contracts. The company is open to reviewing its space portfolio and may consider divesting elements of those operations or seeking cooperation with others, Faury said. "We are evaluating all strategic options for the space business," he added.

Airbus is contending with a range of issues on some of its satellite programs. These include a challenging telecommunications sector environment, supply chain issues and the


company having bid on too many programs that are coming together at the same time, with technical challenges causing execution problems. Many of those contracts were booked in the 2018-21 time frame, the company said.

Airbus said a reassessment of program costs will lead it to take a €900 million (\$966 million) earnings charge in the second quarter. It is only the latest earnings setback for the European aerospace giant's defense and space portfolio. Management has for years struggled to improve the unit's financial performance. Last year, Airbus took a €600 million charge on its space programs and put in place a new management team that conducted a review identifying the latest problems.

Faury said the new charge initially appears as "a shocking number," but it is so big because the figure wraps up cost increases that stretch over years, in some cases into the next decade. He added that the space portfolio was not at risk of becoming another A400M, the military transport aircraft that for years has been a drag on earnings.

Airbus expects to have clarity this year on the technical maturity of most of the troubled programs. The majority of issues involve telecom and navigation satellites projects, though some observation activities also are affected because of bottlenecks in key testing infrastructure, the company stated.

Although Airbus is taking the hit to earnings now, some of the higher costs will not occur for years. The company said about a third of the cash impact will come this year, as it has trimmed its free cash flow guidance before customer financing to €3.5 billion from €4 billion. Its adjusted earnings target has also fallen to €5.5 billion from a range of €6.5-7.5 billion.

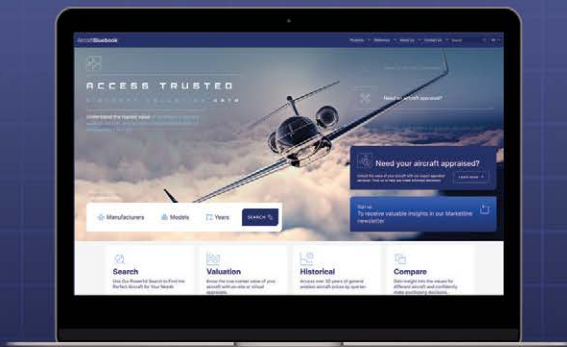
Airbus Chief Financial Officer Thomas Toepfer said the space business still aims for mid-to-high single-digit earnings margins, although it will take longer to meet that goal. Airbus became more selective in bidding projects several years ago, he noted, which should help achieve those margins. 

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# European OEMs Reconsider Supply Chain Strategies

- AIRBUS, SAFRAN PRIORITIZE SUPPLIER RESILIENCE
- SOVEREIGNTY, SHIPPING AND RAW MATERIALS ARE THORNIEST ISSUES

Thierry Dubois Paris

**P**ermacrisis is a neologism created to reflect how a series of crises—climate change, COVID-19, the war in Ukraine, energy price inflation and mushrooming geopolitical tensions, among others—has created a state of unending crisis. Airframers and engine manufacturers, especially in Europe, are adapting to an enduring risk of supply chain disruptions. They have factored the notion



THIERRY MONASSE/GETTY IMAGES

of permacrisis into their strategy and are endeavoring to make their supply chains more resilient. The balance between outsourcing and insourcing is part of the picture, but the effort is more about simultaneously helping current suppliers and finding new ones.

Before reconsidering the supply chain, it is imperative to support the current one, OEMs say. "Supply chain management is coming higher in our priorities," Airbus Commercial Aircraft Chief Operating Officer Florent Massou said on June 13 at the Paris Air Forum.

Such supervision is no small task. Airbus receives 2.2 million parts on a daily basis to produce 3-4 commercial aircraft. Around 80% of the manufacturer's activity is sourced externally, working with more than 12,000 suppliers worldwide.

"At Airbus, 3,000 employees take care of the supply chain," Massou said. "We have worked a lot to improve our practices, our processes, our level of professionalization and our organization system in relation to our suppliers, for us to be understood and competitive."

The idea is to help them in terms of technical knowledge and processes. "We are not where we should be yet," Massou said. "Our role is to help our suppliers to be good. Otherwise, we pay the price."

The airframer is considering a way to guarantee steel access for its suppliers. Airbus already secures a quantity and price from aluminum and titanium providers, Massou said. Suppliers then purchase from that defined amount according to their needs. This scheme is called conbid.

"We envisage doing the same for steel," Massou said. "There is a steel crisis, and 250 grades of steel can be found in an Airbus aircraft."

Safran is on the same page. "We must collectively step up in our capacity to react to upturns, downturns and geopolitical crises," said Marjolaine Grange, group head of industry, procurement and performance for Safran. The team that works with suppliers on short-to-medium-term demand has grown 50%. Together, they manage investment plans, hiring and adjusting to demand, she explained.

Safran has regrouped the training schemes for those employees under a single name this year—the Supply Chain Academy. "The branding has given greater visibility to the job," Grange said.

OEMs are analyzing their supply chains in terms of single points of failure—particular problems that can thwart the construction of an aircraft or engine. Massou cited the 2021 closure of the Suez Canal after a ship ran aground as another example of a crisis happening at no notice. "Hence our questions about supply chain resilience," he said. "What are the locations where we rely on a single supplier—in China, Portugal, the U.S.? Shall we look for dual sourcing and find another supplier elsewhere?"

**Safran has grown its team that works with suppliers on short-to-medium-term demand by 50%.**

Safran is taking the same kind of fresh look at its supply chain. "Our Resilience 2030 project is also about single points of failure,"

Grange said. "We want to have [more than one solution] to react in case of a temporary or permanent blocking."

Sovereignty can be a factor in supply chain strategies. Safran decided in late February to build a new factory rather than rely on its U.S. suppliers to increase turbine blade production. Some countries, such as the U.S., give priority to sovereign production, which creates uncertainty for foreign customers. That is why Safran plans to open its own manufacturing site in Rennes, France, in 2027.

One way to decarbonize production is to reduce the distance components travel. "During COVID, Safran Nacelles reconsidered their strategy," Grange explained. "They determined they should have the flows [of goods and services] around their production sites." The objective was to cut the need for transport and become more resilient. "Indeed, Safran Nacelles is weathering the current crisis: Their on-time-delivery performance is not impacted," she noted. Therefore, Safran has instructed other companies in the group to make flows more local, she said.

As for insourcing versus outsourcing, the debate is not as acute as it has been in the U.S., where Boeing hopes to solve some production issues by taking over Spirit Aero-Systems. "The debate is not about the right level of outsourcing," said Bruno Bouf, vice president of aerospace and defense at consultancy Capgemini. "It is, rather, about control of the supply chain."

Controlling the production of future, innovative components has been one of the points at issue. "It is often when preparing for the future that we identify [crucial] production technologies and make verticalization decisions," Grange said.

Taking over Aubert & Duval—a supplier of titanium, steel and materials for hot sections in turbine engines—thus made sense, she said. Airbus, Safran and Tikehau Ace Capital acquired the ailing metallurgy company from Eramet in 2023. 🌐

# Evidence-Based Training To Make Pilots More Resilient

> NEW METHODOLOGY TO BENEFIT FLIGHT SAFETY

> IMPLEMENTATION REMAINS CHALLENGING

**Thierry Dubois** Lyon

**A**s evidence-based training—a methodology aimed at better preparing pilots for unexpected situations—gains ground in air transport, the challenges of implementation are becoming clearer.

An improvement in safety, the new approach requires time and effort for the transition away from conventional performance-based training. It may take a few more years before evidence-based training (EBT) is widespread, but industry can count on its benefits. Existing flight training procedures cover only known problems, stopping short of addressing unforeseen difficulties that may cause future accidents. EBT addresses those circumstances.

“When facing an unknown situation, a conventionally trained pilot may try to cling on to known exercises,” says Thomas Bessiere, co-founder and CEO of Hinfact, a Toulouse, France-based startup offering EBT tools. “If you ensure the pilot masters a basis of competencies for adaptation to any situation, they become much more resilient when the unexpected arises. Hence the importance of nontechnical skills.”

The International Air Transport Association (IATA) developed EBT under the Training and Qualification Initiative launched in 2007. A working group defined nine competencies: knowledge, manual control, automation management and application procedures as technical skills; and workload management, situational awareness, leadership, decision-making and communications as nontechnical ones. EBT focuses in particular on the latter and applies to recurrent training and assessment.

EBT is mandatory in China and India, and the European Union Aviation Safety Agency’s (EASA) EBT regulation was published in 2020. EASA recommends the methodology and incentivizes it by requiring one line check every two years for those using EBT instead of annually, Bessiere says.

In 2021, Iberia became the first operator to use EBT in Europe. Air France followed in the same year.

Once an operator’s program is approved, the crew is assigned a biannual simulated 7-hr. EBT session. “The first part of the simulator session is an evaluation phase, where the crew flies through a scenario very close to the operational environment and have to deal with unexpected situ-

ations, such as failures, weather or security,” says Eric Francois, who oversees crew training at Air France. “In the second phase, the instructor will adapt the exercises according to what they saw in the first phase—those competencies that are well in place and those that need to be reinforced. That is the instruction phase.”

If necessary, the instructor may spend time reexplaining concepts, using their entire range of pedagogical methods and tools. That second phase leaves time to be used at the instructor’s convenience, possibly upon a pilot’s request.

While the instructor remains an examiner, unlike in a pure exam, the EBT session prioritizes sharing and teaching. “Overall, it means less stress for everyone,” Francois says. In the conventional approach, checks are based on the pilot’s performance in a number of exercises. They pass or fail.

Such a far-reaching evolution requires many labor hours.

“The operator has to analyze data under a systemic feedback scheme,” Francois says. “Major organizational changes are required. You need people who believe in the project.”

Collecting and managing data is challenging but crucial in EBT. Training data analysis should enable the instructor to find a pilot’s strengths and weaknesses so they can put those points in perspective with flight operations data. If a problem recurs in operations, the instructor may want to

reinforce a skill among the airline’s pilots.

Data may be powerful, but it also brings challenges. “The quality of recurrent training depends on the quality of data,” Bessiere says. “And the data has to be updated twice a year.” Data from flight data monitoring systems may be used for EBT.

“A number of carriers would like to transition to EBT, but implementation is difficult,” Bessiere continues. “Over the last six years, we have seen carriers use digital tools for operational data management and training management, but those tools are not always suited to EBT needs.”

Hinfact’s training management system includes tools for instructors to take notes and give grades, manage schedules and track pilots’ ratings.

“Our software suite enables the creation of solid foundations,” Bessiere says. Hinfact has seen some success, especially as it takes into account EBT’s personalized dimension. Some 30 training centers use its training management system.

Only one, however, uses a data collection and analysis system that hinges on eye-tracking. That system was Hinfact’s original *raison d’être*. Thales has been developing a similar device with the same goal: to facilitate EBT.

Francois doubts such tools can help instructors. “EBT is about recurrent training; the pilot is not learning how to create a visual pattern,” he says. “The instructor knows how to detect that a problem stems from the visual pattern.”



GABRIEL BOUYS/AFP/GETTY IMAGES

**With the skills to adapt to any situation, pilots become more resilient when the unexpected arises.**



# Europe Goes Shop

> EUROPEAN DEFENSE MARKET STAYS HOT AS FARNBOROUGH NEARS

> MILITARY EQUIPMENT SPENDING IS ON THE RISE ACROSS THE REGION

**Robert Wall** and **Tony Osborne** London

**E**urope is in buying mode. Norway has put long-range surveillance uncrewed aircraft systems and helicopters on its equipment shopping list, Bulgaria wants new coastal defense capabilities, and Romania is enhancing its short-range air defenses. Those examples illustrate the breadth of threats countries are trying to address—from countering small uncrewed systems to dealing with hostile fleets at sea—while handling security concerns from the Arctic to the Black Sea.

What has unfolded over the past two years in the region is the most expansive defense equipment drive in the modern era, putting pressure on industry to deliver. Since 2021, owing to Russia's February 2022 full-scale invasion of Ukraine, commitments on defense equipment purchases from the largest European spenders have increased 73% in real terms to \$146.1 billion from \$84.6 billion, Aviation Week Network data shows.

When the defense industry last de-

scended on Farnborough two years ago, European defense planners were starting to draw lessons from the fighting unleashed by Moscow's unprovoked attack on Ukraine, including the need for deeper inventories in anti-tank weapons and air defense missiles, among others. As the war continues into its third year, the list of topics on the agenda at this month's Farnborough International Airshow has grown longer and now includes countering loitering munitions, demand for cruise

missiles and the need to enhance electronic warfare capabilities.

While the war in Ukraine has spurred Europe into action, Houthi attacks on shipping in the Red Sea starting in October and China's increasingly assertive foreign policy have amplified a motivation in European capitals to rebuild their countries' defenses.

The threat environment has brought widespread pledges to increase defense spending. Farnborough will unfold in the wake of the July 4 general elections in the UK, where the two major parties have called for defense spending to increase given the security situation. Norway's government plans to double defense spending by 2036; a parliamentary committee in Sweden also has called for a sharp increase by the end of the decade.

A lot of the fresh money flowing in Europe already has been allocated following a wave of procurement decisions over the past year. The Czech Republic and Romania, for instance,

DEHL



Air defense equipment demand has soared since Russia's full-scale invasion of Ukraine in 2022.

# ping

## > SYSTEMS TO COUNTER UAS ARE IN DEMAND

have committed to buying Lockheed Martin F-35s to modernize their air forces. Several NATO members have agreed to buy \$5.5 billion worth of Patriot interceptors jointly, and countries across Europe are investing in short-range air defenses.

Not known for its speed of action when it comes to defense, Europe is moving with a sense of urgency. The UK, Italy and Japan—partners on the Global Combat Air Program to develop a future fighter—want to get the system into users' hands by 2035. London also is pushing for fast development on a new air-launched cruise missile. Germany, after a slow start, has effectively allocated all €100 billion (\$107 billion) it set aside in a special defense fund in 2022 after Russia's actions in Ukraine, committing to items such as F-35s, the Israel Aerospace Industries Arrow 3 anti-ballistic missile system and modernizing its suppression of enemy air defense fleet.

Even with all those financial commitments, Europe still faces questions about its defense capabilities—such as in cruise missiles. Ukraine has used MBDA Storm Shadow/SCALP-EG cruise missiles provided by France, Italy and the UK to great effect. However, less is being said about how to replenish those stocks. Germany has refused to send Kyiv its Taurus KEPD-350 air-launched cruise missiles, citing inventory depth as a concern, among other excuses. But Berlin has held off on restarting the production line that MBDA has said is ready to go.

Other countries have been more aggressive in trying to build up long-range strike inventories. The Netherlands has committed to buying Raytheon Tomahawk land-attack cruise missiles after years pondering the move. Poland, Romania and Italy are among those stocking up on Lockheed Martin M142 High Mobility Artillery Rocket Systems.

The UK Royal Air Force (RAF) is

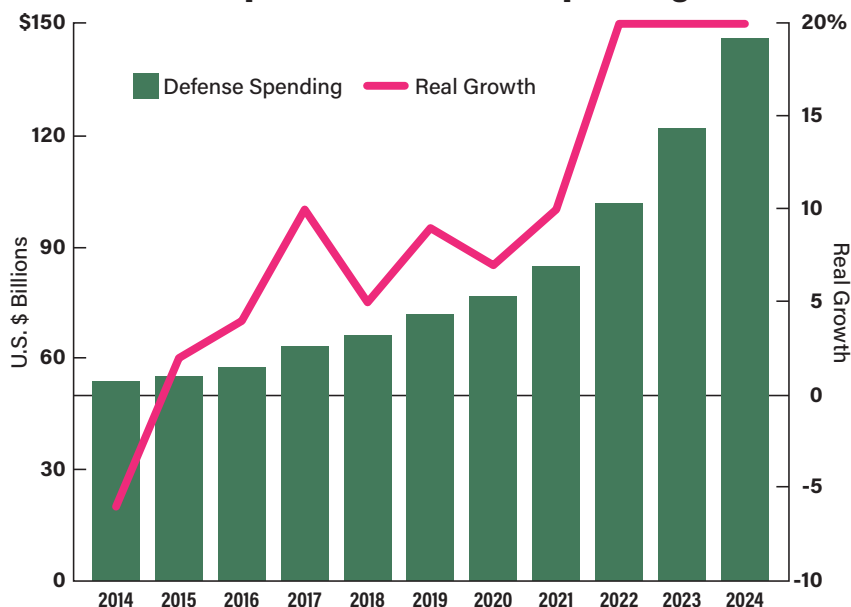
**The Netherlands is buying Tomahawk land-attack cruise missiles.**

exploring weapons that would give it a 1,000-mi. strike capability, with efforts underway to field a standoff capability of 500 mi. by the 2030s. "We need to double that," Air Cdre. Patrick Shea-Simonds, the service's head of capability strategy, said at the Royal

ates. The service currently can fire only Tomahawk cruise missiles from its submarines.

Germany and France, already partnered on development of a future combat aircraft, are discussing cooperation on long-range strike systems.

## Europe Boosts Defense Spending



Note: Data for top 16 European defense spenders.

Source: Craig Caffrey/Aviation Week Intelligence Network

Aeronautical Society's Future Combat Air and Space Capabilities Summit May 22. That month, the British government also said it planned to add land-attack missile capability to the Royal Navy's Type 26 and Type 31 frig-

Berlin called out the need for such systems in its first-ever National Security Strategy in 2023.

The discussion around air defenses has evolved over the past two years. Early in the Ukraine war, the focus





was largely on traditional air and missile defense needs, but the increasing use of often low-cost, one-way attack drones has heightened the challenge of having enough interceptors in inventory. The heavy use of those systems has raised cost-per-kill concerns, as the interceptors are far more expensive than the systems they shoot down. In the Red Sea, Iran-backed Yemeni Houthi forces have menaced commercial and military vessels with one-way attack drones, anti-ship ballistic missiles and other systems, extending those concerns to the maritime domain.

Germany is reviving the air defense mission for its army after phasing out the Gepard anti-air armored vehicle over a decade ago and has green-lighted development of a Gepard replacement. Last year, Finland agreed to become the launch export customer for the Rafael-Raytheon David's Sling air defense system, while the Netherlands awarded Elbit Systems a contract for a counter-uncrewed aircraft system (UAS). The UK is accelerating the fielding of the DragonFire laser system on ships to have it in service in 2027 and to reduce the cost of downing a UAS. The European Sky Shield Initiative has swelled to more than 20 member countries.

Russia's use of Kinzhal air-launched hypersonic ballistic missiles in Ukraine has added pressure on Europe to counter them, although some have been shot down by Patriot air defenses. The European Organization for Joint Armament Cooperation (OCCAR) last year signed a contract with a consortium led by Spanish defense company SMS to develop a hypersonic missile interceptor under the Hypersonic Defense

Interceptor (HYDEF) program, which is co-funded by the European Union. This year, OCCAR also signed a deal with an MBDA-led group for the concept phase of the Hypersonic Defense Interceptor Study (HYDIS<sup>2</sup>) project.

"For us in industry, the challenge is to provide both volume and capacity, particularly on the battlefield, but at the same time to drive high-tech evolutions and developments forward to cope with new threats," MBDA Germany Managing Director Thomas Gottschild said in May.

Many of these developments are echoed in the U.S., which is ramping up production of air and missile defense interceptors and pursuing counter-drone technologies. The U.S. Army is leading the way in development and spending for the Pentagon's counter-UAS efforts, earmarking \$447 million for them in its fiscal 2025 budget request. The efforts span technology types and include procurement of mobile and fixed-site low, slow, small uncrewed aircraft integrated defeat systems.

Additionally, the Army is trying to field directed energy systems to thwart small UAS and increasing spending on the 300-kW Lockheed Martin Indirect Fire Protection Capability-High Energy Laser prototype. In May, the service received from defense startup Epirus another four prototype counter-UAS systems using high-power microwave technology for deployment in the Middle East.

Signaling a sense of urgency, the Army is using new rapid-acquisition authority granted by Congress to start counter-UAS acquisition programs for the Middle East ahead of legislative authorization, according to

Doug Bush, the service's assistant secretary for acquisition.

The U.S. Marine Corps has been deploying its own new technology, including the Marine Air Defense Integrated System, which is mounted on two Joint Light Tactical Vehicles and includes radars, surface-to-air missiles and command-and-control elements. In a January test, the system tracked and hit multiple targets using Raytheon Stinger missiles and a 30mm cannon. The service plans to conduct initial operational testing and evaluation throughout this fiscal year ahead of fielding to the 3rd Littoral Anti-Air Battalion.

The Marines also are developing the larger Medium-Range Intercept Capability (MRIC), which couples the Northrop Grumman AN/TPS-80 Ground/Air Task Oriented Radar with the Raytheon SkyHunter missile to target larger drones, cruise missiles and other threats. The MRIC could enter production in fiscal 2025, following an assessment expected this year.

The U.S. and Europe are not just investing in counter-UAS systems to intercept loitering munitions—they also are looking to field such systems themselves. Last year, France placed an order for AeroVironment's Switchblade 300 loitering munition systems. The company is scaling up manufacturing capacity following the Pentagon selection in May of its Switchblade 600 as part of the Replicator rapid fielding program.

The UK is exploring the purchase of first-person-view uncrewed air vehicles (UAV), which have gained prominence in Ukraine. The initial purchase for testing could lead to production of around 1,000 of the UAVs per month, the British Defense Ministry said in May.

The collective order volume has driven backlogs for companies in the U.S. and Europe to record or near-record levels. While the booming business promises healthy top-line growth for suppliers, it is also drawing a growing list of companies vying for orders. Turkish Aerospace Industries, for instance, is bringing its Hurjet advanced jet trainer to Farnborough's flying display for the first time, along with its Gokbey helicopter, in the hope of securing buyers. 🇹🇷

—With Brian Everstine in Washington and Craig Caffrey in London



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# FRAGMENTATION

- > AIRBUS A321XLR CERTIFICATION IS IMMINENT
- > CUSTOMERS FOR THE TYPE INCLUDE LEGACY AND LOW-COST AIRLINES
- > NEW VARIANT ENABLES OPERATORS TO OPEN THINNER LONG-HAUL ROUTES

**Jens Flottau** Toulouse and Frankfurt

**T**he service entry of an aircraft derivative is not normally something that shakes up the commercial airline industry. New aircraft variants usually introduce incremental improvements, less fuel burn or updated cabins. However, the arrival of the Airbus A321XLR could be different: The narrowbody has the potential to change the structure of long-haul networks.

Launched in 2019, the latest version of the A321neo is on the verge of flying its first scheduled route. Airbus expects to deliver the first aircraft in the third quarter to Iberia, which plans to

introduce the XLR on the Madrid-Boston route.

Airbus is hoping that the aircraft will be certified ahead of the July 22-26 Farnborough International Airshow.

The OEM had planned to reach that milestone by the end of June, but it says the sheer volume of paperwork has slowed down the process somewhat. The XLR, which recently flew at the ILA Berlin Airshow, also will be displayed at this year's largest aerospace event.

The A321XLR is reviving a niche created decades ago by the Boeing 757, currently the only narrowbody capable of flying true long-haul services. Airbus asserts that the XLR will feature about 30% lower fuel burn than its predecessor, creating economic viability for thinner routes and new business models for long-haul travel. The A321XLR also could eat into some hub-and-spoke traffic as it enables competing airlines to fly direct to smaller markets beyond the hubs and poach transfer passengers—making it operationally cheaper for the carrier

**The A321XLR can fly ranges of nearly 4,700 nm.**



# PLAY

and more convenient for passengers to avoid connections at large, often congested airports.

The limit lies in the number of markets with sufficient demand for nonstop routes. A much smaller cargo capacity compared with widebodies makes the XLR less attractive for airlines on routes with strong cargo demand.

Commercially, the A321XLR is already a success. Airbus has collected more than 500 firm orders for the aircraft, according to Aviation Week Network's Fleet Discovery database.

## Airbus A321XLR Orders

Operator	On Order
Aer Lingus	6
Air Arabia	20
AirAsia X	20
Air Canada	30
American Airlines	50
Cebu Pacific Air	10
Flynas	10
Frontier Airlines	18
Iberia	13
IndiGo	70
JetBlue Airways	13
JetSMART Airlines	14
Jetstar Airways	36
Middle East Airlines	4
Saudia	15
Sky Airline	10
United Airlines	50
VietJet Air	20
Wizz Air Hungary	47

Sources: Aviation Week Network Fleet Discovery and Airbus

IndiGo is the largest customer with a commitment for 70 aircraft, followed by American Airlines and United Airlines with 50 each and Wizz Air with 47. The lineup shows that the aircraft has generated interest from both legacy and low-cost airlines. At American and United, the XLR will fill the role of the aging 757; elsewhere, the

XLR will allow carriers to reach into new strategic spheres.

Although the aircraft is a version of the highly popular A321neo, the XLR is substantially different. The key difference is the XLR's fuel capacity: The new rear center tank (RCT) has a capacity of slightly less than 13,000 liters (3,400 gal.), enabling the aircraft to fly routes of nearly 4,700 nm. Because the tank is integrated into the fuselage frame rather than sitting on a cargo floor structure, "we can put the equivalent volume of four tanks in the space of two," says Gary O'Donnell, head of the A321XLR program. Airlines also have the option to add a second tank to the front cargo hold of the aircraft. For comparison, the 4,000-nm-range A321LR has three tanks in the back and one in the front fuselage.

Whether airlines will install the forward tank depends largely on their cabin choices and required ranges. For instance, for carriers that install heavy premium business class seats and want to fly from Europe to the U.S. but farther than the East Coast, the added tank might be necessary, though it would reduce space for cargo and baggage. "Not all full-service carriers would have the additional center tank," O'Donnell says. "Some would want the forward capacity."

While the RCT extends to the bottom of the fuselage skin, it does leave space for the escape rafts on each side below the exit doors, and channels on the upper sides provide room for electrical wiring and air conditioning. The fuel system has been adapted accordingly.

Because of the extra fuel capacity, Airbus raised the maximum takeoff weight to 101 tons from 97. "We have completely changed the main landing gear and simplified the mechanism," O'Donnell says. The nose landing gear has been reinforced, and the tires, wheels and brakes have been updated.

Airbus also has "reinforced 80% of the airframe," O'Donnell says. "Most of the parts are similar but stronger because of the extra weight."

In addition, engineers have simplified the mechanism of the inboard flaps. On the A321neo, a double mech-

anism extends twice, but on the XLR only once. The landing gear has also been changed, from double pistons to single.

Airbus engineers took advantage of an opportunity to bring the A320neo

family closer to the technological standard of the A330neo and A350 by changing an important flight control element that still had a mechanical layout. Because of the RCT's location, the traditional rudder controls have been replaced by what Airbus calls the eRudder. The technology is planned to be integrated into the baseline A321neo within the next three years.

The flaps, landing gear and electronic rudder control all help with weight reduction, which became a rather significant challenge after the European Union Aviation Safety Agency (EASA) and later the FAA insisted on special conditions to ensure better fire protection and crashworthiness of the RCT. Airbus had to make several modifications. First, the OEM changed the lower skin of the aircraft to a fiber metal laminate, a material used on the upper skin of the A380 that is more fire-resistant than traditional aluminum alloys. That measure is supposed to help against so-called pooled fires from the outside.

Engineers also designed an extended belly fairing with a gap between it and the fuselage skin so that heat would not transfer inside as easily, O'Donnell explains. Airbus also had to demonstrate to airworthiness authorities that the aircraft could sustain a hard landing on the belly and absorb a large amount of the energy. For this improvement, Airbus added extra structure inside the belly fairing and a rubber liner on the RCT floor, the same material it uses on the A340-500. The material is supposed to prevent fuel from leaking in the event of a crash. "We have an extremely robust proposal, which is now being discussed with EASA and the FAA," O'Donnell says. "It meets what they need. We now need to process through the documentation to get certification before the summer."

O'Donnell notes that EASA "has a



Gary O'Donnell, head of the A321XLR program

HERVE GOUSE/ARBUS



large workload. . . . We have submitted all our documents apart from two or three. EASA is processing them.” The final few documents are summaries that need to be signed. O’Donnell concedes that the “certification workload has grown.”

Because of the various weight additions and reductions required to comply with certification, the aircraft is slightly heavier than planned. “We still have the ability to meet everything that we have sold for 90% of city pairs,” O’Donnell says. “For [the remaining] 10%, we have 50-70 nm that we are looking to recover. We have a couple of ideas of how to get there over the next two years. We believe we will get half of that back, at least.”

want to get to maturity in Hamburg, and then we can decide as a business where we want to put production,” O’Donnell says. “What I’m trying to build most is flexibility. We cannot have so many single points of failure.”

To derisk XLR production, Airbus tries to “push complexity to the left as much as possible,” he notes. Complicated components, such as the RCT, are built in their own factories (Premium Aerotec in Augsburg, Germany, in this case) so that elements of substantial change are isolated and dealt with before the parts enter the final assembly line. Airbus hopes the sequence of moving aircraft from one assembly station to another can be maintained with few disruptions.

derbook are scheduled to be handed over in 2033.

International Airlines Group (IAG) confirmed in May that Iberia, rather than sister carrier Aer Lingus, will receive the group’s first XLR once deliveries start “by the end of the summer.” IAG placed a firm order for 14 of the type at the 2019 Paris Air Show; eight are designated for Iberia and six for Aer Lingus. After a pilot pay dispute at Aer Lingus was not resolved in time, IAG decided to switch to Iberia as the launch operator.

Iberia’s A321XLRs will feature 182 seats in a two-cabin configuration, including 14 in its business cabin featuring fully flat seats that convert into beds and offer direct aisle access.

“One of the great innovations offered by the A321XLR is its ability, as a single-aisle aircraft, to make long-haul flights while also providing a premium service at the same level as that enjoyed in widebody models, like the A330s and A350s in Iberia’s fleet,” the airline stated.

#### **The rear center tank is built at Airbus subsidiary Premium Aerotec in Augsburg, Germany.**

The XLR could enable the Spanish flag carrier to serve U.S. cities such as Atlanta; Charleston, South Carolina; Houston; Orlando, Florida; and Philadelphia.

Possibly the most interesting case study will be how IndiGo uses the XLR to expand its long-haul network. The Indian low-

cost airline operates only two Boeing 777-300ERs to Istanbul on a wet lease from Turkish Airlines and has ordered 30 A350-900s for long hauls on dense routes. The airline also has purchased 70 XLRs that it can use to develop routes from secondary markets in India to destinations in Asia, Europe and the Middle East.

Growing IndiGo’s long-haul operations could disrupt European legacy carriers that are reliant on feed beyond their hubs and the Middle Eastern super-connectors that channel large numbers of connecting passengers through their systems. IndiGo’s future long-haul network also will compete with Air India, which is trying to recover market share based on a more traditional model.



The first four aircraft are either in final assembly or have left the line for completion. Airbus initially will build the XLR in Hamburg, its main single-aisle production site. One of the four final assembly lines there will be dedicated to the long-range variant plus some of the more complex versions and cabin layouts of the standard A321neo. Airbus has not revealed its choice among the four Hamburg facilities; the OEM introduced the fourth, more modern and automated assembly line in 2018 in a building originally dedicated to A380 completion.

All final assembly lines in the Airbus system—Hamburg; Mobile, Alabama; Tianjin, China; and Toulouse—are being updated to be A321-capable, so they could also assemble the XLR. “We

Since the A321XLR will add to the growing number of complex layouts for the A321neo, that goal is particularly pertinent.

Airbus has not revealed detailed XLR production ramp-up plans. According to Fleet Discovery, seven aircraft are scheduled to be delivered this year, 51 next year, 120 in 2026 and a peak of 142 in 2027. If Airbus reaches its target rate of 75 per month for the A320neo family, 15-20% of production capacity could be allocated to the XLR. That snapshot view might change depending on future orders for the type and other A321neo variants. Fleet Discovery forecasts that XLR deliveries will fall steeply after 2029 based on current orders. The final eight XLRs from the current or-

"We are expanding more and more internationally," IndiGo CEO Pieter Elbers said at the recent International Air Transport Association (IATA) annual general assembly in Dubai. "The XLR will introduce direct flights to Europe and Asia. Passengers will no longer have to connect elsewhere."

IndiGo has introduced a premium cabin layout for the main domestic routes in India, a move that could indicate plans to abandon pure low-cost play on the much longer international flights.

Of the U.S. Big Three, American and United have large XLR orderbooks, but Delta Air Lines has not yet ordered the type. American plans to offer a business class section with lie-flat seats in suites with doors, a premium economy section and regular coach. The airline has not yet announced how many seats will be available in each cabin or when operations will start. According to Fleet Discovery, the first aircraft is to be delivered in May next year, and all remaining XLRs are to be handed over by the end of 2027.

United is expected to receive its first XLR later in 2025 and plans to install a new version of its Polaris business class configuration. The aircraft will replace the 757 fleet and fly pri-

**"One of the great innovations offered by the A321XLR is its ability to make long-haul flights while also providing**

**a premium service at the same level as that enjoyed in widebody models like the A330s and A350s."**

marily routes from the East Coast to Europe and Latin America. The premium product would also make it a good option for transcontinental domestic flying.

Air Canada plans a 50-50 split between international and North Amer-

ican routes when it scales up to 30 A321XLRs. The airline is scheduled to take delivery of its first aircraft in late 2025, "but for us it's really like a 2026 event," Mark Galardo, executive vice president of revenue and network planning, said at the IATA meeting.

Canada is a very seasonal market with "big amplitudes between summer and winter, and that's why that airplane was so key to our strategy going forward," Galardo said. He cited the Montreal-Toulouse route, noting: "In the summer, a widebody is fine—but in the winter, it's a bit much. As you get the A321XLR, you start to better match demand with capacity."

Galardo speculated that the A321XLR could open up new European routes, such as Porto, Portugal, and Marseille, France. "There are still a few European destinations that we want to cover," he said. "It's just the opportunity cost of a widebody is just way too big." ✈

—With Lori Ranson in Washington and David Casey in Manchester, England

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# 'There Is Always S

- > NEW AIRBUS SALES LEADER EMPHASIZES CUSTOMER RELATIONS
- > BENOIT DE SAINT-EXUPERY FOLLOWS CHRISTIAN SCHERER AT SALES PEAK
- > FOCUS IS ON DELIVERY PERFORMANCE AND RAMP-UP GOALS

**Jens Flottau** Toulouse

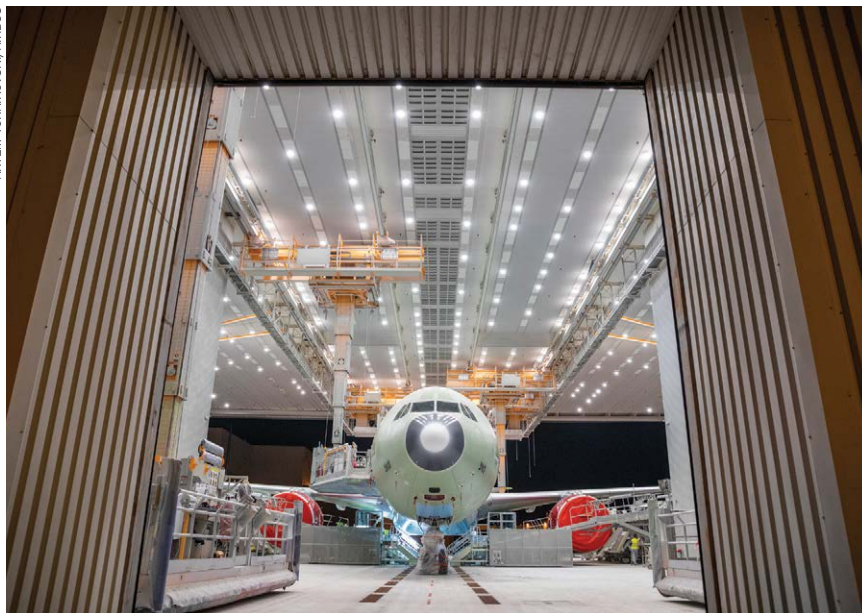
If everything were somehow to go wrong at Airbus, Benoit de Saint-Exupery has a fallback option. He grew up near Narbonne in southwest France on the Mediterranean coast, where his family is involved in wine-making and owns a vineyard. The La Clape region is famous for its excellent red wines; not surprisingly, one of de Saint-Exupery's passions, besides aircraft, is wine. "I can always sell wine, even today," he says.

To start with, de Saint-Exupery's name is world-famous. Aviation pioneer and author Antoine de Saint-Exupery, whose *Le Petit Prince* is standard literature for students learning French, was a remote uncle from another family branch. The famous relative died in 1944 in an aircraft accident under circumstances that are still mysterious. Although Benoit de Saint-Exupery never met him, that family link had an influence nonetheless. "I grew up with aviation stories from a young age, so there definitely was an unconscious bias [toward aviation]," de Saint-Exupery says. "We heard all these fantastic stories about the pioneers of aviation. He was one of them crossing the Andes, crossing the Atlantic. It is part of me, part of my DNA."

Sometimes the link had its downsides. "I was not good at French in school, so I was always criticized by my teachers, because with a name like this, you should be much better," he says. The teachers did not know that Antoine de Saint-Exupery, too, came home from school with bad marks in French at times.

Benoit de Saint-Exupery had a brief professional life before joining Airbus. He earned a master's degree in law and, after a short stint at a legal firm, he became an in-house attorney at Aerospatiale. De Saint-Exupery moved on to Matra, where he joined the commercial team selling satellites in the UK. Five years later, he joined Airbus' contracts department. After nearly 22 years at the OEM, he now runs the manufacturing giant's sales team.

Christian Scherer is a tough act to follow. The new Airbus Commercial Aircraft CEO is known for the close customer relationships he developed over decades in the business. In 2023,



ARTEM TCHAIKOVSKI/AIRBUS

**Securing more orders for the A330neo is a key target for de Saint-Exupery in 2024.**

Needless to say, that is not at all the plan. In fact, de Saint-Exupery's career at Airbus has taken off big-time. Since January, the 49-year-old has been leading aircraft sales during one of the most successful periods the European aircraft manufacturer has ever experienced. Sales are thriving because of exceptionally strong demand while Boeing has been weakened and will be for years.

But Airbus' new top salesman also

faces some challenges: Narrowbody production is sold out until 2031, and widebody slots will not be available in large numbers much sooner. Complicating matters, de Saint-Exupery follows in the footsteps of legendary sales guru John Leahy and company veteran Christian Scherer, who was promoted to run the manufacturer's commercial aircraft division.

So who is the new leader of Airbus sales, and what are his plans?



# Something To Sell'



**Benoit de Saint-Exupery**  
has been running the  
Airbus sales organization  
since January.

ED JONES/AFP/GETTY IMAGES

Scherer sold 2,300 aircraft, that most that had ever been sold in one year. “You dried up the well—there is nothing left to sell,” de Saint-Exupery once joked to Scherer and Airbus Group CEO Guillaume Faury. Humor aside, de Saint-Exupery says he and Scherer discussed the transition and “acknowledged that there would be a period in which customers would still keep going to him because they know him.” Scherer is “mindful” of that and “is always asking whether he should come along” to a meeting when invited, de Saint-Exupery notes.

A change in mindset might be a challenge for de Saint-Exupery. As head of contracts, “my goal was to safeguard the company and make sure my colleagues would not give the house away” by agreeing to too many concessions, he says. As head of sales, “I just have to make sure to put aside my old instincts—being transactional before being commercial—and focus on the sales side of the relationship,” he says. “I’d like to think that I am a

responsible leader. I am the one managing the customer relationship at the top. I don’t want to be seen as the obstacle. In my position, I have to make sure to be seen as the top sales guy and should not get into the weeds. Everyone has to have his role to play.”

One of de Saint-Exupery’s first decisions was to merge the former contracts department with sales finance and asset management, creating the Commercial Transactions unit, largely to leverage the synergies between the divisions.

De Saint-Exupery has little reason to complain to his former boss about a lack of opportunities. “There is always something to sell,” he says. “We sold two years of production last year and are now selling well into the 2030s, which means that customers are still buying.”

The booming widebody market is a major contributing factor. “I am surprised by how early it has come back,” de Saint-Exupery says. “We were expecting it to come back by the end of

this year, but in fact it became really dynamic in mid-2023.”

Numerous large widebody campaigns are ongoing, many of them in the Middle East—involving Qatar Airways, Riyadh Air, Saudia and others—or the Asia-Pacific region. Before de Saint-Exupery started his new position, Qatar resumed deliveries of Airbus A350s, following an out-of-court settlement of a dispute with the OEM over surface degradation. Now the airline is talking about ordering 200 additional widebodies from both Airbus and Boeing, likely including many more A350s.

In response, Airbus has decided to boost A350 output to 10 per month in 2026 and 12 in 2028. But even with the increase, the manufacturer is “essentially sold out” of the type until 2030, he says.

De Saint-Exupery says one of his main goals for 2024 is for “the [Airbus] A330neo to deploy its wings.” Since the type’s launch in 2014, Airbus has received only 319 firm orders for the A330neo; 131 aircraft have been delivered so far. Part of the problem: The large in-service Airbus A330 fleet in China is still relatively young. Even so, de Saint-Exupery says, “China is awakening to the A330neo; it is quite looked after by the airlines.” China is allegedly considering an order for about 100 of the aircraft, which would also help generate work for its currently idle A330 Completion and Delivery Center in Tianjin.

The widebody boom creates its own dynamic. “Not ordering means relying on a market turn—which is a bit of a bet and not one we like—or relying on lessors,” de Saint-Exupery notes. While some airlines may be tempted to get into the queue, he says he does not see “irrational behavior.” Orders for deliveries in the early 2030s are generally “well thought through,” he says.

Lessors make up the one market segment that is currently weak by comparison. Lessors’ share of the Airbus backlog has grown to about 30% in the past few years, and although lessors were critical in helping airlines bridge the pandemic financially, the conditions today play somewhat

against them. Interest rates are much higher, and the long lead times for deliveries are a particular problem. "Buying an aircraft for 2030 or 2031 means escalation in pricing and uncertainty about whether lease rates [can be] sustained at the [necessary] level," de Saint-Exupery explains. Airbus has, therefore, "seen a slowdown in lessor ordering," he notes, although "they are looking at [orders] again."

Nonetheless, de Saint-Exupery expects lessors' share in the orderbook to decline in the next few years. He is concerned that the share might drop too much, pointing out that "[lessors] are extremely resilient and very good partners in times of crisis." De Saint-Exupery says the lessor share could drop to the low 20s but thinks "a good spot is probably in the middle [between 20% and 30%]." Of course, lessors also have the option of getting back into the market quickly through sale-leaseback transactions at the time of delivery, which would remove the risks associated with long lead times.

Airbus does not keep slots in reserve

in case a big lessor changes its mind, but "we talk to them daily and tell them where we are," de Saint-Exupery says.

One frustration in the new job: having far fewer aircraft available for sale than airlines would take. "Would I like to have more aircraft being produced in due course?" de Saint-Exupery asks. "Yes, of course, because right now the market would actually take everything. But I would like to think that I'm a reasonable leader. I'm conscious that we will have to get there first in a reliable and stable way, [to] sustain that, and then we will see whether we can do something else. The market would take more than that today, for sure."

But Airbus is delaying the ramp-up of A320neo-family production to 75 aircraft per month into 2027 from 2026 because of worsening supplier issues. The supply chain is still "very constrained," and there are "many areas of friction," so "we are not out of the woods yet for sure," de Saint-Exupery says.

Airbus' next narrowbody plans,

which Faury announced ahead of the 2023 Paris Airshow, are not yet a subject for customer conversations, as the new sales chief has found out. "It is still too far out for fleet-planning purposes," he says. Plus, 70% of the in-service fleet belongs to the old generation. Many Neos and Boeing 737 MAXs remain to be delivered before the manufacturers can take the next step.

What are the greatest frustrations, apart from not having enough aircraft to sell? De Saint-Exupery just attended his first International Air Transport Association (IATA) Annual General Meeting in Dubai, where he met with 60 customers. One of the recurring topics was the delivery delays that have ailed Airbus, either through its own fault or because suppliers have been late.

Ultimately, it is de Saint-Exupery who receives the messages from unhappy customers. "The thing that I am most worried about is executing on our commitments," he says. "I face customers every day, and I hate to disappoint them." 🌐

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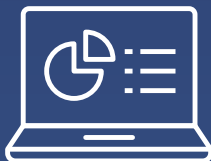




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# GPS Interference Grows as a Concern for Civil Aviation

➤ JAMMING CAN BE DISCERNED FROM ADS-B DATA

➤ SPOOFING IS MORE DANGEROUS BUT ALSO HARDER TO COMBAT

**Graham Warwick** Washington

Increased jamming and spoofing of GPS have regulators and startups alike looking for ways to detect and mitigate the impact on civil aviation of interference with global navigation satellite signals, unintentionally and intentionally.

Most of the interference has been seen in Eastern Europe and the Middle East, where jamming and spoofing of GPS is being used as a defense against drones in conflicts in Ukraine and Syria. But jamming has also been seen in the U.S.

Jamming—the unintentional or intentional denial of signals—is relatively simple to detect using data already included in automatic dependent surveillance-broadcast (ADS-B) messages transmitted by aircraft. But spoofing is harder to combat—and potentially more dangerous—as it

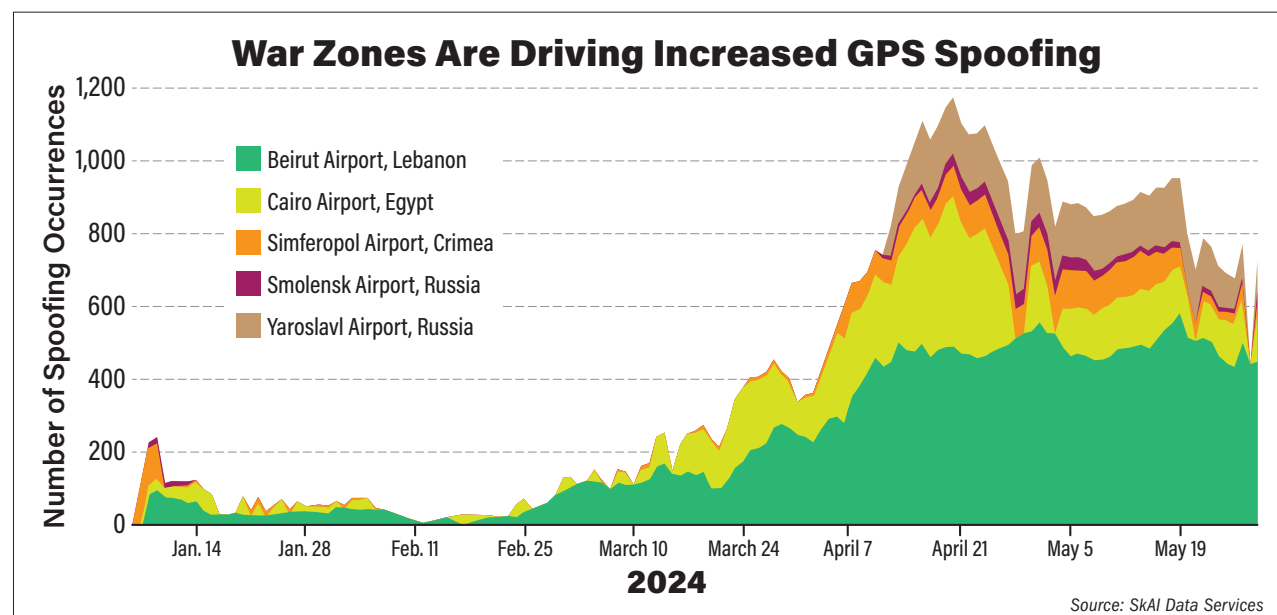
is still 40% higher than the baseline, the organization says.

According to IATA, Europe accounted for almost 70% of GPS signal-loss incidents from January 2023 to March 2024, the Middle East and North Africa 15.4%, the Commonwealth of Independent States 7.2% and the Asia-Pacific region 3.6%. The U.S. saw less than 1% of events.

In the U.S., where jamming remains the principal issue for civil aviation, Mitre Corp. has developed a prototype system called the Navigation Operational and Planning Agility Suite (NOPAS) for the FAA to monitor signal degradation and assess its impact on aircraft navigation.

The federally funded research and development center points to two recent cases in the U.S., at Denver International Airport in January 2022 and Dallas-Fort Worth (DFW) International Airport in October 2022. The event at Denver lasted 33 hr. and affected aircraft within a 230-nm radius at altitudes up to 36,000 ft. The interference was traced to a source unintentionally emitting a signal on the GPS L1 frequency. The DFW event lasted 24 hr., and the source of interference was never identified, ending on its own.

“When GPS signals become unavailable, the FAA needs to know as quickly as possible,” says Wayne Cooper, NOPAS project lead at Mitre. “They also need to know whether ground-based navigation aids are available for use in the af-



involves the malicious manipulation of signals to mislead the GPS receiver about its actual location.

While jamming has been a recognized problem since the early days of GPS due to the satellite signals' very low power, spoofing is a relatively new and growing issue for civil aviation. This is because the techniques are increasingly being used in combination to combat the massive growth in the use of drones in conflicts, making signals unreliable over large areas around war zones.

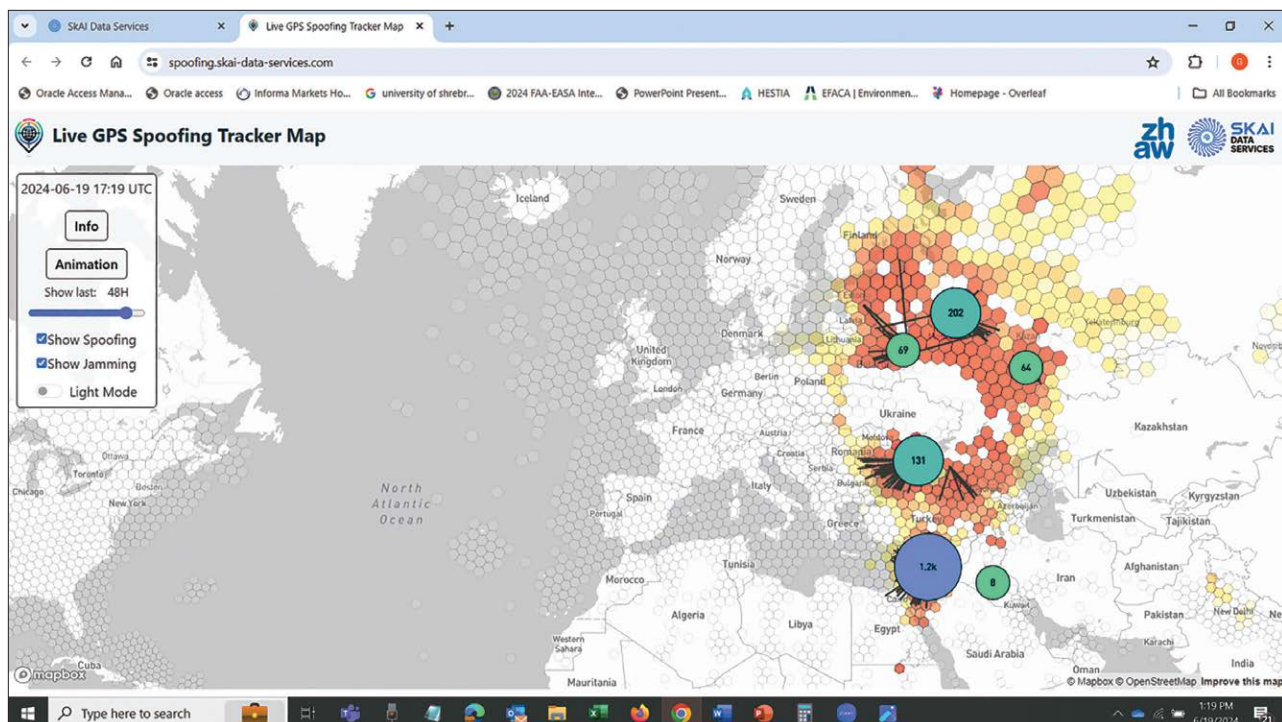
Globally, the average number of GPS signal-loss events was 24 per 1,000 flights before May 2023, when interference began to peak, says the International Air Transport Association (IATA). Events spiked by almost 79% to peak in August 2023 at 40 events per 1,000 flights before dropping to 34 per 1,000 flights. The current average number of events

affected region so they can determine the best means to maintain safe and efficient flight.” Mitre is working to accelerate the speed at which NOPAS processes data. “Right now, we can identify a GPS degradation event within a few hours of when it began,” Cooper says. “Our target is to do it within 15 min.”

The U.S. jamming events in 2022 underlined the importance of backup navigational aids. “No quantifiable effect of the GPS disruption could be observed at either airport, despite the closure of a runway at DFW,” states a June 14 report by policy consultancy London Economics International. “The readily available backup systems at DFW and [Denver] and the aircraft’s immediate ability to revert to these systems preserved value and prevented disruption.”

The same was not true at Tartu Airport in Estonia, where Finnair suspended its flights on April 29 this year after GPS





### SkAI Data Services' live tracker shows the concentration of GPS jamming and spoofing around Ukraine and Syria.

interference forced two of its aircraft to abort landings there. Unlike Denver and DFW, Tartu had no ground-based navigation aids. The airport subsequently installed non-GPS backups, and Finnair resumed flights on June 2.

Today, air traffic controllers typically find out about GPS degradation events through pilot reports. But ADS-B messages from aircraft contain data about GPS accuracy and integrity. NOPAS uses this data to identify jamming events in near real time, Mitre says. The system produces a heat-map display of the locations where GPS is unreliable, overlaid with a map showing the other navigation systems pilots can use in these regions.

"Today, the impact of a GPS jamming event can last for several days," Cooper says. "By reacting faster, the FAA has the potential to limit the impact to a few hours." Disruption can also result from planned GPS jamming in support of U.S. military exercises. As a result, additional NOPAS capabilities are being developed to help the FAA better coordinate with the Defense Department on scheduling.

As a next step, Mitre plans to develop the capability to distinguish GPS jamming from spoofing. But detecting spoofing is more challenging and requires more data than just that from ADS-B. "There will be several methods, including comparing radar data to ADS-B data and looking for system dynamics that aren't possible for the aircraft, such as derived aircraft velocities that aren't physically possible," Mitre says, adding that it "is also pursuing onboard spoofing detection algorithms."

While Mitre says spoofing is "very, very rare" in the U.S., it is not so in Europe and the Middle East, says Benoit Figuet, co-founder of SkAI Data Services. The Swiss startup provides an open-access, live GPS interference tracker using ADS-B data provided by OpenSky Network. And spoofing is on the increase. "There has been jamming around Syria for years. Now we see spoofing on top," Figuet notes.

Detecting GPS spoofing with just ADS-B is impossible,

Figuet says, although it is possible with wide-area multilateration, a surveillance system that uses a network of ground sensors to cover an area in combination with ADS-B. "Post-processing is easier than live, as you can check for jumps in aircraft position," he says. "But it doesn't really work as you catch all the noise in the data."

"We assume it is not targeted spoofing, so we look for concentrations of aircraft," Figuet continues. "We can detect it if more than one aircraft is spoofed. We usually have jamming at the same time in the same area. With jamming, we lose position, but still get accuracy data [from ADS-B], so the aircraft disappears, appears at the spoofed location, then reappears."

There are also distinct patterns to spoofed flights. "Some airplanes are spoofed to a static location, some of them are circling, and some of them are doing weird shapes," he says. Recently, SkAI detected spoofing of flights between North and South Korea. Although only four spoofed flights were detected by the live tracker, post-processing revealed more than 40 flights were affected on May 28-30.

"The GPS spoofing we've observed in Korea is something new . . . and quite different from what we see elsewhere," Figuet says. "Unlike the constant positions, circular patterns or '&'-shaped patterns we see in Crimea, the spoofed locations in Korea were changing frequently."

Spoofed GPS signals can affect not only aircraft position information, but also ground speed and altitude indications as well as the aircraft's clocks, says the U.S.-based National Business Aviation Association. The erroneous position information may also set off the aircraft's terrain alerting systems in all flight phases and lead to other confusing aircraft behaviors.

Spoofing can also lead to issues hours later, Figuet notes. The reason why this happens is not clear but could be related to how the flight management system processes data, "and we believe it could be different between aircraft types," he says. 🌐

# Gaining Momentum



- > EMBRAER EXPECTS A SURGE IN E2 SALES
- > THE OEM WEIGHS ADDING A LARGER NARROWBODY
- > THE ENERGIA CONCEPT SHIFTS CAPACITY FOCUS TO A 50-SEAT SUSTAINABLE AIRCRAFT

**Jens Flottau** Sao Jose dos Campos, Brazil

**F**or one reason or another, sales of Embraer's E2 family have lagged the manufacturer's expectations. Among the airframer's explanations: a young in-service fleet, the COVID-19 pandemic, U.S. scope clauses and airlines up-gauging rather than "rightsizing"—Embraer's favorite assertion in favor of its E-Jets. Now executives at the Brazilian aircraft manufacturer are becoming more confident that E2 sales will soon take off, and the implications could reach far beyond the program.

The upcoming Farnborough International Airshow could be "the best show ever for Embraer," CEO Francisco Gomes Neto said during a company briefing at its headquarters here

on June 18. A combination of factors is at play: strong passenger demand leading to fast growth, production constraints at Airbus and Boeing pushing carriers to look at alternative

lift and more airlines waking up to the idea of adding smaller narrowbodies to their fleets.

In the market for jets up to 100 seats, Embraer effectively enjoys a monopoly. It secured an order for 90 E175s from American Airlines, which could soon be followed by commitments from some of American's competitors. Canada's Porter Airlines is fast introducing a large fleet of 75 E195-E2s, 34 of which have been delivered. As Porter flies the aircraft to many U.S. destinations, Embraer hopes other carriers also will recognize the value of the aircraft—scope clauses notwithstanding.

In Mexico, Embraer has landed its first E2 deal for 20 E190-E2s and E195-E2s, split evenly, at the new Mexicana.

A strengthened Embraer could have deep strategic consequences as the company considers its next steps, which might include a new aircraft larger than the E2 that would compete with narrowbodies such as the Airbus A320neo and Boeing 737 MAX. "We see this window of oppor-





# tum

EMBRAER

tunity, of course, just like the market, but we need to better understand the scenarios,” Gomes Neto tells Aviation Week. “We don’t want to put the company at risk. If we do some movements in the future, we have to be financially very stable to finance this together with other partners.”

Embraer is putting some serious thought into its options. “We are making studies all the time. We are investing in new technologies to be ready when one day we decide to move,” Gomes Neto says. “We are talking about the propulsion system, autonomous flight to simplify the operation and airframe competitiveness. We are studying new wings and new fuselage designs. We are working on all those fronts to help us apply these technologies to a new product. I know the anxiety in the market, but we don’t have a concrete plan yet to share. Our engineers are working on it.”

For now, the strategy is about gaining more momentum for the E2s, which current operators are praising. KLM Cityhopper Managing Director

Maarten Koopmans said at the Embraer briefing that the airline’s E2s use about 30% less fuel per seat than the previous generation on the same missions. Porter CEO Michael Deluce said at the briefing that the aircraft have a 26% trip cost advantage over larger narrowbodies and “highly competitive seat costs versus the MAX.”

As in-service efficiency and performance exceed Embraer’s own numbers, the OEM plans to calculate updated E175 and E2 family figures for the Farnborough Airshow. They will include better fuel burn and takeoff performance as well as lower maintenance costs, Rodrigo Silva e Souza, vice president of marketing at Embraer, said June 19. Embraer also will

### **Embraer aims to produce up to 80 E-Jets by year-end and plans to build around 100 in 2026.**

reveal cabin upgrades. On the E175, Embraer plans to introduce improvements to the interiors and avionics functionalities as well as add connectivity options. “We want to keep it competitive in the market,” Silva e Souza said.

The weakness observed in the U.S. market due to the pilot shortage has been “more or less addressed” by the airlines, he noted. “American was very important to mark a return of the regional market in the U.S.,” he noted.

Embraer also is talking with other U.S. carriers as it projects a considerable replacement wave. The company expects U.S. regionals to retire more than 300 76-seat aircraft through 2029, leading to a replacement demand of about 40 aircraft per year for that market alone. Embraer plans to deliver between 72 and 80 commercial aircraft by year-end, up from 64 in 2023.

Gomes Neto says the company is targeting 100 in 2026, and he can see a further production increase to about 130 in the following years, mainly as demand grows for the E2.

For now, Pratt & Whitney geared turbofan engine issues are preventing a production ramp-up. “Deliveries are restricted by the number of engines; we would like to deliver more,” Silva e Souza said. Still, he stressed that “we are growing faster than the competitors” and deliveries could increase 30% this year. He added that he expects the engine issues to be largely overcome by 2026.

Meanwhile, Embraer has embarked on a project to introduce a more even production and delivery stream. “We want to improve the linearity of production and deliveries” to avoid peak workload at the end of each quarter and year to meet output targets, Gomes Neto explains.

“We decided to do something different,” he says. “It is a cultural issue. It is not OK to deliver only at the end of the quarter,” as it makes the production process less efficient and creates more overtime work, thus increasing cost. To even out the production and delivery stream, Embraer is developing more detailed weekly rather than monthly production plans, trying to ensure that “the right parts are there at the right moment” while reducing quality issues.

Gomes Neto says the first results should already be noticeable, but the real effects should be felt starting next year.

Concept studies for Embraer’s sustainable Energia family of regional aircraft have changed focus to 50-seat configurations, a move that will require more time for development than expected for the initial 19-30-seat versions. Customer feedback has been positive in general, but airlines told Embraer they need a larger capacity than what the company originally envisioned, Silva e Souza said.

A hybrid-electric version of the Energia series could be available after 2030, whereas the smaller aircraft is targeted for service entry by 2030. A dual-fuel variant that can use sustainable aviation fuel or hydrogen could be available by 2038. A fuel-cell-powered version is planned to be ready by 2035, around the same time that Airbus hopes to introduce its first hydrogen-powered aircraft.

Energia aircraft are picking up the rear-mounted engine placement from earlier studies for a more conventional turboprop. The company had shelved that project after it could not secure an engine partner.

The hybrid version would fly ranges up to 600 nm, the dual-fuel-powered aircraft could go up to 900 nm, and the fuel-cell version could be designed for ranges up to 600 nm, Silva e Souza said.

Embraer also has signed a memorandum of understanding with Finair for deeper studies of the Energia aircraft requirements and performance parameters. ☛



# Flight Attendants at U.S. Carriers Are Weighing Strikes and Deals

- SOUTHWEST HAS SET THE BAR FOR FLIGHT ATTENDANT CONTRACTS
- DELIVERY DELAYS PUT PRESSURE ON U.S. AIRLINE STAFFING

**Christine Boynton** Boston

**H**alfway through 2024, flight attendants at U.S. mainline carriers are beginning to see progress in contract negotiations.

For some, terms of the last agreement became amendable before the onset of COVID-19, when talks were paused as the industry entered one of its most disruptive periods in recent decades. As talks resumed and months turned into years, several bargaining groups turned to the National Mediation Board for assistance in the process.

By late April of this year, flight attendants at Southwest Airlines had ratified a \$6.3 billion contract their union described as “set[ting] a new standard for the profession.”

**The union representing more than 27,000 flight attendants at American Airlines has requested a release from federally mediated negotiations as it seeks to begin a 30-day cooling off period that would precede the ability to strike.**

Two months later, Alaska Airlines flight attendants have reached a tentative agreement that the Association of Flight Attendants (AFA) expects will produce a “record” contract. Delta Air Lines’ nonunion group in June received 5% pay increases, following employee profit-sharing bonuses of 10.4% in February.

Among the five largest U.S. carriers, United Airlines and American Airlines have yet to reach deals with their flight attendants and remain in federally mediated talks.

Having seen their colleagues achieve landmark deals, Alaska, American and United flight attendants have high expectations—and in some cases, starting points are low.

According to the AFA, 37% of Alaska flight attendants have reported that they currently—or at some point over the past five years while employed by Alaska—received government food assistance, visited their local food bank

or relied on family loans or charity assistance to make ends meet. All six of the carrier’s flight attendant bases are located in cities that are among the nation’s most expensive, the union noted.

The Association of Professional Flight Attendants (APFA), representing more than 27,000 flight attendants at American, also has stressed low pay as an issue for the carrier’s junior flight attendants.



“New-hire flight attendants at American Airlines start at just \$27,000 per year,” the APFA said in early June. Drawing a stark comparison, the union pointed to the chief executive’s cumulative 2023 earnings of \$31.4 million.

“Robert Isom’s compensation package is now 1,162 times that of a new-hire flight attendant,” the APFA said.

American’s flight attendants began their negotiations at the start of 2020, then paused that spring before resuming in June 2021 and filing for federal mediation in March 2023. The APFA has requested a release from the process twice, seeking to start the clock

on a 30-day cooling-off period that would precede the ability to strike.

Under the Railway Labor Act, the National Mediation Board has to approve a release. The board denied the APFA’s request in November 2023, and the union expected a decision on its most recent request by the end of June.

“We remain apart on the key issues of the date of signing wage increase and retroactive pay,” APFA said in a June 20 communication to members, describing six weeks of intensive mediation as ending without agreement. It has opened a strike command center for internal preparations should a work stoppage occur.

Pressure to reach an agreement is building as the industry heads into what is projected to be a sustained period of high passenger volumes.

The Transportation Security Administration (TSA) has reported record-breaking summer travel passenger numbers in recent weeks. On June 23, the agency broke its record for the most people screened on a single day—nearly 3 million.

“We expect this summer to be our busiest ever,” TSA Administrator David Pekoske said.

Just months separate the end of lengthy U.S. airline pilot negotiations and the current state of open flight attendant contracts, and a shift has occurred in the interim. Heading into this year, several carriers announced plans to slow or freeze hiring as they assess

SCOTT OLSON/GETTY IMAGES

staffing while the bar for industry-leading pay gets higher.

Southwest and United have each directly tied their need to moderate staff headcounts to Boeing delivery delays.

While United and Alaska were the only two U.S. carriers operating Boeing 737-9 MAXs at the time of the type's January grounding, cascading consequences for the OEM have since broadened the event's impact, slowing deliveries of in-production aircraft and delaying certification of newer MAX variants.

United has removed the Boeing 737-10 MAX from its fleet plan and now expects to take delivery of 61 narrowbody aircraft this year, down from the 183 contractually expected and the 101 projected at the start of 2024. Southwest's anticipated deliveries of Boeing MAXs for the year have dwindled from the originally projected 79 and 85 contractual to 46 and then to 20.

For the rest of the year, Southwest

is cutting its capacity growth to 4% from the guidance of 6% and is working to reduce a now-surplus staff headcount by 2,000. United has lowered its hiring targets for this year to 10,000 from 13,000-15,000 due to delivery delays, although the carrier plans to lift the freeze on pilot hiring in July.

Delta, too, has moderated the intensity of its hiring and training in an attempt to normalize post-pandemic growth patterns.

American will pause new pilot class start dates for September, October and November in an effort to help optimize capacity and tailor talent growth plans to serve current needs. Last August, the carrier became the second of the Big Four (following Delta) to ratify a pilot deal—raising compensation rates by more than 46% over the contract's four-year term. A little over a week later, American's flight attendants authorized potential strike action in a nearly unanimous vote.

Now, with Southwest "having most

recently set the bar," the U.S. airline industry "is still working on setting a market rate for flight attendant pay," a June analysis from Jefferies notes. The report projects that American and its flight attendants are likely to reach a deal before a strike can occur, "due to the airline's desire for certainty."

The last group of U.S. airline workers released to strike were Spirit Airlines pilots, in 2010.

Seeking continued mediation with its flight attendants, American reported in a June 21 statement "good progress in negotiations this week," explaining that it had "add[ed] even more to the industry-leading proposal we've had on the table for months." Describing an agreement as being "within reach," the carrier stated it saw no indication of a release or approval to strike.

"We look forward to continuing negotiations so our flight attendants can benefit from the contract they deserve," an American spokesperson said. 🗳️

## European Consolidation Is Finally Taking Shape

➤ SAS WILL LEAVE STAR ALLIANCE FOR SKYTEAM AT THE END OF AUGUST

➤ EUROPEAN COMPETITION AUTHORITIES ARE SET TO APPROVE LUFTHANSA'S ITA DEAL AT LAST

**Helen Massy-Beresford** Paris and **Jens Flottau** Frankfurt

**T**he latest round of European airline consolidation is finally gaining momentum, with approval of Lufthansa's bid for ITA Airways expected imminently and Air France-KLM upbeat about its plans for Scandinavian Airlines as the carrier makes progress toward completing its restructuring.

The planned departure of Scandinavian Airlines (SAS) from the Star Alliance to join SkyTeam as part of Air France-KLM's deal to take an initial minority stake is "a huge plus," Air France-KLM CEO Ben Smith said at the Paris Air Forum June 13.

"We're very happy with this transaction," Smith said. "What's also a big plus for us is that they were part of the Star Alliance, they're exiting Star Alliance and coming into SkyTeam and potentially our transatlantic joint venture [with Delta Air Lines and Virgin Atlantic]—that is a huge plus." Smith noted that SAS already had moved some capacity to the mega-hub of Atlanta.

The swap will mark the first time an active founding member airline exits an alliance. SAS is set to leave the Star Alliance Aug. 31 and join SkyTeam Sept. 1.

"The frequent-flyer base is going to go through a transi-

tion period trying to ensure frequent flyers . . . do not lose any of their privileges in the transition," Smith said. "We do not have a management stake or position yet on the network of cities or schedules of SAS, so we're hopeful that through interline agreements and through the decisions SAS takes customers will be able to continue to fly on the major routes they need to through that transition period. It's a bit difficult; we'll get through it. It's a few months before we'll start to ensure that customers flying SAS will get exactly the same . . . as they have today."

In mid-June, SAS said it had published a reorganization plan in Sweden, and a vote on the plan is expected to take place in mid-July. Plan approval is necessary to complete SAS' Chapter 11 bankruptcy proceedings in the U.S.

Asked about Lufthansa Group's plans to buy ITA, Smith said "it will be pretty difficult for Lufthansa to be successful there" because of the configuration of the Milan and Rome bases, seasonal traffic patterns, the strong position of low-cost carriers in the Italian market and demanding conditions imposed by the Italian government for the ITA buyer. "It's a real challenge in terms of business model," he said.

For now, the good news for Lufthansa is that approval from European competition authorities appears to be close.

The European Commission and Lufthansa apparently have agreed at last on additional remedies that clear the way for the group's planned investment in ITA.

Lufthansa submitted a proposal in early June for additional concessions intended to alleviate the commission's concerns about competition on long-haul routes, industry sources told Aviation Week. Neither the company nor the commission commented about the proposal.

Lufthansa has agreed to take an initial 41% stake in ITA and also will appoint its new CEO, thereby taking leadership in the carrier's strategy and management. Full control is



planned for whenever ITA becomes profitable. The transaction has been subject to intense scrutiny by the commission, which launched an in-depth investigation into its potential effects on competition, particularly long-haul routes.

The commission demanded that ITA be kept out of Lufthansa's A++ transatlantic joint venture with United Airlines and Air Canada. According to the industry sources, a compromise has been reached, but they declined to share further details, noting that those could still change.

As the Lufthansa-ITA dossier moves slowly through the competition approval process, positive signs for approval are encouraging for other regional players interested in consolidation.

A parallel investigation is taking place for International Airlines Group's (IAG) planned buy of Air Europa. IAG recently submitted more concessions to the commission, and the verdict deadline has been pushed back to July 29.

For the Lufthansa-ITA deal, the commission has until July 4 to publish its decision, and the German and Italian parties are likely to continue working on some aspects of their agreement in the meanwhile.

The effects of Lufthansa's ITA buy on long-haul routes have been under particular scrutiny.



JOE PERSIMMONI/NET

Lufthansa plans to integrate ITA into the group just as it did with Austrian Airlines, Brussels Airlines and Swiss. ITA will retain its brand and separate management, while core functions, such as fleet procurement, group network management and sales, will be centralized. Rome-Fiumicino Airport will become another hub in the Lufthansa Group system with a particular focus on services to Africa and Latin America.

ITA's fleet fits well with Lufthansa requirements. The airline is taking delivery of more Airbus A320neos, A220s and A330neos. It also operates A350s. The A330neo is the only type no other Lufthansa Group carrier currently flies. 📌

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# Qantas and Airbus Overcome Regulatory Hurdle for Project Sunrise

- EUROPEAN REGULATORS ARE SATISFIED WITH CHANGES TO AN EXTRA FUEL TANK ON THE AIRBUS A350-1000
- AIRLINE EXECUTIVES ARE CONFIDENT IN THE REVISED 2026 TARGET

**Adrian Schofield** Dubai

**Q**antas has taken a major step toward gaining clearance for its Project Sunrise ultra-long-haul initiative after European regulators approved a key aircraft modification that had delayed the program.

Project Sunrise is aimed at operating record-breaking flights, initially from Sydney to London and New York, beginning in mid-2026. Qantas first announced the program in 2017, so

EASA has since approved the extra fuel tank, Qantas Group CEO Vanessa Hudson confirmed at a briefing on the sidelines of the International Air Transport Association's (IATA) Annual General Meeting here. This means the airline is "feeling very optimistic about the delivery timetable" for the A350-1000s, she said.

Airbus is also upbeat about progress on Project Sunrise following the

flights of more than 15 hr. to Europe and North America using Boeing 787-9s, and these are among its best-performing financially, Wallace said.

Qantas' flights in the 15-17-hr. range are from Perth to London and Rome, from Melbourne to Dallas and from Auckland to New York. Both of the initial Project Sunrise flights are estimated at 19-20 hr.

The Sunrise flights will complement Qantas' current network and boost revenue, Wallace said. The airline is increasingly optimistic about the "premium-dense" configuration on the Sunrise aircraft. Wallace noted that Qantas is seeing growing demand for premium products on long-haul aircraft, such as its 787-9s and Airbus A380s.

Qantas has been using its flight planning system to monitor the proposed Sunrise routes and gather data on optimal tracks based on wind and other factors, Wallace said. The airline is confident it will be able to develop a flight plan to account for any airspace restrictions that may still exist when Sunrise launches. Qantas is also continuing to work with Rolls-Royce on the engine specifications for these aircraft.

The airline is planning more international medium- and long-haul additions before launching its Sunrise routes. Some of these stem from a new deal it reached with Perth Airport on May 31.

Qantas intends to develop Perth as its second-largest international hub. The carrier is due to launch Perth-Paris flights in July and has announced routes from Perth to Johannesburg and Auckland beginning in 2025.

In the longer term, deliveries of additional 787s and A350s could allow new routes from Perth to destinations in Europe and Africa, Hudson said. And the arrival of long-range Airbus A321XLRs would enable narrowbody flights from Perth to markets such as India, Japan, Malaysia and Singapore.

Qantas sees a lot of growth potential in India in particular, Wallace said. The carrier operates a route from Melbourne to New Delhi and plans to increase frequency on its Sydney-Bengaluru service. Qantas also announced an expansion of its partnership with Indian carrier IndiGo in May.

India accounts for just 3% of Qantas' international capacity. But Wallace noted that "the economic fundamentals [in India] are really compelling for us—we're going to invest more in that market." 🌐



## Qantas ordered 12 modified long-range versions of the Airbus A350-1000.

there would be almost a decade from inception to launch due to a long gestation period and setbacks that were largely beyond the airline's control.

The Australian carrier was poised to order modified versions of the Airbus A350-1000 for the initiative in 2020, but the COVID-19 pandemic put the plan on ice. Qantas finally ordered 12 of the aircraft in 2022, with service entry planned in late 2025, but another delay in February of this year pushed this target back about six months.

The latest holdup came from the European certification process for the modified A350-1000s. Airbus added an extra center fuel tank as part its specifications for the long-range version of this aircraft. However, the European Union Aviation Safety Agency (EASA) asked for a redesign of this fuel tank.

fuel tank approval. "We are on track for certification of [all] the modifications to the aircraft and first delivery in mid-2026," the manufacturer told Aviation Week.

Hudson's comments indicate that Qantas' enthusiasm for Project Sunrise has not waned despite the delays and the carrier's leadership transition. The project was initiated and avidly backed by former CEO Alan Joyce, whom Hudson replaced in September. Qantas remains fully committed to the ambitious plan and is "very excited" about launching it, Hudson said.

In the meantime, more "economic proof points" about the viability of the Project Sunrise flights are emerging, Cam Wallace, Qantas CEO for international and freight, said at the IATA meeting. Since the plan was first mooted, the carrier has added multiple



# Boeing, Pressured To Show Change, Points to Process Improvements

- CHANGES IN TRAINING AND INSPECTIONS ARE IN PLACE
- INDEPENDENT SAFETY MONITOR IDEA REMAINS IN PLAY

**Sean Broderick** Renton, Washington

**M**etrics that indicate an aircraft manufacturer's success—backlog, production rates and deliveries—will always matter for Boeing. But the struggling company's progress toward operational and financial stability will be tracked by different figures that show the effectiveness of its effort to make fundamental, lasting changes.

figures for production rates and deliveries will come when Boeing's production lines can move faster without triggering warnings built into the KPIs.

For instance, if too many jobs are traveling—or not being completed within their designated production line positions—alarm bells should sound. Conversely, if Boeing stays within the parameters it set, produc-

rectly the first time or workers have sufficient proficiency requires fundamental changes. The most visible of these is Boeing's pending purchase of Spirit AeroSystems, intended as a long-term solution for halting the steady flow of mistakes that come out of the supplier's shops and create havoc within the airframer's walls (AW&ST May 6-19, p. 20).

Boeing has stepped up quality inspections at Spirit to help cut down on the number of nonconformances that leave the supplier and become potential bottlenecks—or worse. All of the recent changes—and many still to come—can be traced to five incorrectly installed rivets on a 737-9 fuselage and, as Lund revealed, a woefully inadequate Boeing process for addressing such issues.

The airframer flagged the problem soon after the fuselage was delivered to the Renton plant last fall. The fuselage, nonconforming rivets and all, went through the entire production process while Boeing and Spirit deliberated over how to fix the issue.

**New parts-tracking processes and simplified work instructions are among the changes Boeing is introducing.**

"The airplane was at the end of the line by the time we all reached agreement that some rivets needed to be removed and replaced," Lund said. Accessing the rivets required opening a mid-exit door plug by removing four retaining bolts, or pins. "We believe that plug was opened without the correct paperwork," she said.

Once the rivets were repaired, a Boeing "move crew" that relocates aircraft went through its checklist, which includes closing doors. They closed the door plug, but without paperwork to reference, the move crew team did not know that bolts needed to be reinstalled.

As part of the documentation of its work, the move crew took a photo of the door plug after it was closed. Clearly visible in the image: gaps where pins should have been.

"They did not reinstall the retaining pins," Lund said. "That is not their job. Their job is to just close it, and they count on existing paperwork. The paperwork goes with the airplane. All



JENNIFER BUCHANAN/SEATTLE TIMES POOL PHOTOS

Both Boeing and the FAA were criticized when the manufacturer's much-anticipated turnaround plan, developed in 90 days and handed over to the agency at the end of May, emphasized six business school-like key performance indicators (KPI). Tracking issues such as the number of hours spent reworking incorrectly done jobs or incomplete tasks on aircraft rolling off the assembly line sound rudimentary for an aerospace manufacturing titan.

But Boeing's plan, developed with the FAA's input, does not introduce the KPIs. Rather, it establishes ranges to be maintained within each. Improved

tion should run more smoothly—and eventually more quickly.

"We are running our business based on these KPIs, as well as reviewing them with the FAA," Elizabeth Lund, Boeing senior vice president of quality, explained during a June 25 media briefing at the airframer's 737 production facility here.

Each KPI has a green, yellow and red range, or "control limit," Lund said. The precise ranges were derived by looking at "seven or eight years" of historical data for each aircraft program from "when we were healthy."

Ensuring that jobs are done cor-

of the jobs are worked. Any open job gets worked later in the process. In this case, because we believe the paperwork was never created, there was no open paperwork that traveled with the airplane.”

The 737-9 was delivered and flew 154 flights before the door, resting inside stops attached to the frame, worked itself free and blew off during Alaska Airlines Flight 1282 on Jan. 5.

While the flight crew landed the aircraft safely, and nobody was seriously hurt, the near-disaster exposed a stark reality. Boeing’s quality control processes and tolerance for fixing mistakes instead of preventing them were so risky that a routine production issue such as nonconforming rivets could be enough to cause a major in-service event.

The NTSB, which earlier blasted Boeing for not having paperwork detailing who opened and closed the door plug, said Lund’s comments were not vetted in advance with the board—a violation of investigative rules. Boeing is still participating in the Alaska probe, but with newly restricted access.

Following the Alaska occurrence, the FAA launched immediate probes into both the 737-9 and Boeing’s production.

The 737-9 was quickly cleared of any systemic risks. However, an FAA audit found deep-rooted problems at Boeing that prompted the agency to limit 737 production to 38 per month until the manufacturer can demonstrate consistent stability (*AW&ST* Feb. 12-25, p. 16). Boeing is now rolling out 20-25 737 MAXs per month, according to data from Aero Analysis Partners/AIR, and does not expect to reach 38 for several months at least. The 90-day plan ordered by the FAA lays out how it intends to achieve that.

Beyond that plan, Boeing’s immediate steps included developing a written procedure for opening and closing mid-exit door plugs. It then examined other seemingly benign procedures that, if not done correctly, could put an aircraft at risk. It added predelivery inspections on many of them “out of an abundance of caution,” Lund said, and reexamined documentation to ensure procedures are clear.

That led to broader conversations with employees who are identifying production issues that merit attention, she said.

Among the recent changes are new



### Boeing is seeing fewer defects on fuselages produced by Spirit AeroSystems.

work-in-progress racks that follow an aircraft around with digitally tracked parts and documentation detailing what work remains to be done.

Boeing also is revisiting archaic documentation that often left jobs unfinished and workers scratching their heads.

“We have been operating under the same foundational elements of many of our processes and procedures for 50 [or more] years,” Lund said. “We have updated them . . . but primarily we have added to them. What we ended up with is a deep and broad list of [documentation] that is particularly difficult for new employees to come in, grasp and understand.”

Increased inspections at a supplier or enhanced training programs for new employees can be implemented quickly. But rewriting work instructions or lifting the general experience level on an aircraft factory floor is more involved.

“This is a journey,” Lund said, repeating a line often used by Boeing executives in recent months.

But some are losing patience. Family members of victims killed in the two fatal 737-8 accidents in 2018 and 2019 want the U.S. government to charge Boeing criminally, citing the company’s violation of a 2021 deferred prosecution agreement linked to the accidents. Some members of the U.S. Congress agree.

The Justice Department determined in May that Boeing violated the agreement. It is considering criminal charges; a decision is expected in early

July. The company says it has honored the agreement’s terms.

Also in play is an independent safety monitor, which the FAA said it would explore as part of its audit. Family members of 737-8 accident victims also have asked a U.S. judge to name one.

The idea has been floated to alleviate issues flagged within Boeing’s FAA-granted organization designation authorization (ODA). But given the manufacturer’s scope—it holds four different types of ODA authority, including one for type certification and one for production—a single organization, let alone just one monitor, may not be enough.

“A single, third-party ODA may not be able to adequately monitor all Boeing activities,” says Mike Borfritz, a former FAA and Boeing engineer with extensive certification experience who is now CEO of consultancy Kilroy Aviation, which recently earned ODA approval. “Boeing has three final assembly plants. The concept of separate ODAs for each plant and airplane model, including out-of-production models, may be worth considering.”

Borfritz acknowledges in a soon-to-be-published white paper that an independent ODA could not be set up overnight, but he suggests that a “supervisory audit function” reporting to the FAA and Justice Department could stand in as it is formed.

“The third-party Boeing ODA concept would admittedly be a difficult undertaking,” Borfritz says. “But it offers a solution to many aspects of Boeing’s current troubles.”



## AAM Launch Plans and Challenges Are Coming Into Sharper Focus

> **JOBY'S AIR TAXI OPERATING SYSTEM IS APPROVED FOR USE**

> **ARCHER UNVEILS PLANS FOR eVTOL NETWORK IN THE SAN FRANCISCO BAY AREA**

**Garrett Reim** Seattle, **Angus Batey** London, **Ben Goldstein** Boston and **Graham Warwick** Washington

**L**eaders in the development of electric air taxis have unveiled details of their plans to launch services, but whether paying passengers will fly first in the U.S. or another market remains unclear.

Archer Aviation and Joby Aviation both aim to certify their electric vertical-takeoff-and-landing (eVTOL) air taxis in 2025. But whether they can

Level C-approved flight simulator for pilot training. That is not the case in markets such as the United Arab Emirates (UAE).

At the Revolution.aero event in London on June 18, Archer Chief Commercial Officer Nikhil Goel said it was “really tough” to assess where the company’s Midnight eVTOL will begin commercial operations first.

full-flight simulator to train type-rated pilots, “for initial commercial operations in Dubai, we’ll use a fixed-base Level 7 simulator, which will be delivered by CAE next year,” says Bonny Simi, Joby president of operations.

She describes the Level C simulator, also being developed by CAE but requiring validated aircraft data from flight testing by Joby, as a “long lead” item, requiring hundreds of tests to ensure the simulator matches the aircraft and meets FAA requirements. “Once we complete the type certificate for our aircraft, the simulator process kicks in. It runs in parallel, and we anticipate it to be just a few months,” Simi explains.

“But we will be able to operate our aircraft prior to that in market surveys as well as through our Part 91 operations, including air tours,” Simi

says. Market survey flights would allow Joby to carry nonpaying passengers on demonstrations, while the startup sees air tours conducted under Part 91 rules for private aviation as a potential niche market.

Flights under Part 91 could offer the opportunity for a soft launch in 2025 if full commercial service is delayed. “While our core focus is bringing commercial passenger service to market using our Part 135, we do think air tours operated under Part 91 offer an interesting opportunity,” Joby says, noting that tours often take place over environments easily disrupted by noise, such as national parks.

Joby on June 20 unveiled ElevateOS, a vertically integrated software suite that is designed to

handle everything from the pilot checklist to passenger bookings. The FAA has authorized the company to use ElevateOS in its existing Part 135 operation, and Joby has been testing the software to book and coordinate charter flights for employees and outside passengers on a company-owned Cirrus SR22.

ElevateOS includes preflight and post-flight checklists for pilots, and it tracks passenger and luggage weight as well as aircraft balance. The oper-



**Joby's ElevateOS software suite is designed to integrate with Uber's app and Delta's booking system to enable end-to-end journeys.**

JOBY

launch commercial operations by the end of next year, as promised to their investors, depends on their completing regulatory steps required after type certification.

Joby and Archer have received their FAA Part 135 air carrier certificates, allowing the companies to gain experience operating an internal air taxi service using fixed-wing aircraft. However, launching commercial service in the U.S. will require not only a type-certified eVTOL but also a

“We’re pushing really hard with the FAA, we’re pushing hard with the UAE, India and [South] Korea. We’ve got the highest-level support in all those countries,” he said. “But they also have their processes, and it’s not on me to predict who could be first. I think they’ll all come through in the next 18-36 months.”

Joby indicated previously that it could launch service first in the UAE in 2025. Where on-demand operations under FAA Part 135 require a Level C



ations part of the software manages aircraft and pilot availability, maintenance data and landing pad access information. The matching system is designed to line up passengers, aircraft, pilots, routes and landing pads.

To build its software, Joby drew on experience from Uber Elevate, the ride-hailing company's air taxi initiative that, for a time, included a service called Uber Copter, which allowed customers to book helicopter flights in New York using the Uber app. Joby acquired the Elevate team in 2020.

Uber is now an investor and partner, and ElevateOS will integrate with its app to allow passengers to book end-to-end journeys. ElevateOS also will integrate with the booking system of Delta Air Lines, with which Joby has partnered to provide airport shuttle service beginning in New York and Los Angeles.

Archer announced on June 20 as well plans for an air mobility network connecting five locations in the San Francisco Bay Area. The news came two weeks after the FAA awarded a Part

135 certificate to Archer Air, the subsidiary that plans to operate Midnight eVTOLs on behalf of United Airlines. United has 200 aircraft on order, and the companies have announced their first routes in New York and Chicago.

Archer has signed a memorandum of understanding (MOU) with developer Kilroy Realty to anchor the new network at Kilroy Oyster Point, a waterfront campus in South San Francisco. The network would include vertiports at Livermore, Napa, Oakland and San Jose.

Home to a wealthy population that might be willing to pay for time savings, the region is famously car-dependent, traffic-choked and geographically divided by a large bay and series of mountain ranges. Archer imagines 1-2-hr. car drives being reduced to 10-20-min. hops in its eVTOL.

Archer also has announced an MOU with Signature Aviation, giving it access to the fixed-base operator's (FBO) network of more than 200 U.S. locations. Under the agreement, Archer plans to install Beta Technologies'

multimodal charging stations across the network and expects to begin electrifying initial FBO locations as early as 2025. Archer signed a similar MOU with FBO operator Atlantic Aviation in January, and Joby has agreements in place with both Atlantic and Clay Lacy Aviation.

Operating plans for other eVTOL aircraft also are coming into focus. In May, airline startup UrbanLink signed an agreement to purchase 20 Lilium Jets, with an option for 20 more, for operation in South Florida and other U.S. markets. Service launch is targeted for 2026, linking Boca Raton, Fort Lauderdale, Miami and West Palm Beach.

UrbanLink subsequently partnered with Ferrovial Vertiports to collaborate on the development of facilities beginning with the infrastructure developer's planned South Florida vertiport network. Lilium, meanwhile, has joined forces with Luxaviation Group to electrify Execujet's network of FBOs across Europe initially and later in the Middle East. 🌐

## Regional Aviation's Future Could Rest With FAA Actions on Public Charters

➤ THE AGENCY IS REWRITING RULES FOR PART 135 PUBLIC CHARTERS

➤ A NEW OPERATING AUTHORITY COULD EMERGE FOR 10-30-SEAT REGIONAL AIRCRAFT

**Christine Boynton** Boston and **Graham Warwick** Washington

**T**he FAA's move to address the growing frequency and complexity of public charter flights presents both challenges and opportunities for the advanced air mobility industry.

On the challenge side, rewriting the operating rules could prove an existential threat to the likes of JSX, which operates Part 135 public charters with used Embraer regional jets refitted with 30 seats but plans to buy a total of more than 330 hybrid-electric 9-, 19- and 30-seaters.

On the opportunity side, the FAA has promised a parallel effort to assess the feasibility of new operating authority for scheduled operations in 10-30-seat aircraft. This could lead to new regional air mobility operations that major airlines do not view as a direct threat.

The agency announced two actions on June 17 to address public charter flights. The first will see amendments to the definitions of scheduled, on-demand and supplemental operations under the Part 110 general requirements for commercial air carriers.

The second will provide for a safety risk-management panel of agency experts and external stakeholders "to put a safety lens over the options of future innovation, as we work to further connect small and rural communities, to open up more options for everyone at the same high level of safety," FAA Administrator Michael Whitaker said in a statement.

In response to an earlier FAA request for comment on proposed regulatory changes, industry trade organizations in October jointly warned

that eliminating operations conducted as public charters from Part 135 risked removing that opportunity for innovative business models using electric aircraft.

Public charter services have grown as the major airlines have cut back on flights to smaller communities. Opposition has come from major airlines and pilots' unions, which argue operators like JSX are providing scheduled flights without having to meet the same safety and security rules as scheduled carriers.

A public charter operator sells seats on chartered aircraft that can operate from private terminals at airports, using on-demand operating authority under Part 135 rules. This allows the operator to use simplified security screening and hire pilots with less than the 1,500-hr. minimum required for scheduled airlines operating under Part 121 rules.

"Some services appear to operate like scheduled airliners but under less rigorous safety regulations," the FAA said in announcing its actions. "If a company is effectively operating as a scheduled airline, the FAA needs to determine whether those operations should follow the same

stringent rules as scheduled airlines,” Whitaker said.

“If finalized, the effect of this proposed rule change would be that public charters will be subject to operating rules based on the same safety parameters as other nonpublic charter operations,” the FAA said. The agency intends to issue a notice of proposed rulemaking “expeditiously” but plans to seek comment on an effective date that would allow industry to adapt to any change.

The National Air Transportation Association (NATA) said it expects the FAA’s rulemaking process will include time “to base any changes on accurate data rather than competitive issues,” while expressing a commitment to safeguard Part 135 from what it considers harmful regulatory changes.



AURA AERO

**Public charter operator JSX has signed letters of intent to acquire more than 330 hybrid-electric regional aircraft, including 30-seat Heart ES-30s.**

## Lilium Welcomes Closer EASA/FAA Alignment as Certification Tests Begin

- > FIRST LILIUM JET PROTOTYPE WILL BE USED AS AN IRON BIRD
- > F&R TESTING REQUIREMENTS HAVE BEEN ADAPTED TO eVTOLs

**Graham Warwick** Washington

**F**or Lilium, recent revisions of the certification requirements for electric vertical-takeoff-landing aircraft that narrowed the gap between European and U.S. regulators come as welcome news as the German startup assembles its first flight-test aircraft and begins component ground tests for certification credit.

Despite starting out with widely different approaches, the European Union Aviation Safety Agency (EASA) and the FAA have narrowed the gap—at least on type certification. And, while not yet fully harmonized, the regulations are now close enough to enable transferability between jurisdictions with minimum duplication of effort.

Among the gaps that remain “there is not much that keeps us awake,” says Bhavesh Mandalia, Lilium’s chief airworthiness officer and deputy chief technology officer.

As part of the efforts, Lilium is building six prototypes to be divided between development and certification testing. “We will use three aircraft for

development testing that we can modify as we find the need for changes,” Mandalia says. “We will end up with test aircraft in the configuration to be certified, then manufacture three additional aircraft in a fixed configuration for final testing for certification credit.”

The first of these aircraft, MSN-1, is in final assembly. This aircraft will not fly. Instead, it will be used as a ground-test iron bird. Major pieces of the second aircraft, MSN-2, are coming together. This will be the first Lilium Jet to fly and will have a pilot onboard from the outset of testing.

“We will use the iron bird for safety of flight testing for first flight,” he says. The iron bird is then planned to stay ahead of the flying aircraft, simulating test flights on the ground before they are flown with a pilot onboard. “We will start ground test later this year and flight test by the end of year,” he adds.

Lilium secured its design organization approval (DOA) from EASA in November after two years of work. It is the first DOA specific to EASA’s Special

Condition for VTOL-capable aircraft (SC-VTOL). “The DOA allows us to do our own conformity of test specimens and aircraft,” Mandalia says.

Conformity is a key step required to ensure components and aircraft as produced and tested are representative of the type design being certified. “There is a production inspection system within the DOA that allows us to manufacture aircraft, inspect them and provide a statement of conformity,” he says. “We’re doing that now.”

“We do not have to have full aircraft conformity to begin testing. We can do conformity at a component and system level as long as the test substantiates performance in a representative environment,” Mandalia continues. “We can do that with the iron bird, which is quite complex and can simulate different scenarios for the aircraft, even in extreme parts of the envelope where we might want to fly the aircraft.”

Lilium is planning an 18-month flight-test program, with aircraft flying in Spain as well as Germany to take advantage of better weather. The company is aiming for EASA type certification by the end of 2026, followed by validation of the type certificate by the FAA, Brazilian civil aviation authority ANAC and the UK Civil Aviation Authority.

The company hopes to have a validation agreement in place “soon” with the Civil Aviation Administration of



“Public charter is a long-standing economic authority granted by the [Transportation Department] that has existed for over 40 years,” NATA President and CEO Curt Castagna said. “Part 135 operators provide valuable, safe and secure services.”

The Air Line Pilots’ Association (ALPA) applauded the FAA’s announcement. “Under the public charter loophole, some airlines are held to lesser standards while operating in the same airspace with the same passengers from largely the same airports, and that is unacceptable,” ALPA President Jason Ambrosi said. “Despite calling itself a charter operation, JSX has applied to operate 110,305 scheduled departures in 2022 with its 37-aircraft operating fleet—more scheduled departures than comparably sized Piedmont, a re-

gional Part 121 operator,” ALPA said.

Reacting to the FAA’s announcement, JSX applauded plans to evaluate a new operating authority for certain Part 135 operations, noting:

“More than half of JSX’s public charter markets operate in airports that are not served by large network airlines, yet there are thousands more airports—funded by the American taxpayers—that remain inaccessible to the vast majority of Americans unless they have the means to afford private jets.”

In December, JSX revealed plans for a massive expansion of its public charter service, signing nonbinding letters of intent for a total of 332 hybrid-electric aircraft with U.S. startup Electra.aero for up to 82 nine-passenger aircraft, France’s Aura Aero for 150 ERA 19-seaters and Sweden’s Heart

Aerospace for 100 30-seat ES-30s.

With deliveries planned to begin in 2028, JSX said the deals represent its “commitment to the renewal of low-impact regional transportation in North America.”

In their October comment letter to the FAA, trade organizations—including the General Aviation Manufacturers Association, National Business Aviation Association and NATA—noted that developers and operators of electric aircraft with as many as 30 seats intend them to be operated under business models facilitated by Part 110.

“Removing this flexibility could not only limit the scope of upcoming advanced air mobility ventures, but also slow down the industry’s overall commercial growth,” the letter from the organizations stated. 🌐



**Produced by Spain’s Aciturri, the fuselage for the second Lilium Jet, MSN-2, has arrived at the final assembly plant outside Munich.**

oping pilot and maintenance training.

“With EASA, training is part of the TC [type certificate],” he says. “We get the TC, then provide flight crew and maintenance technician data to the training organizations that they can use to create the syllabus. But we can start training pilots before TC to verify the data is applicable.”

Including training development and route proving, the process from the Lilium Jet’s type certification to service entry should take only months, Mandalia says. “It should not be very long, provided we are proactive, and we have our own internal airline operations and maintenance teams,” he adds.

Lilium applied for certification with EASA in 2017 and with the FAA six months later, in early 2018. At that time, the company compiled a list of so-called significant standard differences that might need additional testing to show compliance with FAA regulations.

The latest revisions by EASA and the FAA have reduced those differences. “There were only 14 items that we had to go back to the FAA on, and many of those have gone away. There are a few items still being negotiated,” Mandalia says. “We will dissect the AC, but at the moment we have no concerns.” 🌐

China, Mandalia says, in support of its partnership with the Bao’an district of Shenzhen to establish service in China.

Under European and U.S. certification rules for eVTOL aircraft—EASA’s SC-VTOL and the FAA’s Part 21.17(b) special class for powered-lift aircraft—the final step in certification is function and reliability (F&R) flight testing.

The latest versions of these regulations—SC-VTOL Issue 2 and the FAA’s Advisory Circular (AC) 21.17-4 released on June 10—require at least 300 hr. of F&R testing. This is the same total as required for Part 23 fixed-wing aircraft and Part 27 light helicopters, but the way that total is divided up has been redefined.

“Of the 300 hr., 150 hr. has to be flight testing. We can use bench testing for the other 150 hr.,” Mandalia says. “And of the 150 hr. of flight test, 75 hr. has to be on a single aircraft. The remaining 75 hr. can be on several aircraft.” He adds that the changes recognize the endurance limits on battery-powered eVTOL flights.

In addition to F&R testing by the manufacturer, the operator must conduct route-proving flights with the aircraft, but these can be performed in parallel if the aircraft is in the proper configuration, he says. Under EASA rules, the OEM must also collect operational suitability data during certification flight testing for use in devel-

# Electrification Pioneer MagniX Launches First Battery System

➤ NASA DEMONSTRATOR PROGRAM IS LEADING DEVELOPMENT

➤ BATTERY MODULE OFFERS 300 WH/KG ENERGY DENSITY WITH 1,000-CYCLE LIFE

**Graham Warwick** Washington

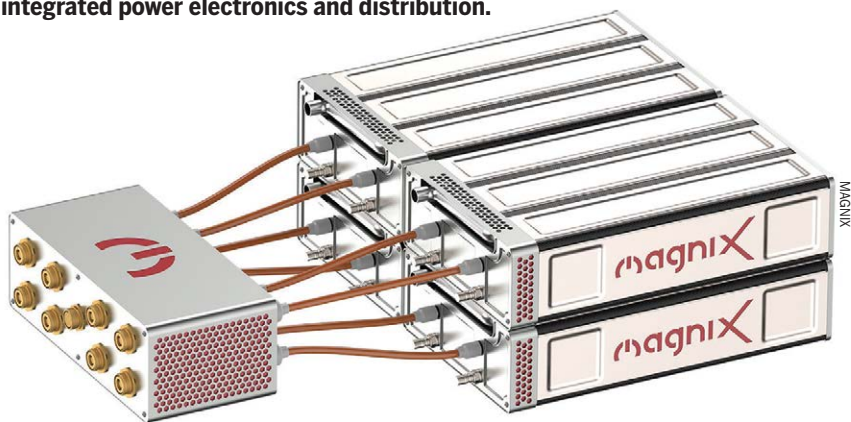
**E**lectric propulsion developer MagniX has launched its first battery product line, focused on maximizing energy density and cycle life with the safety required for certification. Alongside the startup's Magni350/650 electric engines, the Samson battery allows MagniX to offer a complete electric powertrain.

The first member of the family, the Samson300, has an energy density of 300 Wh/kg at the module level to maximize aircraft range and a cycle life of more than 1,000 full-depth discharge cycles to minimize operating costs.

on several demonstrators—including the eBeaver, eCaravan and e-R44, as well as the first prototype of Eviation's Alice. "We learned a lot from those, and the learnings have been taken into this project," says Ben Loxton, MagniX vice president of energy storage systems and NASA EPFD program manager.

"High energy density is a key," Loxton says. "We see 300 Wh/kg as the tipping point to these applications becoming viable. Not just as a demonstrator, but as something that can carry a payload, whether it be passengers or cargo. Anything less doesn't really achieve that."

**MagniX's Samson300 battery system includes integrated power electronics and distribution.**



Battery development is being advanced under NASA's Electrified Powertrain Flight Demonstration (EPFD) program, for which MagniX is converting a De Havilland Canada Dash 7 regional turboprop into a hybrid-electric propulsion testbed.

The goal of EPFD is to burn down the risks to certification of an electrified powertrain, and the project is central to MagniX's plans to obtain FAA certification of its electric propulsion unit (EPU) and energy storage system (ESS).

MagniX decided to develop its own battery system as part of the program, building on experience flying its motors

MagniX is not revealing details of the pouch cell it is using, but while the energy density is higher than that quoted by rival battery developers, Loxton says: "It's still a lithium-based chemistry—nothing exotic. We didn't want to go with anything super-exotic because of the challenges industrializing that."

Another design driver is aircraft turnaround time and "maintaining the ability to turn the aircraft reasonably quickly, within an hour," he says. "It has to be able to fly multiple times a day for it to be commercially viable, for the customers operating the aircraft."

"And it has to be safe," Loxton says. "Part of the work we are doing with

EPFD is developing a battery that's reliable, that's fault-tolerant, so we don't have a system where if any one part fails we lose a big chunk of our energy capacity."

Having flown on several different aircraft, MagniX has seen multiple different battery architectures. "We've seen what works and what doesn't work and what that means for actual operators," MagniX Chief Technology Officer Riona Armesmith says.

"We've seen architectures where if you have a single bad cell you have to take off a whole string, which could be a quarter or a third of the whole battery pack," she says. "That's not viable. Everything that we are trying to do is to give as much to the pilot as possible."

That includes not compromising on cycle life to achieve high energy density. "We've settled on something that gives us the energy density we need and we still get over 1,000 cycles," Armesmith says. "So you are not replacing these things frequently, which operationally is a nightmare for customers and expensive."

The Samson battery has active cooling on the ground during charging, with the option for passive cooling in flight to minimize weight and complexity. The system includes integrated power electronics and distribution and the modular design allows the battery to be scaled to power larger aircraft.

"We have the cells, we have the architecture, and now we're doing the work to build up the integrated package," Loxton says. A "significant" ground-test campaign is planned before the EPFD flies. "Next year is when the buildup into the aircraft happens," he adds. "Late 2026 is when flight test is aimed to start."

The Dash 7 will be modified first with a single electric powertrain replacing one of the aircraft's four turboprops, with a second to be replaced in a later phase. Each Magni650 will be paired with a 450-kWh battery pack. This combination is also the powertrain size for a Cessna Caravan, Armesmith notes.

While the EPFD is the first application, the modular design means battery systems can be assembled in ways that suit different applications. The systems also do not necessarily have to be paired with MagniX's EPUs, she says, expanding the startup's ability to address the electrified propulsion market. 🌐



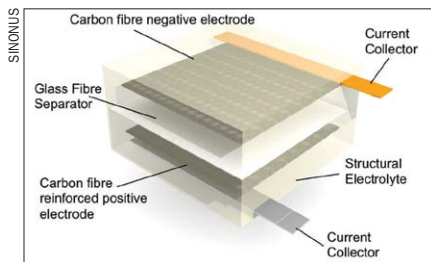
# TECH TAKE

By **Graham Warwick**

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## Material Made of Carbon Fiber Capable of Storing Energy

Swedish startup Sinonus is developing a carbon-fiber material that can double as battery electrodes and enable electric energy to be stored in structures for a variety of industries, including aircraft.



**Load-carrying carbon-fiber electrodes embedded in a structural battery electrolyte can be used to store energy.**

Gothenburg-based Sinonus is a spinoff from Sweden's Chalmers University of Technology and KTH Royal Institute of Technology as well as part of Chalmers Ventures' investment portfolio.

In the startup's structural battery, load-carrying carbon fibers form the positive and negative electrodes, sandwiching a glass-fiber separator and embedded in electrolytes that have both high ionic conductivity and high mechanical strength and stiffness.

"Storing electrical energy in carbon fiber may perhaps not become as efficient as traditional batteries, but since our carbon-fiber solution also has a structural load-bearing capability, very large gains can be made at a system level," says new Sinonus CEO Markus Zetterstrom.

The positive electrode, or anode, has coated fibers and an aluminum foil current collector. The negative electrode, or cathode, has uncoated fibers and a copper-foil current collector. The strength and light weight of carbon fiber enables the battery to become an integral part of the product's structure.

The carbon fiber used is provided by Oxeon, another Chalmers Ventures

portfolio company that has developed a spread-tow, thin-ply reinforcement called TeXtreme. Used in NASA's Ingenuity Mars Helicopter, the material increases the mechanical performance of the composite materials and reduces weight.

Sinonus says it has demonstrated the potential of its technology by replacing AAA batteries in low-power products in the laboratory. "The goal is to expand the technology to larger applications such as Internet-of-Things devices and eventually to drones, computers, larger vehicles and even airplanes."

## GE To Test Small Hybrid-Electric Core

GE Aerospace is to test hybrid-electric core technology in a Passport 20 business-jet turboprop as part of the company's development of an open-fan propulsion system for future single-aisle aircraft.

The test, planned for fiscal 2025 under Phase 2 of NASA's Hybrid Thermally Efficient Core (HyTEC) program, follows runs of the unmodified engine at GE's Peebles, Ohio, test site to verify baseline performance. For the upcoming Turboprop Engine Power Extraction (PEX) segment of the test, the engine is being fitted with multiple electric motor/generators.

The overarching aim of HyTEC is to develop technology for small, high-power-density turbine engine cores for integration with larger, lower-pressure fans—ducted or open—to enable higher bypass ratios.

One of the key objectives of HyTEC, through PEX, is to achieve up to 20% power extraction, or roughly four times the current state of the art, at altitude to optimize propulsion system performance and enable hybridization. The PEX engine test is scheduled to take place in fiscal 2025.

The program is targeted at maturing a megawatt-class hybrid engine for single-aisle aircraft and involves the development of low-pressure-spool electrical generators, motor controllers and cooling systems.

The challenge is to see if power extraction for more electric aircraft systems is feasible from such compact cores. The program's key performance parameter is to achieve a minimum of

5% hybridization—with a goal of 10%—as measured by the level of power extraction from the core.

Initial component-level testing of motor/generators and power electronics has been completed for the PEX demonstration at GE Aerospace's EPISCenter in Dayton, Ohio. Technology for PEX also builds on GE's work with NASA and Boeing on the megawatt-class Electrified Powertrain Flight Demonstration program, under which a Saab 340B is being converted to fly with a hybrid-electric propulsion system.

Under the RISE (Revolutionary Innovation for Sustainable Engines) technology development initiative launched by GE-Safran joint venture CFM International, a follow-on series of demonstrators will include a flight-test version of the 130-in.-dia. open fan propulsor driven by a Passport 20 gas generator.

In parallel, the high-power-density core targeted at the eventual production engine to emerge from the RISE program will be tested in a ground demonstration of the full-up HyTEC core. This is likely to include elements of the hybrid-electric technology from the PEX program.

"What we learn with PEX is how do you add hybrid electric to a Passport-size engine and be able to run it through takeoff, climb and cruise—all the mission points—and demonstrate that improved efficiency from the electric insertion motor/generator," says Arjan Hegeman, GE's general manager of advanced technology.



**Power extraction tests on a modified GE Passport 20 will form a precursor to small core tests for CFM's RISE.**

"Everything that we're applying to RISE with this demonstrator comes out of these programs," he says. "This is how these things build up. We do component tests, we do module tests, we do engine tests. All of it runs in parallel and then starts to merge and combine and it all leads to the next-generation narrowbody 30,000-lb.-plus thrust-class engine."

Use of the 19,000-lb.-thrust Passport 20 is highly appropriate, Hegeman says. “This core size is about right for what we’re envisioning for the next-gen narrowbody open fan,” he adds. “The value proposition is we’ve got a very small core with high temperatures and high pressure for thermal efficiency. Now we’re combining a tiny core with a giant open fan, and that gives you bigger bypass.”

—Guy Norris in Cincinnati

## Basalt-Fiber Cabin Sidewalls Save Weight, Emissions

Germany’s Diehl Aviation has developed a technology for cabin sidewalls that reduces weight 10% while cutting the carbon footprint 19% during production.

DIEHL AVIATION



**Unidirectional basalt-fiber prepeg tape is used only where required by the load paths, reducing material waste.**

The ECO Sidewall uses basalt-fiber prepeg materials, with a bio-based furan resin, Kevlar honeycomb core and lightweight powder coating. Basaltic prepregs reduce CO<sub>2</sub> emissions 20% during production versus glass fiber, Diehl says, while the Kevlar core provides a 30% weight savings.

The sidewall also has a load-optimized design with basalt-fiber unidirectional tape used as structural reinforcement only where loads are carried. This results in 33% less prepeg trim waste during production. Brackets are made from bio-based polyetherimide thermoplastic.

Diehl, with Swiss startup 9T Labs, also has developed the ultralightweight ECO Bracket, made from a combination of 3D-printed carbon elements and recycled thermoplastic composites de-

rived from production waste. 9T has developed an additive fusion process that combines 3D printing with post-processing to produce high-performance parts.

Used to mount cabin components to the aircraft’s structure, such brackets are conventionally made of aluminum in high-used areas such as overhead bins. Diehl says the ECO Bracket offers a 50% reduction in weight through the use of lightweight materials and design optimization, while manufacturing costs are halved for the same mechanical performance as aluminum. Reusing production waste and recycling used components cut down on production waste, the company says.

## New Radar Will Monitor VLEO Space

Space situational awareness provider LeoLabs has secured a U.S. Air Force small business contract to develop a new generation of space radar better able to track objects in very low Earth orbit.

The company has received an almost \$1.25 million contract for the Air Force Research Laboratory and the AFWERX innovation unit to develop an S-band 2D direct radiating array (DRA) ground-based radar.

The 2D DRA is LeoLabs’ fifth generation of satellite- and debris-tracking radar, says Dan Ceperley, LeoLabs’ co-founder and chief operating officer. “Most of our radars going forward are going to be this technology,” he adds.

LeoLabs has six radars operational at sites in New Zealand, Australia, Costa Rica, the Azores, Texas and Alaska. These use earlier-generation dual S-band phased-array radars with “half-pipe” dishes that scan in one dimension.

The DRA is a flat antenna that can scan in two dimensions. Where the earlier radars can detect objects in low Earth orbit (LEO) within an arc above the half-pipe antenna, the 2D array has a wider field of view, Ceperley says, and the beam can be steered to search within a larger circular volume. The transmitters in the 2D array “just shoot radio frequency power straight up into the sky, rather than at the dish surface,” he says.

The DRA is also modular, allowing radars to be deployed more quickly, in more places and without the need to lay



**LeoLabs’ current space radars scan electronically in one dimension to track objects in low Earth orbit.**

the foundations required for the large 1D arrays. The radars can also be scaled in size for different missions.

Ceperley points to the growth in numbers of very-low-Earth-orbit (VLEO) satellites, skimming the Earth’s atmosphere at altitudes below 300 km (186 mi.). To detect and track VLEO satellites, he says: “You do not need a very big radar, but you need a lot more of them.

“And it’s not only VLEO; it’s also unannounced or uncoordinated launches,” he adds, noting that not all countries cooperate. “That’s a question on the military side, but it’s also on a space traffic coordination side. We need to find them fast, so we need a lot of radar sites.”

The Phase 2 Small Business Innovation Research contract will take the 2D DRA to a technology readiness level of 9 by mid-2025—with a multiple-module radar deployed and operational against satellites, feeding into LeoLabs’ tracking network. The company is preparing to begin rooftop testing of the array at its Menlo Park, California, headquarters, Ceperley says.

In addition to the growth in VLEO, another recent trend LeoLabs has observed is an increase in proximity operations in LEO. “We’re seeing universities and governments doing it. And there’s about five ongoing proximity operations by China,” he says.

“There are pairs of satellites working together, and one going back and forth between them,” Ceperley says. “The Chinese spaceplane has been releasing and capturing objects. And they’re doing this in orbits that fly right past commercial satellite constellations.

“It’s this blending of defense and commercial and, frankly, I’m surprised at the speed it has. I didn’t think it was going to come this fast,” he says. “So we’re seeing that proximity operations are driving a lot of use of our [space situational awareness] service.”



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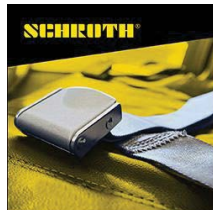
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July 1-14, 2024

**VOL. 186, NO. 13 (ISSN 0005-2175)**

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# Six Titans of Aerospace and Defense M&A

By Stephen Perry

*The aerospace and defense industry is an ever-evolving landscape of large and small companies jockeying to add value to their customers and upend their competitors. Mergers and acquisitions have been a formidable tool in shaping the industry. A handful of leaders stands out for their adept use of mergers, acquisitions, divestitures and spinoffs. They are ranked here alphabetically. Dollar amounts are in then-year figures and not adjusted for inflation.*



## Mark Donegan

Donegan joined Precision Castparts Corp. (PCC) in 1985 and became CEO in 2002. Upon taking the reins, he stated that “buying companies is going to be our primary objective.” During Donegan’s tenure, PCC has made more than 35 acquisitions, including Titanium Metals Corp.

(\$2.9 billion) and Wyman-Gordon (\$825 million). In doing so, Donegan transformed PCC from a relatively unknown company to an aerospace and defense powerhouse with leading positions in castings, forgings, fasteners and machining. Based on 16 merger and acquisition (M&A) deals for which financial terms were disclosed, Donegan completed more than \$10 billion in acquisitions. Post-closing, he was reported to be a hands-on CEO with a ruthless adherence to cost reduction. In 2016, Warren Buffet’s Berkshire Hathaway acquired PCC for \$37.1 billion (more than 40% above what Boeing paid for McDonnell Douglas in 1997, adjusting for inflation). In 2021, Berkshire Hathaway announced an \$11 billion write-down on its PCC investment.



## Greg Hayes

Hayes started his career at Sundstrand in 1982. Sundstrand was acquired by United Technologies Corp. (UTC) in 1999 for \$4.3 billion. Hayes ascended to become chief financial officer of UTC (now RTX) in 2008, CEO in 2014 and chairman in 2016. He retired as CEO this year but

remains executive chairman. Since 2011, he completed more than 20 M&A transactions, including the merger of UTC and Raytheon (\$137 billion), acquisitions of Goodrich (\$18.4 billion) and Rockwell Collins (\$30 billion), divestiture of Sikorsky Helicopter (\$9 billion) and the spinoff of Carrier (\$14.7 billion) and Otis Elevator (\$20.5 billion). UTC narrowly missed acquiring Honeywell for \$40 billion in 2000, and in 2016 Hayes thwarted Honeywell’s quasi-hostile proposed \$90.7 billion merger with UTC.



## Nicholas Howley

In 1993, Howley, Doug Peacock and Kelso & Co. acquired four underperforming manufacturing businesses from IMO Industries. Thus TransDigm was born. TransDigm was recapitalized by Odyssey Partners and Warburg Pincus and filed an initial public offering (IPO) in 2006.

Since TransDigm’s inception, Howley has acquired over 90

businesses, including McKechnie Aerospace (\$1.3 billion), Esterline Technologies (\$3.9 billion) and CPI Electron Devices (\$1.4 billion). Howley took a run at acquiring Meggitt in 2021, offering more than \$9.7 billion, but later bowed out. Today TransDigm boasts revenue of \$7.3 billion and a market capitalization of \$74 billion. Since its 2006 IPO, the company’s stock has increased by a 26% compound annual growth rate (CAGR).



## Kent Kresa

Following the 2001 collapse of a merger between Lockheed Martin and Northrop Grumman due to antitrust concerns, Northrop was reported to be in trouble. “We could close our doors and just go out of business,” then-Chairman and CEO Kresa told *The Los Angeles Times*. “Or we could reinvent ourselves.” He chose the latter. Northrop went on to make 16 acquisitions, including TRW (\$7.8 billion), Litton (\$5.1 billion), Westinghouse Defense (\$3.6 billion), Newport News (\$2.6 billion) and Ryan Aeronautical (\$140 million). During Kresa’s tenure, the company’s revenue increased from \$5 billion to more than \$28 billion. He retired in 2003.



## Frank Lanza

In 1997, Lanza, Robert LaPenta and Lehman Brothers formed L-3 Communications to acquire 10 operating business units from Lockheed Martin, with \$650 million in revenue and 4,900 employees, for approximately \$500 million. In 1998, L-3 filed an IPO on the New York Stock Exchange and embarked on an acquisition spree. Over the

ensuing decade, Lanza completed 24 acquisitions, assembling a defense electronics powerhouse. Asked in a 2000 interview what his next move was, Lanza quipped, “We’re gonna go buy Lockheed.” He died unexpectedly in 2006 before fully implementing his agenda. Over Lanza’s tenure, L-3’s revenues grew at a 43% CAGR, reaching \$12.5 billion in 2006.



## Larry Mendelson

Mendelson acquired control of publicly traded HEICO Corp. in 1990. At the time, it was a fledgling operation with a market cap of just \$25 million. Mendelson subsequently embarked on a remarkable M&A journey, transforming HEICO into an aerospace and defense aftermarket parts

and electronics leader. To date, HEICO has completed more than 100 acquisitions, including the recent acquisition of Wencor for \$2 billion from Warburg Pincus. HEICO now has more than 10,000 employees, approximately \$3.2 billion in annual revenue and a market capitalization of \$26 billion. According to *Forbes* magazine, HEICO is one of the “hottest stocks of the past 30 years.”

*Investment banker Stephen Perry is managing director at Janes Capital Partners in Irvine, California.*



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