PINNACLE, REGIONALS AND THE 'RACE TO THE BOTTOM'

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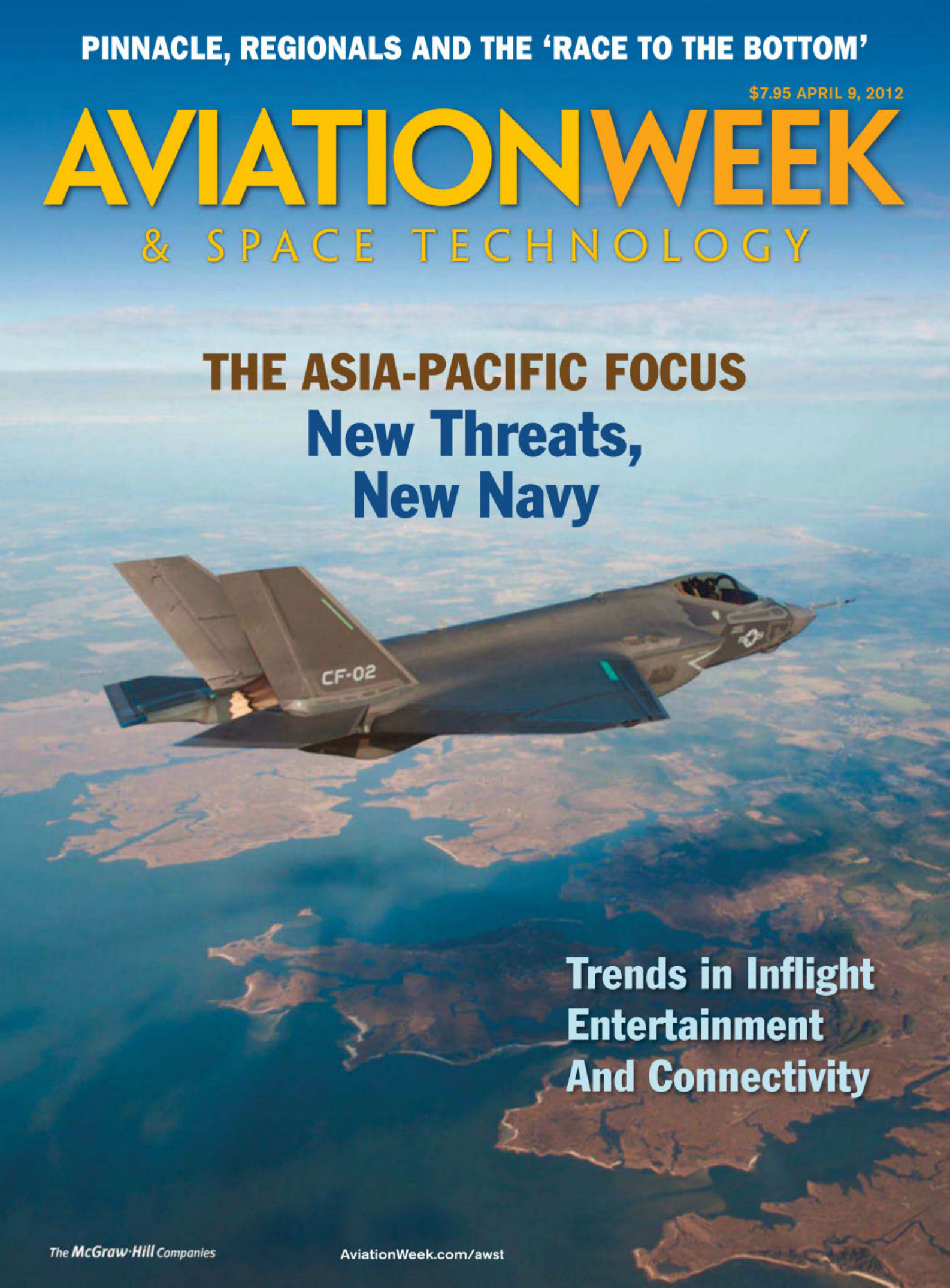
THE ASIA-PACIFIC FOCUS

New Threats, New Navy



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April 9, 2012

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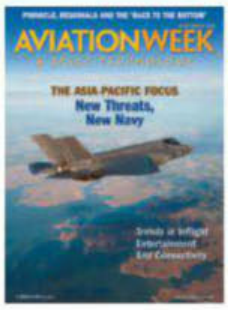
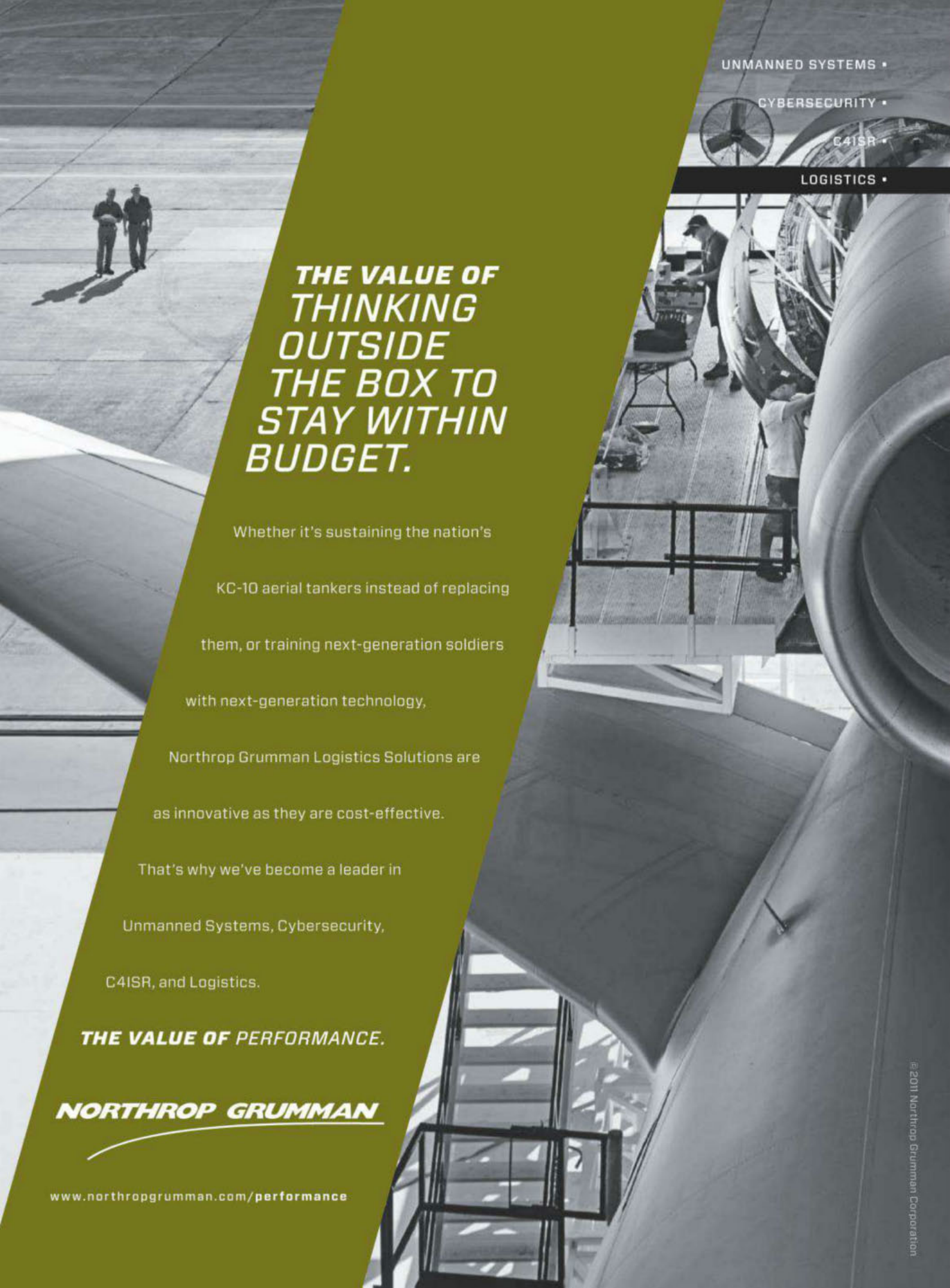


COVER STORIES

A U.S. Navy F-35C flies near NAS Patuxent River, Md., where the design is being fine-tuned in a flight-test program designed to prepare the aircraft for flight training. Ultimately, the stealth aircraft will move onto large-deck aircraft carriers, including the new Ford-class design, along with F/A-18F precision-strike, EA-18G electronic-attack, E-2D early-warning and unmanned-strike aircraft. Naval Aviation coverage begins on p. 46. Lockheed Martin photo.



THE VALUE OF THINKING OUTSIDE THE BOX TO STAY WITHIN BUDGET.

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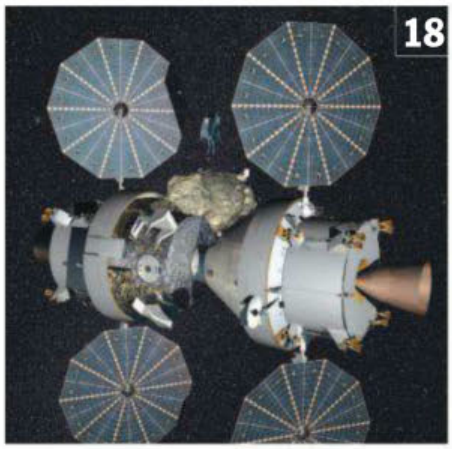

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DUTCH MINISTRY OF DEFENSE

DUTCH CUTS

The Netherlands Court of Auditors has concluded that the Dutch defense budget is too tight to achieve the goals for the F-16 fleet. That touched off a conversation on our **Ares** blog about current Dutch goals and the affordability of the Netherlands' F-35 plans (**tinyurl.com/7m9866w**).
AviationWeek.com/Ares

MRO WRAPUP

Find out the latest on maintenance, repair and overhaul from the industry's largest annual gathering—Aviation Week's MRO Americas conference. Our editors on the ground at this year's event, held in Dallas last week, provide a host of news and blogs at:
AviationWeek.com/mro12

BILLIONS AND BILLIONS

The Joint Strike Fighter program continues to grapple with costs and a new auditor's report in Canada adds to the political imbroglio in Ottawa (see p. 24). On Ares, the total life-cycle cost of $1.5 trillion for the F-35 and our analysis of the latest Selected Acquisition Report for the JSF program sparked more than 100 comments from readers (**tinyurl.com/7tnbg5v**). Join the conversation.

LOVE AFFAIR

Pan Am is more than just a memory to an avid Redondo Beach, Calif., man, whose $200,000 in memorabilia from Juan Trippe's legendary airline includes a full-size replica of a Pan Am 747 first-class cabin. For more aviation stories off the beaten trails, go to **tinyurl.com/bl7aohx**. There are even more commercial aviation blog posts at **Things With Wings**, **AviationWeek.com/wings**

PREMIUM CONTENT

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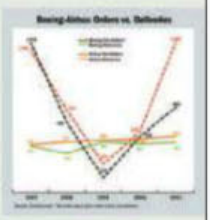
FROM THE WEB

Comments from readers on AviationWeek.com

Rupa Haria, head of the civil aviation team's online efforts, displays the Aircraft Order graphic on her Things With Wings blog and links to the recent "Bubble Trouble?" article, which covers the debate over whether Boeing/Airbus are producing too many jets.



Amiga500 notes:

2007 is nowhere near enough time to be sure of longer-term trends! Are order data available from 1997? This would provide a 15-year stretch, including the dip starting in 2001-02 and the subsequent reemergence. The 2007 orders could just be compensation for the dry spell in 2001-04.

Congressional Editor Jen DiMascio's piece in the Aerospace Daily & Defense Report about the influx of counterfeit parts from China, and the U.S. government's attempt to put an end to this, elicited a heavy response, parts of which include:

123xyz wondering:

Do Chinese military systems use their own counterfeit parts? The U.S. government had a program encouraging purchases from "small business." Online sites either don't care or don't know what they are selling; it's just parts with numbers. Mandatory Q&A processes are needed to ID counterfeits before they are installed in critical systems.

Bill asking:

Does anyone really believe that the U.S. military buys little else other than low-bid items? Why aren't these circuit boards destroyed post-test in the field? Are we this obsessed with low cost?

LHC opining:

Parts used in defense do go through tight quality control, I don't believe any player in industry will tell you they purchase parts used in military hardware from online stores based anywhere.

U.S. DEFENSE DEPARTMENT

Comment on articles, blogs and photos at: **AviationWeek.com**

FEEDBACK

Aviation Week & Space Technology *welcomes the opinions of its readers on issues raised in the magazine. Address letters to the Managing Editor, Aviation Week & Space Technology, 1200 G St., Suite 922, Washington, D.C. 20005. Fax to (202) 383-2346 or send via e-mail to:* **awstletters@aviationweek.com**
Letters should be shorter than 200 words, and you must give a genuine identification, address and daytime telephone number. We will not print anonymous letters, but names will be withheld. We reserve the right to edit letters.

C-27 GONE FOR GOOD REASON

The reader who found the demise of the C-27 in the U.S. Air Force fleet "simply outrageous" misses the point (*AW&ST* March 15, p. 8). USAF moved away from the aircraft because it offered no unique capabilities to the existing fleet, and strategic and budgetary changes made buying a private-theater airlift fleet for the Army an unaffordable luxury. Numerous assessments of the Lockheed Martin/Aeritalia C-27, including a 2007 Rand Corp. study that I coauthored, questioned the need for a small-theater airlifter of such bread-and-butter operational characteristics.

As the Air Force later confirmed, the C-27 required almost the same runway length as the Lockheed Martin C-130 and opened up only about 1% more runways in Afghanistan into which bigger airplanes could not operate. Justification for a niche fleet of short-range, expensive airlifters evaporated as the U.S.'s approach to Afghanistan-type situations altered.

The Army, flush with windfall funds from the canceled Comanche project in 2004, chose the wrong aircraft for its organic, fixed-wing airlift needs. The service focused on two aircraft—the C-27J and CASA C-295—which were larger than it needed and provided no significant improvement over runway conditions required by the C-130.

The Army has a legitimate need for fixed-wing capability to provide maneuver and administrative support for far-flung field units and to relieve its more expensive helicopters from routine, small-package cargo and personnel movements. The solution likely would have been a smaller fleet of smaller aircraft with true short-takeoff-and-landing-from-rough-fields capabilities. If the Army had gone after the M-28 Skytruck or the Viking 400, it would have had a greater chance of gaining its own aircraft to fill its requirements.

Prof. Robert C. Owen
Aeronautical Science Dept.
Embry-Riddle Aeronautical University
DAYTONA BEACH, FLA.

BANDWIDTH EFFICIENCY

"Droning On" (*AW&ST* March 19/26, p. 37) highlighted the increasing remotely piloted aircraft (RPA) demand for satellite bandwidth and indicated that video is the predominant bandwidth consumer.

The ground segment, another video-dominant user of satellite bandwidth, vies with RPAs for the same resources. Further, the use of small-aperture satellite terminals mandates the need for high-performance satellites.

Just as gasoline will be in strong demand going forward, so will satellite bandwidth. For gasoline, the government mandates vehicle fuel efficiency in miles per gallon. Similarly, satellite transponder efficiency may be mandated in terms of bits, seconds and hertz.

New video compression and signal transmission techniques can be used to improve bandwidth efficiency and operational flexibility. High-compression-ratio video codecs, video transcoding supplying only the necessary amount of bits, advanced carrier modulation methods and antenna systems, which negate the need for signal spreading, would substantially reduce transponder bandwidth requirements.

George Mancuso
SAN DIEGO, CALIF.

SHADOWING THE FUTURE

The photo of the muzzle blast (*AW&ST* March 5, p. 33) is reminiscent of a photo taken in the mid-80s at the Maxwell Labs Green Farm Electric Gun Test Facility (GFEGTF) in San Diego. It showed a then-world-record-setting blast of almost 9 mega-joules of muzzle energy. The GFEGTF was also instrumental in developing electro-thermal gun technology, using electrical power to enhance conventional gun performance. Jon Farber, a visionary at the Defense Nuclear Agency (now part of the Defense Threat Reduction Agency), led the development of the advanced high-energy capacitor technology in use with the U.S. Navy today. I led the GFEGTF group of dedicated scientists, engineers and technicians who are now scattered in various other endeavors. These technologies seem to have a 20-year life cycle, after which they go dormant for 20, only to rise again from their state of suspended animation.

Michael M. Holland
CARLSBAD, CALIF.

WHO'S WHERE

Lilian Chin

Sharon Pflieger

Samantha Sharif

Denis Coleman

Jonathan Galaska

Rudy Toering

Winston Leong

To submit information for the Who's Where *column, send Word or attached text files (no PDFs) and photos to:* **awinder@aviationweek.com** *For additional information on companies and individuals listed in this column, please refer to the* Aviation Week Intelligence Network *at* **AviationWeek.com/awin** *For information on ordering, telephone U.S.: +1 (866) 857-0148 or +1 (515) 237-3682 outside the U.S.*

Phebe N. Novakovic has been appointed president/chief operating officer of *General Dynamics*, Falls Church, Va. She was executive VP.

Randy Sloan has been named VP and chief information officer of *Southwest Airlines*. He was senior VP and CIO at PepsiCo. **Kathleen Wayton** has been promoted to VP-technology of the commercial portfolio from VP-change leadership and business performance and **Jeff Buhr** to VP-technology for aircraft operations portfolio from senior director of technology.

Lilian Chin (see photo) has become director of finance at *Metrojet*, based in Hong Kong. She was the financial executive for Intertek Group.

James G. Brunke and **Peter Bull** have joined the advisory board of *AirVault*, Addison, Texas. Brunke is a consultant on commercial and defense aviation, and Bull was executive director on the board of Airclaims.

Gregory Keeley has become VP-defense and homeland security policy at Washington-based *TechAmerica*. He has held senior staff positions in the U.S. House of Representatives and Senate. **Peter Kaminskas** is VP-business development. He was director of membership at Business Software Alliance. **Meryl Hickman** is the new director of member relations.

Sharon Pflieger (see photo) has been appointed director of organizational effectiveness for Savannah, Ga.-based *Gulfstream Aerospace Corp.* She was manager of organizational development.

Virginie Guyot and **Birgitte Stalder-Olsen** have joined the Paris-based *Airbus Corporate Foundation* as external board members. Guyot is the former leader of the Patrouille de France and a fighter pilot. Stalder-Olsen is head of logistics of the International Federation of Red Cross and Red Crescent Societies.

Samantha Sharif (see photo) has become interim director general of the Amsterdam-based *Civil Air Navigation Services Organization,* succeeding **Graham Lake**, who stepped down last month.

Sal Cipres has been named head of global programs at *Smiths Detection*, Edgewood, Md. He was general manager of the Edgewood facility and director of global chemical and biological programs.

Denis Coleman (see photo) has joined *TruTag Technologies* of Honolulu as senior scientific adviser. An inventor and entrepreneur, Coleman co-founded Symantec and helped start 13 other companies.

USAF Maj. Gens. **James F. Jackson** and **Andrew E. Busch** have been nominated for promotion to lieutenant general. Jackson has been appointed chief of Air Force Reserve/commander, Air Force Reserve (AFR) Command at USAF headquarters at the Pentagon. He was deputy to the AFR chief. Busch has been named vice commander of Air Force Materiel Command, Wright-Patterson AFB, Ohio. He has been commander of the command's Ogden Air Logistics Center, Hill AFB, Utah. Brig. Gen. **Stephen A. Clark** has been named deputy commander of Joint Special Operations Command, U.S. Special Operations Command, Fort Bragg, N.C. He has been director of plans, programs, requirements and assessments at the command's headquarters, Hurlburt Field, Fla. Clark will be succeeded by Brig. Gen. **Marshall B. Webb**, who has been the command's assistant commander for support.

Jonathan Galaska (see photo) has been named a field sales manager for *Dymax Corp.*, Torrington, Conn. He was program manager for electronics.

Marco Harries has been appointed chief pilot at *ExecuJet Africa*, Zurich. He was a first officer for South African Airways and training captain for Anglo American.

Rudy Toering (see photo) has become VP-business development at *FlightPath International*, Alliston, Ontario. He was an executive at CAE in the Pilot and Maintenance Training Standards Div.

Raymond Scodellaro has been named VP-contracts at *CFM International*, West Chester, Ohio. He was corporate purchasing manager for the Safran group.

Winston Leong (see photo) has been promoted to Asia-Pacific marketing manager for commercial simulation from remote assets manager at New York-based *FlightSafety International.*

HONORS AND ELECTIONS

Wanda M. Austin, president and CEO of The Aerospace Corp., has won the 2012 Horatio Alger Award, given by the Washington-based *Horatio Alger Association of Distinguished Americans*. The award, which includes lifetime membership in the society, is presented to individuals who overcame challenges early in their lives and achieved success in their fields.

Abraham Karem, founder of Karem Aircraft and a pioneer in aeronautics, has been named a recipient of a 2012 Navigator Award, given by the *Potomac Institute for Policy Studies*, Arlington, Va. His successes include developing the Predator UAV and the predecessors, Amber and Gnat.

Mary M. Miller, VP-industry and government affairs at Signature Flight Support, has been named the recipient of the Alexandria, Va.-based *National Air Transportation Association's* Distinguished Service Award. **Kenneth C. Ricci**, chairman of Flight Options and CEO of Nextant Aerospace, received NATA's William A. Ong Memorial Award.

BY MADHU UNNIKRISHNAN

Business Editor
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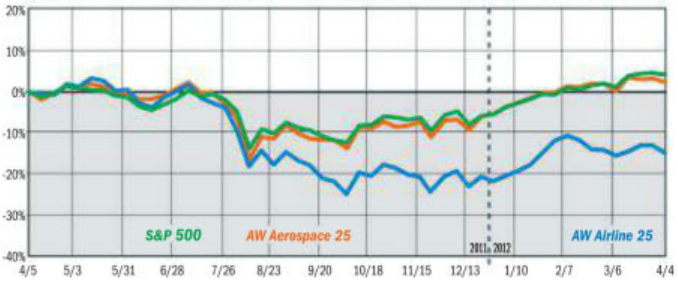
madhu_unnikrishnan@aviationweek.com

AW&ST/S&P Market Indices

(as of 4/4/2012) PERCENT CHANGE

MARKETS	INDEX VALUE	WEEK AGO	YEAR-TO-DATE	YEAR AGO
AW Aerospace 25	1477.3	-1.0% ▼	8.4% ▲	2.6% ▲
AW Airline 25	849.4	-2.3% ▼	10.6% ▲	-14.4% ▼
S&P 500	1399.0	-0.5% ▼	11.2% ▲	4.7% ▲



Weekly Market Performance

Closing Prices as of April 4, 2012

Company Name	Current Week	Previous Week	Fwd. P/E	Tot. Ret. % 3 Yr.	Tot. Ret. % 1 Yr.	
AIR TRANSPORT						
AAR Corp.	17.91	18.12	8.9	33.1	-33.1	▼
ACE Aviation Holdings	10.75	10.75	....	94.7	-8.8	▼
AerCap Holdings N.V.	11.05	11.37	5.8	286.4	-12.7	▼
Air Berlin	3.02	3.15	-1.8	-30.1	-27.2	▼
Air Canada	0.90	0.98	-3.1	7.1	-61.0	▼
Air France - KLM	5.23	5.71	-2.0	-49.2	-65.3	▼
Alaska Air Group	36.33	36.07	8.0	267.3	16.1	▲
All Nippon Airways Co Ltd.	2.82	3.01	17.5	-37.1	-0.9	▼
Allegiant Travel Co.	60.33	55.17	15.9	34.8	40.2	▲
Asiana Airlines Inc.	6.20	6.18	6.1	83.5	-30.2	▼
Atlas Air Worldwide Holdings	48.68	48.39	9.7	145.6	-28.2	▼
BBA Aviation plc	3.43	3.43	11.9	151.7	10.6	▲
B/E Aerospace Inc.	46.78	47.28	16.8	377.8	29.0	▲
CAE Inc.	10.37	10.18	13.8	36.6	-18.1	▼
Cathay Pacific Airways	1.78	1.91	13.0	73.7	-21.6	▼
China Southern Airlines	22.55	22.52	....	95.1	4.5	▲
Copa Holdings SA	82.03	79.84	11.0	194.6	55.6	▲
Delta Air Lines Inc.	10.48	10.00	4.7	57.8	8.0	▲
Deutsche Lufthansa AG	13.34	14.07	17.4	26.0	-28.3	▼
easyJet plc	7.68	7.76	10.3	....	....	
FedEx Corp.	90.64	91.49	12.8	84.5	-3.2	▼
GOL SA	6.27	6.81	16.9	112.0	-54.1	▼
Hawaiian Holdings Inc.	5.15	5.37	4.4	18.4	-11.8	▼
Heico Corp.	50.01	52.19	24.3	189.6	1.1	▲
Jet Airways (India) Ltd.	6.64	6.36	-4.5	93.8	-28.0	▼
JetBlue Airways	4.89	5.22	10.0	10.8	-20.6	▼
Korean Air Lines Co. Ltd.	44.71	43.42	7.8	27.7	-23.7	▼
Lan Airlines SA	29.03	29.25	21.7	238.0	12.1	▲
Qantas Airways Ltd.	1.75	1.87	12.3	-9.7	-25.1	▼
Republic Airways Holdings Inc.	4.92	5.01	6.9	-34.7	-23.0	▼
Ryanair Holdings ADS	36.11	35.89	67.4	50.5	29.1	▲
Singapore Airlines Ltd.	8.53	8.57	21.0	76.7	-3.2	▼
Skywest Inc.	10.83	11.29	20.0	-20.6	-32.2	▼
Spirit Airlines, Inc.	21.10	19.42	10.9	....	....	
Southwest Airlines	8.38	8.36	11.8	22.8	-31.2	▼
TAM SA	25.00	25.29	19.3	353.2	26.8	▲
TransDigm Group Inc.	116.18	116.00	18.2	308.2	39.9	▲
United Continental Holdings, Inc.	21.43	21.89	5.3	305.1	-1.5	▼
United Parcel Service Inc.	79.86	80.04	16.3	65.8	11.0	▲
US Airways Group	7.86	7.79	4.0	164.6	-7.0	▼
WestJet Airlines Ltd.	13.67	13.27	11.3	13.7	-6.2	▼
Zodiac Aerospace SA	101.57	103.85	14.4	297.0	47.0	▲

COMMENTARY

What Shortage Of Engineers?

The U.S. faces a critical engineering shortage. U.S. high school students' science and math scores are off the international pace. Competitiveness is at risk. That's the conventional wisdom, now elevated to accepted truth. But a group of academics now argues that these assumptions are flat wrong.

In fact, the U.S. faces an oversupply of engineers and other graduates in science, technology, engineering and math (STEM) compared with the number of jobs in those fields. "STEM-defined occupations are only 5% of the labor force," says B. Lindsay Lowell, professor of demographics at Georgetown University. Of those STEM-prepared graduates, only 44.9% are taking jobs in STEM-related fields, Lowell and Hal Salzman, professor of public policy at Rutgers University, found. "We can't find any evidence to back up a single claim that industry is making," Salzman says.

The aerospace industry often points to an influential National Academy of Sciences study, "Rising Above the Gathering Storm," co-authored by former Lockheed Martin CEO Norman Augustine, which called for more government research and development spending. Augustine says the main issue facing the aerospace industry is mismatched skills, with the most talented engineers leaving the field. "To make an extreme example, the world is filled with propeller designers in a jet age," Augustine says. Plenty of today's executives share that view. "It's about finding the right skills mix," says Richard Stephens, Boeing senior vice president for human resources and administration.

Salzman has another explanation: "Wages are too low. If wages rise, then shortages will disappear." According to the Labor Department, the median salary for an aerospace engineering graduate is $97,800, versus $114,080 for a petroleum engineer. Demand for petroleum engineers has shot up in the last decade and, correspondingly, the number of graduates in the field has tripled in the past four years. "It's a marketplace: Students respond to demand," says Salzman.

Test scores similarly are a poor index of U.S. competitiveness. "It just ain't so," says Salzman, who adds, "you can repeat it often enough and people will believe it." Finland and Singapore regularly appear at the top of international rankings, but it is impossible to compare a heterogeneous country of over 300 million people with countries with populations under 10 million. "Individual school districts and states in the U.S. often compare favorably with both Singapore and Finland," says Ron Hira, associate professor of public policy at the Rochester Institute of Technology.

One reason for the lower scores is more students are taking SATs and other tests in the U.S. than ever before. This brings down the average score, but is a net positive, as more students remain in school.

In fact, the large number of STEM graduates puts the U.S. far ahead, auguring well for the country's future competitiveness. "If a company is looking for a hiring pool of talent, it comes to the U.S., not Finland, Singapore or Latvia, where the numbers of top-ranked students are small," says Salzman.

Source of financial data: Standard & Poor's and Capital IQ Inc. (a Division of Standard & Poor's) U.S. dollars and cents. Forward P/E ratio uses S&P and Capital IQ forecasts of current fiscal year.

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AIR TRANSPORT

Bigger Quarter

Boeing delivered 99 737s and 20 777s in the first quarter, beating market expectations and marking a record-setting pace that contributed to 137 commercial aircraft deliveries so far in 2012. The tally, which also included five 787s, six 747-8s and seven 767s, compares to 104 deliveries for the same period in 2011 and 108 in 2010, and reflects the first significant indications of Boeing's rising production and delivery rates across the 737, 747-8, 777 and 787 lines. Based on the current delivery trend, the 137 aircraft handed over in the first quarter are slightly below the number required to hit the 585-600 it expects for 2012. The continuing ramp-up in production and completion of rework on 747-8s and 787s are expected to fill out the gap.

Kenya Picks GE Engines

Kenya Airways has selected General Electric's GEnx-1B engine for its forthcoming Boeing 787 fleet as the contest with Rolls-Royce heats up over the remaining customers yet to select an engine. The GEnx-1B will power the carrier's nine firm-order 787s and four options. The deal bolsters GE's claim to around two-thirds of the 787 orderbook and underscores the company's bullish outlook as it makes progress with the latest engine performance upgrade work. The uptick in the tempo of engine marketing comes as both GE and Rolls continue to perfect improvement packages.

Blacked Out

The EU has added Venezuelan airline Conviasa to its aviation safety blacklist, owing to "to numerous safety concerns arising from accidents and the results of ramp checks at EU airports." Two other Venezuelan airlines, Estelar and Aerotuy, are being closely watched. In Indonesia, six new carriers were automatically added to the list. Similarly in the Philippines, seven carriers were added. Several other adjustments were made in countries that have blanket bans, such as the Democratic Republic of Congo, where Jet Congo Airways was added to the list, as was Punto Azul in Equatorial Guinea. Mauritania Airlines was added and Mauritania Airways removed after ceasing operations.

WILLIAM G. HARTENSTEIN/AW&ST

Untried Delta IV Configuration Orbits NRO Payload

The first United Launch Alliance (ULA) Delta IV in the Medium-plus 5.2 configuration lifts off surfside at Vandenberg AFB, Calif., at 7:12 p.m. EDT April 3 with a classified National Reconnaissance Office payload. The launch clears the way for three more intelligence satellite launches by the end of the summer for the the joint Defense Department/Intelligence Community agency.

The Delta IV that carried the NROL-25 spacecraft aloft consisted of a single common-core booster with an RS-68 rocket engine, boosted by two solid-fuel 70-ft.-long, 60-in.-dia. Graphite Epoxy Motors supplied by ATK. The upper stage was powered by a Pratt & Whitney Rocketdyne RL10B-2 engine, with the spacecraft encapsulated in a 5-meter fairing.

The configuration is able to lift 18,500-20,500 lb. to a low polar orbit from Vandenberg. NROL-25—likely a radar-imaging satellite—lifted off from Space Launch Complex-6 on a mission the NRO later termed "successful." One of the launches later this year is planned from Vandenberg, with the other two from Cape Canaveral. The April 3 mission comes after six NRO flights last year, all also termed "successful."

ULA says its next launch—now set for early May—will carry the second U.S. Air Force Advanced Extremely High Frequency military communications satellite on an Atlas V flying from Cape Canaveral's Launch Complex 41.

No Night Ops

In a highly anticipated ruling, a German federal court has blocked night flights from Frankfurt airport. The move could have wider consequences, with anti-noise campaigners in other locations expected to use the ruling to press their cases. The Hesse state government had authorized 17 night flights from Frankfurt, but that will have to be revisited.

DEFENSE

Deliveries at Boeing Defense

Boeing Defense and Space deliveries in the first quarter were marked by the rising number of CH-47 Chinook comple-

Improper Deicing Linked To Russian ATR 72 crash

Russia's Interstate Aviation Committee has released the first data retrieved from the so-called black boxes of the UTair ATR 72-200 turboprop that crashed shortly after takeoff from Tyumen's Roschino airport on April 2 killing 31 of the 43 people onboard.

According to IAC, the engines worked until the collision with the ground. "After takeoff, the aircraft ascended to about 210 meters [700 ft.], then it rolled right more than 35 deg. followed by a left roll that exceeded 50 deg. at the moment of the ground impact," says the report. IAC is continuing the investigation, backed up by representatives of French aviation authorities and ATR, who arrived in Tyumen on April 4.

ITAR-TASS/LANDOV

Although the officials will not give exact reasons yet, the Russian investigative committee reported on April 4 that the lack of deicing of the aircraft before takeoff is considered the likely cause.

"This version is confirmed by accounts of witnesses who should have done this work on April 2, as well as the records from the airport's CCTV cameras," the committee says in a statement.

The crash is the latest in a spate of aviation safety incidents in Russia. Unusually, this one involved a Western-built aircraft.

Meanwhile, on April 3 UTair decided not to resume flying its remaining two ATR

Some Tests Complete on Sukhoi Engine Upgrade

SALUT

Russian aero engines maker Salut has completed the climatic bench tests of new AI-31FM2 turbojet engine, which is a further development of the AI-31FM that powers the Sukhoi Su-27 fighter family. These tests have confirmed the static thrust increase of 4,080 lb. to 32,000 lb., compared with the basic engine. It also produces 2,200 lb. more thrust than the AI-31FM1, an earlier upgrade. An improved low-pressure turbine and full-authority digital engine control system are behind the FM2 improvement. Also, the engine has an assigned life of more than 3,000 hr. "The modernization of the AI-31F engine is being conducted without changing its size. It is aimed at providing a chance to reengine the whole fleet of Su-27s without changes to the airframe or nacelles, says Salut's acting chief designer, Gennady Skirdov. The engine will be shown for the first time at an industrial show at the Zhukovsky flight-test center this summer. Flight trials are to start by early 2013. The manufacturer hopes that the Russian air force will select the engine to power Su-27SM3 fighters and Su-34 bombers.

tions, with 10 new-build helicopters handed over in the first quarter compared to seven, this time last year and two in 2010. The slowdown in C-17 deliveries saw just two aircraft handed over versus three for the previous quarters, while this year also marks the first delivery of a P-8A Poseidon in a first quarter. Deliveries of F/A-18E/Fs remained stable at 13, while F-15 handovers moved up to five for the quarter against four in the first quarter of 2011 and three the year before.

Growler Grows

The Australian government is moving forward with plans to upgrade its Boeing F/A-18E/F Super Hornet fleet with EA-18G Growler electronic attack equipment. The military already has taken delivery of 12 of its 24 Super Hornets on order wired for the electronic attack (EA) system and now is laying the groundwork to equipping aircraft for the EA-18G role. The final decision will not come until later this year, says Defense Minister Stephen Smith. Australian officials say the U.S. Navy experience with the EA-18G in Libya underscored their interest in the EA capability.

Integrated F-35

Northrop Grumman's newly implemented Integrated Assembly Line (IAL) is now producing F-35 Joint Strike Fighter center fuselages at the rate of one every five days as the company continues to ramp-up toward a target of one per day. The first unit to roll off the IAL was delivered to Lockheed Martin's Fort Worth assembly line on March 16. The transition to the advanced production system at Northrop Grumman's Palmdale, Calif., facility, began with installation of the first equipment in April 2010 and marks the end of a phased-in move from the adjacent assembly line that delivered the first center fuselage in 2005.

ROTORCRAFT

MDHI Bids for AAS . . .

MD Helicopters injected swirl of speculation around the U.S. Army's Armed Aerial Scout (AAS) requirement when it unveiled the MD 540F light combat helicopter at last week's Army Aviation Association of American convention in Nashville, Tenn. MDHI says it will offer the 540F—its first new helicopter in 15 years—for the AAS requirement despite having already agreed to supply the airframe for Boeing's contender, the AH-6i, which is also a derivative of the original Hughes 500/OH-6 model. First flown in March, the 540F has the six-blade rotor from the larger MD 600 and new composite blades, giving it a 4,000-lb. gross weight, up from the 530F's 3,100 lb., and almost 500 lb. more useful load. Although it has the same fuselage, Boeing's AH-6i is a different aircraft, says MDHI, with a different engine, rotor and avionics, a 4,700-lb. gross weight and more capability.

. . . as Bell Advances

Bell has received a U.S. Army contract for non-recurring engineering on a "new-metal" cabin for the OH-58D Kiowa Warrior, with the first new-production cabin to be delivered late in 2014. Although the new cabin is planned only for wartime-replacement aircraft converted from OH-58As, restarting airframe production is a key element in Bell's strategy to meet the Army's Armed Aerial Scout requirement to replace the OH-58D.

72-200s until the investigation is over. These aircraft , manufactured in 1990 and 1991, have been operated by Utair since 2008.

"There are no doubts about the aircraft's serviceability," says CEO Andrey Martirosov, adding the two other ATR 72s were removed from operations for "psychological" reasons. And, he adds, the order does not affect 15 new ATR 72-500s received by the UTair in 2011. According to ATR, the aircraft involved was completed in October 1992 and had been in service with UTair since August 2008.

First Flight for New Diamond

Diamond Aircraft has completed the first flight of its DA52. The 5-6-seat aircraft is powered by two 180-hp AE300Es built by sister company Austro Engine. The Austrian company's chairman, Christian Dries, and head of flight testing, Ingmar Meyerbuch, flew the DA52 on its 1-hr. maiden flight from Wiener Neustadt, taking off at 2:30 p.m. local time on April 3. The first flight involved landing gear retraction and saw the aircraft reach 12,000 ft. at its cruise speed of 190 kt.

DIAMOND AIRCRAFT

BY MICHAEL MECHAM

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COMMENTARY

Cleaning Up

Boeing outsources painting for 787s

Boeing will roll out the second 787-8 destined for Air India from its new South Carolina assembly plant this month, marking another step in that state's expansion as one of the American South's rising stars in aviation manufacturing.

Like every new aircraft, Air India's first 787 will emerge from the final assembly line as a "green" airplane and head to the paint shop for the distinctive livery that marks it as a member of the carrier's fleet. In Seattle, Boeing paints its own airplanes. But for its North Charleston, S.C., operation, which is its first commercial jet final assembly line outside Seattle's Puget Sound region, Boeing has named Leading Edge Aviation Services to provide that service.

Michael Manclark, Leading Edge's founder and CEO, got his start in the 1980s cleaning and detailing general aviation airplanes on weekends at John Wayne Airport in Santa Ana, Calif., while going to business school. His first step beyond GA services came when Lockheed needed help cleaning P-3s for heavy maintenance checks. Manclark said his five-person company could do the job even though he was not sure of the expected standards. "We didn't know exactly what heavy check maintenance cleaning was, so we just did it like detailing," he recalls. His detailing-standard cleaning job turned out to be better than the overhaul people were accustomed to and he soon attracted other heavy overhaul prep work, including for McDonnell Douglas on KC-10 tankers for the U.S. Air Force's Air Mobility Command.

That work prompted setting up at the Greenville-Spartanburg International Airport in South Carolina, stripping paint from military aircraft—which included removing compounds, cleaning fuel tanks and performing leak and pressurization tests. Manclark decided that if Leading Edge could take paint off, it was time to begin putting it on, and the company began bidding for aircraft painting jobs.

The painting business is now largely based on commercial contracts and Leading Edge counts itself as the industry's largest independent paint contractor. Painting in excess of 550 aircraft a year—more than two a day—it is in a league with the output of Airbus and Boeing. The North Charleston factory is scheduled to assemble three 787s a month by the end of 2013, adding 36 more widebodies to Leading Edge's annual total—assuming all goes well on the final assembly line.

Major clients include International Lease Finance Corp., Delta Air Lines, United Airlines, Air Canada and Southwest Airlines. Much of the company's work in recent years has come from rebranding fleets of merged airlines, such as 400 aircraft in the combined Delta-Northwest fleets and more than 300 for United-Continental. The company has produced special jobs on short notice, including replicating Air Force One for a movie. It also is known for turning out unusual one-offs, like a reclining *Sports Illustrated* swimsuit model for Southwest.

The company has grown beyond its Santa Ana roots, although that remains its home base. Air India's 787 will be sent to Amarillo, Texas, where Leading Edge has converted a former B-52 hangar to handle one widebody and four narrowbodies at a time. It operates two lines in Miami for AAR Corp., does narrowbodies and regional jets in Greenville, Miss., and up to three widebodies and two narrowbodies in its newest facility in Victorville, Calif.

Boeing has been a frequent customer for overflow aircraft in the past. But the agreement for Leading Edge to handle all 787s assembled in North Charleston marks the first time Boeing has asked an outside contractor to play such a role. Boeing's own paint shop at its widebody factory in Everett, Wash., does not have the capacity to handle the South Carolina airplanes.

Manclark attributes his company's growth—it has painted more than 5,000 aircraft in the past 20 years—to its early days when attention to detail was what brought in its first private pilot customers. It takes 4-7 days to strip, sand and paint a narrowbody like a Boeing 737 and about 12 days for a widebody as large as a Boeing 747.

Suppliers paint the 787 composite fuselage and wing assemblies with a white coating rather than the traditional green applied to aluminum airframes. However, they need to be primed and prepped before each airline's livery can be applied.

Air India's first 787 (below) was assembled in Everett; North Charleston's will be its second. After being painted, the aircraft will return to North Charleston for final preparations and customer acceptance flight-testing before delivery.

BOEING

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AERION CORP.

COMMENTARY

Looking for a Home

A fast promise with a slow start

Paper airplanes—not the kind schoolboys fold and toss, but rather the detailed imaginings designers hope will one day take full form and ply the world's airways—could be bound into a thick volume of dreams unfulfilled. Most are quickly forgotten, but a few are so bold in concept and their backers so stubborn that, however unlikely, they might someday actually take flight.

Aerion (above) is such an undertaking. Save for the Concorde's quarter-century of service, civil aviation has remained decidedly subsonic. And wary of the double "Boom!" that typically signals Mach 1 passage, the general population endorses the prohibition against over-land supersonic flight that exists throughout the International Civil Aviation Organization's (ICAO) global neighborhood.

By adhering to a natural laminar flow design and adapting the proven Pratt & Whitney JT-8D turbofan, Aerion's designers believe their eight-passenger business jet can happily exist in both the sub- and supersonic realms. It can streak across oceans at Mach 1.5 cruise, or traverse continents quietly at near-Mach speeds with equal efficiency.

The design's promise is hardly unknown; its supporters have been promoting it for the better part of a decade. The company has collaborated with NASA to prove the technology in flight tests, and more testing might occur this summer.

That the concept has appeal is underscored by buyers who have put down $250,000 refundable deposits on nearly 50 units, each of which is $80 million. And that backlog has changed little despite the near-global fiscal meltdown that began three years ago.

Unfortunately, the same can pretty much be said of the entire program: Not much has changed in years. What Aerion needs is a company to build, test and certify the thing. And Brian Barents, Aerion's vice chairman and a well-known business aviation veteran, says that given the aircraft's pricing and target market, it's "essential" to the project's success that this eventual partner be "a bona fide substantial OEM."

Yet none of those—and he's talked to them all—have signed on for the $2.5-3 billion venture. Yet.

Fortunately, the project has deep pockets—namely those of Chairman Robert Bass, the Fort Worth financier. According to Barents, "Bob has said he will continue to invest as long as he sees progress" and he's "not only financially committed, he's intellectually and emotionally committed as well."

Maybe that's exactly what's needed to transform paper into aviation-grade aluminum.

MAKING SOMETHING HAPPEN

It's no secret that Hawker Beechcraft has been having a tough time since the business aviation market took its swan dive in 2008. That was just a year after the Wichita maker of King Airs (photo upper right), Hawkers and T-6 military trainers was acquired by Goldman Sachs and Onex Corp. for a hefty $3.2 billion, two-thirds of which was borrowed.

The company has streamlined operations and reduced costs, but suffered operating losses of $1 billion, and servicing the debt has added mightily to its burden. Something had to give.

Recently, lenders holding some 70% of the publicly traded debt agreed to defer interest payments on certain senior loans, and granted further relief. Meanwhile, the company says it is "working with its lenders toward a comprehensive recapitalization."

Robert Miller, a turnaround specialist recently installed as CEO, says this deferral "demonstrates confidence in the long-term value of the company."

But the new forbearance agreement is set to expire on June 29, and one insider says the deadline is intended to "force something to happen." High on the list of possibilities is placing the hard-pressed company under Chapter 11 bankruptcy protection from creditors as it reorganizes, a move many on Wall Street have predicted. Should that occur, the $1 billion invested by the acquiring partners could be in jeopardy.

HAWKER BEECHCRAFT CORP.

A VERY BIG YEAR

The Boeing Business Jet (BBJ) team has a new rallying cry: 12 in 12! The slogan refers to the plan to deliver eight 747-8s, two BBJs and two BBJ 2s, all for VIP service, in 2012. Total value: $2.7 billion, or more than double the highest figure ever attained by the unit in a single year.

The first of the 747s (below), delivered in February by BBJ President Capt. Steve Taylor to Wichita for installation of an eight-person sleeping berth designed by Greenpoint Technologies, is believed to be ultimately destined for the government of Qatar's Amiri Flight.

BOEING

The backlog of executive Boeing aircraft, which stands at 32, includes a dozen 787s.

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COMMENTARY

'Burying' the CSeries

Bombardier needs to be more aggressive in its marketing of the CSeries

The CSeries family of medium-range airliners may end up meeting the same fate as the short-lived Boeing 717. So says Bryan Bedford, the CEO and chairman of Republic Airways Holdings, the CSeries' largest customer. Bedford's remarks seem rather curious, particularly since one would expect him to be touting the aircraft.

Republic placed a firm order in February 2010 for 40 CS300s for delivery starting in 2015. The U.S. group said the aircraft would be assigned to its carrier Frontier Airlines.

AIRBUS

Then in December 2010 Airbus launched the A320NEO program. Airbus's chief salesman, John Leahy (pictured), used the occasion to assert that, because of his company's new offering in the narrowbody market, there is almost no business case for the CSeries.

Within six months of the official launch of the A320NEO, Leahy had persuaded Republic to sign a memorandum of understanding for the A319NEO and the A320NEO; and then in November 2011, Republic signed a firm order for 20 and 60, respectively. At the time, Airbus said the aircraft would be delivered to Frontier. Airbus also highlighted in its press statement that Republic had chosen CFM Leap-X engines.

This is an interesting engine choice, considering that the Pratt & Whitney geared turbofan (GTF) will power both the A319NEO and A320NEO as well as the CSeries. To this observer, it would make sense to stick to the same engine type if one planned to operate both NEO models and the CSeries. Having a common type of engine across aircraft platforms helps with maintenance and spare-parts support. But then again the engine makers behind CFM, namely General Electric and Snecma, were probably incredibly keen to have their engines on Republic's Airbus narrowbodies—assuming that they have no desire to see the P&W GTF muscle in on their share of the narrowbody-engine market.

Bombardier's orderbook still shows Republic's order as firm. But if the company cancels its CSeries order, what would be the implications? Republic would lose the deposits and the pre-delivery payments that it put on the CSeries. But Airbus has the ability to make the deal so sweet for Republic that the loss of some deposits and pre-delivery payments would become inconsequential.

Also, the amount of money Republic could stand to lose might be minimized further if managers were smart enough to persuade Bombardier to commit to firm delivery dates. Bombardier said the CS100 would enter into service (EIS) in December 2013 followed by the CS300 about a year later. These milestones are becoming increasingly hard to attain, considering that there is still no sign of a rollout of the first aircraft. Theoretically, to achieve EIS for the CS100 20 months from now, one would expect the first aircraft to come out of the factory and complete its first flight before the end of this year.

For Bombardier, an order cancellation from Republic would have huge ramifications. Republic today accounts for 40 of the 138 CSeries aircraft currently on firm order.

The low number of firm orders has already led some leading industry figures to speak out. Air Lease Corp. CEO Steven Udvar-Hazy has publicly called on Bombardier to be more aggressive in its marketing and sales of the CSeries. And he is right, because Airbus's Leahy is being very aggressive in his marketing and sales of the A320NEO.

The history of how the 717 program came to a sudden end may also give Bombardier reason to be concerned.

In 2004, Filipino carrier Cebu Pacific Air had to choose between the A319 and the 717-200. It was a hugely important pitch for Boeing because the future of the 717 production line depended on it. Cebu Pacific was considered a good sales prospect for the transport because at that time the airline was operating the McDonnell Douglas DC-9, the precursor to the 717.

As everyone knows, Boeing lost to Airbus in that competition.

The win was considered a huge boost for Airbus, but Leahy's strategy was simple. He allowed Boeing to present to Cebu Pacific executives first, then he went in and offered Cebu a deal they could hardly refuse. It worked. Following the loss in the Cebu pitch, Boeing announced it was shuttering the 717 production line. The 717 was buried.

Cebu Pacific benefited greatly from the healthy competition that existed between the 717 and the A319. So it could be argued that it is in all airlines' interests to see the CSeries survive and prosper. After all, the best way to extract a good price is to create a lively competition.

BY FRANK MORRING, JR.

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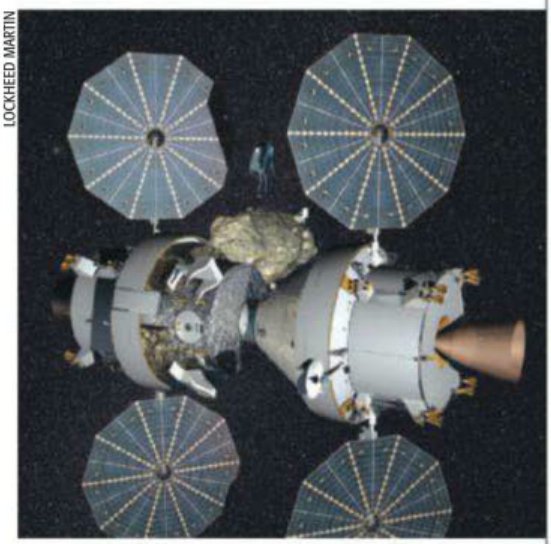
COMMENTARY

Missing Piece

Filling in the blanks on space exploration policy

Steve Squyres knows a thing or two about exploration, and he has a great soapbox for passing on his experience where it might do some good. A Cornell University astronomy professor, Squyres is principal investigator on NASA's Mars Exploration Rover mission. He is also chairman of the NASA Advisory Council—a distinguished group of outside experts who do their best to guide NASA's political leadership in its decisionmaking.



LOCKHEED MARTIN

At the annual Goddard Symposium organized by the American Astronautical Society, Squyres offered an important lesson he gained from overseeing the development, delivery and operation of the rovers Spirit and Opportunity on the Martian surface.

He started his presentation with an endorsement of the plan to use commercial vehicles to fly cargo and perhaps eventually crew to the International Space Station, freeing NASA to develop the Orion crew capsule and the heavy-lift Space Launch System to go beyond low Earth orbit. But there is a "missing piece," he says, and until NASA figures it out, its space-exploration task will be unnecessarily difficult.

"It depends on the destination," he says. "If you want to go to the Moon, you need a lander. If you want to go to an asteroid, you need something that can support a crew for the very long period of time it takes to get to an asteroid [see illustration]. If you want to go to Mars, you need a lot of stuff, and at the current time we don't have that next piece, the missing piece, clearly identified."

Ultimately, everyone agrees the destination is Mars. NASA and its international partners have been discussing exploration architectures to get there for years, and have narrowed it to two approaches. The "asteroid-next" route is supported by President Barack Obama, who proposed it in an April 15, 2010, speech at Kennedy Space Center. The other would use the Moon as a steppingstone to Mars (*AW&ST* Oct. 3, 2011, p. 18). Under the rules of the International Space Exploration Coordination Group that drafted them, neither 25-year plan is binding on group member-nations, and both serve mainly as a framework for future discussions.

As a guide for diplomacy, that may be fine. But Squyres says it is not the way to go for a mission with a destination. The "mission success statement" for his Mars rovers fit on half a sheet of paper and carried very specific goals, such as the minimum number of 360-deg. panorama images each rover was to collect on the surface (one).

"The beauty of that was it lent a crystalline clarity to every single decision we ever had to make," Squyres declares.

NASA is not there yet, although there is a lot of behind-the-scenes work under way within the agency on the "multi-destination capability-driven framework" for exploration that Congress has ordered, according to John Olson, who oversees architecture development in NASA's Human Exploration and Operations Mission Directorate.

"We're doing extensive analyses of multiple options," says Olson, another Goddard panelist. "We have a fairly robust set of asteroid work completed in terms of design reference missions. . . . Our policy pathway is Mars as the ultimate destination, with asteroids first. We're also looking extensively, building beyond the International Space Station . . . at early test flights doing missions as well."

Some of those involve cislunar space, including the possible use of pressurized ISS modules moved to the Earth-Moon L1 Lagrange point as a destination that is easier to reach than the lunar surface. Such a way-station could serve as a training ground and jumping-off point for deeper human journeys into space. "From a scientific, from an economic, from an education perspective, there's lots of interest there," says Olson.

An early look at that work may come by the end of April, when NASA owes Congress a "180-day report" on its exploration plans. But the plans are necessarily a moving target right now, says Olson, because there is so much political and fiscal uncertainty in the U.S. and among the international partners the U.S. clearly will need in order to achieve any kind of long-term exploration program.

For Squyres, though, it all comes down to the need for a clear mission statement. "In the absence of that missing piece, it is harder than we would like it to be to articulate to our stakeholders and our workforce what the agency is trying to achieve, and in the absence of that it makes it harder to get the job done," he says.

BY JEN DIMASCIO

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COMMENTARY

Deal for Delta

Bank chief highlights big loan guarantee

Delta may be suing the Export-Import Bank for helping foreign competitors to buy Boeing aircraft, but a new deal will add to the Atlanta-based carrier's bottom line, the bank's president says. Just about a month before the bank is expected to hit its lending cap, it has announced an $84.8 million loan guarantee to the Brazilian low-cost carrier Gol for engine maintenance services in Atlanta by Delta TechOps.

NASA

"Ex-Im Bank's financing will support high-quality, high-wage, technical jobs for Delta employees in Atlanta," says Fred Hochberg, the bank's president. "This transaction truly highlights why Ex-Im financing is so critically important to U.S. businesses such as Delta."

The Ex-Im Bank is facing a reauthorization fight that has become tougher than expected. As the May 31 deadline nears, lawmakers on Capitol Hill have engaged in a back-and-forth, with some claiming that the bank's loan guarantees put U.S. carriers at a competitive disadvantage. Others argue the guarantees increase Boeing's sales and create more U.S. jobs.

PRIVACY POW-WOW

The government is already struggling to overcome technical and procedural hurdles to expand the use of UAVs in civil airspace. The Association of Unmanned Vehicle Systems International (AUVSI) and the American Civil Liberties Union (ACLU) are teaming up to make sure policymakers craft privacy rules for UAVs before they take flight.

The two advocacy groups met last week to see where they have common ground. With the FAA formulating rules for how UAVs will be used in civilian airspace, Catherine Crump, an attorney for the ACLU, calls this a "unique opportunity" to build privacy protection into policy. "If we can think through these things at the outset, we all would be better off," Crump said during an event at the Brookings Institution.

Industry agrees that no one wants to be spied on. So AUVSI has reached out, both to the ACLU and the Justice Department. "We want to work with everyone and have a discussion on the best way to move forward," says Melanie Hinton, an AUVSI spokeswoman. But she says that rules for the use of cameras and sensors in the sky already exist for manned aircraft. "We believe there's a robust legal framework that says you cannot sit in front of somebody's window for hours on end."

FAREWELL FLYOVER

NASA pilots will take the space shuttle Discovery for a spin over the nation's capital—and Capitol—before delivering it to the Smithsonian Institution's Udvar-Hazy Center later this month (see photo). The retired orbiter, known as the workhorse of the shuttle fleet, is due to leave Kennedy Space Center April 17 atop a Shuttle Carrier Aircraft (SCA) en route to the National Air & Space Museum annex at Dulles International Airport. Two NASA T-38 trainers scouted photo angles over Washington last week, descending to about 1,500 ft. in a preview of Discovery's finale flight. Discovery is set to replace the atmospheric test article Enterprise in the James S. McDonnell Space Hangar at Udvar-Hazy. The SCA will transport Enterprise to New York on April 23 for eventual display at the Intrepid Sea, Air & Space Museum.

TAKE TWO

Within the next three weeks, the Air Force will release a modified request for proposals (RFP) for the botched Light Attack Support contract. The service selected Sierra Nevada/Embraer to build 20 Super Tucanos for use in Afghanistan over a Hawker Beechcraft AT-6-based design. But the $355 million contract was abruptly terminated earlier this year after Hawker Beechcraft filed suit in federal claims court. "We lacked confidence in the documentation available," Air Force Secretary Michael Donley says. "That was the basis for withdrawing the contract award."

The revised RFP will include adjustments to the delivery schedule owing to the delay in work since the suit was filed, Donley says. The first of the aircraft had been expected in Afghanistan by April 2013. Additionally, Donley says the Air Force will reexamine whether flight demonstrations are needed in the forthcoming competition. An industry official notes that in the original competition, Air Force test pilots were allowed to fly each aircraft for a risk assessment, but not for a performance demonstration.

Blunt Advice

GRAHAM WARWICK/NASHVILLE, TENN.

U.S. Army aviation is offering industry a deal: Work with us to slow our procurement as budgets decline and we can continue to invest in the clean-sheet rotorcraft we both need; work against us to protect your individual programs and we will both get nothing.

As the Army wrestles with its first budget cuts in more than 10 years, the aviation branch is trying to protect its long-term investment in advanced replacement rotorcraft under the Future Vertical Lift (FVL) initiative by slowing the near-term modernization.

"What we have got to focus on is balance," says Maj. Gen. Tim Crosby, Army program executive officer for aviation. "The easy thing to do in the near term is to cut investment programs. But if we kill all the investment programs, in a few years we will not have a program."

In pointed remarks aimed at industry, Crosby told the Army Aviation Association of America convention here: "We have to do this as a team, or we will not get through this in a pleasant fashion. We will not do it if your lobbyists run to Congress yelling, 'My system, my system!'"

The issue of balancing the Army's near- and long-term needs has come into sharp focus around the long-unfulfilled Armed Aerial Scout (AAS) requirement to replace the Bell OH-58D Kiowa Warrior. Although an analysis of alternatives concluded only a new-build aircraft could meet the requirements, the Army has decided it could not afford a new program and still invest in development of new medium utility/attack rotorcraft to replace the Boeing AH-64 Apache and Sikorsky UH-60 Black Hawk after 2030.

"We have to maintain our investment in FVL," says Crosby. "You may ask why go after attack/utility when the capability gap is the scout? Well, attack/utility is 75% of the fleet. We have to accept some risk in the scout while investing in the long range." The Army still faces a bill to either extend the life of the Kiowa Warrior or buy an off-the-shelf replacement, but is trying to contain industry's expectations for an AAS competition leading to a new procurement. "We have to decide what's good enough," he says. "Is there an 80% solution out there and is it worth trading something else for, because no one is going to give us any more money."

The Army also is trying to build some flexibility into its existing procurement programs so it can adapt to uncertain budgets. The service has reached agreement with Sikorsky on the eighth multiyear buy of UH-60 Black Hawk utility helicopters—the second for the UH-60M variant—achieving the targeted 10% savings over year-by-year procurement despite reducing quantities.

When negotiations began, procurement was expected to continue at 70 a year. The reduction to 60 "took out some of our downward flexibility but kept the price based on 70 a year," says Col. Thomas Todd, Army program manager for utility helicopters. The "unique contract" gives the Army quantity flexibility based on budget resources, says John Palumbo, Sikorsky vice president for Army programs, adding: "They can make a small reduction and maintain the savings."

The upside for Sikorsky is the five-year, fiscal 2014-18 contract contains options for more than 300 aircraft for other U.S. government customers and foreign military sales. "The flexibility in the multiyear is in additional quantities," says Todd.

The same downward flexibility on quantity does not appear to be planned for the second multiyear procurement of Boeing CH-47F Chinook heavy-lift helicopters, the contract for which is to be signed by January 2013. The savings were certified to Congress on March 1, says Col. Robert Marion, Chinook program manager, adding: "Multiyear 2 is for 155 Chinooks. The budget is set. If it changes, we will have to go back."

Award of the first multiyear for the Boeing AH-64D Apache Block 3 attack

The Armed Aerial Scout requirement to replace the long-serving Bell OH-58D Kiowa Warrior is a test case for the U.S. Army's determination to cut back its near-term procurement appetite to protect its long-term investment programs.

U.S. ARMY

U.S. Army asks industry help to balance near- and long-term aviation needs

helicopter is to follow a full-rate production decision in the third quarter. "Over the next four to five years, we will buy fewer aircraft," says Col. Shane Openshaw, Apache program manager. "We will stretch out procurement and buy aircraft back later, but the numbers will not change substantially."

As currently planned, procurement of 700 remanufactured and new AH-64D Block 3s will continue to fiscal 2025, while purchase of 1,375 new-build UH-60Ms has been stretched to fiscal 2026. The Army plans to begin replacing the Apache and Black Hawk after 2030 with the new medium utility/attack FVL, beginning with the older, lighter UH-60Ls.

To keep the Black Hawks in service until replaced, the Army plans two major upgrades to the L and M models. The L Digital program will see the UH-60L updated with a glass cockpit to provide interoperability with the UH-60M. The M model, meanwhile, is to be reengined with more powerful, 3,000-shp turboshafts developed under the Improved Turbine Engine Program (ITEP).

Because they are scheduled to be replaced first, the Ls will not be remanufactured to give them 20 years more life. Instead, they will go through recapitalization, to give them 10 more years. The Army has validated the requirement for the L Digital, and the program will begin in fiscal 2013. "We will begin trade studies in [fiscal 2012] to see what industry has to offer," he says. "We expect a three-year program to select and integrate the upgrade, with production beginning in 2016."

Both General Electric and Honeywell/Pratt & Whitney are developing 3,000-shp engines under a technology demonstration program. ITEP engineering and manufacturing development is planned to begin in fiscal 2014, with the goal of fielding in fiscal 2019. Todd says the Increment 1 of the M ITEP program is planned to involve minimum integration. "There is no plan to upgrade the transmission," he says, because the existing gearbox has capacity that the Black Hawk cannot use at altitudes above 4,000 ft. in temperatures up to 95F because of power limitations with the current GE T700 engines.

Several Army programs are targeted for termination in the fiscal 2013 budget, but the service is hoping to use money remaining in some of those to keep its options open. The Joint Air-to-Ground Missile (JAGM) program is being restructured, rather than canceled. Industry is being told the Army plans to use the $300 million appropriated in fiscal 2011 and 2012 to fund an extended technology-development (TD) phase, while it tries to come up with a cheaper way of replacing the Hellfire missile.

Development of a new missile and its integration on six Army and Navy fixed- and rotary-wing platforms was deemed unaffordable, so the 24-month extended TD phase will focus on the guidance section with its tri-mode all-weather seeker. Both JAGM competitors, Lockheed Martin and a Raytheon/Boeing team, expect to receive contracts.

"The focus will be affordability and risk reduction in the guidance section," says J. R. Smith, Raytheon business development manager for advanced missiles and unmanned systems. Extended TD is expected to result in two fully qualified guidance sections, he says, and give the Army "time to figure out a way to keep tri-mode capability."

What will happen next is not clear: The Army could use the tri-mode seeker in an improved Hellfire or proceed into a second phase to complete work on the longer-range JAGM motor and warhead. "They could stagger integration, focusing on the rotary-wing Apache and the [U.S. Marine Corps Bell] AH-1Z first," says Smith.

"We are waiting for programmatic direction from the customer," says Lockheed Martin, which adds that initial efforts under extended TD will focus on affordability and requirements trades. "We need a request for proposals soon, if we are to get to contract award by August so the Army doesn't lose the 2011 money," Smith declares.

The Enhanced Medium-Altitude Reconnaissance and Surveillance System (Emarss), meanwhile, has been marked for termination, but the Army plans to complete development and deploy the aircraft to Afghanistan in 2013 for an assessment. Prime contractor Boeing is hoping that the November delivery of the four MC-12S aircraft on contract, and subsequent deployment, will per-

suade the Army to reverse its decision.

Based on the Hawker Beechcraft (HBC) King Air 350ER, Emarss was intended to replace a mixed fleet of intelligence-gathering aircraft with a single configuration. Boeing's approach is to modify the aircraft on the production line, and all four have been built and are now in "demod" at HBC before being modified to the MC-12S configuration, says Waldo Carmona, Boeing director for network tactical intelligence, surveillance and reconnaissance (ISR).

Boeing, meanwhile, has modified a company-owned King Air 350ER to the Emarss external configuration, with extended sensor nose and fuselage-top K_a/K_u-band radome, to obtain FAA supplemental type certification. This aircraft is due to fly in May, ahead of the first MC-12S in June. All four are to be delivered by the end of November, with government testing to begin early in 2013. "We hope support for the program will change when we deliver aircraft," Carmona says.

Although no additional aircraft are budgeted, the Army still plans a Milestone C production decision in March 2013. The future of Emarss could rest with a congressionally directed report on Army and Air Force ISR roles and missions to be completed this year. The Army is also trying to decide which of the many quick-reaction capabilities fielded during wartime should become programs of record.

"The Army is looking broadly to see what the future SEMA [special electronic mission aircraft] platform is," says Col. Brian Tachias, fixed-wing aircraft program manager. "There are a lot of programs supporting the forces in theater, and the Army is looking to see which are the enduring SEMA requirements, to pull together a common fleet."

Stood up in October 2011 to take over responsibility for all the Army's fixed-wing assets—366 aircraft in 10 organizations—the program office is awaiting Pentagon approval of its requirements document for a future utility aircraft to replace 117 Hawker Beechcraft C-12s operated in a variety of roles. "Once the initial capabilities document is approved, we will go into an analysis of alternatives," he says.

The aircraft to be replaced—various King Air models—do not include the MC-12 and RC-12 variants used for intelligence-gathering, but Tachias says the future utility aircraft could become the common platform for ISR, signals intelligence and other special electronic missions.

Under Siege

Foreign countermeasures proliferate as U.S. electronic warfare programs falter

DAVID FULGHUM/WASHINGTON

The murky world of U.S. electronic warfare and its more esoteric airborne electronic attack (AEA) subset is being overtaken by a new generation of international threats. Cyberweapons and other sophisticated countermeasures can now attack aircraft, ships and ground vehicles through their antennas and sensors.

Now a new report by the Government Accountability Office (GAO) points out that central electronic attack (EA) and warfare (EW) planning and coordination are encountering stiff problems with acquisition, testing and operational redundancies. Entitled "Achieving Mission Objectives Depends on Overcoming Acquisition Challenges," the report suggests that budget-cutting will worsen this situation (www.gao.gov/assets/590/589765.pdf). Already, U.S. Air Force and Navy planners have been stunned by the lack of money and focus on EA/EW in the fiscal 2013 defense request.

Analyses of international threats are alarming.

"One of the challenges with any electronic system is the [disappearing] boundary between electronic- and cyberwarfare," says Mark Maybury, the Air Force's chief scientist. "If I am able to have remote access to a system through a radar, I can change its behavior. If I am very clever, I can make it react and change its behavior. One of the challenges is that virtually anything could be infected. We have to assume that adversaries may get into our systems."

Losing EW dominance is a trend the U.S. military has become increasingly aware of during the last two decades since the Air Force retired its EF-111 Raven fleet in favor of the Navy's EA-6B Prowler. As an example of the problems that ensued, the Navy was to continue the AEA and surveillance mission and pass the latest information on foreign threats to the Air Force. But in the government's zeal to cut defense spending following the 1990-91 Persian Gulf war, the office to oversee the cross-service transfer of information also was eliminated. The result was that U-2s monitoring Iraq were suddenly confronted with new surface-to-air missile signals that their automated systems did not recognize.

In the last several years, the Pentagon and U.S. aerospace industry have labored to increase EW capability only to see programs such as the EB-52, Advanced Anti-Radiation Guided Missile, miniature air-launched decoy (MALD), AEA expendable, Intrepid Tiger II and other projects canceled, delayed or pressured to consolidate, the study says. The GAO's woeful prognosis is encapsulated in a plea for the Pentagon to "determine the extent to which the most pressing AEA capability gaps can best be met using the assets that are likely to be available."

Industry officials thought the Pentagon would launch an AEA blitz to attack those shortfalls in the fiscal 2013 budget request.

"Most of us expected to see that change of investment in the president's budget," says a veteran EW specialist. "[Additional funding] not only wasn't there, it went in the opposite direction. We expected to see a much more aggressive shifting of priorities. Putting money behind something is what really indicates intent. I think it's a momentary hiccup. If it's not, this whole new Asia-Pacific strategy [which has electronic surveillance and attack at its heart] is a facade.

"The threat of electronic- and cyberattack on U.S. expeditionary forces, both manned and unmanned, is out there," the official says. "The Russians and the Chinese have designed specific EW platforms to go after all our high-value assets. There's no denial that it's going to be a major part of any campaign."

Another issue is that EA and cyberattack have overlapped, say industry radar specialists. A key new U.S. technology—the active, electronically scanned array (AESA)—that provides the antenna structure for the most advanced, wide-spectrum radars and EA systems can become the method of penetrating

a system to implant viruses unless it is properly protected against the new lineup of foreign threats.

Other items on the short list of recent problems in the EW field are equally daunting. The Lockheed Martin F-22 and F-35, with their stealth signatures and the right software upgrades, could have been major weapon platforms for stand-in jamming; however, those upgrades have not been funded. Money for the jamming variant of the MALD is absent in the fiscal 2013 budget request, and a jamming pod for the MQ-9 Predator B has been canceled.

The systems that are making progress are the Navy's Next Generation Jammer, EA-18G electronic attack aircraft and upgrades to the Air Force's EC-130 Compass Call standoff EA aircraft.

The Pentagon's 2002 vision of a family of AEA systems with specialized fixed-wing, stealthy and unmanned aircraft (including their mission systems and weapons) has been decimated by shrinking budgets and the demands of irregular warfare in Iraq and Afghanistan. Preparations to counter increasingly sophisticated threats from surface-to-air missiles and systems to launch cyberattacks on the radars of the U.S.'s most advanced strike aircraft have also been stunted.

The primary solution, according to GAO, is a "designated, joint entity to coordinate activities." Specialists contend that warfighters are better prepared than industry to confront electronic- and cyberattacks.

"The military is used to thinking in terms of fighting in a contested domain," says Richard Bejtlick, chief security officer for Mandiant, an information security company. He contends that new tactics must focus on what happens after a system is breached by an intruder. "The military can lead the way. This is how you continue to operate and run your business despite having bad guys inside your enterprise."

However, the study warns, even with a successful addressing of "acknowledged leadership deficiencies within its electronic warfare enterprise . . . current and planned acquisitions will not fully address materiel-related capability gaps identified by [the Defense Department over the last decade]." Furthermore, the GAO continues, "acquisition program shortfalls will exacerbate these gaps." It calls for creating a steering council to link capability gaps to research initiatives. Despite pointing out several programs that could be combined, the report makes the counterintuitive suggestion that "these steps do not preclude services from funding their own research priorities ahead of department-wide priorities."

Those gaps, the GAO recommends, should be bridged by "evolving tactics, techniques and procedures for existing systems, enabling them to take on additional missions." However, the worst may be yet to come. The Pentagon will soon start preparing for yet another round of cuts as the threat of budget sequestration—forcing additional across-the-board reductions—draws nearer.

U.S. NAVY

The U.S. Navy's aircraft carriers will carry an electronic attack aircraft—the EA-18G Growler (below)—but many other nonkinetic-weapon programs are faring less well as budget plans continue to be juggled.

EA-18G Planned Acquisition Investments

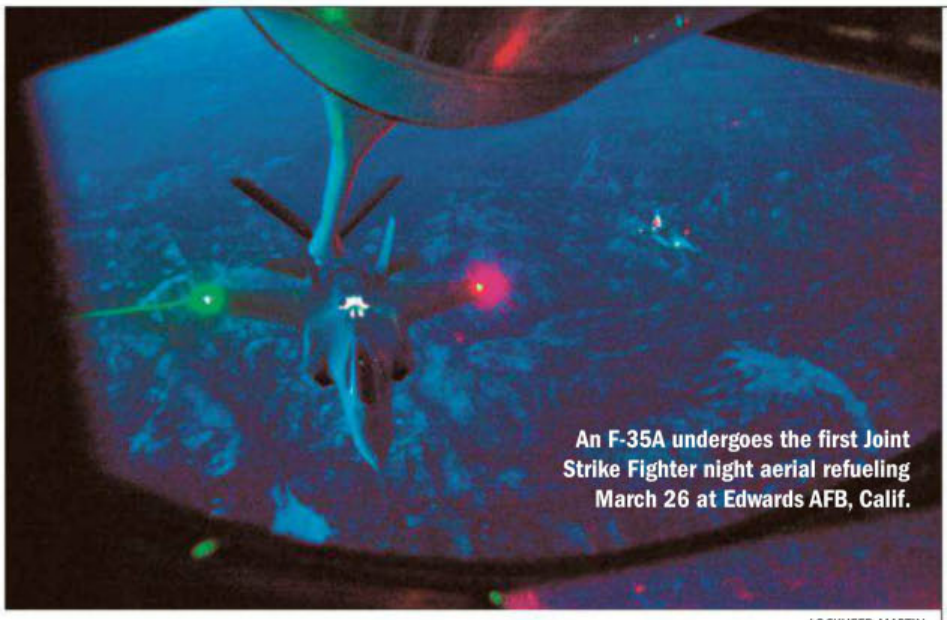
(Then-year dollars in millions)

Fiscal	2012	2013	2014	2015	2016	2017	TOTAL
RDT&E*	$17.100	$13.009	$15.311	$16.002	$16.106	$16.393	**$93.921**
Procurement	1,022.715	1,027.443	21.970	8.111	0.000	0.000	**2,080.239**
TOTAL	**1,039.815**	**1,040.452**	**37.281**	**24.113**	**16.106**	**16.393**	**2,174.160**

**RDT&E = Research, development, testing and evaluation.*

Note: These budget figures do not include $34.151 million in fiscal 2013 for procurement of initial spares.

Source: U.S. Navy



An F-35A undergoes the first Joint Strike Fighter night aerial refueling March 26 at Edwards AFB, Calif.

LOCKHEED MARTIN

Growth Spurt

F-35 cost estimate rises again, this time due to sustainment issues

AMY BUTLER/WASHINGTON

In what is becoming an annual event, the Pentagon has again revised the estimated cost of developing, buying and operating the Lockheed Martin F-35. In this latest pricing increase, the Defense Department estimates the program will total $124.2 billion (9%) more than the $1.385 trillion forecast only a year ago through a projected 55-year fleet life.

This is the latest challenge for a program whose customers are already unhappy with what they see as excessive cost and management problems. However, U.S. Air Force Maj. Gen. John Thompson, F-35 deputy director, says the estimates include many assumptions that are likely to change, such as the amount set aside for spares and fuel, and reflect the long projected fleet service as well as development, which began in 1994.

Cost increases continue to rattle international customers. However, a recent report by Canada's auditor general questions the process its government used to select the F-35 to replace its F-18s. The auditor cites a lack of coordination among Canada's relevant defense and procurement officials, a downplaying of the F-35's actual cost and a seemingly fast-tracked process that led to a sole-source decision for the stealthy fighter. Though the report does not suggest halting the F-35 buy, Canada's political opposition has pounced on it and is calling for a review. Prime Minister Stephen Harper notes that Canada has not yet signed a contract and is keeping its options open.

Such political scrutiny of the F-35 has ebbed and flowed in the governments of various international customers, including Norway and Australia. While some have reduced their anticipated buys, none has yet walked away from the effort because of internal political discord.

The new estimated cost of $1.51 trillion assumes an international buy of 716 aircraft over the program's life; currently, the last U.S. aircraft is planned for 2037.

Full-rate production is slipping to fiscal 2019, when the Pentagon plans to buy 110 aircraft per year, including 60 F-35As and 25 each of the B and C versions for the Navy and Marine Corps, respectively. The Air Force has long hoped to ramp up its buy to 80 F-35As annually in order to reduce the cost. Thompson says that is now forecast to take place in 2021.

The preponderance of the cost increase—$107.9 billion—falls into the "operating and support cost" account, which will pay for flying hours and spares once the F-35 enters service. This estimate was derived from the Pentagon's Capability Assessment and Program Evaluation office and is 6% higher than the F-35 Joint Program Office's. Fuel costs consume about 14% of the projected operating and support cost increase.

The new estimate conservatively assumes the Air Force, Navy and Marine Corps will fund 100% of their F-35 sustainment requirements. However, typically they fund a lower percentage, allowing for some risk, Thompson says.

The program office is continuing a "should-cost" review of F-35 sustainment to target cost reductions. For example, the Air Force baselined purchasing more spares than it expects to need, and the service is trying to determine the correct amount, Thompson says. The services are also looking into collocating their maintenance and support centers.

Lockheed Martin officials emphasize what they say is good value for the money put into the program. In a statement, the company says it "remains confident that F-35 operations and sustainment costs will be comparable to or lower than that of the seven legacy platforms that it will replace." Furthermore, it says the aircraft "will provide greater capabilities, while assuming a larger share of indirect costs, such as basing support, than that of legacy systems." Company officials also suggest the Pentagon reduce the manpower dedicated to F-35 operations and "fully [use] planned support concepts."

Meanwhile, the development and procurement estimates have also increased by 4.3% in the past year, in part because of a slower buy rate brought on by delays in flight testing. The Pentagon put off purchasing 179 fighters, adding about $5.3 billion to the cost; this shift ripples through the program and extends by two years both Air Force and Navy purchases, to 2037 and 2029, respectively. Consequently, the price tag for the engine also rises $1 billion.

In December 2010, the total development and acquisition cost—for both the aircraft and the Pratt & Whitney engine—was estimated at $379.4 billion; it is $395.7 billion now. Among the higher prices is a $4 billion increase in the estimate for labor hours as a result of data gleaned from the first four low-rate initial-production lots of aircraft.

Meanwhile, the program office hopes to soon wrap up development contract renegotiations with Lockheed Martin to solidify an incentive-fee schedule that emphasizes events such as design reviews and testing milestones. The new contract will be a cost-plus-award-fee deal, while production contracts will continue to stress fixed pricing for the aircraft.

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Taking Stock

U.S. military tracks suppliers during budget downturn

JEN DIMASCIO/WASHINGTON

As the Pentagon begins a 10-year reduction in its spending plans, its database of the vast network of companies that supply its prime contractors is already helping to spare companies from budget disaster.

The effort may provide some small measure of reassurance to lawmakers, who are concerned about maintaining high-quality jobs in a presidential election year during a time of high unemployment. The aerospace and defense industries employ more than 1 million people, according to an economic impact study conducted by Deloitte for the Aerospace Industries Association (AIA).

BOEING

Decisions regarding the fate of C-17 production and other major defense platforms sent ripple effects through the supplier base.

"We're watching the industrial base probably more closely now than at any other time since perhaps the end of the Cold War," Frank Kendall, undersecretary of defense for acquisition, technology and logistics, recently told the Senate Armed Services Committee. "We're taking account of it as we make budget decisions in particular because we're no longer in a period of growth in the budget."

Kendall referred to what is known as a "sector-by-sector, tier-by-tier" (S2T2) effort led by Brett Lambert, deputy assistant secretary of defense for manufacturing and industrial base policy. It is designed to head off problems in the supply chain, pinpoint areas where the government relies too heavily on foreign companies and identify where competition is limited.

"We are going to be limited in our resources," Kendall says. "So any intervention in the industrial base is going to have to be on a case-by-case basis and probably fairly rare. But if there are niche capabilities that are critical to us, we may well intervene, and there may be cases where just to compete—keep competition for critical components—we'd do the same."

In fiscal 2013, S2T2 led the military to invest more heavily in American Pacific, a supplier to solid rocket motor makers ATK and AeroJet, than it otherwise would have. Now up and running, the ongoing effort will feed into future budgets even more significantly, Lambert tells Aviation Week.

Initially, the Pentagon conducted a very detailed survey of about 5,000 companies. This summer, a new C4ISR survey for the industry is expected. "Our intent is to do once a quarter, different deep dives," he says.

While the Pentagon intends to share the data in the future to provide more transparency about the health of the industrial base, Lambert points out the data will not be used when making competitive awards.

The data represent such a trove of information that Congress is watching. Sen. Carl Levin (D-Mich.), chairman of the Senate Armed Services Committee, asked Kendall for an update on the industrial base effort by May 10 to inform the defense authorization bill the committee will mark up shortly after.

And the House Armed Services Committee's (HASC) recent report on the industrial base called for "semiannual updates" about the status of the S2T2 assessments of the industrial base. For lawmakers, protecting the industrial base is a part of protecting their home states and districts.

Levin is monitoring the health of the ground combat and tactical vehicle supply chains. Other rust-belt lawmakers last year added millions back into the defense budget to keep General Dynamics' Abrams tank line from closing temporarily—against the wishes of the U.S. Army. The same fight is under way this year, as members of Congress talk about the need to prevent work from stopping, while Army officials are trying to maintain production via foreign sales.

The Aircraft Carrier Industrial Base Coalition and the Shipbuilding Caucus have rounded up more than a half-dozen lawmakers for a rally against budget reductions. The carrier coalition is putting numbers alongside its outreach, stressing just how much money carriers bring to the nation: $3 billion in the last seven years nationwide and $870.6 million in Virginia.

And Rep. Buck McKeon (R-Calif.), chairman of the HASC, was in his home state last week for a rally with employees from Northrop Grumman, who stand to lose if the Pentagon's decision to stop building Global Hawk Block 30 aircraft holds.

Sustaining niche capabilities is a national security, technical leadership and competitiveness issue, says Tom Captain, a senior aerospace and defense analyst at Deloitte, who conducted the economic analysis of the industry for AIA. "This is where the reality of a budget situation collides with our national policy interests," Captain says. "Once you stop something, building it back up in the face of heated international competition is difficult, if you can ever do it."

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ROYAL AIR FORCE

MBDA is looking to capitalize on Dual Mode Brimstone's success in Libya with new customers and missions.

Cashing In

MBDA eyes Brimstone evolutions and Raytheon new opportunities for Paveway 4

ROBERT WALL/LONDON

That rearming after last year's NATO-led air war in Libya would bring some short-term financial benefits to weapons makers has been clear. Now, they are looking to build on those successes to generate additional business.

France, for instance, is looking for a low-collateral-damage weapon. MBDA CEO Antoine Bouvier sees a chance of selling the Dual Mode Brimstone (DMB)—used heavily by the U.K. on its Tornado GR4s—to the French air force. The service is currently studying low-collateral-damage weapons options for use on the Rafale strike fighter (the French navy does not appear interested). Other options also are being looked at, including a concrete-filled laser-guided bomb Lockheed Martin has put forward.

The newfound enthusiasm is also giving rise to a ship-launched version, called Sea Spear. The 50-kg (110-lb.) weapon is intended to help ships defeat the threat from small boats, says an MBDA official. Swarms of small, fast boats have long a been a concern, particularly in the Persian Gulf, where Iran has shown interest in using them to overwhelm an adversary's defenses.

Another application would be for antipiracy, or simply to give smaller boats themselves a precision strike capability. The weapon would use the radar-seeker for all-weather capability and come with a new launcher. Also, it could use the insensitive munition warhead being eyed as part of a British effort to refresh its Brimstone inventory—more than 200 were used in Libya and Afghanistan.

The so-called Brimstone 2 features several enhancements over the baseline DMB first fielded in 2008 as an urgent operational requirement. The U.K. expects to start using Brimstone 2 air-to-ground missiles from Tornado GR4s next year. The Brimstone 2, also known as the Selective Precision Effects At Range (Spear) Capability 2, Block 1 builds on the DMB and deals with technology issues that could not be handled at the outset of the program when the emphasis was on putting the laser/millimeter wave weapon quickly into service. Brimstone 2 features an insensitive munition rocket motor, warhead and airframe improvements, as well as software refinements.

The new model will largely retain the shape of the DMB, which should ease integration onto the Tornado. Brimstone 2 also should bring enhanced operational flexibility and logistics capabilities.

Raytheon, too, is reaping financial benefits from the rearming, having just secured a £60 million ($95 million) U.K. Defense Ministry contract to replenish Paveway IVs used heavily in Libya (but the number of weapons being acquired is not being disclosed).

The Defense Ministry also says it is moving to integrate the bomb with laser and GPS/INS guidance on the Eurofighter Typhoon. The goal is to have the aircraft/weapons combination in inventory next year, a delay from earlier plans that foresaw operational trials in 2012.

Industry officials note there are plans to further evolve the weapon. They include warhead and seeker options now in development. One is a low-yield system to allow Paveway IVs to be used in close air-support roles to minimize the risk of harming friendly forces or civilians. Different technology options are still being looked at. A second warhead option, in development with Qinetiq, is an enhanced, compact penetrator to boost the ability to attack buried targets. The design approach involves building a thin, long penetrator enveloped in a shroud to maintain the outer mold lines of the standard weapon. In both cases, the warhead would use a Mk. 82 bomb aerodynamic configuration to ensure the weapon's integration on aircraft does not change.

A seeker upgrade to better engage moving targets also is being studied, but so far only with internal company funding. It features a digital laser seeker and proportional navigation to improve strike of moving targets. Air-dropped trials are planned this year.

Several other weapons issues are on the European agenda. For MBDA, "it will be an important year about securing the opportunities for the future," says CFO Julian Whitehead. For example, France and the U.K. are to award the development contract for the FASGW(H)/ANL anti-ship missile. Due to be awarded last year, that contract slipped because of delays in London and Paris.

Another key effort on the tactical missile side is the effort to secure the MMP (medium-range missile) development contract; since last year MBDA has been working on a risk-reduction phase. MMP is intended to have a range of 2,500 meters (8,200 ft.), the French government says, although longer ranges have also been cited. It is being designed to engage fixed and moving targets and be day/night capable. It is to be acquired for special forces and regular ground troops.

Bouvier also hopes European governments will start focusing earnestly on ballistic missile defense, with the NATO Chicago summit next month a potential catalyst. There are sovereignty and industrial base issues to be dealt with, he argues, warning that without some initiatives soon, European states will be forced to buy American weapons.

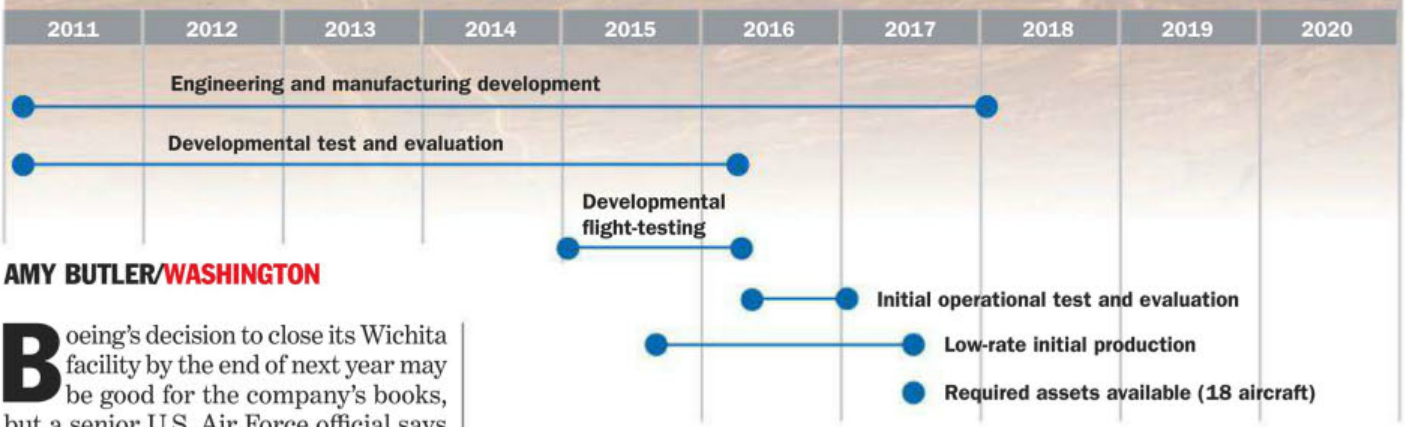
Risky Business

Boeing's Wichita plant closure carries both perils and promises for USAF tanker program

BOEING CONCEPT

Production of the Boeing KC-46A is scheduled to last through 2028.

KC-46A Development and Production Plans



Source: Government Accountability Office presentation of U.S. Air Force data

AMY BUTLER/WASHINGTON

Boeing's decision to close its Wichita facility by the end of next year may be good for the company's books, but a senior U.S. Air Force official says it adds risk to its ability to execute the KC-46A aerial refueling contract.

The Wichita facility was "well-suited" for militarizing the 767-2C aircraft, including adding the refueling equipment, owing to decades of experience, says Maj. Gen. Christopher Bogdan, the USAF's KC-46A program executive officer. Now, however, that work is being set up between Boeing's Puget Sound and Everett facilities, both in Washington.

This move, announced nearly a year after the company won the contract over an EADS A330-based tanker entry, will introduce risk in three key areas, Bogdan says. They include the transfer of refueling boom assembly work, shifting oversight of the FAA supplemental type certification (STC) and moving the military modification and finishing center.

"Without a doubt, closing Wichita is a change to the plan, and any change on a program like this is going to introduce some uncertainty and some risk," Bogdan tells Aviation Week. "We are adding some oversight."

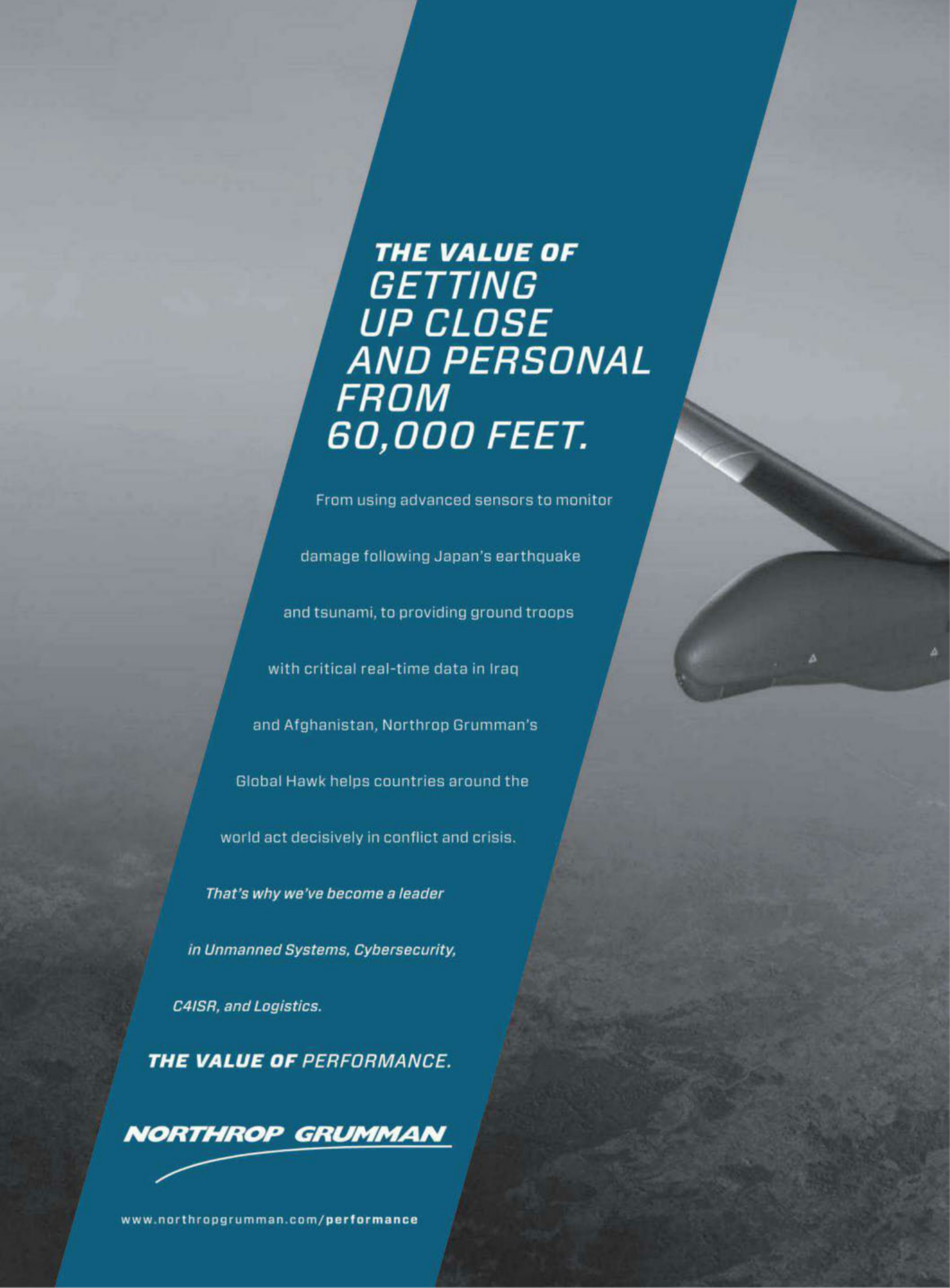
The government has asked for details on how Boeing plans to ensure the STC will be addressed, Bogdan says. Also, "Boeing owes us [a] more detailed report on the Wichita move [and] progressively more details on their plans for integrating the boom and other aspects of the schedule," says Air Force Secretary Michael Donley.

"The fact that they chose to close Wichita was not part of the original plan. And so—quite frankly—we're going to hold them accountable to make sure that risks don't manifest themselves," Bogdan says. "We are involved in the oversight of that move . . . under the same cost structure, under the same schedule, with the same requirements," he says.

Boeing opted to close the facility by the end of 2013 due to a lack of "sustainable business on the horizon," company officials say. Additionally, "this action will ensure that Boeing is competitive in the aircraft maintenance, modification and support business and will place the company in a stronger position to win new business," says company spokesman Jerry Drelling.

The move, however, does not necessarily bode ill for the KC-46A program.

"If Boeing can make this transfer from Wichita . . . without introducing any risk in cost or schedule . . . the program will be less risky because they are going to build the boom in the same place where they build all of the other military [tanker] stuff," Bogdan says. "The consolidation of all of those elements in one place is really a good thing . . . The problem is that they have got to make the transition now while they are designing the airplane."


THE VALUE OF
GETTING
UP CLOSE
AND PERSONAL
FROM
60,000 FEET.
From using advanced sensors to monitor
damage following Japan's earthquake
and tsunami, to providing ground troops
with critical real-time data in Iraq
and Afghanistan, Northrop Grumman's
Global Hawk helps countries around the
world act decisively in conflict and crisis.
That's why we've become a leader
in Unmanned Systems, Cybersecurity,
C4ISR, and Logistics.
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Refueling boom assembly work that was shifted to Puget Sound is slated for completion by October 2012, Drelling says. The finishing center move is scheduled to wrap up by the end of 2013. "Any risk associated with the move would be mitigated by early next summer, at the latest," Drelling says.

Timely certification and flight testing are key risky areas in the program, as noted by both Bogdan and a recent report from the Government Accountability Office (GAO). The auditors note that 50 testing and certification flight hours for each of four development aircraft are required per month. But, Bogdan notes, commercial certification is often a "high-intensity, rapid" operation, including six-day-a-week schedules at Boeing. Military-type certifications, however, are laborious, highly bureaucratic and not under the sole control of the contractor's team. "Can they transfer some efficiency to military testing" from the commercial work, Bogdan asks. Slow testing as a result of procedures at Edwards AFB, Calif., has caused delays in other programs, such as the Global Hawk unmanned aircraft, and could impact the KC-46A fielding dates.

Boeing officials say the flight-test schedule "will rely heavily" on use of its flight-test facilities. "By operating primarily from contractor facilities, we are confident we will be able to conduct flight test of the aircraft at closer to historical Boeing Commercial flight-test rates," Drelling says, adding that the schedule has five months of management reserve built in.

The fiscal risk to the government, however, is negligible owing to protection from a fixed-price, incentive-fee contract. Financial risk would only be introduced if the government and Boeing opted to change requirements or reopen negotiations.

The real problem is that development snags could prolong deliveries, forcing the Air Force to keep aging and maintenance-hungry K-135s in service longer than planned. This is especially true should problems arise late in development or while production is under way, the GAO auditors say.

The development contract requires that 18 combat-ready aircraft be delivered in fiscal 2017 at a cost target of $4.4 billion. However, owing to a government estimate of $5.3 billion at completion of the work, the Air Force is anticipating paying the total amount allowable on the contract, which is $4.9 billion (the Air Force and Boeing share cost overruns 60/40, respectively, up to the ceiling). Any additional overage—estimated by USAF as $400 million—is Boeing's responsibility.

Thus far, the government has paid $558 million in seven progress payments. Bogdan says the government withholds 20% of Boeing's billing requests, which is payable at completion of development. Additionally, USAF is withholding another 9% from each payment as a loss ratio since Boeing is expected to burn through the government money in advance of completing development.

Boeing officials decline to discuss the specifics of their independent cost estimates for program completion, but GAO auditors report that the company estimates its overrun to be about $187 million less than the Air Force's estimate. "We remain on target with our initial estimate of the cost of developing the KC-46 tanker. Initial cost productions are just that, projections," Drelling says. "Should we be able to reduce the costs of the program—and Boeing has both the opportunity and incentive to do so—it will benefit both [USAF and us]." Boeing officials have not outlined how they plan to reduce the cost of the overrun.

The Air Force estimates the development and procurement cost of all 179 KC-46As as $51.7 billion.

Bogdan and GAO auditors are watchful of the concurrent KC-46A development and production phases. Concurrency refers to the risk associated with producing aircraft before discovering all possible defects in a design through testing.

Bogdan also notes that the government has leverage over Boeing in that its production decision is event-driven. "If the test program doesn't go well or is delayed, we are not going to make a production decision and that is at great risk to Boeing for two reasons: One, it is a fixed-price contract so as long as EMD [engineering and manufacturing development] continues, they are going to have to pay anything above $4.9 billion. Two, the longer we wait to get into production, the longer Boeing waits to make money on this program," he says.

The KC-46A contract also contains a deficiency clause that is "the most airtight I have ever seen," Bogdan says. The language was drawn in part from lessons gleaned from the F-35 experience. Lockheed Martin's F-35 development program is fraught with concurrency anomalies, exposing the government to hundreds of millions—and potentially billions—of dollars of liability in the form of retrofits. The KC-46A contract stipulates that if any deficiencies are found in the six years of development, Boeing is required to design a fix, gain Air Force approval for it, retrofit it into delivered aircraft and insert it into the production line at no cost to the government.

Bogdan says Boeing has set aside three system-integration laboratories specifically for KC-46A work. Additionally, Fedex has ordered 27 767 freighters that Bogdan suggests will provide some risk-reduction work leading into the build of the first 767-2C (the baseline for the tanker). The freighter will have a cargo door and structurally enhanced floors, tail, wings and empennage—as will the 767-2C. The 2C, however, will include such tanker-specific equipment as specialized wiring and plumbing, a refueling receptacle and boom equipment.

The GAO auditors note that the "aircraft weight forecast is near the aircraft's weight limit," a potential concern. The design now has about 2,000 lb. of margin after having grown 600 lb., Bogdan says. However, if Boeing exceeds the 2,000-lb. limit, the aircraft still has margin to meet the performance requirement for range and offload. The risk, he says, would largely be to Boeing's ability to meet a contractual requirement, not its ability to meet the performance standards.

During a requirements review, the Air Force and Boeing had an "absolute meeting of the minds" on what the "secondary requirements," which are design elements derived from the key performance parameters, would be for the KC-46A design, says David Van Buren, the outgoing Air Force senior acquisition executive. In the past, a misunderstanding on these "derived" requirements has driven the cost of programs up. In the case of the KC-46A, however, USAF is working aggressively to control requirements in order to avoid reopening the contract for negotiation.

A KC-46A preliminary design review is expected to be completed at the end of the month.

KC-46A Development Contract

		TOTAL CONTRACT (millions $)
Contract amounts:	Target price	$4,393.9
	Ceiling price	4,897.6
Current estimates by:	Contractor	5,163.5
	Government	5,351.0

Source: Government Accountability Office

Stuck at Starting Block

Dassault faces several hurdles before finalizing Indian fighter contract

ASIA-PACIFIC STAFF/NEW DELHI

Such is India's idiosyncratic procurement system that, in the run-up to the award of the $12 billion Medium Multirole Combat Aircraft program, the joke was that the only thing worse than losing would be winning. For Dassault, that reality is not that far off.

After its Rafale offer beat out the Eurofighter Typhoon in January as the low-cost bidder for the MMRCA program, there has been much talk about the fate of the project, but very little action. Talks have been stuck since late February, with departmental inquiries into allegations that the final selection process was manipulated to favor Rafale.

Following weeks of uncertainty, Defense Minister A.K. Antony revealed last week that the program would move forward only after all inquiries were made and the ministry was satisfied that the selection process had not been corrupted. But that may not happen anytime soon.

"There are at least seven to eight more levels of scrutiny and process before the MMRCA contract can be signed," Antony says. "The contract has to be vetted at multiple levels, including the finance ministry and the cabinet committee on security. Right now an inquiry is on. Only after we receive the inquiry report, study it and are satisfied that all processes have been followed unfailingly will the procurement effort move to the next level."

Less than a month after the Rafale got the nod, the defense minister received a letter from M. V. Mysura Reddy, a member of the Indian parliament's standing committee on defense, asking for an inquiry into the selection process.

Allegations of favoritism are not new in Indian defense contracting, and the MP's letter could be the first of many twists in a journey that hardly suffers from a lack of drama and intrigue. Initially, officials indicated that the favoritism issue might only receive a cursory glance to satisfy the legislator's concerns, but the process may now be more extensive.

Formally, negotiations between the Indian contract committee and Dassault have begun, but in reality the two parties have not met even once as a result of the complaint, according to officials close to the proceedings. The ministry has refused to divulge the nature of its inquiries, although in March it acknowledged that internal questions raised about the Rafale's life-cycle cost had been looked at but dismissed.

A Dassault official says: "We are waiting to see if we can help with any information. We've worked with the Indian air force and [defense ministry] for years, and are confident that we have provided all the information necessary and are fully compliant with the selection process. The Rafale was selected because it was the better aircraft backed by a better industrial package."

The delays are beginning to worry the eventual customer, however. Indian air force sources say IAF leader Air Chief Marshal Norman Browne, who met the defense minister last week as part of a defense acquisition council (DAC) meeting, raised both the MMRCA program and delays in a final contract for a basic trainer as issues of concern.

The Indian government doused speculation that India and Brazil would jointly negotiate with Dassault for a common best price on the Rafale. "That is impossible and can never happen," Antony declares. Brazil is due to make a type selection among the Rafale, Boeing F/A-18E/F and Saab Gripen. A visit by Defense Minister Celso Amorim to India shortly after the Rafale selection gave rise to speculation that a partnership was in the offing, but that has been dismissed as merely coincidental. Furthermore, Brazilian President Dilma Rousseff is due in Washington this week, and the F-X2 fighter competition also is expected to be on the agenda.

The company most eager to see the derailment of MMRCA talks is runner-up Eurofighter. Officials for EADS, the Typhoon partner in charge of the Indian campaign, have signaled that they view the contest as still in play. "As L2 [second-lowest bidder], we take our responsibility seriously," a company official said during the recent Defexpo defense exhibition in New Delhi. "There is a larger concern that the Indian air force shouldn't suffer on any count as a result of delays. They need their aircraft as soon as possible."

The loss in India also has given rise to renewed interest in Europe for core Eurofighter governments to press forward with a radar upgrade to add an active, electronically scanned array (AESA) to

Talks between India and Dassault regarding the Rafale fighter have hardly begun since January's type selection.

ASIA-PACIFIC STAFF

the fighter. Eurofighter industrial partners have been self-funding the development in the absence of government backing. That has created uncertainty over the fielding schedule, although industry officials insist they could meet a 2015 objective. In contrast, the first Rafale with the Thales RBE2 production AESA is to fly this year; the first radar was recently delivered to Dassault for installation on C137, the aircraft to be used for the test campaign at the Istres flight test center in southern France. France would become the first European air force to field an AESA when the system becomes operational.

The fluid status has also led to continued political lobbying in India over the program. British Chancellor George Osborne, who visited India last week, is understood to have pushed Eurofighter's case with the government. A French delegation also called on the country's junior defense minister to see if it could gain more information about the inquiry.

Not all program activities are on ice, though. Hindustan Aeronautics, which will license-build 108 MMRCAs, has requested bids for a new design and manufacturing facility in Bengaluru for the new production line.

With Robert Wall in London.

Light and Lethal

New BrahMos missile version would expand fighter options

ASIA-PACIFIC STAFF/NEW DELHI

That the BrahMos high-speed anti-ship missile is a formidable weapon is not in doubt, but its air-launch suitability remains a question. Now industry is pursuing a dual path to ease those concerns.

As a first step, the core BrahMos missile is due to undergo flight trials to clear its airborne use. But perhaps more significantly, the Indo-Russian joint venture behind the weapon has drawn up plans for a new lightweight anti-ship cruise missile deployable by light and medium fighters. Tentatively called BrahMos-3, the company says it is looking to address a large requirement for such weapon by the Indian navy's MiG-29K and future fighter fleet as well as the Indian air force's (IAF) Medium Multirole Combat Aircraft and Sepecat Jaguars.

The current BrahMos, at 2.5 metric tons, is too heavy for a light or medium fighter, and the only Indian air asset that stands to deploy it is the Sukhoi Su-30MKI, and only on a highly modified belly pylon.

"We are considering a smaller-diameter, lighter-weight anti-ship weapon because we cannot address all requirements with the missile we have," says BrahMos CEO A. Sivathanu Pillai. "It is a considerable market, and the BrahMos-3 could compete. We are working on a techno-commercial proposal that will need endorsement from both India and Russia before we can get started. We see the BrahMos-3 competing with the Harpoon and Exocet in the global market."

The Indian navy's P-8I Neptune long-range maritime reconnaissance aircraft and IAF Jaguar maritime strike aircraft will be armed with the Harpoon Block II.

The company believes it can develop and deliver the missile in less than four years, although previous schedule estimates have been overly ambitious. The air-launched version of the BrahMos-1 remains untested, for example, with delays forcing the program to remain on the ground for at least another year.

Hindustan Aeronautics Ltd. has finalized the structural modifications necessary on two Su-30MKIs in collaboration with Russia's Sukhoi Design Bureau. The bureau's unwillingness to prioritize the assistance was one reason the air-launched BrahMos effort was delayed by more than two years, say company sources. "Things are now moving well, and we hope to test-fire the BrahMos from a Su-30MKI by early next year," says Pillai.

The BrahMos-2, a concept scramjet-powered hypersonic version, has begun development, with initial results "positive and promising," according to the company chief. The scramjet version is slated for a first test by 2017.

The Indian army recently activated its second BrahMos unit in the western deserts, with a third regiment expected to be raised in the mountains of the northeast bordering Tibet. The company said two recent tests of the BrahMos Block III land version saw the missiles engage in supersonic steep dives in the endgame phase, and had proven the capability.

BRAHMOS

Integration of the Su-30MKI-launched BrahMos missile has slipped into 2013.

Brahmos Supersonic Cruise Missile

Length	9 meters (30 ft.)
Diameter	0.67 meters (2.2 ft.)
Launch Weight	3,900 kg (8,600 lb.)
Payload	200 kg (440 lb.)
Propulsion	Ramjet with solid booster
Range	300 km (160 nm)
Guidance	INS, GPS, active and passive radar
Cruise altitude	15 km (9.4 mi.)
Cruise speed	Mach 3

Sources: Company data and GlobalSecurity.org

High-tech engine parts mean high-tech engine repairs are needed.

Ratcheting Up

Powerplant OEMs seek aftermarket strength amid next-gen engine MRO capacity concerns

FRANK JACKMAN/DALLAS

The surge in commercial transport orders in the past few years and aggressive plans by Airbus and Boeing to ratchet up aircraft production rates are likely to create a bow wave of engine shop visits by the middle of the 2020s, particularly for the high-tech CFM Leap and Pratt & Whitney PW1000G powerplants. And unlike in decades past, when airlines and independent third-party maintenance, repair and overhaul (MRO) providers would have been in position to absorb much of the energy from such a wave, the 2025 shop-visit tsunami likely will land squarely on the shoulders of the engine OEMs and their maintenance partners.

CFM has about 3,400 orders and commitments for the Leap and Pratt has roughly 2,500 orders and options for the various PW1000Gs. By combining aircraft order and scheduled delivery information with basic assumptions about hours of operation per engine/per year and data on time-between-scheduled removals, US Airways estimates there could be up to 3,000 Leap engine removals and another 1,400 PW1000G removals due by 2025, according to Joseph Maloy, director of propulsion engineering and aircraft acquisitions for the carrier. Given the complexity of the engines and advanced materials that will be used in their production, "engine removal rates will create an out-year bubble that will stretch" the industry's high-tech repair capacity, Maloy predicted during Aviation Week's MRO Americas conference in Dallas last week.

Much, if not most, of that high-tech repair capacity will reside with or be controlled by the engine original equipment manufacturers. Driven by new engine research and development costs, the need to protect intellectual property, and the desire to ensure aftermarket revenue streams, engine OEMs increasingly are pushing into the engine MRO market.

Roughly 80% of all engine overhaul work is outsourced, with a growing segment going to the OEMs, all of whom work actively to lock-in customers with long-term service/support agreements during the original engine sale. Rolls, for example, says 92% of its Trent-powered aircraft are under Total Care contracts.

"The OEM as MRO paradigm continues to gain momentum," says TeamSAI Executive VP/CFO Mike McBride. "New engine pricing pressure is pushing the OEMs deeper into the aftermarket." The company predicts the commercial engine maintenance, repair and overhaul market will be worth about $22.4 billion this year.

But it is not just aggressive OEM sales tactics that are pushing the engine MRO market to the manufacturers. The materials and technologies that go into the engines to make them more reliable and fuel-efficient play an important role, as do the changing market dynamics.

Engines manufactured in the 1960s and 1970s, like the Pratt & Whitney JT8D, had a life expectancy of about 30 years, during which time an engine was likely to be removed 9-12 times for shop visits, according to Christoph Heck, vice president of sales-the Americas for MTU Maintenance Hannover GmbH. Mature engines, those installed in the 1980s-90s, likely would see 6-9 shop visits over a life cycle of 28 years.

New engines now in service, such as the IAE V2500-A5 and the CFM56-5B, likely will see 4-6 shop visits over a 26-

year life, Heck says. Engines still in the development stages, such as the Leap and PW10000G, will see 3-5 shop visits over a 25-year life span, he says, and 80% of those visits will be under the auspices of the original equipment manufacturer.

Fewer expected shop visits per engine makes less appealing an already difficult business case for investing in the expensive tooling and technology that will be needed to overhaul engines that feature space-age materials and complex, highly engineered parts. Detailed design data are needed to develop repairs for new engines introduced during the past decade and for those yet to come, and OEMs are more than reluctant to license that data or to authorize most independent MROs to do the work. Sole-source repairs are becoming more common and often are controlled by the OEMs, Maloy says.

"To get a license as an independent shop is extremely difficult, and if they give it to you, it's horribly expensive," says Heck.

Engine OEMs bristle at criticism that they don't share data with independent MROs. Rather, they say, they are selective with whom they share data. They want to ensure that potential licensees are capable of fulfilling the promises that OEMs have made to their customers.

"We have a ton of skin in the game," says Tom Levin, general manager of material services at GE Aviation Services.

> **"The OEM as MRO paradigm continues to gain momentum"**

General Electric and the other OEMs have invested a lot in developing new engines and in supporting them, or preparing to support them. Levin says GE spent $40 million on developing new repairs in 2011. "We've been pumping out 1,200 repairs per year for the last year two years and we're on a pace to exceed that this year," he says. Many of the repairs are for older GE and CFM engines, but Levin says that GE already has 200 repairs ready for its GEnx powerplant.

Still, the OEMs cannot go it alone, which brings the model back full-circle to airline and MRO partners. Companies such as GE recognize the need to partner to meet market demand and customer desires for competition. According to Levin, GE competes with its licensees and those companies compete among themselves. There may be fewer licensees, "but they compete," he says.

And airlines want choices, value pricing and lasting solutions. Scott McGovern, managing director of technical operations and planning at US Airways, says he feels like he has been battling with some OEMs over the last 5-7 years to get permanent fixes for engine problems, but instead, he "just gets Band-Aids," which can introduce other problems. "OEMs needed a bigger sense of urgency for fixes," he says.

Fire Sale

JOSEPH C. ANSELMO and FRANK JACKMAN/DALLAS

Three years ago, Rolls-Royce & Partners Finance was leasing an engine for a large narrowbody jet for $120,000 a month. Today, a similar powerplant commands a rate of just $50,000. Underpinning the 58% price cut is a simple equation: supply and demand.

Slumping interest in used aircraft is forcing owners to park jets much sooner than anticipated, flooding the market with engines and surplus parts and depressing prices. "There are too many aircraft being parked," says Bobby Janagan, general manager for engine leasing at Rolls-Royce & Partners Finance, a joint venture between Rolls and GATX Corp., owners of the largest portfolio of Rolls-Royce and International Areo Engine powerplants. Yet Janagan has little choice but to accept the lower rates. "If an engine is on the ground for six months, we don't make any money at all," he lamented during a panel discussion at Aviation Week's Engine MRO Forum last week in Dallas.

Aircraft lessors complain that Boeing and Airbus are producing too many new narrowbody jets, diluting the value of used 737s and A320s and, by extension, their engines. "Lease rates have gone dramatically lower," noted Bob Matson, director for technical services at Willis Lease Finance Corp., a Novato, Calif., company that leases spare aircraft engines.

Industry veterans say that lessors base their lease rates for new jets on the assumption that they will have an economic life of 25 years. But with soaring fuel prices driving demand for more-efficient jets, those life cycles are proving in some cases to be as short as 15 years.

"The A320 market is totally upside down," says an aircraft lessor, who spoke on the condition of anonymity. "There are so many available that lease rates are probably half of what they should be." The lessor says his company recently opted to dismantle four Airbus A318s when it could not find an airline that was interested in leasing them and put their engines—which still had more than half of their life-cycle remaining—back on the market. "We added used engines to the market," he says.

Skeptics of such complaints note that aircraft and engine lessors have a vested interest in seeing fewer new jets hit the market because a tight supply bolsters the value of their assets and allows them to command higher lease rates. And Airbus and Boeing say their plans to increase single-aisle output—Airbus will be producing 42 A320s a month later this year and Boeing the same number of 737s by 2014—are simply responses to surging demand for new jets, particularly from customers in emerging markets.

But lessors complain that demand is being distorted by government export banks, such as the Export-Import Bank of the United States, which guarantee loans for new jets sold to foreign buyers. Such guarantees, they say, are enabling distressed airlines to finance new jets at blue chip rates, instead of buying or leasing a used model.

Still, nobody expects the two airframers to throttle back production so long as demand is there. "Boeing and Airbus continue to produce," says one lessor, "because that is what they get paid for."

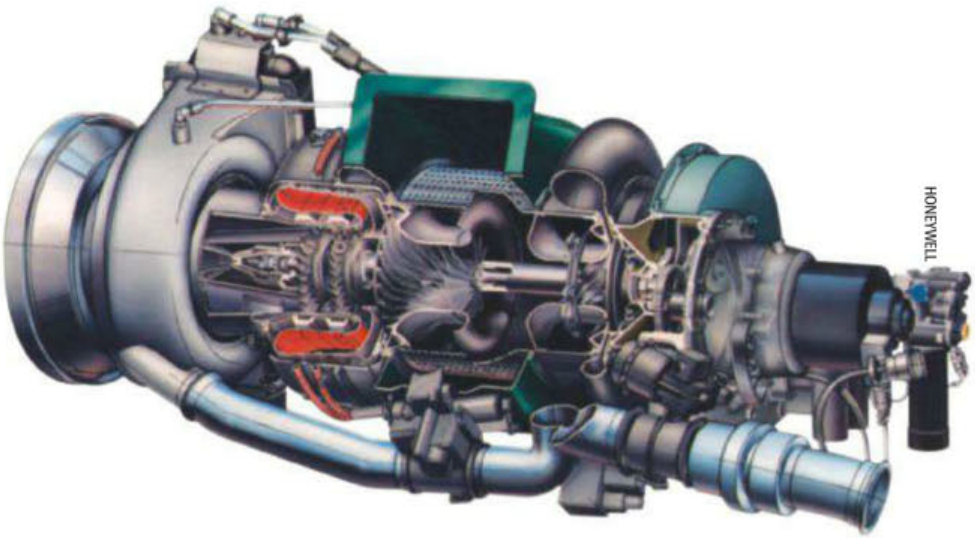
Local Demand

Proposed Chinese aircraft programs grab the attention of many Western suppliers

BRADLEY PERRETT/BEIJING

One rule in business is to follow the money; in aircraft systems, it is to follow the programs. Since the Chinese industry is proposing many new programs—probably more than is generally appreciated in the West—advanced aircraft systems companies are setting up there for the long haul.

The rush to establish joint ventures in China is not just a response to the Comac C919 program, though that project for a 158-seat narrowbody airliner has been the undoubted catalyst. And it is not just about China's famously cheap capital and talent. The ambition of the local industry is drawing suppliers' attention to a degree that Russia, Japan and India have never managed to achieve.



HONEYWELL

Honeywell plans to assemble its 131-9[C9C] auxiliary power unit for the C919 in China. It will develop other products jointly with Chinese partners.

Honeywell is a case in point. The company is arranging joint ventures in China mainly to feed the Chinese market itself, says Briand Greer, the president of Honeywell's Shanghai-based Asian aerospace business. Exports from the company's Chinese businesses are a possibility but are not the focus, he says. An unspoken assumption is that a protectionist Chinese industrial policy will favor local factories when aircraft development makes Avic and Comac look for suppliers.

The most immediate prospective Chinese program for Honeywell and its competitors is the MA700 regional turboprop from Avic Aircraft, the large-airplane subsidiary of the Avic group. The MA700 received approval from the government—equivalent to program launch—in January, say industry executives. Greer expects to offer Honeywell's Primus cockpit for the turboprop.

Honeywell has already developed a version of the Primus for the Avicopter Aircar, a utility airplane formerly known as the Y12F. While that would normally suggest an advantage as an established partner—especially in China, where relationships are unusually important—two rival companies are also well-placed. Rockwell Collins supplies its Pro Line 21 cockpit suite for the Avic Aircraft MA600, a modernized Antonov An-24 that is currently Avic Aircraft's main commercial product; and General Electric is a supplier for the C919 cockpit and has also agreed to set up a joint company with Avic.

Western suppliers are progressively signing agreements for their C919 work.

Extraordinarily, many have been working on the C919 for more than a year without definitive contracts. Executives say they have chosen to do so because business with China is based so much on relationships and because the C919 would have been badly delayed if they had waited for conclusion of the protracted contractual negotiations before beginning work.

Rockwell Collins said on April 2 it had agreed to set up a joint company with an electronics research institute of Avic. "Avic Leihua Rockwell Collins Avionics Co. [the joint company] will develop, manufacture and deliver integrated surveillance system products for the C919 program in China," says the U.S. company. "By introducing Rockwell Collins' advanced avionics technology and international avionics technical services into China, the joint venture will boost the development and prosperity of the country's commercial aviation sector." That is just the sort of thing that Comac and Avic were looking for when they dangled C919 work as an incentive for setting up aircraft-systems businesses in China.

Since the Chinese onboard-systems industry—grouped into Avic Electromechanical Systems and Avic Avionics—is inexperienced in civil products, the MA700, like the C919, will be fitted mainly with equipment from the West or at least based on Western technology. Avic Electromechanical and Avic Avionics cannot for the foreseeable future stand on their own feet, so the Avic head office has decided that their future must be in joint ventures with the Western companies.

Beyond the MA700 stands a long line-up of proposed aircraft: a business jet that fighter specialist Avic Aviation Techniques plans to build with Cessna, smaller private and business aircraft likely to come from Avic general-aircraft maker Caiga, a Caiga 30-seat transport, helicopters from Avicopter and at

least one freighter from Avic Aircraft.

And then there is the big one: the C929, the intended widebody follow-on to the C919.

Compared with the loose connection between the C919 and preceding ARJ21 regional jet, "there will be a much more direct relationship between the C929 and C919," says Greer. Comac will presumably be inclined to go back to C919 suppliers to ensure that operators of both types can save money in working with the same or similar parts and systems.

But the investment of money, technology and management effort into the Chinese joint ventures will probably also help determine which suppliers secure a place on the C929. There is not much point in trying just to make a quick profit on an immediate program in China, say Western executives. The Chinese managers "are very smart in determining whether you are committed," says one.

That helps explain why Honeywell is investing cash in China rather than relying only on transferring technology and letting its partner stump up the capital. For the C919, Honeywell will supply the auxiliary power unit, which will be assembled by a joint company with Dongan, part of Avic Engine based in Harbin. The location of the assembly line has not yet been fixed.

The aircraft's Honeywell flight controls are being jointly developed with Facri, an Avic flight-control unit at Xian. The wheels and brakes are similarly being developed in China, in that case with a private company called Boyun. Honeywell inertial reference and air-data systems will be made in the U.S.

No timetable for the C929 has been published. More than a gleam in the eye of a preliminary design engineer, the aircraft has a definite place in Comac's development plan, but the company is far too occupied with the C919 to even consider launching it yet.

Comac has, for a start, been rather busy spending money. Only halfway through the C919 development schedule, the budget has almost all been spent and will not be enough to see the aircraft into service, says Feng Peide, a member of the Chinese Academy of Engineering and a representative on the Chinese People's Political Consultative Congress. Comac's coffers will be topped up and central government departments are attending to the issue, Feng tells the *National Business Daily*, adding that it looks like the aircraft will be developed on time. Feng's connection with the program is unclear.

Losing by Winning

'Race to the bottom' leads to bankruptcy for another U.S. regional carrier

ANDREW COMPART/WASHINGTON

Pinnacle will keep flying CRJ200s for Delta until July 2022, if it can restructure successfully in bankruptcy.

JOEPRIESAVIATION.NET

Pinnacle Airlines, the third-largest holding company for U.S. regional airlines, is citing a "race to the bottom" among the country's regionals as a major contributor to its filing for Chapter 11 bankruptcy protection this month.

Its own missteps contributed to its downfall, admits the holding company for Pinnacle Airlines, Colgan Air and Mesaba Airlines in its filings to the U.S. Bankruptcy Court, Southern District of New York. Nonetheless, its troubles are indicative of the challenges facing most of the larger U.S. regional airlines and their holding companies.

"For many years, regional airlines enjoyed profit margins under contracts that offered protection against rising fuel costs and other market risks. This is no longer the case," Pinnacle COO John Spanjers declares in a statement filed with the court. "As major carriers have aggressively cut costs and decreased capacity, they have transformed the market for regional air service, consuming and paying less and demanding more from their regional partners.

"The result has been a race to the bottom, as [Pinnacle] and other regional airlines have been forced to bid ever-lower rates and accept increasingly unfavorable contract terms to win the business of major carriers," Spanjers continues. "These sacrifices have drained regional carriers and continue to do so, with frequently unsustainable consequences."

It is not difficult to see the consequences. Mesa Air Group filed for bankruptcy in 2010, eventually emerging at about half its former size. In February, SkyWest Inc., the largest U.S. regional airline holding company with SkyWest Airlines, Atlantic Southeast Airlines and ExpressJet Airlines as subsidiaries, reported a 2011 fourth-quarter loss of $18 million. SkyWest says its major airline partners must be convinced to pay higher rates for its services in part because of an issue plaguing many U.S. regional carriers: rising maintenance costs for aging aircraft.

Republic Airways, the second largest, says a big problem for it and other regionals is that fixed-fee flying for major airlines is not producing the historical level of returns because the automatic rate increases in those contracts are tied to the Consumer Price Index. And CPI increases have not kept pace with the regionals' growing costs for labor, health care and aircraft maintenance, Republic CEO Bryan Bedford says.

Individually, many regional carriers have compounded the problem with misguided, mishandled or misjudged efforts to adjust their businesses or find solutions in a sector where growth has slowed substantially and profits have become more difficult to sustain.

SkyWest, which aimed to grow by acquiring ExpressJet in 2010, has struggled with the integration. Republic, parent of regional carriers Republic Airlines, Chautauqua Airlines and Shuttle America, tried branching out into branded flying by acquiring Frontier Airlines and Midwest Airlines (eventually integrated into Frontier). But Republic had to un-

dertake major cost-cutting at Frontier last year to return it to profitability and now is trying to sell or spin it off.

In its bankruptcy filing, Pinnacle details several wrong turns that contributed to its problems.

Like SkyWest, it ran into trouble integrating a newly acquired carrier: Mesaba, which it bought from Delta Air Lines for $62 million in mid-2010 (using money that Delta lent to Pinnacle at 12.5% interest). Pinnacle estimated it has incurred unanticipated costs and lost revenue in the tens of millions of dollars because of integration delays (or overly optimistic assumptions about how quickly it could be accomplished).

Pinnacle's leadership also contends, in retrospect, that the February 2011 joint collective bargaining agreement with pilots for its three subsidiaries was too generous. Training costs for pilots also increased substantially, Pinnacle says, because those on the newly integrated seniority list could bid for new aircraft types or domiciles at any of the three subsidiaries, creating an "overwhelming number of transfer requests."

How this all shakes out for the U.S. regional airline industry remains to be seen. Pinnacle CEO Sean Menke told his employees that "all of the regional airlines are trying to figure out what their futures really entail."

If Pinnacle survives its restructuring, it will emerge as a markedly smaller carrier. It will stop operating Saab 340 and Bombardier Q400 turboprops and remove 16 of its CRJ900 regional jets from Delta Connection services. That means its Colgan subsidiary, which operates only turboprops, will cease to exist.

The plan is for Pinnacle to emerge from bankruptcy with 140 50-seat CRJ200s that it will continue to operate as Delta Connection under a newly revised deal extending the contract from the end of 2017 to July 2022 (with provisions for Delta to reduce the number of CRJ200s being used). It will keep flying 41 CRJ900s, too—all leased by Delta—under a contract that also lasts until July 2022. The fate of the 16 CRJ900s not included in the contracts remains unclear.

The 50-seat CRJ200 seems a peculiar choice on which to build a future, given its fading popularity as high fuel prices make it unprofitable in many markets, but Pinnacle says those are the only two contracts it has that are "potentially viable." Menke also says he believes emerging from Chapter 11 with a lower cost structure—in part with voluntary or imposed cost cuts for unionized employees—will leave it "agile" enough to participate "in the next phase of our evolving industry."

Some of Colgan's turboprop business will move elsewhere, but those airlines will have to achieve a better financial outcome through their use. For example, Pinnacle says it lost more than $11 million on its Q400 operations for United in 2011, so whichever carrier takes it over will need to operate with costs lower than Pinnacle's or higher rates from United.

In the end, the regional carriers will need help from their major airline partners, which in turn rely on regionals to serve smaller markets. Delta, it should be noted, is providing Pinnacle with $74 million of debtor-in-possession financing, although $44 million of that loan is being used to pay back what Pinnacle still owes Delta for the loan to buy Mesaba. If Pinnacle restructures successfully, Delta will have the benefit of regional feed from a carrier that can survive with lower rates due to its substantially trimmed costs.

"The big carriers are still determined to continue to cut costs and part of the costs are regional feed," Maxim Group analyst Ray Neidl says. "They do need regional feed, but they need less of it, and the contracts are going to be tighter-margin than we've ever seen."

On the Line

A350XWB final assembly line faces challenging schedule, aggressive ramp-up

ROBERT WALL/LONDON

Airbus has started the final assembly process of the A350XWB in Toulouse, kicking off a two-year period in which the aircraft maker hopes to validate the new twin-widebody in ground and flight demonstrations before it begins customer deliveries in 2014.

The first aircraft assembled will serve as the static ground-test article. The second A350-900 (MSN1) will be the next aircraft down the line and the first flight aircraft. Assembly is to start in the summer and first flight is to occur in 2013.

Five flight-test aircraft will be built along with a fatigue version to complement the static-test aircraft as part of the ground trials phase. The first aircraft to go to Qatar Airways, lead customer for the A350, is MSN6, which should enter the final assembly line (FAL) next year. Although the handover is planned for 2014, that schedule, already adjusted several times, remains challenging.

The FAL has been ready for some time. The assembly process was due to

AIRBUS/P. PIGEYRE

start last year, but was delayed by design issues that proved more complex than expected. Airbus also held off on assembling aircraft too early to avoid A380- and Boeing 787-like problems that required cumbersome rework late in the process and caused large delays.

For the static-test asset, Airbus says the center fuselage was delivered on April 4, the last major component missing before the FAL process could start. The front fuselage was delivered to Toulouse late last year. Still pending is delivery of the aft fuselage, due in "the coming weeks," Airbus says, with wings to arrive later.

The two main stages of the FAL are Station 50, where the three fuselage sections are put together (see photo p. 39) and nose landing-gear added, and Station 40, where the wings and tail section are put on.

The cabin will be installed as the aircraft is assembled on the FAL, which can support a monthly output of 10 aircraft and has capacity to grow. Airbus plans an aggressive production ramp-up, with 545 firm orders, and can ill afford serious delays after the reputation damage caused by A380 problems.

White Tails

An-148 production moves forward though its order backlog is thin

MAXIM PYADUSHKIN/MOSCOW

DMITRY A. MOTTL

An-148 reliability and operational profitability has improved, but its prospects remain difficult.

The Antonov An-148 regional jet has never been the kind of industrial darling of the government as the Sukhoi Superjet 100, and it has faced many challenges in development. Ironically, now that the program is reaching operational highs, its prospects are at their bleakest.

A weak order backlog is drawing into question the Ukrainian-Russian program, developed by Antonov's Kiev-based design bureau and built under license by Russia's VASO plant. But VASO officials are not ready to throw in the towel yet.

Late last month, VASO's board approved the 2012-14 production plan that calls for assembly of 21 An-148s. Eight deliveries had been planned for this year to Polet Airlines, based in VASO's home town of Voronezh, but now none are scheduled. Instead, two aircraft will go to the country's emergency relief ministry, two to the air detachment of the Russian presidential administration and three to Angara Airlines, a regional carrier based in Irkutsk that placed a firm order through Ilyushin Finance on the day of VASO the board meeting.

It is uncertain who will buy the other aircraft. The Russian manufacturer includes in this number two An-148-100Es built for Myanmar but rejected after a crash near Belgorod in March 2011 killed six people. Although VASO's parent, the United Aircraft Corp. (UAC), insists it is close to a deal with a new potential customer for these aircraft, money appears to be getting tight. "We are waiting for Ilyushin Finance to make the advance payments for the aircraft for Angara," UAC representatives say.

The difficult period comes after five years during which the aircraft has undergone a slow but steady improvement. The 75-seat An-148 was certified in 2007 (three were produced in Ukraine and are operated by Ukraine International Airlines), and the 99-seat An-158 received certification last year, but it has no firm orders so far.

The program received a boost when license production with VASO commenced. Government-owned Rossiya Airlines received the first locally assembled aircraft at the end of 2009; it now operates six An-148-100Bs. The airline had difficulties with the aircraft at first, but CEO Sergey Belov says that by early this year the type's average monthly flying time reached 309 hr., making operations profitable. Increases to 4,000 hr. per year are in the cards, he says.

To further improve the type's profitability, Rossiya is converting its An-148s to a single-class configuration from a two-class layout, increasing the number of seats to 75 from 68. This work is expected to be completed by the end of April.

Rossiya operates its regional jets on 33 routes both inside Russia and abroad. That comes after two years of hard work, though. In early 2011, the carrier reported a loss of 300 million rubles ($10 million) for the first year of operations, as the aircraft at first flew only 50-70 hr. per month. This was not due only to technical problems with the aircraft—a shortage of funds and facilities for crew training contributed to the loss. The technical defects have been fixed and the warranty package amended, with the manufacturer taking financial responsibility for the aircraft's downtime.

Training capabilities have been expanded with the launch last December of a new full-flight simulator (built by St. Petersburg-based Transas) at the S7 Training center in Moscow's Domodedovo Airport. The project was financed by Ilyushin Finance Co., a lessor that is a driving force in An-148 promotion.

Angara, set to become a new operator, now flies a small fleet of Antonov An-24 and An-26 turboprops and Mi-8 helicopters. It opted for the An-148 because it is designed to be operated at low temperatures and from unpaved air strips. Angara plans to fly it on regional flights from Irkutsk through Siberia to Yakutsk, Novosibirsk, Blagoveshchensk and Khabarovsk.

Further An-148 deliveries are in question, however. In 2011, VASO handed over to Polet Airlines the first two An-148-100Es with longer range: 4,400 km (2,735 mi.), 900 km more than the -B variant. Polet ordered 10 of the twinjets in 2010 through Sberbank Leasing. A UAC representative says two more aircraft have been built for this customer, but their delivery has been postponed, as UAC received no advance payment for them. A Polet official says the airline is ready to accept the jets and is waiting for all parties to reach an agreement.

Revamping Revealed

JOEPRIESAVIATION.NET

Lufthansa, Air France and other European carriers ponder major overhauls

ROBERT WALL/PARIS

That the face of Europe's network carriers is changing has been clear for some time, but even those in the drivers' seats are wondering just how deep those changes will go.

The process will take time to sort out. Air France signals that there will be significant shifts in the next three years, although some progress is already noted. Lufthansa, for instance, is a step closer to shedding BMI British Midland, a financial albatross for the German carrier, now that the European Commission has green-lighted the proposed takeover by British Airways' (BA) parent, International Airlines Group (IAG).

Air France may have been late to the game in dealing with major structural changes, but it is becoming more aggressive and expansive with what its "Transform 2015" agenda is supposed to deliver. New vectors are planned for everything from the long-haul business, to the troubled short- and medium-haul sector, and its Transavia low-cost venture. Freight and maintenance, repair and overhaul activities also are being targeted.

But the turnaround will not be easy. Air France warns that "drastic" cost reductions will be needed to maintain its medium- and short-haul operations as it tackles its fiscal disarray.

The airline's goal is to reach a 20% reduction in controllable costs. A framework agreement is in place with unions to negotiate new terms that will allow the significant changes to go forward, although the prospect of union unrest has not been dispelled. A key pilots' union points out that the changes cannot just be about cutting costs, but also need to offer growth prospects. And, a union official emphasizes, no agreements to contract terms have been agreed to yet.

Air France only has to look to Iberia to see how disruptive big structural changes can be. Pilots have staged numerous strikes to protest that carrier's new entity, Iberia Express.

But Air France CEO Alexandre de Juniac leaves no doubt that significant changes are in the cards. "The 20% cost-reduction objective is a minimum threshold; to fall short would jeopardize the recovery and the company's future. These equally shared efforts must be implemented without delay."

Closer integration with sister company KLM is being targeted, as is streamlining the organization to reduce overhead and make it more responsive.

Core elements of the day-to-day operations are also up for an overhaul. The medium- and short-haul business has long been a headache for Air France, given the competition from high-speed rail and low-fare rivals. The target date is now 2013 to reach a break-even point for at least the point-to-point elements of the service. The entire short- and medium-haul operations should break even a year later.

Exactly how this will be accomplished has not been settled. But the parent airline intends to gird its low-cost venture, Transavia, to combat low-fare rivals. Also, Air France aims to standardize its regional operations with various subsidiaries. But, the airline states in updating its "Transform 2015" plan, "additional savings still must be found to reach the break-even point in 2014."

The long-haul service, which has been the airline's one bright spot for several years now, also is undergoing scrutiny. Air France states: [We] must find ways to better respond to growing leisure travel demand," and notes that long-haul upgrades are contingent on success of the savings plan.

Survival of Air France's short- and medium-haul operations is contingent on meeting key cost targets.

In the freight business, greater integration of Air France, KLM and Martinair services is being sought.

The maintenance operation also is under fire, with management saying "competitiveness in major overhaul maintenance is wholly inadequate." The engine and equipment maintenance operations, specifically, are being eyed for restructuring. The company's goal is to become the second-largest player globally.

More details on Air France's plans are due mid-year. Meanwhile, Lufthansa must decide how to deal with BMI Baby, the low-fare adjunct of BMI. The EC approved the sale of BMI Baby to IAG when the latter agreed to shed 14 daily slot pairs at London Heathrow Airport. The slots are on routes where BA and BMI have competed, such as to Aberdeen or Edinburgh, Scotland, and, long-haul, to Riyadh, Saudi Arabia; Cairo, Egypt; Nice, France; and Moscow. Moreover, other carriers will receive access to seats on the BMI/BA short- and medium-haul aircraft "on normal commercial terms" to accommodate their transfer passengers. This is being done to make sure that "the competitive dynamics will be maintained so as to ensure choice and quality of air services for passengers," says EU Competition Commissioner Joaquin Almunia.

If Lufthansa is unable to divest BMI Baby, IAG's purchase price would be reduced from the current £172.5 million ($273 million) to offset the difficulties of having to deal with the low-cost business. Lufthansa and IAG expect the sale of BMI to close around April 20.

By 2015, IAG expects BMI to add about £100 million to its bottom line. In the short term, IAG faces around £100 million in restructuring costs.

The EC's approval of the deal has angered Virgin Atlantic; that carrier has long-opposed any BA expansion on the grounds that the "remedies have not been subject to a detailed assessment."

First Articles

787-9 laminar flow studies validated, as Boeing completes first fuselage articles

MICHAEL MECHAM/SANTIAGO, CHILE

Boeing tested its hybrid laminar flow control system on ZA003's vertical stabilizer but also will apply the drag-reducing technology to the horizontal stabilizers on 787-9s.

MICHAEL MECHAM/AW&ST

After validating assumptions on the manufacturing cost and efficiency of laminar flow, Boeing says it is proceeding with a baseline design that will apply the technology to the horizontal and vertical stabilizers of the 787-9, but not the wing.

"We did it where it is most practical," says Chief Project Engineer Mike Sinnett, who accompanied ZA003, the third 787-8 flight-test airplane, to its presentation at Chile's Fidae air show here in late March.

ZA003's vertical stabilizer was used in the validation tests of Boeing's patented hybrid laminar flow control (HLFC) system, but its use will be extended to the horizontal stabilizer as well. While the drag-reducing concept's introduction will be on the stretched 787-9, it is expected to work its way into production of the standard-sized 787-8.

Boeing has completed initial barrel sections for the first pre-production 787-9 and is past the 50% mark in release of the airplane's detailed 3D design drawings to the supply chain. The company expects to complete 90% of those drawings and begin production of the first test aircraft in the fourth quarter. "Once you reach the 90% mark, you're home," Sinnett says.

First flight of the 787-9, which has the same 197-ft.-long wing as the 787-8 but a fuselage 20 ft. longer, is expected in the summer of 2013. The 206-ft.-long aircraft is to carry 250-290-passengers—up to 40 more than the standard -8—on ranges of 8,000-8,500 nm. Sinnett says the program is on schedule.

HLFC will be the industry's first use of a drag-reducing technology that works by sucking in the air flowing over the skin to keep the smoother boundary layer attached to more of the chord. The result is a delay in the transition from laminar to turbulent flow. That cuts drag.

Rather than using mechanical suction (turbo compressors), HLFC relies on a passive system that works off pressure gradients produced by the aircraft's own speed to generate suction.

The company has considered applying HLFC to the wing leading edges but is deliberately taking a conservative approach to the technology's introduction, says Sinnett. Studies have shown a potential for a reduction in profile drag of up to 25% and in block fuel consumption of up to 20%.

But for this initial application, Boeing is targeting a more conservative 1% drag cut.

Sinnett emphasizes that introduction of the HLFC technology involves trade-offs in terms of the costs to Boeing of manufacturing the control surfaces and to its airline customers for life-cycle maintenance. "It has to be efficient enough to pay its way on" to the airplane, he says.

Sinnett declined to discuss exactly how much of the empennage's leading edges will use laminar flow, citing proprietary reasons.

The 787's airframe is largely outsourced, but manufacturing of the empennage for the 787-9 will be at two of its Frederickson Fabrication Div. plants. The facility in Puyallup, Wash., will produce the vertical fin for both variants, while the Salt Lake City factory will be the lead producer for the -9's horizontal stabilizer. Alenia Aeronautica, which suffered delays in manufacturing the 787-8's horizontal stabilizer, will be a secondary source for the -9.

Meanwhile, LAN Airlines, Fidae's host carrier, says it will operate its first two 787-8s from its home base in Santiago to reach Frankfurt through Madrid and Los Angeles through Lima, Peru, when it puts them into revenue services in the fourth quarter. LAN is to receive 32 787s, 22 of them 787-8s and the rest -9s.

Eventually, LAN will replace its five Airbus A340s with the 787s, says Marketing Director Pedro Margozzini. But the airline's need for fleet growth means the A340s "will be with us for a long time," he adds. LAN's 787s will be flown in a 247-seat configuration, with 30 in business class and the rest in economy. The airline will receive 787-8s through 2018.

With Guy Norris in Los Angeles.

Heart of Asia

Taiwan renews its push to be an Asia-Pacific hub

LEITHEN FRANCIS/TAIPEI, TAIWAN

Taiwan is hoping improved relations with China, an upgrade to Taipei's international airport and a new aerospace park will help it establish itself as an Asia-Pacific hub.

Better relations with China have led to the opening of flights across the Taiwan Strait, a boon for Taiwanese carriers that are now being welcomed into global airline alliances. Late last month, EVA Air signed an agreement that paves the way for it to formally join the Star Alliance in 2013.

EVA President Chang Kuo-wei says Taiwan is well-positioned to be a gateway into China, particularly for travelers coming from North America. "Everybody is trying to get into the mainland China market, but for political reasons, some are not able to benefit. But [Taiwan can because] the whole political situation has changed between Taiwan and mainland China," Chang says.

Chang says EVA transported 6.6 million passengers last year, 1.1 million of whom were traveling between Taiwan and mainland China. Last year, EVA's traffic to the mainland grew 23%, and it is forecast to grow 33% this year, he adds.

Demand is so high that various airlines' booking sites reveal flights often fully booked and airlines that can charge a premium. For example, a one-way economy-class ticket for the 1.5-hr. flight between Taipei and Shanghai can cost as much as $800. Such high demand means carriers are operating widebodies on routes where they would normally use narrowbodies.

It is inefficient to operate long-haul aircraft, such as the Boeing 747-400, on short-haul flights, says Chang. He says a further liberalization of air services between China and Taiwan will allow airlines to increase frequencies using smaller aircraft types. "This is why we ordered the A321NEO," he notes.

Chang also reveals that EVA is considering turning its Uni Air subsidiary, which largely operates within Taiwan, into a low-cost carrier, but he says this is only in the early stages of discussion.

Although the island has no local low-cost carriers (LCCs), Taiwanese airlines do have to contend with LCC competition. Jetstar Asia, for example, flies Singapore-Taipei-Osaka. In future, there will be Jetstar Japan, Jetstar Hong Kong, Peach (Japan) and AirAsia Japan to deal with.

"LCCs compete by offering the passenger a more competitive price and, as a consequence, they are looking for a more competitive operational cost from the airport," Taoyuan International Airport Corp. (TIAC) President Samuel Lin says. "But I don't think it's justified. Airports offer standard choices to airlines, so they have to treat airlines equally."

However, LCCs could provide a welcome boost to TIAC. Lin says about 25 million passengers came through the airport in 2010 and slightly fewer in 2011. This is because Taoyuan airport is increasingly having to compete against Taipei Songshan International Airport, according to Lin, a smaller secondary airport right next to Taipei's central business district. TIAC is a 40-min. drive away.

Until a few years ago, only domestic flights served Taipei Songshan, but Taiwanese authorities have allowed some services to mainland China as well as to Tokyo's Haneda Airport. This has resulted in a drop in the passenger load factor for similar flights from Taoyuan.

TIAC is trying to improve passenger convenience. A rail line linking Taoyuan airport to downtown Taipei is under construction. Lin says the first phase, to the Songshan metropolitan train station, is to be completed in 2013 and the second phase, to the center of Taipei, a year later. He says the plan is to have airline check-in facilities at the downtown station.

As for passenger terminals at Taoyuan, terminal one's upgrade is due to be completed by year-end, says Lin, adding that it is costing 2 billion Taiwan dollars ($68 million). The size is being increased by 13,000 sq. meters (140,000 sq. ft.) to 170,000 sq. meters, boosting annual passenger capacity to 15 million from 13 million, he says. Passengers at terminal one, and later terminals two and three, will notice that the signage will be exactly the same as Hong Kong Airport's, Lin notes.

Terminal two is EVA's home, but Chang says, "we are very interested to move into terminal three."

Lin says TIAC estimates terminal three will cost 60 billion Taiwan dollars.

JOEPRESANTATION.NET

EVA Air has been operating widebodies on short-haul flights to China. It is on track to join the Star Alliance next year.

Construction is due to begin in 2014 and finish in 2018. The terminal will be up to 430,000 sq. meters in size and have an annual passenger capacity of 43 million. Terminal two is 300,000 sq. meters and has an annual capacity of 17 million passengers.

TIAC also plans to build a third runway, north of the existing two, that Lin says is targeted to open in 2030. But the airport needs to obtain 700 hectares (1,730 acres) of land on which to construct it, he adds, and land expropriation is a difficult and time-consuming exercise in Taiwan. In fact, the Taoyuan county government wants to develop an aerospace park in and around the airport, called the Aerotropolis, but land is the issue holding it up.

About 4,000 residential properties and large tracts of agricultural land would have to be expropriated, says Taoyuan Aerotropolis Corp.'s general manager, Jimmy Liu. This has the potential to be the largest land expropriation Taiwan has ever seen, he says.

The Taoyuan government's plans for the Aerotropolis site show that 4,115 hectares have been set aside for the aerospace sector. Of this, 1,770 hectares are for Taipei Taoyuan International Airport, 670 hectares are for an aviation industry zone, 1,345 hectares are for an airport-related industry zone and 330 hectares are for a free-trade zone (FTZ). The FTZ will be shared among aerospace and other industries. Another 2,035 hectares within the Aerotropolis have been designated for other industry sectors, as well.

Liu says there is already an FTZ east of the airport runways, but it is only 45 hectares, with tenants including FedEx and Hewlett-Packard. Taiwanese company Far Glory Group built and manages it under a build-and-operate scheme, says Liu. The new sections of the FTZ are likely to come under Taiwan's transportation and communications ministry, he adds.

Another issue to be addressed is the incentives package for businesses. Liu says this needs to go through Taiwan's top government administrative body that includes representatives from seven key ministries.

Taoyuan has the advantage, thanks to the automotive industry, of established precision engineering expertise and logistics capabilities, says Liu. Nissan, Scania and Ford manufacture cars and parts in Taoyuan county, he says, adding that some are shipped overseas.

Promises To Keep

Cabin interiors and inflight entertainment industries are making new technologies work

JENS FLOTTAU/HAMBURG

As technologies mature and delivery dates for many new products near, the cabin interiors and inflight entertainment (IFE) supply chain must deliver on many its promises—and soon.

A host of new services particularly in the IFE world are being installed on aircraft worldwide and, with broadband Internet and communication applications becoming widely available, the key question is whether passengers will use the new services to the extent expected.

"The prices are going down and that will drive up the usage on aircraft," Pal Bjordal, CEO of inflight communications specialist AeroMobile, said on the sidelines of the Aircraft Interiors Expo here late last month. The company's technology suite enables passengers to use their smartphones onboard and be billed through their cell phone provider. Today, the inflight roaming rates are still vastly higher than those typical for cell phone use abroad. "Most providers will go to rates equivalent to roaming in the rest of the world," Bjordal says. That means a price reduction of more than 50%, in some cases even 70%.

While many airlines are still hesitant to allow inflight telephony out of concern that use by some passengers might disturb others, that does not worry the equipment industry. Last year, the number of voice-call minutes worldwide declined for the first time, and so did the number of SMS messages transmitted, but at the same time the amount of data transferred quadrupled. So even if passengers were not allowed to make telephone calls, the market would still be booming. "I would be much more concerned if there were limitations for mobile data transfer," says Bjordal.

AeroMobile is forging even closer ties with Panasonic Avionics, which already uses its technology, as Panasonic took a majority stake in the company. As part of the transaction, AeroMobile's previous owner, Telenor, will remain a minority shareholder.

AeroMobile will continue to operate as a separate company, although David Bruner, Panasonic vice president for global communications services, points out that it will benefit from Panasonic's broad airline customer access and marketing. "Our services are absolutely complementary," he says. AeroMobile plans to install its eXphone product on 100 more aircraft this year, which includes six new airlines. By the end of 2014, 770 aircraft are to be equipped.

Panasonic Avionics is focusing on improving its global satellite coverage, introducing new capacity where there are still blank spots and increasing capacity where needed. Bruner says production ramp-up and installation of hundreds of shipsets on order will be the main challenge over the next few years. "You need capacity to handle that growth," he says. A big push in terms of satellite data throughput is expected to come by the end of 2015 for transatlantic routes and later in the Middle East and Asia. Panasonic Avionics is negotiating with one global satellite provider whose identity it has not released.

LUFTHANSA SYSTEMS

Separately, Panasonic Avionics has reached an agreement with Airbus for line-fit capability of its products on the A380.

Thales, another important IFE player, is focusing on the Chinese market to ensure it will be part of the growth in local aircraft programs. It is setting up a joint venture with China Electronics Technology Avionics (Cetca) to develop IFE products for the Comac C919 narrowbody currently under development. The agreement comes after more than two years of negotiations. Operations are expected to begin in the third quarter, following regulatory approvals. Contracts were officially signed at the Aircraft Interiors Expo.

"We believe the C919 will be a highly successful program," says Alan Pellegrini, vice president and general manager of inflight systems at Thales Avionics. "Thousands of aircraft will be sold and it is important for Thales to be on the program." Pellegrini hints at the fact that Thales is already a supplier for most major Chinese airlines.

The joint venture is to be based in Chengdu and a final assembly line for its products will be set up in Shanghai alongside C919 production. Its initial target is the C919, but Thales says that once it is rolled out for the Chinese aircraft, scaled versions will be offered for narrowbodies produced by Boeing and Airbus, and eventually, for Embraer and Bombardier regional jets.

Products include in-seat on-demand services, passenger control units and overhead displays. In the future, the system will "likely include wireless networks and connectivity," Thales says.

Lufthansa Systems CEO Stefan Hansen says it has seen strong demand for its Board Connect IFE offering. The technology allows passengers to use their own computers or smartphones to access IFE options. Airlines can also hand out Apple iPads or similar devices or use in-seat monitors. The system is wireless, providing significant weight-savings. German leisure carrier Condor Flugdienst has signed up for two Boeing 767s to be equipped and is expected to fit its entire long-haul fleet with Board Connect. Virgin America and Qantas have launched trials to test customer response. "Wireless will become more and more an industry standard," Hansen says.

Three airlines including leisure carrier Condor are testing Lufthansa Systems' Board Connect wireless inflight entertainment technology.

On the cabin interiors side, suppliers have to deal with new programs such as the Airbus A350 and the expected production ramp-up following record orders for both Airbus and Boeing aircraft. Many airlines are also in the process of upgrading their business-class cabins to lie-flat seats in order to restore competitiveness.

Airbus is therefore adding three seat suppliers to its catalog for the Airbus A350. Jamco America will offer its new premium business-class seat, "Journey." It targets the long-haul business segment and can be installed in a six- or seven-abreast configuration. It is always forward-facing and can be converted into a flat bed.

EADS Sogerma will put its Equinox business-class seat in the catalog offering. Airbus says it can be turned into a flat bed, too, with a pitch similar to current products.

Sicma Aero Seat will also soon add its Cirrus and Arcus seats to the catalog. Cirrus fits in a four-abreast herringbone configuration, while Arcus is installed in a seven-abreast configuration and is more geared for regional business flying. Both can be turned into a fully flat bed, however.

Airbus Vice President of Marketing Bob Lange says that despite the additions, there are fewer variations on offer for the A350 than there were for the A380. Airbus has been trying to reduce complexity and customization levels to avoid the installation issues it has faced on the A380.

Other manufacturers are benefitting, too. Thompson Aero Seating just signed up Austrian Airlines as a new customer for its Vantage business-class seat. Austrian is installing the seat on its 10 Boeing 767-300ERs and 777-200ERs. Although the seat lies fully flat, the airline says no capacity is lost compared to the current arrangement.

Recaro Aircraft Seating plans to double manufacturing capacity in the next three years to keep pace with growing demand. It is adding another factory to its U.S. operations that will more than double available floor space, and it is opening a China-based facility to serve the local market initially. Capacity at its Schwabisch Hall, Germany, headquarters has been increased as well. Lead times following an order for new seats are typically about one year, but given the strong demand, they can now be as long as two years.

Recaro has focused on short- and long-haul economy seats and is in the process of further developing its business-class portfolio. A new seat for medium-haul business-class or U.S. domestic first-class service is in the making. Managing Director Andreas Lindemann says Recaro is preparing to launch a next-generation fully flat, long-haul business-class seat in the next 2-3 years that will supersede competitors' current models.

WILD WEST

As the U.S. sorts out its Asia-Pacific strategy, China and its cybertools could be either friend or foe

DAVID FULGHUM/WASHINGTON

The U.S. Navy's expanding mission in Asia and the Pacific Ocean is a striking example of early planning turned on its head by changing threats. That upset is now being righted by innovations on the fly.

New technologies—including aircraft carriers and stealthy strike aircraft—will be transferred to the Asia-Pacific theater. But equally new, foreign-built surveillance systems, electronic attack weapons and cyber-invasion tools are unexpectedly threatening crucial sensors and communications on advanced ships and aircraft, say top Pentagon officials.

The advanced F-35 Joint Strike Fighter, for example, has a new vulnerability. Its wide-angle field-of-view radar can be attacked with cyberweapons through its active, electronically scanned array (AESA) antennas. Airborne cyberweapons form data beams that can be packed with malware and directed into a target antenna. These devices are being developed by several nations specifically to electronically attack, jam, invade and exploit high-value, airborne targets, say U.S. electronic warfare (EW) specialists.

In particular, U.S. analysts have been watching China develop EW platforms to attack specific types of high-value sensor and command-and-control aircraft, says a longtime U.S. EW specialist. These include E-3 AWACS air-to-air radar, E-8 Joint Stars air-to-ground radar and P-8 maritime surveillance aircraft.

"Electronic attack can be the method of penetrating a system to implant viruses," says the EW specialist. "You've got to find a way into the workings of that [target] system and generally that's through some sort of emitted signal."

Moreover, three years ago, several terabytes of data—some of it related to the F-35's electronics systems—were copied during a series of break-ins of contractor networks. Penetrations were traced to known Chinese Internet addresses.

Part of the Navy's strategy is to shift at least one additional, new-built aircraft carrier—packed with AESA-equipped aircraft—to the West Coast for duty in the Pacific. The new carrier designs have added aircraft elevators and centralized weapons lifts to increase the speed of rearming and sortie generation by 25%, says Rear Adm. Thomas Moore, the Navy's program executive officer for aircraft carriers.

But Rep. Adam Smith (D-Wash.), ranking member of the House Armed Services Committee, has noted the "constantly evolving and changing" cyberthreat.

In fact, the potential problem threatens the advanced radar on all models of the F-35, F/A-18 Super Hornet and EA-18G Growler. Each has an AESA that doubles or triples the radar's resolution and ranges over conventional radio-frequency sensors. The radars also are adept at collecting signals that can be altered and infected.

"I'm particularly worried about the effects of jammers [and cyberattack] on our radars," says Deputy Defense Secretary Ashton Carter. "It's difficult to separate electronic warfare from cyberattack. EW is an area that is undervalued and understressed. In some places we've fallen behind."

As a result, initiatives are being launched to block those radar vulnerabilities. Last summer, specialists started combing through the Pentagon's EW programs and will decide this fall where to allocate additional funds to catch up, says Carter. Specialists know a lot about EW and cyberoperations as applied in Iran and Afghanistan, but now the Air Force and Navy are looking at the more formidable technologies they will face in the Asia-Pacific region. So far, most of the upgrades for tactical aircraft and shipboard radars to counter jammers and cyberattacks have been sustained in the proposed 2013 budget. But cuts will still impact EW and cyber programs.

"We're still not remotely satisfied with cyber [defenses]," says Carter. "We have several different projects . . . to secure military networks and to provide network support for the civilian infrastructure. When it comes to cyber, we're not only protecting but actually increasing a lot of the new capabilities."

The veteran airborne EW specialist says the threat to radars and other systems using AESA antennas is less a looming catastrophe than simply another thrust and parry in the fencing match of EW that has been going on since before World War II. "As radars mature, the signals processing gets smarter and intrusion becomes less of an issue until some new technique is invented," he says. "The benefit of our new systems is that they have multiple sensors covering different parts of the electromagnetic spectrum that allow sensor fusion to overcome point solutions with digital RF memory and tremendous signal processing capability."

As for whether an AESA could serve as a conduit for EW or cyberattack, the same issue surrounds any other elec-

tronic aperture on an aircraft, ship or vehicle. In fact, AESAs have had to deal with jamming and spoofing from the beginning of their use. The first F-22 squadron, for example, had its sensitive electronic surveillance overwhelmed by large radars on ships from the nearby Norfolk, Va., naval base.

"The only new issue is the attempted introduction of a virus or some other network attack element through the AESA," says the EW specialist. "All are conduits for incoming signals. The question is how you process the signal to retain the value-added information and reject or exploit the hostile content. As in most systems, we have multiple layers of signals rejection."

There are ways to attack an AESA radar on a dedicated one-to-one basis, says Lt. Gen. Herbert Carlisle, the Air Force's deputy chief of staff for operations. However, that vulnerability can be mitigated by the fusion of multiple radars. If several aircraft with AESAs network themselves together, the radar being attacked can shut down and rely on information available on the network. Another option is to switch to infrared or electro-optical sensors.

"There is a technique we are looking at that involves sensor fusion combined with a network-integrated capability to take data from multiple sources as a defense," Carlisle says.

LOCKHEED MARTIN

The F-35C (above) will populate the decks of large U.S. aircraft carriers while the short-takeoff-and-vertical landing F-35B will serve on small-deck ships.

Pacific Vision

New Pacific Command chief faces the shoals of uncharted technologies

DAVID FULGHUM/WASHINGTON

Along with expanded missions and larger force structures, U.S. Pacific Command has a new chief, Adm. Samuel Locklear, 3rd, who most recently oversaw NATO-led operations in Libya and commanded the U.S. Navy in Europe and Africa.

Locklear's new problem set will not be smaller, but it may be significantly different. He will face two daunting issues: China and cyber. Sometimes they will be the same problem and sometimes not.

He is charged with implementing the Obama administration's plan to reemphasize the U.S.'s focus on Asia in general and China's growing military power in particular, in part via the new Air-Sea Battle concept. The refocused U.S. interest includes expanding alliances and development of India as a strategic partner. In the past, China has been reluctant to create tactical and operational ties with the U.S. Moreover, Air-Sea Battle has become a priority for Chinese intelligence, say some U.S. analysts.

The concept is described by U.S. advocates as a tectonic shift in strategy from counterinsurgency back to power projection, a change triggered by the realization that the U.S. cannot afford nation-building as demonstrated by operations in Iraq and Afghanistan.

"Let's concentrate airpower and special forces in the lead and then we can address our overall strategy in the Western Pacific and Iran," says Gen. (ret.) Mike Loh, former chief of Air Combat Command. "That puts air and naval power back in the driver's seat. The Libyan operation means we don't need invasion and occupation in order to help indigenous forces generate regime change. We can do that without boots on the ground and at about one-thousandth of the cost."

That concept is no comfort to Chinese leaders.

"[Air-Sea Battle] is reviving the worry about China's encirclement by Washington and its allies," says Cynthia Watson, professor of strategy at the National War College. "They see the U.S. involvement with Vietnam, which they thought would never happen. They see their military modernization as how to make China a great power. China wants to be the major player in East Asia. They think military modernization is appropriate. We see military modernization as something you do in the face of a threat. There is a fundamental disconnect."

The National Reconnaissance Office's director, USAF Gen. (ret.) Bruce Carlson, says his biggest problem is not a lack of knowledge about what is happening in China and North Korea.

"[But] I would be a lot happier if I knew exactly [China's] intent," Carlson told Aviation Week late last year. "They believe in deception. I also wish I knew North Korea's intent. They are very clever and work hard to deceive us. They are always getting ready for the next surprise."

Cyberoperations will be high on the Pacific Command's revised agenda.

Martin Libicki, a senior management scientist at Rand

In this concept of the USS Gerald R. Ford, the island is moved aft to allow for a fueling and arming area without intruding on launch and recovery space.

HUNTINGTON INGALLS INDUSTRIES

Corp., focuses his research on the almost unimaginable size and form of the cyber problem.

"It's possible to be attacked from any corner of the world without having to move any forces," Libicki says. "People have spent a lot on defense. [There are] estimates of $60 billion, but we still don't have the problem licked."

The first response is to adopt a modified nuclear policy of "if you attack us, we attack you," he says. But "if Al-Qaeda has crashed the [U.S.] power grid, it does us no good to threaten to take down Al-Qaeda's power grid. If North Korea takes down the New York Stock Exchange, there's no Pyongyang stock exchange to retaliate against. Most of what you hear about cyberattacks is espionage, but it is not legal to retaliate for espionage with force."

However, there may be options with more positive potential. Could cyberstrategies be changed for the U.S. to reemphasis the Asia-Pacific theater? "My hunch is that you go after specific systems that have specific vulnerabilities," Libicki told Aviation Week. "Therefore the systems of interest in one theater are not what you are interested in another. However, Microsoft is global, so it depends. If you are talking about active defense to carry out surveillance to look for malware, and you then put up defenses in your system, there's something to be said for it. You are always better off with more knowledge than less."

Worries are growing about the involvement of Chinese civilian telecommunications companies in military and information-warfare programs. For example, a March 8 congressional report questions the relationship between Huawei Technologies—which has twice been blocked from buying into U.S. telecommunications companies—and the People's Liberation Army (PLA) and the ministry of State Security. In fact, the Huawei, Zhongxing and Datang organizations all received direct funding for R&D of cyber, communications and intelligence-gathering systems, says the U.S.-China Economic and Security Review Commission. Other companies providing information security and computer network operations to the PLA have close ties to hacker groups.

The overlapping connections allow for penetration of international supply chains for electronics that support the U.S. military, government and civilian industries, the report states, and offer the "potential to cause the catastrophic failure of systems and networks supporting critical infrastructure for national security or public safety."

Such massive threats to cybersecurity moved the former National Security Agency and CIA chief, USAF Gen. (ret.) Michael Hayden, to say that the U.S. is spending too much time and money on vulnerabilities and not enough on dealing with the actual consequences of a successful cyberattack.

"I cannot stop [cyberattacks] at the perimeter," he said in a Feb. 21 symposium. "It's time to place more emphasis on coping with the consequences of a successful attack and trying to develop networks that can self-heal and self-limit damages."

Agreeing with Hayden, the chief of U.S. Cyber Command, Army Gen. Keith Alexander, told a House Armed Services Committee on emerging threats and capabilities in the cyber-realm that the military's ability to detect and identify attackers in cyberspace is impressive, but is being taxed by the growing sophistication of threats. "Our indications, warning and forensic intelligence capabilities necessary to identify our enemies and attackers in cyberspace . . . are improving rapidly," he says.

Finesse Plus

U.S. Navy tackles China by poking holes in standoff defenses

DAVID FULGHUM/WASHINGTON

The major tactical problems that analysts foresee in the Asia-Pacific theater are the anti-access, area-denial (A2AD) environments that could be created by the array of military products that China sells to other countries and incorporates into its own forces.

At the same time, the U.S. Navy and Air Force are tying their missions more closely together as part of Air-Sea Battle. A particularly revealing comment about the technology and weaponry to support the new concept came from Air Force Chief of Staff Gen. Norton Schwartz, who calls for crafting "domain approaches such as cybermethodologies to defeat airborne threats."

"The way to defeat the A2AD capability of potential adversaries is not just with stealth and the bomber," agrees Gen. (ret.) Mike Loh, former chief of the Air Force's Air Combat Command, who helped introduce the B-2 to worldwide operations. "It is the combination of stealth, electronic warfare [EW], offensive and defense cyber, ISR [intelligence, surveillance and reconnaissance] and standoff weapons which, when combined, allow you to penetrate and defeat A2AD."

The technology is real. Over several years, the Air Force pitted its experimental Suter airborne-cyberattack capabil-

ity against an integrated air defense system during Red Flag exercises. The project was championed by Gen. John Jumper, the chief of staff at the time. The cyberattack system could capture the enemy's radar pictures and, as a surrogate systems manager, might, for example, turn the enemy radars away from a group of incoming strike aircraft. The problem now is how to package that capability into smaller, stealthy, tactical aircraft. Schwartz indicates that such capabilities are nearing an operational status.

"We must maintain the ability to project power in areas where burgeoning threats such as ballistic and cruise missiles, advanced submarines and fighters, electronic warfare systems, mines and advanced air defenses could threaten our access and freedom to operate," Schwartz says. "We are committed to developing highly integrated and tightly coordinated schemes of maneuver to defeat threats on or under the sea."

Military ISR specialists say part of the answer will be the melding of their field with space and cyber operations.

"Bringing all three domains together will be absolutely key in operating in an anti-access, area-denial," says. Lt. Gen. Larry James, the Air Force deputy for ISR and a former signals intelligence official in the National Reconnaissance Office. "How do you bring traditional intelligence tradecraft into the cyberdomain or build a cybertargeting folder? This is going to be a focus in terms of laying out what we need to do to maintain situational awareness and create intelligence from cyber. We need to do a much better job of integrating all those sources of data."

CHINESE INTERNET

The J-20 strike fighter underwent a low-level flight demonstration and will be part of the anti-access, area-denial complex fielded by Beijing.

Both services also are pursuing offensive, air-launched electronic- and cyberattack capabilities that include Boeing's Champ anti-electronics cruise missile, Raytheon's jamming version of the miniature air-launched decoy (MALD-J) and Mk. 84 glide-bomb shapes. They are all being designed to carry high-power microwave warheads.

"Stand-in, stand-off and smart jammers are all essential for effective operations and protecting the [stealthy, F-35] Joint Strike Fighter," says Ashton Carter, the deputy defense secretary. "We love the JSF, but no fighter, no matter how capable, stands a chance without EW. But you can't do all of that onboard. The same is true for the new bomber," which will be a key component of the military's long-range, Asia-Pacific strategy.

The first four F-35 procurement contracts were, combined, more than $1 billion over budget, with the government to cover about $672 billion of the cost and Lockheed Martin the rest, Michael Sullivan, director of acquisition analysis for the Government Accountability Office, recently told House lawmakers. The government also faces $373 million in retrofit costs for aircraft already produced. He says 365 F-35s are now slated to be built by 2017 instead of the nearly 1,600 originally projected.

While none of the services have declared dates for their first units to be operational, the F-35's program executive officer, Vice Adm. David Venlet, says production deliveries of Block 2 warfighting aircraft will begin in 2015, followed closely by the more advanced Block 3 JSF variant in 2017.

Ships will be another major factor as the Navy and Air Force continue their rebalancing efforts over the next several years.

The ratio of ships on the West Coast will shift to 60% from 52%. That involves the net increase of an advanced aircraft carrier, plus seven guided-missile destroyers and a small number of attack submarines. In addition, ships will be forward-based in Singapore (including four new Littoral Combat Ships) and Guam. For each two ships, there will be three rotating crews. Every three ships deployed forward will be the equivalent of four ships based on the West Coast.

Sophisticated capabilities include payload module upgrades for Virginia-class submarines that will allow them to launch cruise- and shorter-range ballistic missiles. In addition, at the biannual RimPac exercise in July, the Navy will demonstrate a "great green fleet," says Navy Secretary Raymond Mabus, "in which all the ships and aircraft are going to be powered by nuclear power or bio-fuels."

Eventually the Navy's 11 aircraft carriers and 11 large-deck amphibious ships will outfit their air wings from a fleet of 680 F-35 aircraft. Of these, 340 F-35Bs will go to the Marine Corps along with 80 F-35Cs to transition Marine pilots to aircraft carrier assignments, Mabus says.

The aircraft carrier fleet will be dominated by Nimitz-class designs until 2025. The Ford-class ships will constitute the majority by 2043.

"I don't think it's a stretch of the imagination that [they] will at some point have an unmanned air wing onboard," says Rear Adm. Thomas Moore, the Navy's program executive officer for aircraft carriers.

"This is the reason why aircraft carriers will remain the centerpiece of battle groups, and why the Ford-class aircraft carriers will be around until 2110."

The Ford-class carriers also will provide three times the electrical-generating capacity of the Nimitz, partially to run the electromagnetic catapult system. In addition, the air-conditioning capacity of the ship will be doubled to retard corrosion and maintenance, and it will have the most capable radar in the Navy, Moore says.

China has its own plans for fielding its first aircraft carrier this year. Beijing says sea trials and aircraft qualifications were successful. The country plans to increase its defense spending by 11.2% in 2012 over the previous year. Senior U.S. officials say the buildup is likely to continue unabated and independent of the repositioning of U.S. forces.

Cynthia Watson, professor of strategy at the National War College, says, "[China] clearly has an international need to find resources and to guarantee they can protect their sea lanes of communication, and they are willing to put [the 4th Fleet] together. That is an expensive proposition."

China sold about 73% of its arms exports, including attack electronics to other Asian countries such as Pakistan. The rest went to the Middle East, Africa and South America, a Stockholm International Peace Research Institute report states.

JIM HASELTINE

F-22s (two at rear) and F-15Cs on Okinawa, all equipped with AESAs, provide long-range radar surveillance and detection of small targets such as cruise missiles.

Cyberwar Strategy

Specialists look for new threats and countermeasures to foil electronic attack

DAVID FULGHUM/WASHINGTON

Expensive automobiles and the most advanced military aircraft share a common vulnerability to cyberattack. The overlapping weaknesses have fixed the attention of scientists and electronic warfare (EW) specialists who are trying to plan for future wars.

The common problem is illustrated by satellite navigation and communications systems on high-end autos and the sophisticated, electronically scanned radars carried by top-line warplanes. Both can be penetrated by cyberweapons. The military systems can be protected with increasingly sophisticated signal processors to weed out malware if Congress approves fiscal 2013 budget requests. Civilians will remain defenseless to car theft and electronic harassment until manufacturers see a profit in adding electronic protection.

The active, electronically scanned array (AESA) has been redefining radar and electronic warfare during the last decade. It can observe the battlefield with high-resolution, wide-angle surveillance. However, it can be attacked by data beams carrying false messages and malevolent algorithms. Those cyberweapons can corrupt, blind or exploit the network to which the radar feeds information.

"AESA is intentionally looking for [unknown] signals, not trying to keep them out," a veteran EW specialist tells Aviation Week. "The benefit that the aperture gives the enemy is that it also is an amplifier leading into the system being attacked."

That digital threat can be measured by the statistic that 90% of the F-35's, 70% of the F-22's, 60% of the B-2's and 20% of the F-15's functionalities are cyber-based, says Mark Maybury, the U.S. Air Force's chief scientist, in a separate interview.

The civilian parallel is high-end cars with communications and navigation devices that share electronic links with the rest of the automobile's electronically controlled systems. Think of being locked in your car on a hot day with full heat blowing while being blasted by the music you hate most. The CarShark software package that demonstrates the capability was created by university students and professors.

"The satellite link was one example of a transport mechanism," Maybury says. "The real vulnerability is the lack of a secure architecture. The modern car has processors that manage the entertainment system, locks, automatic brakes, fuel injection and warning systems. They are set up to take messages from the driver with no expectation that someone else would hack into the car's network. There's no signed digital certificate or a white list of who to accept commands from."

The CarShark code enables unauthorized access to turn off the brakes while in motion, change speed indications and

lock the doors, says Maybury, who offers the demonstration as an unclassified example of cyberwarfare's potential.

"An adversary might be able to plug into the base network and insert fictitious messages or ensure [that operators] see and sense different things than are actually happening," he says. "According to open sources, that actually happened with Stuxnet [attacks on Iran's uranium-enriching process] when their centrifuges were self-destructing even while they were being monitored. The potential for counter-intelligence [and cyberattack] is growing so rapidly that you have to minimize the cyberattack surface [with some degree of compartmentalization]."

On the military side of the threat, a key to stemming cyberexploitation of military land vehicles, ships and aircraft is the speed and capacity of signals processing—the task of identifying unwanted or harmful emissions from a foe.

"AESAs are different from conventional radars in that they are looking everywhere at once," says the EW specialist, who has roots in the development of the F-15, F-16 and F-35 radars. "They are sucking in information that is processed. Some of it is what you emitted that is modified by [bouncing off] what's out there. And some of it is modified by what [opponents] have inserted."

It should be no surprise, he says, that the price of software upgrades needed by new aircraft such as the F-35 and F-22 is escalating as sensor suites are improved and threats change. Advanced sensors will require constantly improving signals processing that identifies and weeds out enemy attempts at penetrating and spoofing airborne sensors and the networks they support.

"What has changed is the speed of the signals processing and what you can do with that speed," the EW specialist says. "There is money [requested] in the budget to fix vulnerabilities across multiple apertures. Because you have an undefined signal coming [into the antenna], processing is more of a challenge."

An AESA continuously attempts to create intelligence from all the information it collects. If the data do not fit known characteristics, the sensor still tries to figure out what the signal is doing.

"That's why it's much more of an open access point [for hackers and electronic attack]," the specialist says. "And what do radars do nowadays? They feed fire control systems, sensor fusion and processors. You have a direct avenue to something that can be exploited."

Processing has to be faster because digital radio-frequency memory devices [that capture, alter and rebroadcast radar signals] allow quick changes to signal characteristics. Therefore, signals processors have to be equally adaptive to find the altered emissions.

"[Improving processing constitutes] the vast majority of the modifications that budget planners are talking about," the specialist says. "It depends on the threat and how rapidly the threat evolves. About 90% of what you have to do to keep hackers out is signal processing."

Navy officials agreed with this analysis in a written reply to Aviation Week. The service intends to fund the development of communications capabilities and the modification of multiple existing systems to restore a protected, anti-jam network. Also, it will invest in capabilities to defeat cyberattack and communications jamming through improvements in EW, cyberoperations, networks and the Joint Airborne Layer Network capability. Other beneficiaries will be the EA-18G Growler, E-2D early warning aircraft, Next-Generation Jammer, shipboard jammers and Ship Signal Exploitation Equipment.

> **"What has changed is the speed of the signals processing and what you can do with that speed"**

Compartmentalization is another option for protecting networks on combat aircraft. Planners isolate functionality such as flight control, weapon and mission systems. "We actually have a history of making sure critical functionalities are independent," says Maybury. "But we have to assume that adversaries might get into our systems, so that is why we are looking at resilient systems that can detect a problem—such as my radar operating out of parameters—and self-heal. [The goal is] future systems that are more self-aware of their capabilities and limitations and knowing when they should be doing certain tasks."

Several R&D initiatives to combat cyberintrusions are under way.

Maybury points to "Trusted Boot" as an example of Pentagon efforts to minimize new threats. It is a program on a small disc that contains an Air Force Research Laboratory-created Lynux system that can be inserted in any computer. When rebooted, the computer becomes a trusted operating system, browser and Adobe reader even on an untrusted infrastructure. He describes the program as a way to wrap or isolate threats and untrusted elements on any machine you want to use.

"At the software level, I've said I won't allow it to do certain things," says Maybury. "So I've contained the threat because I've minimized my own privilege."

A Physically Unalterable Functions system offers inherent randomness because of the nature of the material it is made of. Because foes cannot reproduce its exact properties, they cannot exploit it.

Some industry efforts to predict threats focus on the discovery of a software vulnerability to be projected across an organization's entire infrastructure to pinpoint other places where the software vulnerability exists.

"I can build a signature into the firewall that recognizes when that particular vulnerability is exploited," says Maybury. "I see it in one and predict it in others, so I am ahead of the software hackers."

"Obfuscating data" is another approach that breaks a package into parts, distributes the pieces and encrypts each of them differently. The information can be reassembled only by someone who has been sent the key with instructions about where to find each part.

Systems are being studied that allow no one absolute authority over a network, but that also avoids over compartmentalization.

"I'm the equivalent of a three-star general, but I can't install I-tunes on my computer," says Maybury. "I'm happy with that. Ultimately there's an advantage to giving away some of our personal control. You use fractionated authority so that no one has absolute power."

In the future, "social radar" may look for clues of threats on the Internet and enable designers to build security up front.

"There's no question there are a lot of social indicators," he says. "We have a world with imagery, communications and financial transactions that are all potential indicators of threats. There are technical means to get the indicators we need to protect against threats while maintaining privacy."

"Anonymization" deletes names and Social Security numbers before traffic is read. It can be used to see activity by people on the network training to launch attacks.

Shielding an Alliance

Congress finds common ground in support for Israeli defensive gear

JEN DIMASCIO/WASHINGTON

Despite deep divisions in the U.S. Congress, lawmakers are not missing an opportunity to express their support for the defense of Israel. The question is just how much they will provide in the end.

The Pentagon recently said it would ask for more cash to purchase Rafael's Iron Dome short-range rocket and mortar defense system for Israel. And while some lawmakers are so enthusiastic about Iron Dome that they have already introduced a bill toward that end, there is no consensus about the amount of the allocation.

BUDGET SNAPSHOT
Iron Dome

Fiscal 2011 appropriation: $204 million
Fiscal 2013 request: Coming Soon
Major contractor: Rafael

The "new wrinkle" according to Rep. Jim Moran (D-Va.), a member of the House Appropriations defense subcommittee, is that Israel may want the U.S. to pay for a greater share of the system than in the past. "I understand that [Israeli Prime Minister Benjamin] Netanyahu wants us to pay for all of it, without a match from Israel," Moran says. "I don't know whether there may be some objection" to altering past arrangements.

In fiscal 2011, the U.S. provided $204 million for Iron Dome—enough to equip four batteries, according to a House aide. This year's request, the aide says, is expected to be larger for an ancillary system that intercepts threats from 2.5-45 mi. away.

For fiscal 2013, President Barack Obama has asked for $3.1 billion in foreign military financing for Israel. The request includes $99.8 million for co-development of missile defense through the Missile Defense Agency, about $6 million less than in fiscal 2012.

The administration has now indicated it would provide more in fiscal 2013, saying it is working with Israel about U.S. support for buying more Iron Dome systems, "and intends to request an appropriate level of funding from Congress to support such acquisitions based on Israeli requirements and production capacity," says Pentagon spokesman George Little.

The new rockets would help replace ones used to deflect recent attacks on southern Israel from Gaza. "When nearly 300 rockets and mortars were fired at southern Israel, Iron Dome intercepted over 80% of the targets it engaged, saving many civilian lives," Little says.

NOAM ESHEL/AW&ST FILE PHOTO

Inter-country negotiations are ongoing regarding the level of U.S. assistance for Israel's Rafael Iron Dome program in fiscal 2013.

For lawmakers, backing Israeli defensive systems is an easy "yes" vote—providing assistance to a key ally in the volatile Middle East. In the past, Congress has provided more funding than the administration requested for David's Sling, a short- to medium-range missile interceptor made by Raytheon and Rafael, as well as the Arrow II and Arrow III medium- and theater-range interceptors developed by Boeing and Israel Aerospace Industries.

Theoretically, directing money to a certain program in the budget should be more difficult this year, as lawmakers have agreed to stop "earmarking" or directing funds for specific projects.

But those on the appropriations committees are still prepared to do their jobs. Asked about the ban on directing spending, Rep. Bill Young (R-Fla.), chairman of the House Appropriations defense subcommittee who entered Congress in 1971, pulls from his pocket a worn copy of the Constitution. He turns to a dog-eared page and points to an underlined passage that says the administration cannot spend any money from the general treasury that has not first been appropriated by Congress.

In this case, Congress has worked with the administration to change its request.

Two dozen lawmakers are sponsoring the "Iron Dome Support Act," which authorizes the president to "provide assistance, upon request by the government of Israel, for the procurement, maintenance and sustainment of the Iron Dome anti-missile defense system for purposes of intercepting short-range missiles launched against Israel."

"Iron Dome is a game changer. The threats Israel faces from incoming, indiscriminate terrorist rocket attacks are countered by this cutting-edge anti-missile system," says the bill's chief sponsor Rep. Howard Berman (D-Calif.). "Iron Dome is fundamentally shifting political, diplomatic and military realities on the ground, while saving lives of innocent Israelis."

Leaders of the House defense committees were also ready to wave the Iron Dome flag. Rep. Buck McKeon (R-Calif.), chairman of the House Armed Services Committee, points out that he and Rep. Ileana Ros-Lehtinen (R-Fla.), chairwoman of the House Foreign Affairs Committee, wrote a recent letter asking to bolster Israel's missile defenses. And Young says the appropriations defense subcommittee has "supported it from its inception."

Newer congressmen are pro Iron Dome, too, and Israeli officials have been visiting the Hill, seeking their support.

Rep. Allen West (R-Fla.) explains that Israel, being bombarded by its neighbors on a regular basis, needs a missile shield.

He points out that the administration reduced the necessary misdef funding by $6 million. "The head of the Israeli missile defense came and spoke to me personally," West says. "They know I've got their back."

Watchful Eye

Thailand pursues improvements in ISR, disaster-relief capabilities

LEITHEN FRANCIS/BANGKOK

SCHIEBEL

Schiebel's Camcopter S-100 lands on the deck of a navy ship. The Austrian company has been actively marketing the UAV to Thailand.

Relations between Thailand and its neighbors have been improving, but some border disputes with Cambodia and Myanmar remain unresolved. This means intelligence, surveillance and reconnaissance (ISR) will continue to be an important requirement.

There were incidents last year in which Thai and Cambodian troops exchanged gunfire near the ancient Khmer temple of Preah Vihear. Thai and Myanmar troops, meanwhile, exchanged gunfire in 2001 along their border, near the Thai town of Mae Sai.

Thailand also needs ISR to monitor Muslim insurgents in the south.

The air force has been leading aerial surveillance efforts with its five Diamond DA42MPP aircraft. At the Defense & Security Exhibition (DSE) in Bangkok last month, Diamond touted its unmanned version of the DA42MPP, developed by Aurora in the U.S. The UAV can stay aloft for as long as 24 hr., says Hubert Trunzer, Asia-Pacific regional sales director, noting that the pilot cabin can be converted to fuel storage.

Industry executives tell Aviation Week that the Thai navy is also showing interest in UAVs for search-and-rescue (SAR) missions. Unlike most other Southeast Asian nations, Thailand has no disputes with China over the South China Sea, but it does need to protect its territory in the Gulf of Thailand and Andaman Sea.

Also at DSE, Austrian company Schiebel promoted its Camcopter S-100 unmanned aerial system. The helicopter has a maximum takeoff weight of 200 kg (440 lb.), a dash speed of 120 kt. and a cruise speed of 55 kt. It can stay aloft for at least 6 hr. and typically carries a 50-kg payload—mostly electro-optical and infrared gimbals, synthetic aperture radar and line-of-sight data links. Schiebel is highlighting the CS-100's naval applications by pointing out that the aircraft has a composite fuselage, so salt corrosion is not an issue, and the inertial measurement unit is able to take into account the movement of a ship's deck, which is important for landings in rough-sea conditions.

The company has already sold 130 S-100s to various countries, including the U.S. and the United Arab Emirates, according to Andrew Byrne, manager for global sales and business development. The aircraft uses a 55-hp aviation gas engine; but Schiebel has been developing another 55-hp engine, with BMW Austria, that will use heavy fuel. An S-100 with the new engine is planned to be ready for customer delivery in the fourth quarter, says Byrne. Navies prefer heavy fuels and are reluctant to carry avgas aboard ships because it is more volatile, he observes. Schiebel also is working on an engine that can use both avgas and heavy fuels.

Saab—another contender in the UAV arena—is pushing its Skeldar helicopter. The company received no support from the Swedish government but has self-funded the project because it sees demand for unmanned systems, says Hans Berglund, director of UAV marketing.

Although Saab has yet to secure a Skeldar customer, it is confident it will do so this year, says Berglund. Skeldar is powered by a 58-hp engine, developed by German manufacturer Hirth, that runs on heavy fuel. Saab is also highlighting the UAV's ease of use. For example, the operator interface for the ground station has been simplified, says Technical Sales Engineer Johan Bergsten. The controller on the ground can also use preset flight paths for the UAV, he adds.

Even as Thailand's armed services are eyeing unmanned helicopters, they are also actively seeking manned rotorcraft. The air force, for example, has a requirement for SAR helicopters. Industry executives say the service is slated to issue a request for proposals (RFP) before June for four and eventually plans to order 16. These will replace the air force's Bell UH-1H SAR helos.

The Thai army, meanwhile, grounded its helicopters temporarily last year after three crashes. The fatal accidents involved a Bell UH-1H, Bell 212 and Sikorsky UH-60L Black Hawk.

The chief of the army, Gen. Prayuth Chan-ocha, said in July that his service would seek government approval to buy 30 new utility helicopters. One industry executive familiar with the situation says the army has already issued the request for proposals, but the number is less than 10. He suggests that the army hopes to order more later, assuming that it receives funding. Army and air force helicopters were used during last year's floods that covered large areas of Thailand.

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MICHAEL LOPEZ-ALEGRIA

Commercial Space Will Renew NASA

NASA FILE PHOTO

U.S. Navy Capt. (ret.) Michael Lopez-Alegria is the president of the Commercial Spaceflight Federation. He has been a test pilot, a NASA astronaut and an International Space Station commander.

Decisions by Presidents George W. Bush and Barack Obama to retire NASA's space shuttle and cancel the Constellation program were both received with much—and varied—emotion among my fellow astronauts, the NASA family and others nationwide. Regardless of those sentiments, these choices have brushed in broad strokes the landscape on which our future as a spacefaring nation must be painted. That backdrop reveals a stark reality: As of Atlantis's final flight last July, our nation has no means to launch humans into Earth orbit from U.S. soil. Period.

Whether considered from a geopolitical, economic or technological perspective, recovering that capability should be a national strategic priority. NASA's Commercial Crew Program (CCP) represents the fastest and most cost-effective path to that end.

That program and its cargo-carrying precursor, called COTS, for Commercial Orbital Transportation Services, are NASA initiatives to reduce costs and invigorate the American space industry. To do that, they use competitive, fixed-priced, milestone-based agreements to develop spacecraft and launch vehicle systems, rather than the traditional cost-plus-fee structure. This effort should be lauded. A recent government study using the NASA-Air Force Cost Model concluded that design, development, test and evaluation of SpaceX's Falcon 9 rocket would cost about $925 million (in fiscal 2010 dollars) under the conventional approach, compared to just $300 million under a firm, fixed-price contract.

> "Stable design requirements, leaner management and less oversight by government would bring much lower costs without decreasing safety."

Whence all the savings? Stable design requirements, leaner management and less government oversight all contribute. This last factor has made some wonder aloud whether this could mean a decrease in safety. Specifically, they cite NASA's perceived inability to include safety requirements in Space Act agreements, the contract vehicle used for the first three phases of the CCP.

In fact, NASA did write such specifications into Space Act agreements under COTS. More significantly, last year NASA published standards by which commercial crew competitors will be judged, regardless of acquisition strategy. NASA will not select a system that does not meet its safety requirements, and each of the competing teams is keenly aware that the degree to which they meet them will directly affect whether they win NASA's business. Furthermore, some of NASA's best and brightest—former astronauts and mission-operations and launch personnel—have joined these companies in program management and safety roles. My former colleagues are among the nation's premier space operators. Safety is their highest priority, and I would trust my life to them now, just as I did before.

A different and somewhat contradictory criticism was revealed at recent congressional hearings. This time, the complaint was that SpaceX and Orbital Sciences' upcoming COTS launches are well behind their original schedules. History is littered with examples of complex systems that were late, including every first launch of a manned vehicle by NASA and almost every major weapon system. That's just a fact. But there is a big difference under COTS: The providers must bear the costs of delays, because NASA's contribution is fixed. In fact, the government can even save money by recovering performance penalties.

When industry does launch COTS flights, it should hope for the best but be ready for less. The SpaceX mission will be an aggressive combination of two planned test flights, with a long list of objectives. Accomplishing all would be a home run, but a base hit is still a success. Like in any test flight, SpaceX will be wringing out its systems, to ferret out potential problems.

What is more, COTS and the commercial crew effort are better structured to absorb technical glitches than traditional, single-string procurements. With multiple competitors in each program, no system design or approach is exactly duplicated. Redundancy, specifically dissimilar redundancy, is a hallmark of safety and reliability. NASA has appropriately resisted recent attempts to mandate a premature down-selection in the "integrated capability" phase of the Commercial Crew Program. Its evaluation team, from rocket scientists to financial analysts, is uniquely positioned to assess the recently received proposals and make selections to ensure program success given the budgetary framework.

That framework—the level of NASA funding for CCP—will directly affect the speed with which we restore U.S. independent human access to Earth orbit. This capability is not only a national strategic imperative. It is crucial to protecting our $100 billion investment in the International Space Station. The commercial program meets this objective sooner than any other approach, cost-effectively while keeping safety paramount. Congress should join the administration in leaning forward to ensure the U.S. preserves its human-spaceflight leadership.

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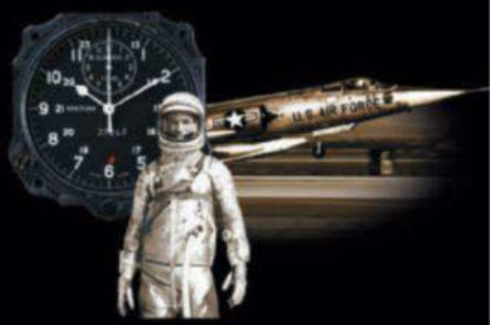

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