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General Electric, which is engaged in performance improvement package upgrades for the 787's GEnx-1B engine, is joining with Boeing and nacelle provider Goodrich to investigate the sources of drag that appears to have hurt fuel burn results.



COVER STORIES

50 Boeing photographers had a chance to shoot two Royal Australian Air Force Wedgetails over Washington state before the new Airborne Early Warning and Control

aircraft left for their home base. The fleet of six aircraft is scheduled to be complete this summer. They will tie into an Australian air and sea surveillance system that monitors traffic as far away as Guam, according to some specialists. The Wedgetail is a Boeing 737-700 derivative carrying a Northrop-Grumman, L-band, long-range, active, electronically scanned array radar.



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The X-47B takes flight.



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BOEING CONCEPT

BLACK BUDGETS

💬 The release of the Pentagon's fiscal 2012 budget request coincided with Aviation Week's Aerospace & Defense Technology and Requirements conference in Washington last week, providing plenty of fodder for **Ares** bloggers about the future of the defense industry. In his "Tales From the Crypt" post, Bill Sweetman, who edits our monthly *Defense Technology International* magazine, looks at the classified portion of the budget and discusses how the \$57 billion line item could include development of a next-generation bomber (a Boeing concept at left). And Senior Military Editor David A. Fulghum analyzes other winners in the budget request. AviationWeek.com/ares

TINY UAV

🎥 Watch the flight test of AeroVironment's tiny Nano Hummingbird UAV. The flapping-wing vehicle has a wingspan of just 16 cm and weighs only 19 grams. See the video in Senior Technology Editor Graham Warwick's Feb. 17 post. AviationWeek.com/ares

EYES ON BOEING

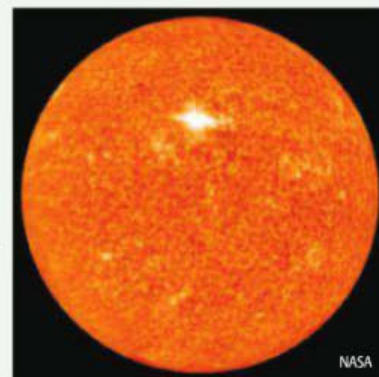
💬 Our **Things With Wings** bloggers had a lot to say about Boeing's 747-8I, 737 upgrades and 787 test updates. AviationWeek.com/wings

AEROSPACE IN INDIA

🌟 Aviation Week's all-India website includes news, photos, blogs and an interactive map of aerospace and defense companies in the rapidly growing market. AviationWeek.com/India

SUN SHOW

📷 NASA's twin Solar Terrestrial Relations Observatory spacecraft have sent back images of both sides of the Sun, providing valuation data and early warning of solar storms—a threat to satellite operations of all sorts. Senior Space Technology Editor Frank Morring, Jr., posted several of the images and a video of the rotating Sun to our **OnSpace** blog. AviationWeek.com/onspace



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FEEDBACK

REQUIREMENT OVERLOAD

"Heavy Lift" (AW&ST Jan. 17, p. 18) illustrates the ambiguities of democratic rocket science. The NASA Authorization Act (PL 111-267) is not a concise engineering requirements document; its truncated democratic assembly favors contradictory interpretations. Administrator Charles Bolden has it right with regard to his space launch system priorities "Affordable, Sustainable and Realistic."

It is not surprising that the initial reference design aims too high. It is a strict response to the Act, coupling the ultimate payload and operational deadline, rather than the initial core goal. The Act stipulates a payload range of 70-130 tons, with the initial capability achieved without an Earth departure stage. A de-populated space shuttle main engine core, using the current operational space transportation system propulsion configuration (>100-ton direct insertion), could fly first, allowing Constellation-derived elements to follow.

Considering how performance requirements will evolve with new technology and exploration discoveries, our initial development effort should target a simplified flexible system, based on existing flight-qualified components that can be augmented as needed. The initial capability can be achieved without waiting for the five-segment solid rocket booster or the J2 engine.

George Eastman

RENTON, WASH.

OUT OF JOINT

I'm not surprised that technical issues are coming to light on the F-35B short-takeoff-and-vertical-landing (Stovl) aircraft, as reported in recent issues of AW&ST. The aircraft has a very complex clutch-drive system. What really surprised me was the Defense Department's attempting a "Joint" Strike Fighter on the assumption it could satisfy all three service requirements with a single platform. Haven't we been down that road before?

A better solution might be to resurrect Boeing's X-32B Stovl design to satisfy the U.S. Marines Corps requirement. The Stovl design of that aircraft was based on the proven technology of the AV-8B Harrier's directed exhaust nozzles, which had much less complexity than the current F-35B design. The F-35A and C models may satisfy Air Force and Navy requirements, but the complex clutch-drive system of the

F-35B will present a significant challenge to the USMC when it comes to reliability and maintainability.

Lawrence Maduras

ELK GROVE, CALIF.

MORE TO THAT STORY . . .

Your obituary for Charles Kaman (AW&ST Feb. 7, p. 15) gives the impression that he invented the intermeshing rotor helicopter concept. This principle was conceived and perfected by Anton Flettner (1885-1961) in Germany in the late 1930s, first with the model Fl 265, and later with the Fl 282 Kolibri "Hummingbird," which was used in combat reconnaissance roles by both the German navy and army in World War II. Fl 282s were captured and evaluated by the Americans, and Flettner came to the U.S. in 1945 as a military consultant.

Kaman formed his company in 1945 to develop his servo flap idea, not to build a "synchropter." His selection of the intermeshing contra-rotating concept for his first machine, the K-125, coincides with Flettner's arrival in the U.S.

Robert Julian

MILFORD, DEL.

DIFFERENT BIRDS

Although I found the Space Shuttle Era articles (AW&ST Dec. 6, 2010, pp. 48-68) to be outstanding overall, I do have one quibble. Expecting the shuttle "to fly back and forth to orbit like an airliner" is unrealistic because the shuttle is a rocket, not an aircraft. If it



is intended to operate like an airliner, it must be designed like an airliner.

Unfortunately, many of the technologies required to build an airliner like a spaceplane were not yet proven when the shuttle was designed. Though almost all of them are now proven, some will need maturing. This will happen

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quickly if encouraged by a new effort to build a practical spaceplane.

Walt Baldwin

MANSFIELD, TEXAS

SAME OLD, SAME OLD

Frank Morring, Jr.'s article "The Accidents" (AW&ST Dec. 6, 2010, p. 59), reminds me of a phrase "the normalization of deviance," which I encountered in Dianne Vaughn's book *The Challenger Launch Decision*. Here at Vandenberg AFB, when there was an anomalous equipment operation that was brought to the attention of the manager, he would say "We'll have to watch that." When the same anomaly would again occur, he would say "Oh, well! We've seen that before."

Paul Lipps

ARROYO GRANDE, CALIF.

'UNKINDEST' CUTS CONTINUE

With budget cuts likely to be the sharpest in 20 years, I hope we don't repeat the mistakes of the Clinton administration, when then-Defense Secretary William Perry convened the infamous "Last Supper" to trumpet industry-wide consolidation. Instead of the lower-cost weapons that were promised, we got a union of government/industry that failed on all counts: cost, innovation and vitality.

Our services are left without a means to counter World War I-based improvised explosive devices and rocket-propelled grenades. Our 30-year development of an anti-missile shield is mired in tests, while cyberwar defenses remain in the labs. We're left with grossly overpaid CEOs, lobbyists and "think tanks" blurring the distinction between industry and government, with cost growth thrice the rate of inflation.

We need competition on risk, technology and prices, and too many rather than too few contractors. One exception is drones. General Atomics came through like Lockheed Martin's Skunk Works used to.

Richard K. Cook

SANIBEL, FLA.

Congratulations to the men and women of the UCAS-D team who helped this unmanned aviator earn its wings.



Nearly 85 years ago, we began powering Navy aircraft. Today, we're honored to continue making history by keeping our naval force on the leading edge of aviation. On February 4, 2011, the Northrop Grumman X-47B successfully completed its first flight as part of the U.S. Navy's Unmanned Combat Air System Carrier Demonstration (UCAS-D) Program. Powered by a Pratt & Whitney F100-PW-220U engine, this remarkable achievement puts our next generation of aircraft firmly on course. It's in our power.™ www.pw.utc.com.



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WHO'S WHERE

Khoi Vu (see photo) has been named vice president and general manager of *Gar-Kenyon Technologies*, Naugatuck, Conn. He was vice president of aeronautics for Smiths and before that, vice president and general manager-aerospace and defense for Mortiz Aerospace.

John Morgan is Kuwait-based *Wataniya Airways'* new chief commercial officer. He was vice president for Europe, Middle East and Africa of Dubai-based Eos Airline and vice president-commercial activities for Royal Jet in Abu Dhabi.

Geoff Hill has been tapped by the *Aircraft Electronics Association* as director of communications and editor of *Avionics News*, Lee's Summit, Mo. He comes from the University of Missouri-Kansas City, where he managed communications and marketing for the intercollegiate athletics department.

Karen A. Williams has become vice president and general manager of *Northrop Grumman Corp.*'s new Defense Technologies Division in McLean, Va. Williams was vice president for Air and Missile Defense Systems and had been vice president of Mission Support Systems.

Johanne Lecomte (see photo) has been appointed vice president of sales, marketing and communications for *International Launch Services*, Reston, Va. She was vice president of sales and marketing at EADS North America and also managed business development projects for Dynegy Communications and Teleglobe International.

Jennifer C. McGarey has been named corporate vice president and secretary of the board of *Northrop Grumman Corp.* of Los Angeles. She was general counsel and secretary of RCN Corp., where she also was vice president-human resources and vice president/compliance officer.

John Jolly will lead *General Dynamics Advanced Information Systems'* Cyber Division, Fairfax, Va., as vice president and general manager. He joins General Dynamics from Northrop Grumman Corp., where he fulfilled program management and strategic planning roles.

Jiri Matousek (see photo) has become chairman of *Central European Private Aviation* of Prague, succeeding

founder **Dagmar Grossman**, who is stepping down to focus on developing Grossman Jet Service. Matousek spent 16 years with SAS.

Robert Verbeck is the new chief financial officer for *Boeing Defense, Space and Security* of St. Louis, succeeding **Randy Simons**, who is retiring. Verbeck was chief financial officer for the Boeing Military Aircraft unit of BDS and was BDS controller and program manager for the U.K. tanker program.

James R. Meltsner has been appointed vice president-government relations and communications at *Alenia North America*, Washington. He was vice president for congressional affairs for Northrop Grumman Corp., following a stint as vice president/general counsel of the Evans Group.

John Lambeth has joined *Qinetiq North America*, McLean, Va., as chief information officer. He was vice president of the Technology Solutions Group of Blackboard Inc.

Klaus Tritschler (see photo) has been named vice president of design for *ICON Aircraft* of Los Angeles. He was creative director at BMW Group Design-worksUSA.

Greg Marshall has been appointed Melbourne, Australia-based director of the Alexandria, Va.-based *Flight Safety Foundation's* Basic Aviation Risk Standard program. He was head of safety and security for Australia's Sharp Airlines.

Steve Walden has become director of sales for commercial engines and airframes in EMEA for *CT Aerospace*, Carrollton, Texas. He has worked for Inventory Navigators, Monarch Aircraft Engineering and Rockwell Collins.

Pamela Parsons has been appointed director of special projects at *Backstage Cargo*, the entertainment freight division of Los Angeles-based Consolidators International.

Tim Rens (see photo) is the new



Khoi Vu



Johanne Lecomte



Jiri Matousek



Klaus Tritschler



Tim Rens



Greg Kinsella



Margie Bricker

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chief financial officer of *Executive AirShare*, a Kansas City, Mo.-based fractional ownership company, where he had been a consultant. He was chief financial officer and treasurer of CVR Energy Inc.

Michael Curto, a Patton Boggs partner and deputy chair of the Washington firm's Business Department, has been named to the board of the *Washington Metropolitan Airports Authority*.

Greg Kinsella and **Margie Bricker** (see photos) have been promoted to senior management positions at New York-based *Arcadia Aviation*. Kinsella is chief operating officer and Bricker vice president of finance. Both are veterans of the company and were instrumental in its integration of Wayfarer Aviation.

Mark Andrews has been named principal subject matter expert for weather at Dulles, Va.-based *Metron Aviation*. He was assistant director of the NextGen Joint Planning and Development Office of the National Oceanic and Atmospheric Administration.

Clark Gordon has become director of marketing for *Pro Star Aviation*, Londonderry, N.H. He was vice president of sales for TruNorth Avionics and is chairman of the Professional Aviation Maintenance Association.

Jeffrey McRae is the new president of *Triumph Aerostructures-Vought Integrated Programs Div.*, Wayne, Pa. He was general manager for United Defense's Armament Systems Div.

Rep. **Tom Petri** (R-Wis.) has been appointed chairman of the *U.S. House of Representatives* aviation subcommittee. ☐

MARKET FOCUS



BY JOSEPH C. ANSELMO

Senior Business Editor
Joseph C. Anselmo blogs at:

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Joe_Anselmo@aviationweek.com

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(as of 2/16/2011)

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AW Airline 25	1056.4	1.1% ▲	20.2% ▲	21.8% ▲
S&P 500	1336.3	1.2% ▲	19.8% ▲	21.5% ▲



COMMENTARY

The Deficit That Ate the Military

U.S. President Barack Obama's fiscal 2012 budget request is largely good news for the Pentagon. Though the \$671 billion defense blueprint is 5% lower than the president's request last year, much of the reduction comes from the drawdown of U.S. forces in Iraq. Other modest cuts already were telegraphed by Defense Secretary Robert Gates. The Pentagon's core budget would actually rise slightly, to \$553 billion, though not enough to keep pace with inflation.

It is almost certain, however, that Obama's proposal will not be the last word. The president's \$3.7 trillion federal budget, which includes the military funding, is an exercise in cowardice that puts off tough choices about spending, entitlements and taxes. Under the Obama plan, the government would borrow 43% of the money it spends and continue to pile up debt for years, forcing it to divert an ever-growing share of spending to service the debt. Obama's budget includes \$240 billion for interest payments next year, more than Pentagon procurement (\$113 billion) and research and development (\$75 billion) combined. Like a boa constrictor, the interest tab is on pace to quadruple in the next decade, putting a squeeze on defense and other discretionary accounts.

Republican lawmakers have reacted to Obama's budget with sanctimonious outrage, but they share the blame for the deficit crisis. Just two months ago, the GOP blew a big hole in the budget by forcing Obama to agree to extend tax cuts for the rich that the nation can no longer afford. Some Republicans are now advocating deep cuts in federal spending, and the sacrosanct status that defense funding has enjoyed on Capitol Hill for the past decade is showing signs of cracking, if just a bit.

On Feb. 15, the House rejected amendments that would have cut hundreds of millions of dollars from defense programs. But the next day, it voted 233-199 to terminate the General Electric/Rolls-Royce F136 alternate engine for the Joint Strike Fighter (JSF), a project centered near Cincinnati and Speaker John Boehner's hometown. Credit Suisse analyst Robert Spingarn says he expects further volatility during the next few months, "as some elements within Congress will undoubtedly call for more cuts."

That is not to say that defense spending is the primary driver of the deficit. Even zeroing out the Pentagon's budget would not come close to solving the nation's fiscal crisis. Finding a solution is going to require unpopular cuts to entitlements and higher taxes. But with funding for military aircraft having doubled in the past decade, defense will be a large and tempting target for budget hawks. The industry's poor program performance and soaring unit costs will be cited by lawmakers proposing such reductions. Is it really going to take another six years for the JSF to become operational? The bottom line: It's hard to see how the deficit crisis will be solved without cutting defense. But the alternative could be much worse. ☹

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.

Weekly Market Performance

Closing Prices as of Feb. 16, 2011

Company Name	Current Week	Previous Week	Fwd. P/E	Tot. Ret. % 3 Yr.	Tot. Ret. % 1 Yr.
AIR TRANSPORT					
AAR Corp.	29.03	27.34	15.5	7.4	25.7 ▲
ACE Aviation Holdings	12.86	13.06	4.1	-44.7	103.8 ▲
AerCap Holdings N.V.	14.86	14.89	8.0	-14.7	84.2 ▲
Air Berlin	4.73	4.85	-16.9	-70.0	-15.3 ▼
Air Canada	3.31	3.44	14.2	-66.3	130.5 ▲
Air France - KLM	16.79	18.61	13.4	-33.9	21.1 ▲
AirTran Holdings	7.39	7.40	20.2	-14.0	49.3 ▲
Alaska Air Group	64.34	62.37	8.7	130.4	87.9 ▲
All Nippon Airways Co Ltd.	3.62	3.66	24.3	-8.6	22.0 ▲
AMR Corp.	7.55	7.21	-22.5	-50.5	-15.6 ▼
Asiana Airlines Inc.	10.59	10.50	7.0	36.0	211.3 ▲
Atlas Air Worldwide Holdings	69.40	53.82	12.7	42.9	72.6 ▲
BBA Aviation plc	3.84	3.86	13.7	31.5	54.8 ▲
B/E Aerospace Inc.	36.25	38.20	18.1	-4.7	39.1 ▲
British Airways	22.90	22.90		71.6	183.1 ▲
CAE Inc.	12.96	13.21	18.2	8.9	52.7 ▲
Cathay Pacific Airways	2.43	2.54	6.4	22.6	40.3 ▲
China Southern Airlines	26.58	24.39		-18.9	49.0 ▲
Copa Holdings SA	58.49	57.41	10.9	58.3	8.4 ▲
Delta Air Lines Inc.	11.82	11.74	6.1	-31.8	-7.1 ▼
Deutsche Lufthansa AG	21.46	21.60	12.0	11.2	42.2 ▲
easyJet plc	6.15	6.26	9.4	-23.8	-3.3 ▼
FedEx Corp.	96.84	91.60	17.6	12.3	21.8 ▲
GOL SA	14.21	13.85	14.2	-20.2	5.8 ▲
Hawaiian Holdings Inc.	7.12	6.98	12.7	41.6	-5.2 ▼
Heico Corp.	57.19	56.18	30.5	62.8	61.2 ▲
Jet Airways (India) Ltd.	10.90	9.79	8.0	-43.1	7.6 ▲
JetBlue Airways	6.03	5.87	15.5	-3.7	14.2 ▲
Korean Air Lines Co. Ltd.	63.70	67.04	9.6	-20.3	21.4 ▲
Lan Airlines SA	29.25	27.14	25.9	116.5	68.1 ▲
Qantas Airways Ltd.	2.39	2.43	8.7	-32.0	-5.7 ▼
Republic Airways Holdings Inc.	6.80	6.34	7.2	-68.1	25.0 ▲
Ryanair Holdings ADS	30.53	30.50	67.8	4.2	20.2 ▲
Singapore Airlines Ltd.	11.18	11.26	10.9	25.7	9.3 ▲
Skywest Inc.	15.71	15.35	10.4	-33.5	9.4 ▲
SpiceJet Ltd.	1.07	0.96	8.1	-40.0	-8.9 ▼
Southwest Airlines	12.38	12.27	15.1	-1.6	0.9 ▲
TAM SA	22.65	21.09	29.6	10.0	22.1 ▲
United Continental Holdings, Inc.	27.48	26.62	5.5	-26.4	77.4 ▲
United Parcel Service Inc.	75.66	74.58	17.7	14.8	35.3 ▲
US Airways Group	10.10	9.88	4.5	-29.9	48.5 ▲
WestJet Airlines Ltd.	15.66	14.83	12.6	-16.5	17.2 ▲

THE WORLD

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DEFENSE

Il-476 Flight Trials To Begin

Long-stalled plans to modernize Russia's venerable Ilyushin Il-76 transport are set to begin this year with the maiden flight of the Il-476 upgrade. Alexander Tulyakov, vice president of Russia's United Aircraft Corp. (UAC), announced last week that Ulyanovsk-based Aviastar-SP facility, a UAC subsidiary, will deliver a prototype aircraft toward year-end for the start of flight trials, along with a second



aircraft for static tests. The Il-476 constitutes a modernization of the Il-76MD transport that is currently in service with the Russian air force. The upgrade has been motivated by the need to increase the range and payload of the aircraft and improve its operating economics. The upgrade will include a new lighter wing and more powerful, 35,000-lb.-thrust Perm PS-90A-76 engines instead of the NPO Saturn D-30KPs. The payload will be increased to 60 from 50 tons. The Il-476 will also receive new digital Ku-pul-3 system with satellite navigation and a glass cockpit.

AIR TRANSPORT

787 Test Progress

Boeing is 80% of the way through its test program for the Rolls-Royce-powered 787 and 60% for the General Electric version, says 787 Vice President and General Manager Scott Fancher. The focus now is "about getting the Rolls-Royce [version] through its final 20%," he adds. The engine maker has delivered the first upgraded Package B variants, which are designed to bring fuel burn closer to specification. "We recently got the first engines and they will be put on aircraft in-flow," says Fancher. Boeing is studying which of the early production 787s will be used for function and reliability tests as well as ETOPS certification. For the final phase of airline-like operational testing "we want to do it in as final a production configuration as we can," says Fancher. Revised power panels, redesigned as a result of last November's electrical fire on test aircraft ZA002 are also arriving for installation.

737 Improvements

Boeing expects to complete introduction of its 737 improvement package into service in the first quarter of 2012, resulting in fuel savings of \$120,000 per aircraft per year, says product marketing regional director George Alabi. The first "wave" of improvements, scheduled to enter service in the first quarter of this year, includes reduced-drag anti-collision light fairings, low-drag

wheel-well enclosures and control-surface improvements. This should yield around a 0.6% fuel-burn reduction. The improved CFM56-7BE engine and nozzle, which will save a further 1.2%, will be introduced in July, adds Alabi. The upgrade is mostly focused on the high- and low-pressure turbines, but also includes a reduced-drag primary nozzle and plug. A third improvement phase will be based around improved modulation of the environmental control system exhaust vent, and be introduced in the first quarter of 2012.

Widebody Orders

Boeing has added three 767 orders from LAN Airlines and four from unidentified customers to its backlog, raising its net for the year to nine total airplanes. The 777 is its best seller with nine net purchases, and the 767 ranks second with three. After 32 earlier cancellations, the 737 net order book stands at just one; four 787 orders have been lost.

Delta Penalized

The U.S. Transportation Department has fined Delta Air Lines \$2 million for its treatment of disabled travelers, in what the department is calling the largest civil penalty it has assessed in a non-safety related case. Of the \$2 million, Delta must pay the government \$750,000, but it can use up to \$1.25 million to improve its service to passengers with disabilities beyond what is required by law. The department says its investigation of Delta disability complaints in

S-400s In The Kurils Would Be 'Overkill'

Moscow is officially vague about perceived threats to Russia in the Western Pacific, but it has declared the need for a military build-up in the Kuril Islands, which Japan has been trying to recover since the Soviet Union invaded them in 1945. The dueling claims have blighted relations between the two countries and derailed even the conclusion of a peace treaty.

The reinforcements will include the S-400 Triumf (SA-21) air defense missile, says Russian news agency RIA Novosti, quoting an unnamed high-ranking official in the Russian general staff. Later, Maj. Gen. Sergei Popov, chief of Russian antiaircraft missile troops, said the S-400 was overkill.

Military support with modern weaponry is a must for the security of the islands, Russian President Dmitry Medvedev said in a meeting last week with Defense Minister Anatoly Serdyukov and Regional Development Minister Viktor Basargin.

The four islands of Iturup (from which the attack on Pearl Harbor was launched in 1941), Kunashir, Shikotan and Habomai in the Kuril

chain, which lies between the northern Japanese island of Hokkaido and Russia's Kamchatka Peninsula, are still claimed by Japan.

The S-400 is a product of the Almaz Central Design Bureau and an upgrade of the S-300 family (SA-10 and SA-20). Almaz/Antey claims the missile system can detect targets at a range of 250 mi. and engage them at 125 mi. The new missile system would be excessive and potentially dangerous, Popov said. The shorter-range Buk (SA-11 Gadfly) systems would be adequate.

Medvedev toured one of the Kurils last November. Japanese officials said then that the visit could complicate bilateral relations. The visit was the first by a Russian or Soviet head of state. On Feb. 8, Japanese Prime Minister Naoto Kan called Medvedev's trip an "inexcusable rudeness."

In August 2009, the Russian air force commander, Gen. Alexander Zelin, said the country's air defense industry is developing a fifth-generation, S-500 air defense missile. "It is able to implement in full the tasks of air and space defense and is capable of engaging ballistic hypersonic targets flying at a speed of 5 km per second."



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THE WORLD

2007 and 2008 revealed many violations of the requirement to provide assistance to disabled travelers for getting on and off aircraft. Some of those violations were "egregious," by which the department means the customers had long waits for assistance or may have missed flights as a result. It also says Delta frequently did not provide adequate responses to complaints and failed to file proper reports about the complaints. Delta officials say they since have made significant investments in technology, feedback assessment and training.

GTF's Icy March

Pratt & Whitney is preparing to ship its first PW1524G geared turbofan for Bombardier's CSeries to Manitoba for ice testing following the completion of initial ground tests at its West Palm Beach, Fla., facility. Testing of Engine 001, set for March, will follow nearly 200 hr. of ground evaluation, which showed "the engine continues to exceed our expectations," says Bob Saia, vice president of the Next Generation Product Family. Assemblies of the second and third PW1524G development engines are nearing completion. The second engine will also be tested at West Palm Beach before being shipped to the company's facility near Montreal. Engine 002 will then be mounted to Pratt's Boeing 747 flying testbed for first test flights scheduled to begin in mid-year.

ROTORCRAFT

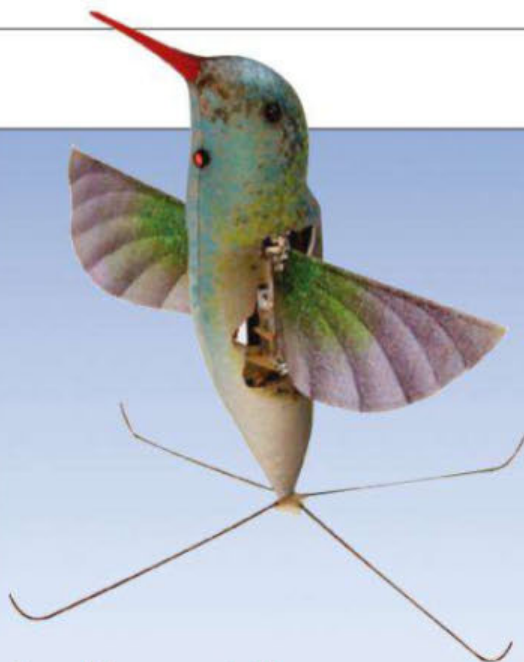
Bigger Scout

The U.S. Navy plans to change the airframe of the Northrop Grumman MQ-8 Fire Scout unmanned helicopter to extend endurance and payload to meet an urgent special-operations requirement for a sea-based medium-range surveillance platform to be operational by 2015. Funds are requested in fiscal 2012 for the first 12 MQ-8Cs, based on the Bell 407 commercial helicopter rather than the smaller Schweizer 333 on which the MQ-8B is built, but using the same avionics, payloads and ground station.

SPACE

Satellite Slippage

The U.S. National Oceanic and Atmospheric Administration's (NOAA) Joint Polar Satellite System (JPSS) is expected to slip 12-14 months as a result



AeroVironment Flies Nano Hummingbird

AeroVironment has flown a prototype flapping-wing unmanned aircraft to complete the U.S. Defense Advanced Research Projects Agency's Nano Air Vehicle program. With a 19-cm wingspan and weighing just

19 grams (less than 1 oz.)—including batteries, motors, video camera and communications links—the remote-controlled Nano Hummingbird has hovered for up to 11 min. on internal power, demonstrated precision maneuvers and transitioned to forward flight at speeds up to 11 mph. The tailless vehicle uses the flapping wings for both propulsion and control, and is as easy to fly as a model helicopter, says project manager Matt Keennon. Early versions could fly for only 20 sec., and the final concept demonstrator—which evolved in incremental steps that included 300 wing designs—exceeds expectations, he says. Seen here enclosed in a hard shell shaped to resemble a hummingbird, the vehicle is actually smaller and lighter than the largest known member of the species, AeroVironment says.

of Congress's failure to pass new appropriations for fiscal 2011. JPSS is the civil follow-on to the canceled National Polar-orbiting Operational Environmental Satellite System on which NOAA was partnered with the U.S. Air Force and NASA. JPSS had been targeted for a first launch in 2014. The Air Force is now pursuing its own polar Defense Weather Satellite System in parallel.

Second ATV Flies

An Ariane 5 ES rocket has successfully launched Europe's second Automated Transfer Vehicle (ATV) to the International Space Station, helping ensure robust station resupply and reboost capability once the space shuttle is retired later this year. ATV-2 lifted off from Kourou, French Guiana, at 18:50 local time on Feb. 16, for a scheduled docking with the ISS on Feb. 24. It was the first of six scheduled Ariane 5 launches for 2012.

More Growth for Eutelsat

Growth at Eutelsat continued unabated in the first half of its 2009-10 fiscal year, prompting the No. 3 fixed satellite service provider to reiterate its strong forecast for the full year and the next three years. Eutelsat reported revenues up 13.3% to €575.9 million (\$783 million) and earnings before taxes, depreciation and amortization up 12.5% to €463 million. Profits jumped 25% to €174 million.

OSC Gets New Sat

Orbital Sciences Corp. has been selected to supply a new communications satellite to SES World Skies. SES-8, equipped with 33 K_u-band transponders and intended to provide growth capacity to India and Southeast Asia, is expected to be orbited in the first quarter of 2013.

BUSINESS AVIATION

Hawker Beechcraft Sales Down

Hawker Beechcraft reports its 2010 net sales of \$2.802 billion were down \$393.8 million from a year earlier, but its operating loss had slowed to \$173.9 million last year, from \$712 million in 2009. The T-6 Texan II military trainer represented a bright segment of the Wichita manufacturer's business. Of the 318 aircraft it delivered last year—versus 418 in 2009—80 were T-6s, valued at \$681.1 million. The company delivered 73 business jets, 114 King Airs and 51 piston models. Its \$1.4 billion backlog at year-end includes "significant orders" from the U.S. government.

Correction

An item in the In Orbit column of Feb. 7 (p. 20) incorrectly stated the number of flybys that NASA's Messenger spacecraft has made of Mercury. Messenger has made three flybys of Mercury, plus one of Earth and two of Venus for gravity assists to reach the innermost planet.



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\$90,000,000



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Initial Public Offering

Co-Manager
November 2009



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BY GRAHAM WARWICK

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COMMENTARY

Helmet Headwind

F-35's lack of HUD makes helmet-mounted display issues flight-critical



LOCKHEED MARTIN

For decades, the head-up display (HUD) has been the primary flight instrument in fighter cockpits. The F-35 Joint Strike Fighter (JSF) program took the bold decision to dispense with the HUD in favor of a sophisticated helmet-mounted display (HMD). Just how big a technical challenge that decision created is now becoming clear.

Developed by Vision Systems International (VSI), a joint venture of Rockwell Collins and Elbit Systems, the visor-projected HMD is performing adequately in daylight flights, but it is falling short of requirements in night-vision mode, says U.S. Navy Vice Adm. David Venlet, head of the JSF Joint Program Office (JPO).

Without a HUD to fall back on, helmet performance is a critical concern for the program. VSI President Drew Brugal says the company has a road map to overcome the issues, but Venlet says F-35 prime contractor Lockheed Martin and the JPO are looking at several other options for providing night-vision capability.

Developing a visor-projected HMD with virtual-HUD and integrated night-vision capabilities has been challenging from the outset. The display was redesigned after pilots found the original "peaked" visor shape unacceptable, and the "Gen 2" helmet with a rotationally symmetric visor has been flying in the F-35 since June last year.

Proving that the helmet is safe across the F-35's ejection envelope has been an onerous task. Currently, the HMD is cleared to 450 kt. for flight testing, but Brugal says an ejection sled test has been completed at the maximum 600 kt. airspeed required.

Although adequate for early flight testing, the helmet has issues with brightness, focus and jitter in day-only mode, says Venlet. VSI is working to resolve these, says Brugal, noting that a "major engineering change" to stabilize the virtual-HUD symbology by isolating the display projectors from helmet motion has just been cleared for flight.

VSI has long experience with

visor-projected displays, producing the joint helmet-mounted cuing system for a range of combat aircraft. But that is monocular, while the F-35 HMD is binocular, and some of the performance issues relate to problems correlating the overlapping images so the pilot sees one sharply focused display.

A fix for the software-related anomaly causing symbology jitter has been presented to Lockheed Martin and "there has been real progress on brightness," says Brugal. "We are confident we can resolve the issues," he says, before F-35 training begins late this year. But problems with the HMD's night-vision performance are tougher to crack.

Increasing image acuity to match night-vision goggles will require "holistic" improvements to the system from the helmet-mounted camera, through image processing to visor projection. "We are working with Lockheed Martin to address the issues step by step and provide a progressive capability as technology evolves," Brugal says.

The night-vision camera uses an electron-bombarded active pixel sensor. "The night-vision sensor integrated into the helmet is one of the first generation," says Brugal. "The next generation and its follow-on are fielded already, and we are working with Lockheed Martin to plan when those new sensors can be cut in."

Although VSI believes it has an "executable road map" to meet the requirements before the F-35 enters service, Lockheed Martin and the JPO are looking at alternatives to using the HMD for night vision. "We are not giving up on the requirement, but we will not drive the program into a ditch," says Venlet.

Options being considered include presenting night-vision imagery on the F-35's single, large head-down display. "We could fall back to the flat-panel display or early use of night-vision goggles, which we would not be satisfied with," he says.

The Pentagon's decision to stretch out JSF development allows more time to resolve the helmet issues, but as the first fighter without a HUD, the F-35 is breaking new ground. ☛



BY ANDREW COMPART

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COMMENTARY

Turboprops Or Bust

Manufacturers eye a U.S. market comeback, but must overcome traveler perceptions

Let's face it: Most travelers in the U.S. who flew on turboprop aircraft in the 1990s and early 2000s do not have pleasant memories. My wife talks about the prospect of another turboprop flight as just a cut above flying on a hang glider all the way from Washington to New York. My most vivid memory is of sitting in the front row, with my left foot practically in the cockpit, watching the pilot's tight grip on the control column as the aircraft shook on takeoff.

A February 2000 *New York Times* story about U.S. airline fervor to replace turboprops with regional jets noted an informal survey by Delta Air Lines, which found that its passengers hated turboprops so much that most of them were willing to drive 2-5 hr. to avoid flying in them.

I mention this because executives from ATR, the French-Italian company that manufactures turboprops exclusively, visited Aviation Week's Washington offices this month as part of their new push to attract U.S. airline orders. CEO Filippo Bagnato says he believes rising jet fuel costs, aging fleets and ATR's new and reconfigured turboprops are opening the door for deals with carriers here.

Facing higher fuel prices that have made smaller regional jets such as 50-seaters economic losers for many routes, the North American market is showing a "new interest" in the more fuel-efficient turboprops, he says, and ATR has been preparing itself for this opportunity. The first of its new -600 series aircraft is slated for delivery this year. With the U.S. market in mind, ATR is offering a two-class configuration of 40-60 seats for the ATR 42-600 and ATR 72-600 (above), with forward doors and more overhead space in addition to the more comfortable cabin.

ATR says its turboprops offer the only profitable way to fly short connections, especially for flights of 350 nm or less, citing operating costs that can be



ATR

as much as 45% lower than regionals.

Mark Neely, vice president of marketing and sales for ATR North America, says the company is finding "more opportunity than we had thought about" for the ATR 42. That's because some markets are outgrowing the 30-seaters that serve them, while other markets are a bit too small for their current 50-seaters. This equation makes a slightly smaller dual-class aircraft a "pretty attractive proposition," he says.

But even ATR acknowledges a perception problem: many travelers think of turboprops in terms of the older aircraft they have flown on, not the newer, quieter, more comfortable versions, and some airlines believe their customers will still eschew them.

Michael Boyd, who for years via his Boyd Group International consulting and research firm has been helping communities attract more airline service, describes the challenge.

Neely, he notes, made a similar pitch at his company's International Aviation

Forecast Summit last October. Boyd believes ATR has a "very cogent and compelling argument," especially for city-pairs of 400 mi. or less, but adds that being correct does not mean it will be successful.

"Their economic argument is airtight. [The question is] just whether or not people want to get on those airplanes," he says, noting the failures of Frontier's Lynx regional service in Denver with Bombardier Q400s in about eight markets where a new-generation turboprop should have worked.

ATR is "on the right track," says Boyd, who notes that the new-generation turboprops are far better than their ancestors. "But you have to really break down a lot of emotional doors to get there." ATR also will have to convince regional airlines to take on another aircraft type when the push has been for more fleet simplification, he adds.

The newer turboprops, however, have made some inroads—primarily, with Q400s, which can seat up to 78 passengers in a single class and about 70 in two. Philippe Poutissou, Bombardier's vice president of marketing for commercial aircraft, says rising fuel prices have pushed the beneficial range for turboprops further out—to routes of 500 mi. or less—and he believes about 200 of the U.S. market's 50-seat regional jets could be replaced by larger, more-efficient turboprops.

Poutissou also notes that Colgan Air flies its growing Q400 fleet for United Continental and has begun replacing some of United's regional jet service, and that Alaska Air Group regional subsidiary Horizon Air (soon to be rebranded as Alaska Air) is transitioning its mixed regional jet/turboprop fleet solely to Q400s. Canadian carrier Porter Airlines has succeeded with its exclusively Q400 fleet.

It's a conundrum. Recent experience shows that U.S. customers might accept newer-generation turboprops, if they can be convinced to try them. But for that to happen, the models have to be available. This means airlines must order them, which they are reluctant to do because customers . . . well, you know. ☹



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BY FRANK MORRING, JR.

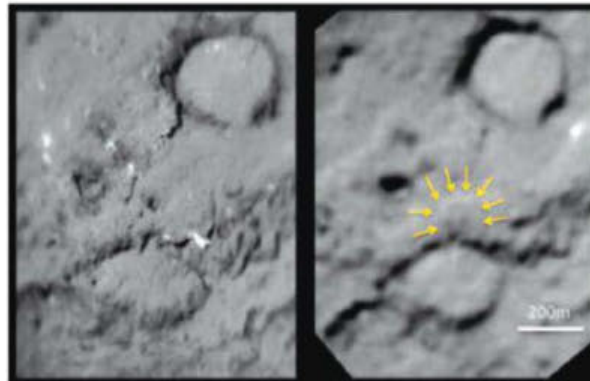
Senior Editor Frank Morring, Jr., blogs at: AviationWeek.com/onspace
morring@aviationweek.com

COMMENTARY

Second Look

Comet impact suggests crater 'healing'

An old comet sample-return mothership, recycled to take a second look at the comet that was blasted in 2005 by NASA's Deep Impact probe, spotted what remained of the crater left from that experiment during a fast flyby on Feb. 14. The Stardust-NExT mission collected 72 images of Tempel-1 as the 12-year-old spacecraft hurtled by at 24,000 mph, approaching as close as 111 mi. from the icy body that circulates between the orbits of Jupiter and Mars. Tempel-1, in a Deep Impact image (left) and the Stardust NExT image (with arrows marking the crater), was roughly at the Mars orbit when the old Stardust spacecraft made its pass. Imagery experts quickly correlated the craters and other surface features collected by the



NASA JPL/CALTECH/CORNELL

Deep Impact spacecraft in 2005 with the new images, and found evidence of the impact in several of them.

Located between two natural craters, the manmade impact crater was muted, with soft features that suggest the ejecta kicked up by the 800-lb. copper projectile fell back where it came from, leaving a mound in the center of the 150-meter-wide (492-ft.) pit. "I think one of the bottom-line messages is that this surface of the comet, where we hit, is very weak, it's fragile," says Pete Shultz of Brown University, a co-investigator on the retargeted mission. "So the crater partly healed itself."

When the projectile collided with Tempel-1, the ejecta cloud obscured the crater from the camera on the Deep Impact probe, forcing scientists to wait for the return mission to examine it. Launched in 1999, the Stardust spacecraft collected samples from the comet Wild-2 in a block of aerogel and returned them to a parachute land-

ing in Utah. It also carried a bumper that recorded impacts from dust and larger clumps of comet material, confirming at Tempel-1 the finding from its Wild-2 encounter that comets don't spew material continuously, but come apart in "clods" that burst and scatter. Conceived by Joe Veverka of Cornell University, the retargeting cost NASA \$29 million instead of the \$300-500 million of a comparable Discovery-class mission built from scratch, according to Ed Weiler, associate NASA administrator for science. ☼

BROADBAND BATTLE

EchoStar Corp. has agreed to acquire Hughes Communications in a move that will recast the battle for control of the fast-growing broadband satellite service sector. The transaction, for about \$2 billion—including the refinancing of Hughes debt—will give EchoStar control of Hughes's main operating company, Hughes Network Systems, as

well as its manufacturing unit, which is a leader in broadband and high-speed mobile satellite service (MSS) technologies. Expected to close later this year, the deal will enable EchoStar to realize a strategic objective of creating solid video and data broadband and MSS activities to help diversify away from its bread-and-butter TV broadcasting and set-top-box manufacturing business. Currently, EchoStar primarily serves the Dish Network, a TV service provider that was spun off in 2008. HNS is the leading North American broadband satellite service provider, with Wild Blue, and the leading supplier of broadband for corporate users. It has 500,000 subscribers and plans to launch a high-throughput satellite dubbed Jupiter in 2012 that will enable it to target consumer broadband on a large scale. ViaSat plans to launch a 120-mbps broadband satellite of its own, ViaSat-1, in mid-year. EchoStar is also poised to take a majority share in TerreStar and a minority stake in DBSD/ICO, two high-speed North American terrestrial/satellite MSS operators currently emerging from Chapter 11 (AW&ST Feb. 10, p. 21). TerreStar wants to roll out a coast-to-coast hybrid wireless network for voice, data and Internet in cooperation with AT&T. ☼

ORBITAL PHOTO OP

Managers are assessing the risks of taking advantage of a one-time opportunity to shoot high-definition video and still photography of the International Space Station while each of the major ISS partner agencies has a crew transport or cargo vessel docked to the orbital outpost. The photo op would come near the end of the shuttle Discovery's upcoming mission to the ISS. If the plan is adopted, station commander Scott Kelly and cosmonauts Alexander Kaleri and Oleg Skripochka would board their Soyuz and back away from the Poisk docking module to a distance of slightly more than 600 ft. for the photo shoot. Discovery, Japan's HTV-2 Kounotori cargo capsule, Russia's Soyuz TMA-20 crew transport and Progress 41 supply freighter and the European Space Agency's yet-to-arrive Johannes Kepler ATV supply ship should all be visible. ☼

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COMMENTARY

Seismic Shift?

Deficit is new card to play in defense debates

It can be difficult to tell when a congressional vote is a mere tactical victory or represents a tectonic shift of the political landscape, but our sense is that the House's 233-198 rejection of the alternate engine for the F-35 Joint Strike Fighter registers on the Richter scale. After the vote, General Electric and Rolls-Royce made the obligatory observation that the Senate has yet to have its say, but this likely is the end of the match for the F136 engine they are jointly developing as an alternative to Pratt & Whitney's F135.

Conservative budget hawks and liberal Democrats came together to reject the argument that competition on the engine would drive down the total costs for F-35 propulsion—even after the costs of two develop-

ment programs are figured in. Proponents of a sole source, who have included Presidents Barack Obama and George W. Bush, are betting greater savings can be had via the economy of scale offered by just one engine. Congress has saved the F136 from the Pentagon's ax five years in a row. But usually, it's the House to the rescue, not the Senate. Harder to assess than the ultimate fate of the F136, however, is the broader significance of last week's vote. With the drive to reduce federal budget deficits at or near the top of Washington's agenda now, defense programs are decreasingly viewed as sacred cows. Significantly, a majority of freshman Republicans, many of them tea party adherents, rebuffed Republican leadership on the vote. House Speaker John Boehner (R-Ohio) backed the F136; much of the work is being done in his home state. He did not waiver, though, in his commitment to more transparency and openness in House operations. He had pledged generally to allow amendments from the floor and did not try to block this one. ☼

UPI/LANDOV FILE PHOTO



'The president's budget does not follow the NASA law Congress passed.'

SEN. BILL NELSON

JAM SESSION

The Obama administration's multi-billion-dollar plan to bring wireless broadband to almost every American could hit an immovable object in society's everyday dependence on GPS, if warnings of disastrous jamming of satellite signals by terrestrial networks come true. Desperate for broadband spectrum, the Federal Communications Commission (FCC) in late January fast-tracked conditional approval for LightSquared to deploy up to 40,000 wireless base stations across the U.S. to augment its mobile satellite service. These high-power transmitters will operate at L-band frequencies adjacent to the low-power GPS satellite signals. The FCC overruled objections from the FAA and Pentagon, but directed LightSquared to set up a working group with the GPS Industry Council to test receivers to see how many are susceptible to jamming. The final report is due by June 15. LightSquared cannot begin commercial service until it has satisfied the FCC on GPS interference, but the Air

Force warns that just testing the base stations will generate unacceptable jamming. ☼

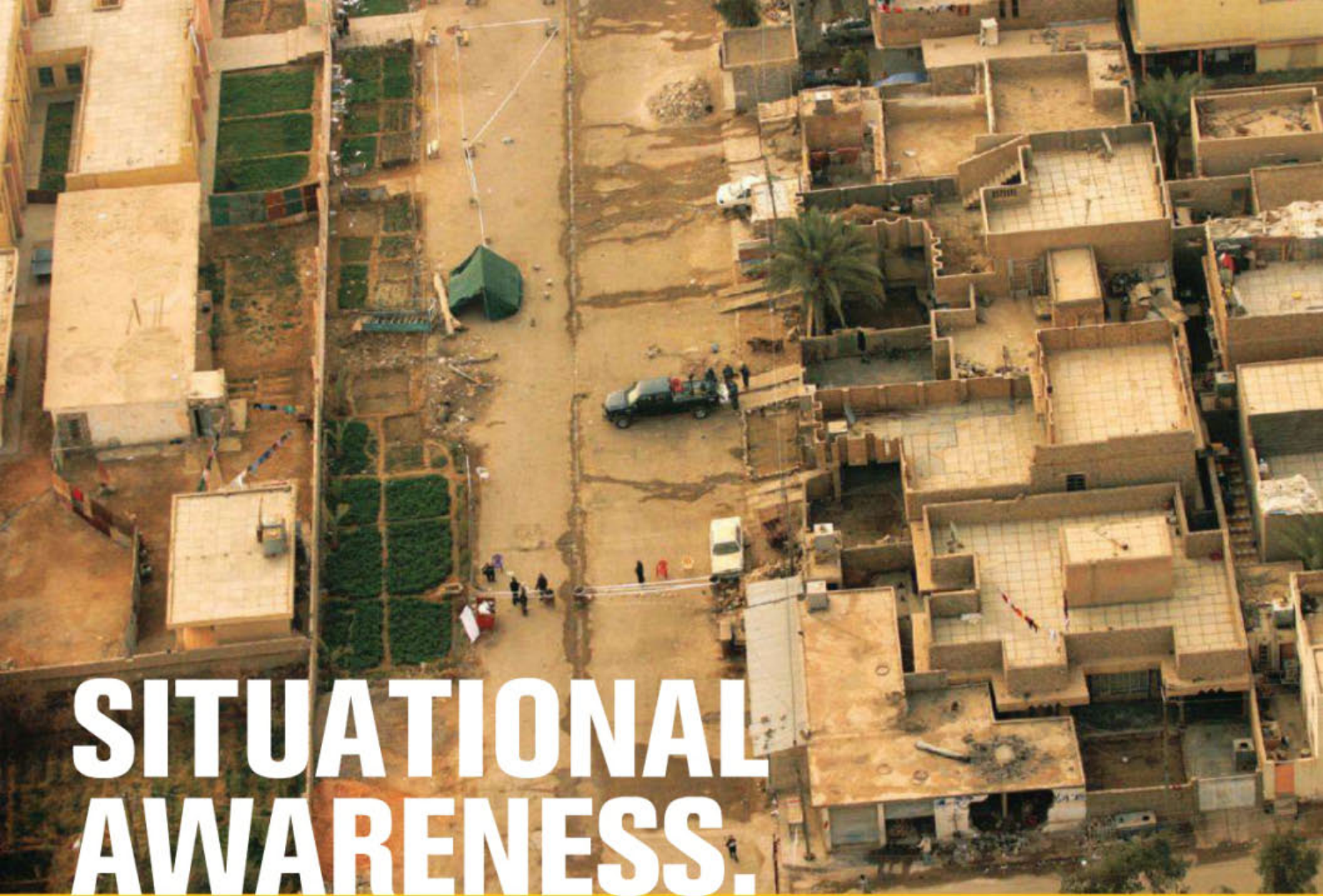
HYPER SLOW

NASA's plan to halve its funding for hypersonic research in fiscal 2012 and redirect \$24.7 million to "higher-priority" projects to increase airport capacity and aircraft safety and reduce environmental impact has been met with disappointed resignation by advocates of high-speed flight. The decision to cut back research on turbine-based combined-cycle (TBCC) engines could adversely affect Air Force plans for a larger demonstrator to follow the scramjet-powered X-51A Waverider, believes the Hypersonic Industry Team. It argues NASA's decision to retrench to fundamental research just as the

Pentagon moves toward developing high-speed weapons is "penny-wise and pound-foolish." But one hypersonics expert suggests NASA was over-invested in TBCC. ☼

SPACE WAR

The Obama administration's new NASA budget request sets up a ready-made conflict with lawmakers who ordered faster work on government-built vehicles and less emphasis on commercial travel to low Earth orbit. The request does not keep the six-year pace set for a new heavy-lift launch vehicle in the three-year NASA authorization enacted in December, and Sen. Bill Nelson (D-Fla.) quickly threw down the gauntlet. "In this time of necessary budget cuts, NASA does well compared to most other agencies," he says. "But the president's budget does not follow the bi-partisan NASA law Congress passed late last year. The Congress will assert its priorities in the next six months." The request does not commit to a date for the first flight of the heavy-lift Space Launch System. Instead, it calls for \$2.81 billion in fiscal 2012 to begin work on that vehicle and the Multi-Purpose Crew Vehicle that would ride atop it on deep-space missions and—as a backup to the hoped-for commercial crew vehicles (see p. 35). Says Administrator Charles Bolden, "Whatever we do has to be affordable ... sustainable and realistic." ☼



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THE NEXT MOVE

Boeing says 737 replacement strategy will be 'aggressive but responsible'

MICHAEL MECHAM/SEATTLE

Memories of program mistakes are weighing on Boeing as it considers the timing of whether to re-engine or replace the 737 Next Generation family.

Two weeks ago, when Boeing CEO James McNerney told analysts that the company's "current bias is not to re-engine [but] to move to an all-new airplane," his comments were taken by some to mean that a new airplane is on the way. In fact, he was reiterating Boeing's view that it cannot find a compelling business case to re-engine. But it has not made a final decision. The complexities of replacing the Boeing 737NG family, which is selling so well that Boeing is boosting production rates, is not easy. The single-aisle family accounts for 65-70% of Boeing's airplane sales year after year.

When she recalls McNerney's comments, Nicole Piasecki, the commercial airplanes vice president for strategy and business development, jumps on a phrase he used in a different context: "aggressive but responsible." The need to be "aggressive" in a highly competitive market is obvious. Being "responsible" relates to "understanding where air travel is going"—the rise of low-cost carriers in burgeoning markets, for instance—before building a new airplane, she says.

Airbus has opted for an intermediary step in the "what's next" race with its A320 family New Engine Order (NEO) re-engining plan. The A320 will come first, followed by the A321 and A319. VIP corporate customers want the A318 included. "The market will decide," says John Leahy, the company's chief operating officer for customers.

Leahy expects "several hundred" A320NEO orders by the Paris air show in June and predicts that Boeing will pursue a clean-sheet aircraft design and then abandon it—like the Sonic Cruiser—to opt for re-engining because of the "low

level of maturity" for "radically new powerplants" needed for a replacement.

Piasecki understands that customers may be confused by this back and forth. "We know that [they] need to know, need to have clarity around where we are going," she says. "We want to see how the NEO is going to do in the marketplace. We want to see how the engine companies and airlines respond. We'll know a lot more in six or 10 months."

Piasecki has her own take on maturity of engine designs. For the NEO, Airbus is offering a choice of Pratt & Whitney's PW1100G geared turbofan (GTF) or CFM International's Leap-X, the follow-on to the CFM56-7B that powers 737NGs. Both must prove themselves, she says, especially the PW1100G, the maintenance of which she regards as an unknown. "We love the GTF technology," she says. "We hope to be working very closely with [Pratt] to understand the technology. But nobody seems to be asking such a fundamental question, particularly as it relates to the NEO."

Piasecki also says Airbus faces greater challenges and more complexity than it is acknowledging in the integration of the new powerplants on the A320 in terms of weight, new nacelles and struts. "You've got complexity in the production system, complexity in the design and, inevitably, the maintenance cost and reliability are big, big questions."

Boeing is mindful that its shift to the NG from the second generation of 737s, called "classics," was too abrupt for many customers. Its mistake was not to have a separate set of assembly mechanics to preserve the old line plus start up the new one. "By planning that way, we had to artificially shut [the classic line] down," she says. "At the time, we had several customers that really, really wanted more airplanes and we couldn't do that."

It is not clear how Boeing plans to ex-

tend its NG line while developing a new airplane, since it has given no indication that it expects a marked increase in shop floor employment. But it has been nearly two decades since the NG was introduced and productivity is far higher now.

"Whether or not we bring a new airplane into the market, the NG will live on for a long time," she says. "We can't afford to [abruptly shut the NG line] with the number of NGs flying. The length of time it will take to transition into any new production will take years."



Boeing expects to overlap production of the 737 replacement with that of the NG family to avoid the unhappiness caused when it shut down the 737 classic line.

The 737 replacement equation is paired with the potential that the Boeing 777 will need to be updated to meet the A350-1000 challenge. So far, Airbus is focused more on the smaller members of that new widebody program, giving Boeing breathing room. Boeing's resources, especially its engineering staff, were strained by simultaneous development programs for the Boeing 787 and the Boeing 747-8, both of which fell years behind schedule.

Boeing's 777 vice president and general manager, Larry Loftis, says there are "probably not the resources" now to undertake 737 and 777 replacement programs simultaneously.

McNerney and other Boeing executives acknowledge the "painful" process of bringing the 787 to market. But Piasecki says the pain of running three years late will translate into stronger

design and production for the 737 replacement.

Boeing expects to benefit from a competitive reaction to the 787's wide use of composites in the airframe. "The aluminum industry really stepped up when they saw us go to composites," she says.

Piasecki also issues an emphatic "absolutely" to the question of whether 787 testing is underscoring Boeing's commitment to a more "electric" airplane. But it is not clear that composite structures scale down well to smaller fuselages, nor that every avionics advance will fit a new narrowbody. "You can't take the flight deck of a 787 and put it in a 737-size airplane," she says.

"We try to take our technology and apply it in an [appropriate] way. We know that [customers] won't pay for technology. They'll pay for something that is going to get them better economics, safety,

simplicity, commonality," Piasecki says.

Such advances might include more use of head-up displays (already options on 737NGs) and other devices that help pilots navigate bad weather and congested air spaces. But other 777/787 features, such as electronic flight bags, are more questionable because airlines are unlikely to pay for them. That bottom-line view prompted Boeing not to invest in fly-by-wire technology in the 737NG.

Another matter is that the empowered and extended 787 supplier base bruised Boeing's schedule. Company officials do not assign blame publicly, but Boeing had to buy out the interests of Alenia Aerospazio and Vought Aircraft to resuscitate fuselage completion, and production was halted when Alenia struggled with horizontal stabilizers.

Asked if Boeing would have been more cautious if it had known then what it knows now, Piasecki responds, "It goes both ways. More cautious and more confident." She is not explicit, but it is not hard to read between the lines: Boeing now knows that it did not fully understand the costs of building a composite airplane using an extended supply chain that had key design authority and which, in some instances, was not fully prepared to fulfill its role.

"I would say one thing for sure," she says. "We believe that our strategic partners need to have very aligned objectives with us."

Lessons from the "challenges" posed by the 787 will not be forgotten on the 737, she vows. "Part of our learning on the '87 was that we need key strategic capabilities inside the walls of Boeing." Those words will be welcomed by engineers and production workers in Boeing's Seattle area factories, who say the company would have had fewer problems if they had played a larger role. But there is a caveat. "When I say the walls of Boeing, I mean a global wall. I'm not saying Puget Sound," she says.

"We're a much better [original equipment manufacturer] for our entire supply chain if we have the lead and the capability [in production], if we, for example, know what a large composite structure costs to build, which we now do. Those are capabilities that allow us to understand what can realistically be done, from a production systems point of view, [in] production and technology." ☐

With Michael A. Taverna in Paris.



MICHAEL MECHAM/AW&S

COMMERCIAL PROGRAMS

JOE WALKER

Twin Peaks

Boeing's future long-range twin derivative studies intensify as A350 threat firms up



GUY NORRIS/SEATTLE

Boeing is edging closer to deciding whether to upgrade the 777 or embark instead on a major derivative as it focuses on the competitive threat of Airbus's similarly sized A350-1000.

Driven largely by calls for longer-range capability for the Boeing 777-300ER from influential long-haul carriers such as Dubai-based Emirates, the company is exploring various design options to extend the large twinjet's range with maximum payload beyond 7,930 nm. "Emirates would love to have a -300ER-sized aircraft that can fly nonstop between Dubai and Los Angeles, so we're looking to close that gap," says 777 Vice President and General Manager Larry Loftis.

Emirates has ordered 20 A350-1000s, but, as currently configured, the aircraft cannot fly Dubai-Los Angeles in the airline's preferred three-class layout, according to statements from Emirates President Tim Clark. The airline also operates one of the world's largest 777 fleets, including 44 777-300ERs, with another 27 on order. Now, as the A350-1000 specification appears to be finalizing, Boeing is gaining a clearer idea of the competition's planned capabilities.

Boeing's dilemma is whether to meet the demand with a major derivative program that would potentially include adding new, all-composite wings and significant engine changes, or to meet less ambitious performance goals through a simpler set of upgrades. Although the latter route would be cheaper and most likely faster and less risky, the more extensive changes could arguably extend the life of the 777 program several years

by providing greater capability and flexibility for further family derivatives.

Nearer-term upgrade options include wing-tip treatments to improve spanwise lift distribution and reduced cruise drag, as well as lowering the 370,000-lb. operating empty weight by using lighter materials "that have been proved out on the 747-8 and 787," Loftis says. Boeing is also continuing to work with General Electric, the exclusive engine provider for the extended-range 777 variants, on improvements to the GE90-115B. Such upgrades could yield "a few more percent improvement in fuel burn."

The studies include options for additional payload and seating capacity, too. "We're also looking at not just improving range but, for revenue-generating capability, looking at things that we can do to get more seats in the aircraft," he adds. The baseline specification for the current -300ER includes typical seating for 370 in three classes.

To date, the studies indicate the upgrade packages considered so far are close to the range targets, but not close enough. "It's at the cusp. We aren't quite there yet, but we've more things to look at," says Loftis, who adds that the company's "gated approach" to product development is guiding the enterprise. The process, which channels the project through a series of gates or milestones, is designed to ensure developments do not go into production with immature technology, or "things we don't fully understand," Loftis comments.

Loftis also notes that the timing of an upgrade, major derivative or replacement effort for the 777 will be impacted by decisions made on a Boeing 737 re-

Wing-tip treatments, engine upgrades and lighter structure could be enough to keep the 777-300ER competitive, says Boeing.

placement. The company "probably doesn't have the resources" to do the 737 and 777 together," he says referring to engineering/production resources. "I don't necessarily need to do that," he says of tackling them at the same time, adding that times have changed since the Boeing 757 and 767 were launched simultaneously in the late 1970s and early 1980s.

With the Boeing 787 creeping toward certification, the aircraft maker is reviving studies of the long-dormant 787-10. Sized in the same class as the 777-200, the -10 is a double-stretch derivative aimed to counter the A350-900, an aircraft described as a "777-200ER killer" by Airbus's chief operating officer for customers, John Leahy. The 787-10 was announced in mid-2007 with an entry-into-service target of 2013. It is designed to seat 310, versus 290 in the 787-9. The derivative study has been on ice for almost three years while resources were redirected to help the troubled baseline 787 development program.

However, according to Boeing product development executives, the company is actively discussing the -10 with airlines and using -8 flight-test performance data to project a more concrete idea of what the double-stretch might look like. Early drivers of the -10, such as Qantas in particular, were eager to push Boeing for transpacific-range capability. But now, with operators facing unrelenting cost pressures, Boeing appears to be finding that efficiency is a more important requirement for the -10 than range. ☐

Jumbo Questions

Brash colors aim to stimulate 747 stretch market as first-flight preparations begin

GUY NORRIS and MICHAEL MECHAM/SEATTLE

Flight tests of the newly unveiled 747-8 Intercontinental will face key challenges ranging from handling to fuel burn as Boeing tries to drum up new orders and meet performance guarantees.

The race for certification is taking on new urgency, since the stretched passenger model has so far attracted lukewarm interest with 33 orders and lags more than two years behind the original

Aimed at key Asian customers for whom red and orange are seen as signs of prosperity and success, the color change comes as Airbus is poised to penetrate Japan, Boeing's long-standing big-jet bastion, with the pending sale of the A380 to Skymark Airlines. The low-cost carrier will be the first from Japan to acquire the A380, and is expected to introduce the initial aircraft in spring 2014 for domestic ser-

747-8F was the news that the GENx-2B67 engine, common to both versions, is falling short of meeting fuel-burn targets. Although General Electric and Boeing decline to specify the shortfall, it is believed to be similar to the 2-3% miss seen on the original GENx-1Bs on the 787.

"When it started to show up a little bit short on the -1B, we had a concern that we'd see a similar issue on the -2B," says Bill Fitzgerald, GENx product line vice president and general manager. "When we did, we gathered together a core group of performance and aeromechanical folks and said, 'OK, what are the things we ought to be considering?'"

Likely areas for improvements will be the low-pressure turbine, as well as adjustments to the compressor and the high-pressure turbine, with design changes leveraging developments al-



Unveiled in striking red and orange, the 250-ft. 2-in.-long 747-8 Intercontinental is nearly twice as long as Boeing's first "Dash 80" jet prototype.

schedule set when the aircraft was first launched in 2006. Boeing is also keenly aware that, coming on the heels of the troubled 747-8 Freighter and 787 test programs, a smooth certification will help bolster market confidence and sales efforts.

As if to jump-start its sales drive, the 747-8I appeared at the Feb. 13 rollout in a startling orange-red livery, a far cry from Boeing's traditional corporate blue. "This is a new airplane and we wanted a new livery," says Pat Shanahan, vice president and airplane production chief.

vice, followed by others for long-haul operations by 2016.

Elizabeth Lund, vice president and deputy program manager, is optimistic that lessons learned during flight tests of the 747-8F will enable the fast-paced 600-hr.-plus test effort for the 747-8I to stay on track for completion before year-end. "The schedule is aggressive but achievable, and we're performing to plan at this point. Based on what we're learning on the freighter, it gives us confidence about how it will perform," she says.

One unwelcome lesson from the

ready under way on the GENx-1B. The 787 engine is being enhanced through two performance improvement package (PIP) upgrades, the first of which enter service in the first quarter of 2012. "As we sit here today, we have not finalized the design," says Fitzgerald. "We're probably somewhere between 60 and 120 days away from a formal commitment." The -2B PIP will enter service on the 747-8 in 2013.

Despite the fuel-burn issue, Lufthansa Executive Vice President Nico Buchholz says the 747-8I will meet all of the airline's mission profiles. However, for Cargolux,

COMMERCIAL PROGRAMS

BOEING

which accepts delivery of its first 747-8F in mid-2011, the picture is not so clear. Neither the airline nor Boeing will comment on the possible impact on Cargolux's route or payload capability plans until data from the recent nautical-air-miles fuel-burn trials are analyzed.

Baseline engines will power the first flight of the RC001 test aircraft in late March, while a second testbed, aimed at evaluating the interior and environmental control system (ECS), will join after a month, says Lund.

A third 747-8I will supplement the final phase by conducting high-intensity radiated fields (HIRF) and electromagnetic interference tests of the interior and its systems. "We're already off to a good start," says Lund. "We rolled it out factory-complete, and that's a sign of how ready it is." Key flight-test challenges will be to validate handling qualities with the stretched upper deck (the -8F retains the original short upper deck), as well as ECS and smoke-sensor tests, she adds.

At 467 seats in a three-class layout, the 747-8I is the culmination of more than 15 years of studies on how to answer the Airbus A380 challenge. The development of the GENx-1B for the 787 provided the final enabler by providing a basis for the advanced engine. Together with aerodynamic improvements for the new airplane—most notably a new 224-ft. 7-in.-span supercritical wing—the 66,500-lb.-thrust engines will combine to ultimately offer 16% better fuel economy than the 747-400 and give the -8I a 12% advantage in seat-mile costs.

When it launched the 747-8I in December 2006, Boeing thought it would capture half of the 900 new airplanes it expected airlines to require during the coming two decades. The A380 would garner the other half. Since then, Boeing has steadily revised its estimates downward as it focused on the mid-size twin-engine market.

The company currently estimates demand for 747-8s/A380s at 720 orders. But the -8I is not gaining the acceptance Boeing projected. So far, the -8I has garnered only 20 firm orders from Lufthansa and five from Korean Air, plus eight in VIP Boeing Business Jet versions. Passenger aircraft account for only 31% of the total 107 orders. However, freighter sales boost Boeing's optimism that its goals for the passenger version are "achievable," says Lund, who adds that a lull in orders is typical after launch as airlines wait to see how the new airplane performs. ☐

Head Winds

Drag reduction will augment GE engine performance upgrades on 787



Drag investigations will focus on airflow in and around the nacelle of the GE-powered 787s.

GUY NORRIS/LOS ANGELES

An industry team will work to find and eliminate suspected areas of drag around the General Electric engine on the Boeing 787 as part of efforts to bring performance closer to specification.

GE, which is already engaged in two performance improvement package (PIP) upgrades for the 787's GENx-1B engine, is joining forces with Boeing and nacelle provider Goodrich to investigate the sources of drag that appear to have affected recent fuel-burn results. The work, starting with test flights on Feb. 17, comes as part of moves to close an estimated 2-3% gap in fuel performance, which is being primarily tackled through engine improvements.

"We're working to put a program in place that eliminates any unknown sources of drag," says Bill Fitzgerald, GENx product line vice president and general manager. The unexpected drag was uncovered during crucial fuel-consumption measurements taken during a recent series of long-endurance nautical-air-miles trials over the Pacific by one of the two GE-powered 787 testbeds. Because of the complexity of calculating discrete contributors to drag between airframe, engine and nacelle, "we are working with Boeing to understand the margins of that," he says.

Boeing estimates that the effect of even a 1% drag increase on a 737 can boost fuel burn by 15,000 gal. per year, while for a 747 a single percent of drag can result in up to 100,000 additional gallons of fuel used per year. Although no figures are available for the 787, it will lie between the 777 and 767, which Boeing's estimates would burn 70,000 and 30,000 extra gallons, respectively, with a 1% drag increase.

The main target for the investigation is excrescence drag, a form of parasite drag that, unlike induced drag due to lift or compressible drag due to high Mach flight, is caused by the shape of the body, skin friction, leakage and interference between components. Although roughly 90% of a new aircraft's total drag is unavoidably attributable to weight and size, Boeing estimates an additional 6% is caused by pressure, trim and interference drag, which can be optimized before development in the wind tunnel. The remaining contributor, around 4%, is excrescence drag caused by antennas, lights and masts, as well as skin joints around windows, doors and control surfaces, airflow leakage and surface roughness.

GE is, meanwhile, two-thirds through flight tests on its 747 testbed of the PIP1 upgrade designed to bring specific fuel consumption within 1% of the original specification. The package, focused on improvements to the seven-stage low-pressure turbine, is due to be flown on 787 ZA005 in mid-year. Certification of the airframe-engine combination is expected in the third quarter of 2011, with service entry in early 2012.

Tests of PIP2—centered on improvements to the high-pressure compressor as well as modifications to the turbine and minor adjustments to the fan blade—began on Dec. 30. The upgrade will also provide thrust growth to 78,000 lb. to meet the expected demands of the 787-9 and anticipated -10, and is due to make its first flight on the 747 testbed in June. Certification is slated for mid-2012, with entry-into-service later that year. PIP2 is designed to meet or exceed the fuel specification. "It will take us all the way home, that's our belief," Fitzgerald says. ☐

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U.S. BUDGET

Last Stand

Defense secretary continues to influence tacair, intel projects in his last budget plan

AMY BUTLER and GRAHAM WARWICK/WASHINGTON



In the Pentagon's latest budget request, Defense Secretary Robert Gates is attempting to terminate more unneeded programs in the name of higher-priority efforts, but he will be forced to leave several major issues undecided in what will likely be his last months in the post.

When Gates agreed to stay on as defense secretary under President Barack Obama, he told *Aviation Week* he intended to work on improving business practices, including acquisition reform, at the Pentagon (*AW&ST* Jan. 5, 2009, p. 44). While he may have put a hearty dent in the surface, only time will tell if his push can be sustained by a successor, or if Congress will dismantle his so-called efficiencies initiative in the name of bringing work to their home districts amid high unemployment rates.

In the Fiscal 2012 request—totaling \$671 million—Gates continues to make a mark on the tactical aircraft (tacair) and intelligence, surveillance and reconnaissance fleets for the three U.S. services. His decision to shift \$4.6 billion from the Lockheed Martin F-35 procurement account to development to allow for 1,800 more flight-test sorties and two years of probation on the F-35B short-takeoff-and-vertical-landing (Stovl) version dominates the changes he's proposing. This is forcing the Marine Corps to look at alternatives in the event Stovl is eventually terminated, acknowledges USMC Gen. James Cartwright, vice chairman of the Joint Chiefs of Staff. And the slip is also funneling additional work to Boeing's F/A-18E/F production line in St. Louis as the Navy buys more Super Hornets to plug the gap. In addition, the Air Force has set aside a modest sum—\$25 million—to study how and whether to extend the lives of its Lockheed Martin F-16s to avoid a fighter shortfall.

Within the request, there are also more subtle shifts that could be a foundation for years to come. Among them is a commitment—though lacking a publicly announced plan—to spend

the lion's share of a \$3.7 billion request from fiscal 2012-16 on a new long-range bomber. It would be nuclear-capable, optionally manned and able to penetrate sophisticated air defenses, Gates says. Two years ago, he put the brakes on the effort; many Pentagon officials felt the Air Force's appetite for bomber capability outstripped its ability to pay for the design. If Gates has made his mark, the bomber will be affordable and purchased in quantity, but it's unlikely Gates will be around long enough to enforce this vision from a seat of power.

Pentagon comptroller Robert Hale says

or downselect. Maj. Gen. Alfred Flowers, the Air Force's deputy assistant secretary for budget, notes that many details will be sorted out only in a classified setting.

Boeing, Lockheed Martin and Northrop Grumman are all expected to propose concepts for the work, and the program will likely reinvigorate hungry stealth-design teams. Boeing and Lockheed Martin had linked up for studies but discontinued the relationship last year to pursue bids independently.

Although Gates says he prefers an optionally manned design, his hopes may be dashed as soon as he exits office, pre-



NORTHROP GRUMMAN

In an effort to save more than \$400 million through 2016, the Air Force is proposing to halve its buy of Global Hawk Block 40 aircraft, which are equipped to carry a new AESA radar under the fuselage.

that a few short years ago the bomber "was all things to all people" and it would have relied on technologies that have yet to be proven. The strategy now is to leverage existing technologies to allow for the purchase of 80-100 aircraft, the first of which would be operational in the mid-2020s (earlier plans called for 2018). Roughly \$197 million is set aside for fiscal 2012, and Air Force officials have yet to say when there will be a competition

sumably this year. There is strong opposition in the Air Force to fielding a platform that can be operated remotely and deploy nuclear weapons; many service officials believe that an onboard pilot is required for this mission.

Included in the so-called Long-Range Strike family of systems is continued work on the Minuteman III ICBM life extension to 2030 and the Navy's Trident II submarine-launched missile.

U.S. BUDGET

The bomber, however, is the centerpiece.

What the Air Force should do for the future of its ground surveillance, or GMTI, fleet is one issue Gates will probably leave undecided. The service plans to sacrifice \$428 million from its fiscal 2012-16 budget by truncating the Global Hawk Block 40 program. It intended to put an active, electronically scanned array (AESA) radar on the high-flying unmanned aerial system (UAS) to collect data on moving targets on the ground and in the air. The Northrop Grumman/Raytheon AESA also can take highly accurate synthetic-aperture radar images through weather and dust.

Service officials originally planned to buy 22 of the Block 40 aircraft; the Air Force now plans to acquire 11, says Marilyn Thomas, Air Force budget deputy. This cut will undoubtedly drive up the per-unit cost. It's still unclear whether this will trigger yet another breach of program cost limits in the Nunn-McCurdy statute.

The Air Force is in the midst of a sweeping study on a ground surveillance architecture; the results are not expected until later this year, and at that time decisions could be made on whether to reinstate some of the Global Hawks, shift to other collection platforms or take risk in this area.

The fiscal 2012 budget asks for three Global Hawk Block 30 aircraft at \$485 million and continues Air Force research at \$423.5 million, with another \$549 million requested for the Navy's Broad Area Maritime Surveillance (BAMS) version.

Before his departure, Gates will continue to pressure the services to field more intelligence-collection aircraft, despite the Air Force's Global Hawk decision.

The fiscal 2012 proposal also boosts production of Air Force Reaper UAS at General Atomics to 48 per year plus 36 Gray Eagle variants annually for the Army, the maximum rate the factory can handle. The Air Force request is for nearly \$1.1 billion, while the Army is seeking \$806 million.

In addition, the Army is boosting its plans to buy the Enhanced Medium-Altitude Reconnaissance Surveillance System, based on the King Air 350ER (MC-12) airframe, to 18 from 12. Boeing was awarded the contract for development, but losing bidders L-3 Communications, Lockheed Martin/Sierra Nevada and Northrop Grumman protested. A decision on their claims is expected next month.

The Navy, meanwhile, is working to field UAS for a variety of missions, including accelerating plans for a long-endurance, carrier-based intelligence and strike system. The service proposes to kick off its Unmanned Carrier-Launched Airborne Surveillance and Strike (Uclass) program a year yearly.

"Uclass was a [fiscal 2013] program, but efficiency dollars brought it into 2012 so we can get a squadron of aircraft on a carrier in 2018," says Rear Adm. Joseph Mulloy, deputy assistant secretary of the Navy for budget. The Navy is requesting \$121 million in fiscal 2012 to begin the Uclass program. The service also is seeking \$198 million to continue the Naval Unmanned Combat Air System project to demonstrate technology for Uclass.

Funding is also set aside for expanding the Pentagon's budding fleet of small UAS.

The Army plans to buy 1,272 Aero-Vironment RQ-11 Ravens in fiscal 2012, while the Navy intends to begin procurement of Insitu Integrator small tactical unmanned aircraft with eight systems in fiscal 2012 and 20 through fiscal 2016.

Though the budget pushes ahead with unmanned technologies, it fails to clarify Air Force plans to buy a replacement for the T-38 high-performance trainer, dubbed the T-X. Flowers says

about \$307 million is outlined across the future-years defense plan for T-X. Funding begins in fiscal 2012 based on the request, but there are no procurement quantities listed. Alenia, BAE Systems and Lockheed Martin/Korea Aerospace Industries are all readying existing designs in anticipation of a competition.

Finally, the Air Force is asking for \$877.1 million to develop a KC-135 replacement. A downselect between Boeing and EADS is expected as soon as this week.

These plans are contingent, however, upon a yet-to-be approved fiscal 2011 budget from Congress; the government has been operating at 2010 levels since the new fiscal year started in October. This has caused major hiccups for the services in funding operations, including flying hours and military construction projects. And it has also stunted their ability to contract for new equipment because so-called new starts do not receive funding when a budget extension is supporting government operations.

One example is a project to buy AESA radars for Boeing F-15 fighters, Flowers says. If the funding is not provided, the service could be forced to ground F-15s owing to parts obsolescence in the old, mechanically-steered radar and a lack of guidance from Congress on buying new ones. ☼

Familiar Terrain

A lack of 2011 funding overshadows the proposed 2012 military budget

MICHAEL BRUNO/WASHINGTON



Even as the Pentagon's proposed fiscal 2012 budget outlines a new era of austerity that pales in comparison to the robust growth rates of the last decade, concern is building around deeper, de facto cuts that would result from Congress's inability to appropriate new funds for the current fiscal year.

"I want to make clear that we face a crisis on our doorstep if the Department of Defense ends up with a year-long continuing resolution or a significant funding cut for fiscal 2011," Defense Secre-

tary Robert Gates declared last week.

The 2012 request landed on Capitol Hill just as the new, fiscally conservative House of Representatives began debating another extension of fiscal 2010 spending levels through such a "continuing resolution" to keep the federal government operating.

Fiscal 2011 started on Oct. 1, 2010, but Congress has relied on budget extensions through at least March 4 and is likely to prolong 2010 funding levels further, possibly through the entire fiscal 2011, which ends Sept. 30. Since Gates previewed the 2012 request on Jan. 6, immediate commentary and

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reaction to the budget rollout around Washington had less to do with the new plan than with the fact that a full-year budget extension could amount to a sudden cut of at least \$23 billion in baseline defense spending.

"Operating under a year-long continuing resolution or substantially reduced funding—with the severe shortfalls that entails—would damage procurement and research programs, causing delays, rising costs, no new program starts and serious disruptions in the production of some of our most high-demand assets, such as unmanned aerial vehicles," Gates explained to the House Armed Services Committee.

Likewise throughout the week, including at Aviation Week's Aerospace and Defense Technology and Requirements conference on Feb. 16, the chief financial officer of the Pentagon said the budget extensions were already having an impact. For instance, the Army has instituted a temporary hiring freeze, and progress on the Ground Combat Vehicle and the Air Force's KC-X aerial refueling tanker program may require laborious special requests to Congress if a budget extension is in place. Elsewhere, defense bases have slowed contracting or are issuing awards on an inefficient, one- to two-month basis. "Bad things will occur with a [longer continuing resolution]," warned Pentagon comptroller Robert Hale.

Indeed, deeper cuts likely would fall most heavily on operations and maintenance accounts within the Pentagon, which are traditionally the short-term bill-payers of choice. "Cuts in maintenance could force parts of our aircraft fleet to be grounded and delay needed facilities improvements," Gates says. "Cuts in operations would mean fewer flying hours, fewer steaming days and cutbacks in training for home-stationed forces—all of which directly impacts readiness."

On that note, Gates says the Pentagon needs at least \$540 billion for the current fiscal year for the U.S. military to properly carry out its missions, including warfighting; maintain readiness; and prepare its forces for the future.

The 2012 base budget asks for \$553 billion, as well as an off-book overseas contingency operations request of \$117.8 billion for the wars in Iraq, Afghanistan and military missions elsewhere (see graphs).

"There is not a lot new in the brief on program specifics—at least nothing

Supplemental Fiscal 2012 Defense Request by Category
(U.S. \$ Billions)

Operations	\$ 66.6
Force Protection	7.5
IED Defeat	2.6
Military Intelligence	6.0
Afghan National Security Forces	12.8
Afghan Infrastructure	0.5
Coalition Support	2.2
CERP*	0.4
Temporary Army End Strength	1.9
CONTINUING THE FIGHT	\$ 100.4
Equipment Reset	11.9
Non-DoD Classified	\$ 5.5
TOTAL	\$ 117.8



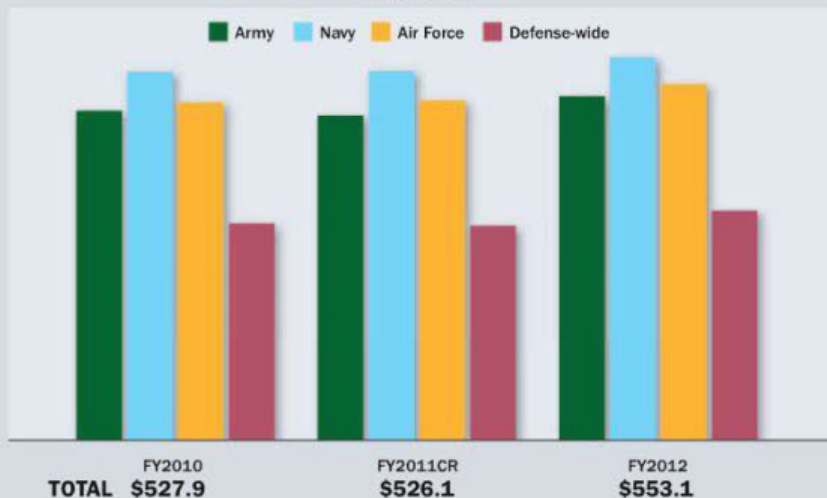
For overseas contingency operations, including Iraq and Afghanistan.

*Commander's Emergency Response Program

Source: U.S. Defense Department

Baseline Pentagon Budgets, Fiscal 2010-12

(U.S. \$ Billions)



Fiscal 2011 figures represent continuing resolution (CR) funding, not administration's request

Source: U.S. Defense Department

that should cause investors and analysts to adjust their earnings estimates for 2011-13," declare analysts at Capital Alpha Partners.

Procurement and overall research would be funded at roughly \$113 billion and \$75.3 billion, respectively. "We are encouraged that the fiscal 2012 Defense Department budget request for procurement and research and development reflects a slight increase from last year's request," said the Aerospace Industries Association (AIA). At 34% of the total budget, the so-called investment accounts come close to reaching the 35% marker AIA has advocated to ensure a healthy industrial base.

"As we look at the overall budget, with most of the near-term program detail available, there are no major shocks

to the system," Jefferies & Co. analysts agreed. Many contractors already were adjusting their production and overhead base to be more productive, lower costs or be more competitive.

"Despite the tsunami of information that is usual on defense budget day, we are struck by how much was in-line with expectations," says defense finance analyst Robert Stallard of RBC Capital Markets. "Similar to our views, it is clear that the [Defense Department] is putting more emphasis on selling the story to Congress, with the consistent mantra of 'pass a fiscal '11 budget.'" ☺

For details on the 2011 and 2012 budgets for dozens of defense programs, go to:

AviationWeek.com/extra

Space Boost

Defense budget request for space emphasizes a procurement/policy synergy

AMY BUTLER/WASHINGTON



The Pentagon's first National Security Space Strategy and its recently released budget request for space are attempting to prioritize procurement and

operations after a decade of problematic performance. But work still needs to be done.

The Air Force's unclassified space budget saw a nearly 10% boost in fiscal 2012—to \$8.7 billion—from the \$8 billion request in fiscal 2011. A portion of this is intended to increase and stabilize the buy of Evolved Expendable Launch Vehicles (EELV) as the government assumes the role of sole supporter of the United Launch Alliance and its massive industrial base in light of an unrealized commercial market.

Even with the boost in funding, Vice Chairman of the Joint Chiefs of Staff Gen. James Cartwright says that the projects now scheduled are impossible to execute within the current planning figures. This, he says, underscores the need to work with international partners in areas such as space situational awareness, communications and, perhaps, shared missile warning. "We still can't afford most of the constellations we have up there. . . . At some point you have to come to a position of partnering" to share the financial burden, Cartwright said last week. "We have this construct where we believe everything has got to come from us . . . but we fight in combined constructs" on the ground, at sea and in the air. He advocates for trust with partners to also provide key pieces of space capabilities—such as augmented intelligence collection and, possibly, precision navigation and timing signals.

He stopped short, however, of suggesting that the Pentagon could curtail its buy of Global Positioning System III satellites, being developed by Lockheed Martin; this request is for \$978 million in development and procurement.

Perhaps underscoring the fact that Pentagon leadership still lacks a unified view on this subject, Deputy Defense Sec-

retary William Lynn notes that some missions will continue to be handled solely by the U.S., though the "goal is to move away from the world where the U.S. develops unilateral strategy." Thus, his focus appears to be more on collaboration rather than interdependence.

Another initiative in the National Se-



If Air Force plans are approved by Congress, the Pentagon will commit to buying five EELVs annually from the United Launch Alliance.

BEN COOPER/AW&ST FILE PHOTO

curity Space Strategy is to improve support for the space industrial base, which experts worry has atrophied since the end of the Cold War. Lynn says the U.S. is still the top provider of space capabilities, but that its share of the market is waning. Previously, the U.S. comprised about 66% of the space market; that figure is now less than 40%.

The Air Force's approach for military space spending is to buy smarter, beginning with more stable and predictable funding. Gone are the days when the Air Force would simply put a "wedge" of funding into the budget for a program without fully understanding the out-year financial impact. "We need to fully fund programs," says Maj. Gen. John Hyten,

space program director for the Air Force acquisition office. "We don't want to just put numbers in the budget."

Included in the fiscal 2012 budget request is a new strategy to procure satellites, the Evolutionary Acquisition for Space Efficiency (EASE) buy of Advanced, Extremely High-Frequency (AEHF) and Space-Based Infrared System (Sbirs) satellites, both produced at Lockheed Martin's Sunnyvale, Calif., facility. The three-pronged EASE strategy includes stable funding for a block buy of two of each satellite type; parallel funding provided separately for continued product improvement and research work (including competitive projects) for the next-generation upgrades or designs; and parallel work on the mission area's architecture.

Implementation of the procurement portion of EASE is fashioned somewhat after multi-year buys for aircraft. The goal is to incrementally fund buys of two satellites at a time to keep a stable stream of income for the prime contractor and its base of subcontractors, all of which lead to some savings. As with aircraft procurements, the goal is to achieve at least 10% savings in the cost of the satellites, but Hyten believes they can get even lower than that. "You take the savings that you find in terms of lower cost on the satellite and reinvest them through a capabilities improvement program," says Erin Conaton, undersecretary of the Air Force.

The Air Force would traditionally spend about \$4 billion buying AEHF 5 and 6, Hyten says. In fiscal 2012, it is requesting \$550 million as an initial payment for these two satellites; additional funding would be requested up through fiscal 2017 to complete the buys.

The Sbirs block buy would follow, beginning in fiscal 2013. The request related to EASE in fiscal 2012 is for \$185 million. A major chunk, \$550 million, would be requested in fiscal 2013 with five more years of additional funding to complete the buy.

Though multi-year funding has become a regular practice for military aircraft production, lawmakers might eye an incremental satellite funding strategy with more skepticism. The Air Force lacks examples of satellite programs delivering on

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time and cost, and lawmakers are leery of obligating future funds for projects. "This is asking Congress to do business in a different way," Hyten says.

Conaton says AEHF and Sbirs were both at key points in their production cycles, allowing for them to serve as the pathfinders for EASE. However, Congress is expected to review this request this summer, well before the Pentagon has a chance to demonstrate the capabilities of the first AEHF and Sbirs satellites produced with development funding.

Officials say that if the EASE concept is accepted by Congress, they plan to implement the strategy for other programs, including Boeing's Wideband Global Satcom and Lockheed Martin's GPS III.

Though the budget assumes additional buys of Sbirs satellites, Hyten says the Air Force will continue work on a request for information that aims to explore other options for the ballistic missile warning and other key missions handled by Sbirs. Launch for Sbirs geosynchronous orbit (GEO) satellite 1 is now set for May 4, Hyten says, noting that the slight slip from the April 30 plan is due to a pad-scheduling conflict, not a problem with the satellite.

Negotiations with Lockheed Martin on pricing for these two buys are ongoing. On the roster are potential financial penalties resulting from the company's introduction of foreign object debris in a propulsion system line of AEHF-1; this prevented the satellite's liquid apogee engine from functioning and prompted a 10-month delay in service with the protected communications satellite.

This was a "very serious error" in Lockheed's production process, says Richard McKinney, deputy undersecretary of the Air Force for space programs. Conaton says the service is "lucky this thing did not have a catastrophic failure." Orbit raising is slowing moving forward with the use of electric Hall Current Thrusters.

Meanwhile, the Pentagon's buy of EELVs will be five annually; the National Reconnaissance Office also plans in fiscal 2012 to buy three launchers from United Launch Alliance. This is intended to help stabilize the buy, but the cost of Delta IVs and Atlas Vs is going up because the commercial market that would have helped shoulder the burden of the industrial base has evaporated.

Conaton says the Air Force is conducting a should-cost review on EELV; this would include the purchase of the rockets as well as the billions required to fund

launch services, including the teams that maintain and operate the variants.

One budding mission area that could add work for the industrial base is that of space situational awareness, or sensors needed to monitor the objects—from paint chips to satellites—orbiting Earth. The White House space policy from last year and the Pentagon's new space strategy emphasize the need to have better data on what items are in space, especially as the number of operators and space objects continues to increase.

The Air Force's fiscal 2012 request lacks funding for a follow-on program to the Boeing/Ball-team Space-Based Space Surveillance (SBSS) satellite, launched last year. Though the contracted amount for this two-axis gimbaled visible-light-sensor spacecraft was estimated at \$823

million, Hyten says the total came to just over \$1 billion, prompting the service to reconsider how it will accomplish this mission in the future.

Architecture studies are under way to examine alternatives to fielding high-cost satellites, Cartwright tells Aviation Week.

Raytheon and Lockheed Martin continue working on the Space Fence ground-based radar system under competing, \$170 million design contracts. However, the failure of Congress to approve a fiscal 2011 budget request has prevented the Air Force from obligating more than \$69 million to those efforts, total. Hyten says that without additional funding soon, deployment of the first radar site, likely in Australia, could slip from its fiscal 2015 date. ☐

Damage Control

U.S. balking on Meads buy, but eager to go ahead with SM-3-based European misdef

AMY BUTLER/WASHINGTON



After years of struggling with how to proceed with the Medium Extended Air Defense System (Meas) with Italy and Germany, the Pentagon has finally cut its losses at \$4 billion for development and canceled plans to deploy the system.

The idea now is to "harvest" technology from this Lockheed Martin-led development while also providing its partners with the opportunity to do the same or, potentially, to buy components of the air and missile defense program once a proof-of-concept effort is complete.

Meads was designed to provide a "plug-and-play" area missile defense system with an advanced, 360-deg. radar and a new interceptor, which improves on the current air defense systems fielded in Europe via better range and target detection. Part of the promise of Meads was for a mobile system that could be transported and deployed faster than today's "relocatable" systems.

The requirement for a high degree of mobility, however, has waned, Vice Chairman of the Joint Chiefs of Staff U.S. Marine Corps Gen. James Cart-

wright tells Aviation Week. "Relocatable seems to be good enough," he says, noting that some technology from Meads has already been infused into the PAC-3 upgrade efforts and the U.S. Terminal High-Altitude Area Defense (Thaad) project, also led by Lockheed Martin.

The Pentagon considered terminating the program, owing to at least a four-year delay in production from 2014 to 2018 and the need for up to \$1.16 billion to continue the effort as planned. Originally, in the mid-1990s, Meads production was slated to begin in 2007; in 2004, planners envisioned production starting in 2014.

The decision was made, however, to honor the financial commitment in the multinational memorandum of understanding (MOU) to avoid high termination costs. The goal now is to simply conduct a "proof of concept" effort, which will end in 2014. The Pentagon has about \$804 million more to contribute, based on the MOU. "Terminating the program now . . . would force the nations to devote significant funding to contractor termination costs instead of using this funding to bring Meads development to a viable level of maturity," according to

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a Defense Dept. white paper. Also, the Pentagon cannot afford to simultaneously fund Meads and upgrade its Patriot system. Because of the projected delay, "the U.S. Army would not be able to purchase Meads to replace Patriot as early as originally planned," the white paper states. "The cost of complementing Meads development and procuring Meads to eventually replace Patriot would also require a significant concurrent investment."

Lockheed Martin has been lobbying hard to keep the program alive. Mike Trotsky, vice president of air and missile defense programs, said in December: "The Meads team also submitted a life-cycle cost estimate which showed that the system could be acquired and maintained within previous estimates." The estimate also showed that "Meads

due to cost. Support from the partners, particularly Germany, has also been in question owing to the global recession and subsequent lessening of funds for defense. It is unclear whether the partners will be able to bear the burden of paying for procurement of the system. However, components—such as the German-led 360-deg. radar—could be attractive options for a future architecture.

Meanwhile, the U.S. Missile Defense Agency (MDA) is requesting \$8.6 billion in fiscal 2011, just a bit more than the \$8.4 billion requested in fiscal 2010, to continue developing and fielding area, medium- and long-range defenses.

This budget reflects about \$2.4 billion that was removed from the MDA's profile from fiscal 2012-16 as the Pentagon trimmed its overall topline.

Aegis fire-control system and SM-3 family of kinetic killers. With procurement of SM-3 Block IA interceptors coming to a close, the MDA is proposing to buy 46 Raytheon-made Block IBs. These will add an improved divert-and-attitude-control system as well as an improved discrimination sensor.

MDA also hopes to conduct its first Aegis Ashore test in fiscal 2012 to demonstrate the Aegis/SM-3 ship-based capability on land, meant to help guard Europe from an attack originating in or near Iran.

Hendrickson says the Pentagon plans to be ready to field the SM-3 Block IIA starting in 2018, a timeline some in industry consider to be ambitious. The IIA will feature a 21-in. booster (over the 14-in. design in the IA and IB). Japan is developing the second- and third-stage motors as well as the nosecone. However, MDA Director Lt. Gen. Patrick O'Reilly told Japanese defense officials the U.S. is preparing to solely produce the missile if Tokyo cannot quickly sign up to a production plan. In a Jan. 3 letter, O'Reilly was trying to ensure that the Japanese realize the "need to start . . . so we don't get too far down the road and not be able to recover," Hendrickson says.

MDA is also continuing to fund risk-reduction for the SM-3 IIB effort, which aims to field an ICMB killer as soon as 2020, agency officials say. Three industry teams—Lockheed Martin, Northrop Grumman and Raytheon—are exploring concepts. Hendrickson says that "product development" is expected in 2013. This program is receiving more funds, redirected from other projects, to try to meet the deployment date.

Several projects begun in the last couple of years are continuing, including vetting unmanned aerial systems (UAS) for the boost and mid-course tracking role and fielding satellites to aid in midcourse tracking.

MDA, via the Airborne Infrared (ABIR) program, intends to continue experimenting with a Predator/Reaper UAS equipped with a Raytheon MTS-B electro-optical sensor for tracking missiles early in flight. Hendrickson says the goal is to eventually field a multi-waveband MTS-C, which could better track cold bodies once the warhead separates from the booster. Though the Pentagon requested \$111.7 million for ABIR in fiscal 2011, the request drops to about \$46.9 million in fiscal 2012 and hovers around \$50 million for the next two years, based on the MDA's proposal. ☐



The Meads system was designed to provide 360-deg. radar coverage in the X- and UHF-bands.

acquisition costs were competitive with current air and missile defense systems."

Lockheed officials contend that they have met the goals laid out for Meads. "Since the Design and Development program began in September 2004, the Meads program has met all major milestones and will leverage its recent successes to complete development and prove this system's capabilities," according to a Lockheed Martin statement. Company officials note that Meads completed a critical design review. The first Meads battle manager and launcher have moved to the test range in Italy to initiate system tests. The first multifunction fire control radar recently completed rotation testing and will soon join the battle manager and launcher, the company statement says.

Last year, the Army, which leads the U.S. portion, pushed to kill the effort

Though another Ground-Based Mid-course Defense (GMD) test is slated, the timing is dependent on the findings of a review board, which is investigating the failure of the last Ground-Based Interceptor (GBI) flight-test attempt in December. The last successful GMD intercept took place in December 2008.

In the fiscal 2012 budget, the Pentagon plans to complete procuring six GBIs and initiate a buy of five more, says Rear Adm. Randall Hendrickson, deputy MDA director. They also hope to bolster the GMD system by beginning the upgrade of the early warning radar at Clear AFB, Alaska.

But it's the Phased Adaptive Approach that is garnering perhaps the most attention for MDA's budget. This four-pronged strategy is intended to incrementally field more capable sensors and interceptors to gradually improve defenses around Europe using an architecture based on the

Privatizing Spaceflight

NASA plans under way to merge Soyuz, commercial missions

FRANK MORRING, JR./WASHINGTON



Top NASA managers are preparing for the day when foreign governments and private businesses help defray the cost of U.S. space operations through the purchase of transportation and accommodation on U.S. commercial human spaceflight assets in low Earth orbit.

The space agency's \$18.7 billion fiscal 2012 budget request continues the Obama administration's effort to refocus U.S. government civil space beyond LEO. Unlike Russia, which uses cash from the U.S. purchase of Soyuz seats to help finance its space operations, NASA hopes a private infrastructure in LEO will relieve it of some of the cost of developing and operating spacecraft.

Even though Congress has yet to provide any funds for NASA under last year's fiscal 2011 request, which initiated the historic policy shift, agency planners are at work figuring out how to bring commercial cargo and crew vehicles into U.S. spaceflight operations, starting with the International Space Station.

"We want to facilitate the development of a U.S. commercial crew space transportation capability with the goal of achieving safe, reliable and cost-effective access to and from LEO and the ISS," says Phil McAlister, acting director for commercial spaceflight at NASA headquarters.

McAlister was executive director of the presidential commission headed by former Lockheed Martin CEO Norman Augustine that found the Constellation

program of government-run human-spaceflight vehicle developments fiscally "unsustainable" (AW&ST Sept. 7, 2009, p. 26). He expects to oversee the planning for and transition to commercial human spaceflight at NASA once Congress gives the final OK to proceed by appropriating funds for the task. McAlister says his "objective statement" was carefully worded to reflect a dramatic change in the way human spaceflight is conducted.

"When that is your objective, then a whole bunch of other things fall out," he said. "We want the partners to take more responsibility for the design, development and eventually ownership of these systems, because we want them to have the capability to sell these services to other customers. That's in NASA's interest, because it reduces our per-seat cost [and] it's in the nation's interest because it helps the industrial base."

McAlister, who has studied private spaceflight markets as director of Futron Corp.'s space and telecommunications industry analysis division, says the space agency wants to give vendors working on commercial crew capability as much flexibility as possible. NASA has not asked for proposals for end-to-end crew ser-

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U.S. BUDGET

vices to and from the ISS. But it expects to begin using commercial cargo services developed under the \$500 million Commercial Orbital Transportation Services (COTS) seed-money program to resupply the station in the next year or two.

The agency has signed \$3.5 billion in Commercial Resupply Services agreements with COTS developers Space Exploration Technologies Inc. (SpaceX) and Orbital Sciences Corp. (OSC). For commercial crew, the idea, still taking shape, is for NASA to have its own requirements for human transportation to the ISS but allow private developers of crew vehicles to design their spacecraft to meet the re-

quirements of other customers as well. Similarly, for commercial crew, NASA's savings will come both from the shared cost of developing the vehicles and from the operators using them to service other orbital customers in addition to NASA.

In the relatively near term, such an operator is likely to mean Robert Bigelow, the Las Vegas-based entrepreneur who has spent almost \$200 million developing inflatable orbital habitats that he plans to lease to industry and countries that cannot afford to build their own human spaceflight hardware.

Now that the ISS is essentially complete, NASA managers are looking at it as

spend as much as \$250 million on the second phase of the Commercial Crew Development (CCDEV-2) effort to encourage development of technologies that can support commercial crew vehicles.

McAlister says NASA will try to follow the COTS model wherever possible as it moves deeper into commercial crew, beginning with a third round of CCDEV work in fiscal 2012. Gerstenmaier says NASA could be using the two COTS vehicles—the SpaceX Dragon and OSC Cygnus capsules—to supply the station before the end of fiscal 2012.

For station operations, a lot will depend on whether NASA is able to fly the planned but as-yet-unfunded STS-135 mission with one last payload bay full of supplies. That mission will buy the COTS players about a year of slack in case they cannot deliver resupply flights as planned. If the shuttle does not make that third and final flight, and the COTS vehicles are late, Gerstenmaier says there may be a reduction in station utilization activities or even crew size because of supply shortfalls in orbit.

The COTS demonstration flights will carry low-value cargo, but once the vehicles are declared operational, they will be slotted into the supply picture just like the European ATV (see p. 14) and Japan's HTV cargo carriers, Gerstenmaier says. Similarly, commercial crew vehicles will overlap with the Russian Soyuz flights as the transition goes forward, he says.

Eventually, McAlister says, they will also overlap with flights that NASA does not buy, lowering the cost to orbit for all.

"Historically, we have seen space tourists pay to go to low Earth orbit," McAlister says. "That market . . . has existed since 2001. Flying other countries' astronauts to and from low Earth orbit also is a service that's been provided by both Russia and the U.S. since 1978. So . . . there is demand, other than from NASA, to launch people to low Earth orbit."

Other topline figures in the new NASA budget request are \$5.017 billion for science; \$2.810 billion for the heavy-lift Space Launch System and Orion-based Multi-Purpose Crew Vehicle (AW&ST Jan. 17, p. 18); \$569 million for aeronautics; \$1.024 billion for space-technology development; \$4.347 billion to fly out the shuttle and operate the ISS; \$138 million for education; and \$3.192 billion for cross-agency support. The request includes \$548 million to cover an unfunded liability in the pension fund for shuttle support workers employed by United Space Alliance. ☐

NASA Administrator Charles Bolden (left) and Stennis Space Center Director Patrick Scheuermann watch a test of the AJ26 engine that is to power the Taurus 2 commercial launch vehicle. The new A3 high-altitude test stand built for the Constellation program overlooks the scene.



NASA/DANNY NOWLIN

quirements of other customers as well.

As an example, McAlister says NASA may not require spacesuits if the operator can demonstrate that a commercial crew vehicle is safe without them, a notion that has raised hackles in the astronaut corps. NASA will certify whether a vehicle is safe for its own astronauts and is working with the FAA commercial space office that licenses commercial spaceflight to divide certification responsibilities.

Still to be determined is whether the agency wants a "taxi" approach, with a private crew piloting its astronauts to the station, or a "rental car" vehicle that NASA pilots would fly and keep docked as lifeboats while on the ISS.

McAlister points out that if the COTS effort works out as planned—and the signs are hopeful—NASA will have obtained two ISS resupply systems to replace space shuttle cargo deliveries for about \$1 billion instead of the \$8-10 billion

an incubator for private industry in LEO and a place to prepare for a leap deeper into the Solar System. William Gerstenmaier, the associate administrator for space operations, says the station could even be a good place to check out the suitability of Bigelow's inflatables for human occupancy, both for orbital operations and for future deep-space exploration.

In addition to valuable stowage for the station, he says, "I look at it as kind of a technology demonstrator for us, where we can take the things that Bigelow's already proved with his Genesis spacecraft and take them into the manned realm of station and see if there's anything we need to learn before we start committing this type of technology to broader and bolder exploration activities."

NASA's new budget request starts with the agency's fiscal 2010 topline figure under the short-term appropriations resolution funding the government. For the current fiscal year, NASA plans to

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AEROSPACE BUSINESS

Coming to Grips



Thales, BAE Systems, Saab turn up focus on operating performance as growth stalls

MICHAEL A. TAVERNA/PARIS and ROBERT WALL/LONDON

Facing a flat sales outlook and bleak budget environment, European defense companies are looking to streamlined operations and targeted acquisitions to help sustain profitability.

The hardest hit is Thales, which even before it started to run into headwinds a year ago—the result of serious program and bidding management issues—was already trailing behind its peers in profitability. In preliminary results posted last week, the Paris-based aerospace and defense contractor reported it was forced to take another €700 million (\$952 million) in provisions for program overruns, after a €240 million write-down in 2009.

The additional charges—which were larger than expected—forced the company into a €100 million operating loss and had analysts predicting it will finish the year with a second straight net loss when final results are issued this week. The company had initially anticipated a 3-4% margin of earnings before interest and taxes to revenues last year after posting an EBIT of €151 million in 2009.

Revenues grew a scant 2% last year and are anticipated to rise only slightly in 2011-12, reflecting the likelihood of reduced defense spending, and orders are expected to grow apace.

Nevertheless, Chairman/CEO Luc Vigneron put a positive spin on things, saying the company has finally “come to grips” with program difficulties, restructuring a ticketing program in Denmark and introducing new management practices in troubled avion-

ics and security projects. Technical execution conditions on the Airbus Military A400M airlifter and the Turkish Meltem patrol aircraft—the two biggest worries—have been stabilized and visibility on execution “significantly enhanced,” he says, though talks on both programs continue.

Vigneron expects the EBIT margin to rebound to 5% this year and 6% in 2012, buoyed by €1.3 billion in cost savings, an improving cash position and an unexpected surge in new business. Orders amounted to €13.1 billion last year—less than 2009 but equal to revenues—as an expected dropoff in defense business was offset by an upturn in commercial aircraft and buoyant transport and space activity. The company had expected orders to come in well below sales levels.

However, new problems with Thales's big Watchkeeper unmanned aerial system (UAS) project in the U.K. suggest the company may not be out of the woods yet. The initial Watchkeepers were due to be ready for fielding this month. But an official familiar with the 54-unit project tells Aviation Week that the date will slip by an as-yet undetermined amount. The exact cause for the new delay—the UAS had been expected to deploy last year—was not immediately known, and Thales is now re-evaluating the project to find out. The British Defense Ministry expects to follow with its own review in a few weeks, at which time a new schedule and potential cost implications could emerge.

BAE Systems, for its part, is forecast-

ing a drop in sales—notably in its land and armaments business—in 2011 as a result of defense cuts in the U.K. and the U.S. Revenues grew just 2% to £22.4 billion (\$36.2 billion) last year, and the order book plunged to £39.7 billion, from £46.3 billion 12 months earlier.

Nevertheless, BAE expects to mitigate the lower volume of activity with

One of Thales's flagship U.K. programs, the Watchkeeper tactical long-endurance system, will miss its targeted in-service date.

continued cost reductions and by re-basing the land business, which will be a strong priority this year. BAE has had its own share of program performance issues that forced it to take almost £1 billion in impairment charges in 2009.

Actions already taken enabled operating profit to climb to £1.6 billion in 2010, from £966 million the year before. However, underlying earnings before interest, taxes and amortization was flat at £2.32 billion after a £100 million impairment from termination of a Trinidad and Tobago ship contract.

BAE Chief Executive Ian King says the company will continue to consider acquisitions to spur growth, particularly in services and high-technology electronics and electro-optic systems. BAE made several purchases in these areas last year, including Atlantic Marine Holding Co., a naval service business.

Saab, too, is looking for external growth opportunities. North America, the U.K., Brazil, India and Thailand are the main targets, CEO Hakan Bushke said in reporting the Swedish company's 2010 results. But Bushke noted there also will be a technology focus to the company's evolution, along the lines of the acquisition early this month of Czech E-Com, a business active in the training and simulation market.

Saab is counting on future acquisitions and stronger-than-anticipated orders—bookings grew 43% to 26 billion Swedish kronor (\$4 million) last year—to help spur a resumption of sales growth, to 5% per year. Revenues dropped 1% to 24.4 billion kronor last year and are expected to decline slightly once again in 2011, reflecting lower bookings in previous years.

Net income fell last year to 454 million kronor, from 699 million kronor the year prior, reflecting high restructuring costs. However, Saab plans to continue streamlining operations, and the 2011 operating margin should be higher. ☐

AIR TRANSPORT

Moving Forward

Senate close to Reagan Washington National slot compromise in FAA bill

JENNIFER MICHELS/WASHINGTON



As fiscal 2011 FAA reauthorization nears conference consideration by the House and Senate, appropriators are already becoming

mired in disagreements over cuts for fiscal 2012. It is, therefore, a race to keep a stripped down FAA bill free of as many extraneous measures as possible, which could stall it again; the last bill, which expired in 2007, was passed in 2003.

And while there is still a chance Congress will be forced to pass an 18th short-term extension, it seems both the House and Senate are committed to pushing this new reauthorization through conference before the current reauthorization expires on March 31.

Washington Dulles International Airport's latest improvements under AIP include the new aerotrain, completed last January.

Propelling this bill at a rapid pace is the continued reference on Capitol Hill to it being a "jobs bill" that will create 280,000 positions in part by accelerating the satellite-based Next Generation traffic management program and forcing program milestones of NextGen on the FAA to keep it on track. But both versions of the bill also have major implications for airport authorities, foreign repair stations, airlines, technology/navigation service providers and rural air service, not to mention, obviously, FAA programs.

But the biggest breakthrough yet in House and Senate debate was a compromise reached Feb. 17 on allowing more flights and farther destinations from Ronald Reagan Washington National Airport (DCA) under the so-called perimeter rule that was initially crafted to protect

investments to build a second airport in the Dulles area in Northern Virginia.

In the 11th hour of debate on its two-year version of the bill (S.223), a compromise was reached that "makes no one happy, but no one truly unhappy," says Sen. Kay Bailey Hutchison (R-Texas). While this compromise could still become unraveled in conference, the language agreed to would give slots to five airlines not now serving the slot-controlled airport. It also would give carriers with limited service to DCA five new slots

and congestion at DCA. This will need to be squared with the House bill, which allows for the five new entrants but does not have provisions for airlines to convert their slots.

The tide has shifted in Washington away from adding more airline taxes—or those that passengers pay—in favor of cutting grants to airports that cover infrastructure and facility improvements, as airlines are claiming a major victory in both versions of this legislation.

The House bill (H.R.658) keeps the passenger facility charge that airlines collect in tickets for airports at a maximum of \$4.50 for each leg. Airports have strongly urged for that cap to either be raised to \$7, or lifted entirely. Incidentally, airlines, which want to keep the cap low, are paid a small collector's fee, which accounted for \$80 million in additional revenue for them last year. The bill provides \$3.176 billion for the Airport Improvement Program (AIP) in fiscal 2011, and \$3 billion in fiscal 2012-14, which is \$500 million less per year than the current appropriated level.

The Senate, on the other hand, specifically wants to reduce the share for AIP



DENNIS BRACK/LANDOV FILE PHOTO

to be used outside of the 1,250-mi. perimeter and would allow incumbent carriers to exchange seven current flights within the perimeter to go outside of it.

Hutchison noted that there was one point of contention on the bill that the senators agreed to address in conference. It concerns how the additional flights will be allocated among the various airlines. She notes that senators with home states west of St. Louis and Denver wanted 75 new flights and came down to the current 16, four of which will be determined after a study is conducted to ensure that added flights are not disrupting noise

projects at small- or medium-sized airports to 75% from the current 95%, and requires airports that grow from small to medium to pay the full 25% match. The Senate bill makes \$4.1 billion available for AIP. The FAA would receive \$9.6 billion for operations, up from \$9.3 billion in 2010. The overall request for two years of funding for the agency is \$34.5 billion.

The Senate bill is not without tax increases; it would raise the general aviation (GA) jet fuel tax to 35.9 cents per gal. from 21.8 cents. This provision was also included in the FAA bill that the Senate passed last year. It subjects

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fractional ownership aircraft to the GA jet fuel tax of 35.9 cents per gal. and a fuel tax of 14.1 cents per gal., too.

Attention now turns to the House, where the Transportation and Infrastructure Committee favorably approved for full House consideration a version of the bill that not even Chairman John Mica (R-Fla.) is too thrilled about, by a 34-25 vote on Feb. 16. But he insisted last week that "we are not going to an 18th extension." The four-year bill provides \$59.7 billion to the FAA.

The bill surprised organized labor by containing a section to void the National Mediation Board's (NMB) change to 75 years of labor law that went into effect last July after a district court rejected an appeal by the Air Transport Association. The rule change now means that in union representation elections, only votes that are cast are counted. In the past, employees who did not vote were counted as "nays," making it more difficult for unions to get a majority. Rep. Jerry Costello (D-Ill.) says this provision to overturn that new rule in the House bill is a poison pill and that "the bill will not pass the Senate or be signed by the president" if it stays in. He offered an amendment to strike it, but it was defeated by one vote on Feb. 16.

During the committee markup on the bill, it was revealed that Rep. Jean Schmidt (R-Ohio) was responsible for the labor provision being inserted. Schmidt said that the NMB made the rule change with "no consultation or transparency" and that the change was intended to blindside and single out one carrier—Delta Air Lines. However, to date, the rule change has not resulted in any unions winning elections at Delta; in fact, three have failed. The Senate version of this bill contains no such labor provision.

One issue that has risen to the top, somewhat oddly because of the little amount of money it will save, is killing the Essential Air Service Program (EAS) that guarantees service to communities that are hours away by car from airports. The program currently receives about \$200 million annually.

Rep. Bill Shuster (R-Pa.) was planning to offer an amendment to continue the EAS program at 2010 levels, instead of drawing down its funds over the next two years and phasing it out by 2013, as the bill envisions. But he agreed to withdraw the amendment after Transportation Committee Chairman Mica asked for more time to "craft something that does the job."

Rep. Peter DeFazio (D-Ore.) noted that in 2013 \$80 million would go to Alaska for EAS as the only exception because while the bill includes Alaska and Hawaii as exceptions, Hawaii currently has no EAS carriers. "I thought we were doing away with earmarks here. If it is about saving money, then zero out the program," he said.

All five of the amendments proposed to the House bill last week were voted down, including two by Rep. Mazie Hirono (D-Hawaii) to aid flight attendants. One would have forced the FAA to work with the Occupational Safety and Health Administration to apply OSHA standards to flight attendants, something that was agreed to in legislation 11 years ago and never implemented by the FAA. The other was to have flight attendants included in flight- and duty-time regulations that cover pilot fatigue.

One issue watched closely by airlines and manufacturers is continued attempts to impose more restrictions on foreign repair stations, but those have so far been held at bay. Rep. Michael Michaud (D-Maine) offered an amendment to require FAA to inspect foreign repair stations no less than twice a year. The provision was defeated by a vote of 32-27. House aviation subcommittee Chairman Rep. Tom Petri (R-Wis.) argued that if this change were added, small repair sta-

tions in the U.S. would go out of business if they had to fly in inspectors from European nations that would want reciprocal rights. He argued for the current "risk-based" system FAA uses to oversee these repair stations.

Rep. Dan Lipinski (D-Ill.) wanted to require drug and alcohol testing for foreign maintenance workers. But that was defeated 34-25 because several members stated that the provision would violate certain bilateral agreements.

The House bill now contains a manager's amendment by the chairman that was not debated. One provision is to encourage the development of "aerotropolis" transportation systems, "which are planned and coordinated multi-modal freight and passenger transportation networks that, as determined by the secretary, provide efficient, cost-effective, sustainable and intermodal connectivity to a defined region of economic significance centered around a major airport."

The manager's amendment also would require the FAA to designate non-exclusionary airspace for integrated manned and unmanned flight operations. The agency would coordinate with NASA and the Defense Department to address both the concerns of commercial aviation and the public that unmanned systems would be used mainly for border protection. These efforts would be coordinated with NextGen efforts. ☐

Airport Alarms

Proposed cuts to Airport Improvement Program send hubs scrambling to save funding

JAMES OTT/CINCINNATI

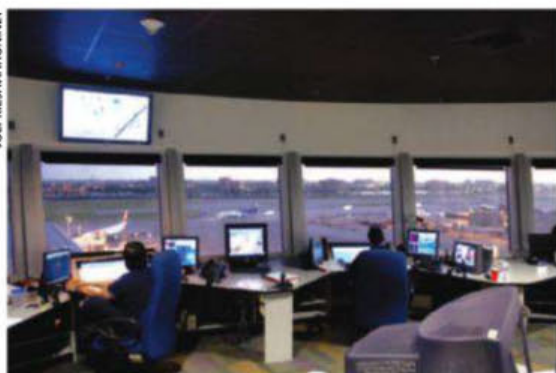


The Obama administration's FAA budget request reduces guaranteed airport grant funding by more than \$1 billion from the current fiscal year, which would leave large and medium-size hubs scrambling to tap other forms of funding.

The fiscal 2012 request cuts Airport Improvement Program (AIP) monies to \$2.4 billion and creates a safety valve in a plan for a stimulus-like \$50 billion "upfront economic boost" for roads, rail-

ways and runways. Under the administration's plan, large and medium hubs left out of the AIP program could apply for grants from the \$3.1 billion AIP share of this "economic boost." The plan also refers to another source of funding—raising the cap on passenger facility charges (PFC) to as high as \$7 per passenger from the current \$4.50.

Airport officials are universally alarmed. Targeting AIP funding is not the solution to U.S. budget problems, says Charles Barclay, president of the American Association of Airport Executives. AIP funds come chiefly from passengers via an airline ticket tax collected to im-



Steep cuts in airport grants will affect medium- and large hubs, such as Miami International.

systems development, and \$26 million for area navigation and required navigation performance.

The facilities and equipment (F&E) budget line falls slightly to \$2.87 billion, down from \$2.94 billion in fiscal 2011.

With funding via the upfront economic boost, the F&E budget increases to \$3.1 billion. For FAA operations, the request includes \$9.82 billion, a boost of \$470 million. The Aviation Trust Fund contribution increases to \$5 billion, up from \$4 billion in fiscal 2011, and the general fund contribution declines.

The FAA workforce would grow to 48,539 full-time equivalent employees from 48,256, and would include 106 new safety inspectors. ☼

prove airports and airways. "Airports need more tools, not fewer," he adds.

Gregory Principato, president of Airports Council International-North America, calls the administration's proposal to raise PFCs "two years too late, most especially because we know that Congress will not include this provision in the FAA bill." The House and Senate versions of the FAA reauthorization bill do not include PFC increases.

The budget request asks for \$15.3 billion in discretionary funding, down nearly \$700 million from fiscal 2010-11 levels. The aviation portion of the upfront economic boost raises the figure to \$18.66 billion, plus \$250 million chiefly for the Next-Generation Air Traffic Control System (NextGen).

Within the overall budget, the administration says \$1.1 billion will support NexGen projects, a \$347 million increase from fiscal 2010-enacted levels. It includes \$285 million for automatic dependent surveillance-broadcast (ADS-B); \$150 million for air-to-ground data communications; \$109 million for

Don't Bank On It

Transportation budget proposal maps uncertain route for aircraft equipage support

ANDREW COMPART/WASHINGTON



President Barack Obama's proposed fiscal 2012 budget would increase Transportation Department spending to \$128.6 billion, about \$52 billion more than the

department might spend this year. But it offers only a glimmer of hope to airlines seeking financial assistance to equip aircraft for the NextGen satellite-based air traffic control system and provides minimal comfort for small communities counting on federal subsidies to maintain or bring back airline service.

In the proposed budget, the president renews his push for a "national infrastructure bank" and—in one of only two specific examples provided by the administration regarding its potential usage—notes the bank could guarantee private loans for aircraft NextGen equipage.

The years-old "I-Bank" idea, however, will face concerns about spending and investor payback requirements, as well as questions about where it should be housed and how it should be run. Obama has expressed support for such a bank before, most notably in a Labor Day speech last September that stopped

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short of particulars and did not gain any immediate traction.

The budget proposal provides a bit more detail. The administration calls for \$5 billion in 2012 and \$30 billion over the first six years to establish the bank, which would work with credit markets and private-sector investors to finance transportation-related projects of "national or regional significance" via grants and loans. The bank would reside within the Transportation Department, report to the Transportation secretary and be run by an executive director and board drawn from the department and other federal agencies, with the executive director appointed by Obama but requiring Senate confirmation.

The bank would publish a prospectus to govern investment decisions and describe analytical criteria and would use "a rigorous project comparison method that transparently measures which projects offer the biggest value to taxpayers and our economy," says

the budget document. The intent is to take politics out of the process.

Airlines are not counting on such a bank to help them, however, and would prefer more direct and certain aid. Will Ris, senior vice president of government

Airlines are not counting on an infrastructure bank and would prefer more direct and certain aid

affairs for American Airlines, seems to acknowledge there is no chance for the grants airlines would prefer. But as an alternative, he calls for "creative financing" from government that would have airlines pay back what they borrow for equipage when or if NextGen starts affording them operational savings.

As for service to small communities,

the administration's budget would provide \$195 million for the Essential Air Service (EAS) program, which subsidizes airlines to fly to low-demand communities that had service prior to airline deregulation in 1978. That is almost as much as the \$200 million EAS receives now, but the proposal would limit the program to communities receiving the subsidized service as of Oct. 1, 2011.

The Future of Aviation Advisory Committee created last year by Transportation Secretary Ray LaHood recommended a freeze backdated to 2010 on the communities within the continental U.S. that are receiving the funding, to give the government time to update and narrow the eligibility criteria. Congress generally fights reductions in EAS, which supports service to about 140 communities, but in this budget-cutting climate, the House is considering a freeze, reduction or elimination in funding as part of the FAA reauthorization bill. ☉

FAA Is Optimistic, Sort Of

ANDREW COMPART/WASHINGTON

The FAA's new 20-year aerospace forecast underscores the recovery U.S. carriers have made in the past year—but also the greater-than-usual uncertainty about the future of the market.

Regarding the former, the FAA forecast released here Feb. 15 in conjunction with its 36th Aviation Forecast Conference predicts more than 1 billion passengers will board U.S. airlines in fiscal 2021.

The threshold is symbolic, but it serves as a guidepost for the growth of the industry. The FAA made the same prediction in the forecast it released in early 2009, but last year, amid the ongoing impact of the Great Recession and a grimmer outlook for growth in the near and mid-term, the FAA pushed back that date to 2023.

The difference now, the FAA says, is twofold: Airline traffic strengthened more than expected in the latter part of 2010, and the economic forecast for the next few years has improved in terms of economic expansion and decline in unemployment.

The FAA's demand forecasts are driven by macroeconomic variables, and the FAA gets its economic forecast from IHS Global Insight. This year's forecast assumes U.S. real GDP growth averaging 2.7% a year in 2010-31—including increases of 2.4% in 2011 and 2.9% in 2012—and world GDP growth of 3.3% a year in the same time period.

In that environment, U.S. mainline carrier domestic traffic, as measured by revenue passenger miles, is projected to increase 3.4% this year and grow at an average annual rate of 2.9% for the remaining years of the forecast. U.S. mainline carrier international traffic is predicted to increase by 8.4% this year and grow at an annual rate of

4.9% for the remaining years, with Asia-Pacific and Latin American traffic leading the surge.

All told, the FAA predicts U.S. airline traffic will more than double in 2011-31.

But here is the caveat: While the FAA's forecast is always subject to uncertainty because of the many factors that can affect its accuracy, the agency says the uncertainty is even greater this time, particularly because of the undetermined strength of the economic recovery.

Another key variable is the price of fuel: The near-term forecast is based on Global Insight's projection of \$74 per barrel on average in 2011—although the price was about \$10 higher than that the day the FAA released its 20-year forecast. The forecast also assumes the price will rise to just over \$100 by 2018, gradually fall to about \$95 by 2023 and reach \$113 by 2031.

The airlines' ability to maintain restraint on adding capacity will be a factor, too, the FAA says. They seem to be holding the line so far, but that has not been their history when the industry's health improves and profits return.

"Given the current state of the global economy, there is much uncertainty as to the timing and strength of a recovery in aviation demand," the FAA notes. "The FAA is confident that these forecasts accurately predict future aviation demand; however, due to the large uncertainty of the operating environment, the variance around the forecasts is wider than in prior years."

The annual growth rate in the forecast is a baseline, but the FAA also includes a "high case" based on a "more favorable business environment, lower inflation and lower fuel prices," and a "low case" characterized by "higher interest rates, weakened consumer confidence brought on by persistent unemployment, and higher inflation."

In the "high case" scenario, for example, U.S. airlines could carry 1 billion passengers per year by 2019. But in the "low case," that would not happen until 2024. ☉

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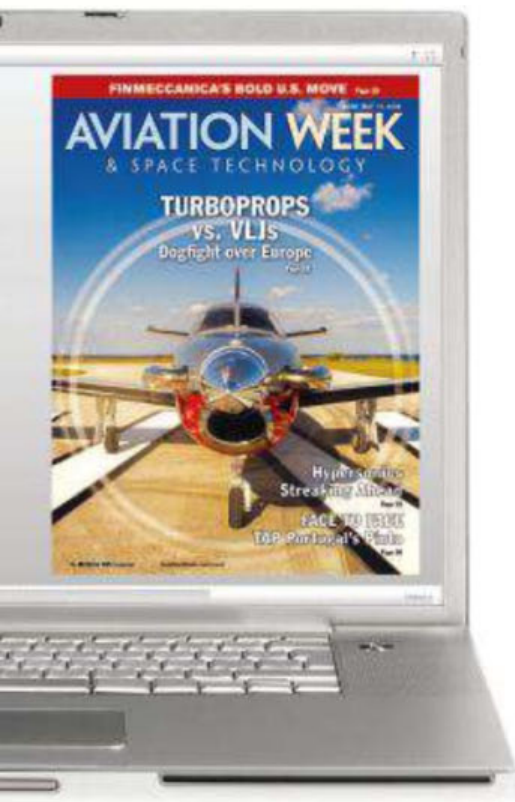
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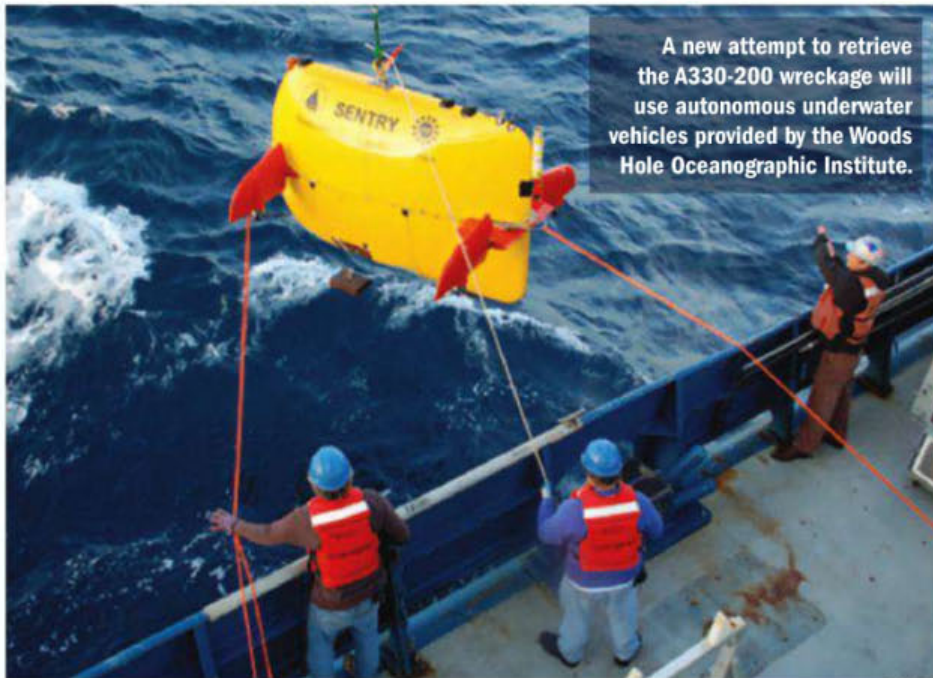
Pierre Sparaco has covered European commercial, military and space issues since the 1960s.

COMMENTARY

Flight 447 Enigma

Hopes are high that, this time, the A330 wreckage and black boxes will be found

All flight safety experts unanimously agree: An unexplained accident is the worst-case scenario. The entire aviation community, as well as victims' families, expects to determine the causes of crashes so that systems and training procedures can be improved, if warranted. The ultimate goal is to come closer to a zero-accident world.



A new attempt to retrieve the A330-200 wreckage will use autonomous underwater vehicles provided by the Woods Hole Oceanographic Institute.

Such aspirations are being echoed again and again while French investigators strive to understand why Air France Flight 447—operating on the Rio de Janeiro-Paris route on June 1, 2009—plunged into the Atlantic Ocean.

The Airbus A330-200 wreckage could not be located and, in the absence of radar imagery and flight recorders, the French BEA accident investigation bureau's preliminary report remains inconclusive. Pitot tube icing is believed to have played a role in the sequence of events, as well as hostile weather, but available information is far too weak to draw conclusions or devise recommendations.

Next month, a new attempt to find the A330 on the sea floor will begin, with renewed hopes of success. This fourth search mission, slated to start on March 18, is based on all-new calculations and is expected to focus on a relatively small zone covering 10,000 sq. km. (3,860 sq. mi.), relying on Remus 6000 autonomous underwater vehicles provided by the Woods Hole Oceanographic Institute in Massachusetts. Air France and Airbus will jointly fund the \$12.5 million search campaign.

A BEA executive tells me that he's optimistic despite unprecedented difficulties. The twinjet's wreckage could

be as much as 4,300 meters (14,100 ft.) deep in the ocean, in the middle of rough terrain. This means, he acknowledges, that finding the wreckage would be no more than a "Step 1" success and would not automatically indicate where to look for the cockpit voice and digital flight data recorders. The aircraft probably hit the surface horizontally, in one piece, at high vertical speed, and debris could be scattered on the sea floor over a large area.

Retrieving the recorders would pose another challenge, without any certainty they would still be in readable condition. Moreover, it is far from certain that recorded parameters covering the ill-fated flight's last few minutes would provide answers to the investigators' many questions. The BEA team nevertheless expects the probe to eventually prove successful.

In a belief that the wreckage will be located this time, the BEA is working on a so-called fifth phase, retrieving the recorders. A tentative list of follow-up measures is being prepared, including the special-purpose vessel that would start working early in the summer.

Thierry Mariani, France's secretary of state in charge of transportation, recently emphasized his interest in the wreckage-retrieval mission. His predecessor, Dominique Bussereau, had stayed in the background, perhaps missing the point: Aviation safety badly needs political support. Flight 447, after more than 18 months of hard work, now appears to be one of the most demanding investigations of recent years. In contrast with the Concorde crash 10 years ago, which involved a mythic aircraft, the A330 accident has a broader meaning. It involves a highly successful Airbus program, still very much in the news. This month, the European manufacturer unveiled a plan to further boost the A330's production rate to 10 per month, from eight, in an indication that the company expects to maintain a strong backlog despite the next-generation A350XWB's entry into service in late 2013 or early 2014.

Meanwhile, let's hope that business-related considerations do not interfere with the ongoing probe. We are talking here about flight safety, not market share. ☛

MAINTENANCE, REPAIR & OVERHAUL



MASCO

Peak Progress

Fuel cost uptick accentuates challenges to aftermarket business, even in the Middle East

ELYSE MOODY/DUBAI, UNITED ARAB EMIRATES

New instabilities in the Middle East triggered events that reveal immediate pressures on the aviation aftermarket. On Jan. 31, oil prices hit \$100 per barrel for the first time since 2008, soaring on word of protests in Cairo's Tahrir Square. This sharp increase sent international jet fuel prices up to more than \$115 per barrel, with those in the Northwest Europe market peaking at just over \$120 per barrel (see chart, p. 46). When fuel prices belled two years ago, airline cost-cutting behaviors put new stresses on aircraft maintenance providers. Among airlines—even the Middle East's service-oriented, ultra-long-haul carriers—that close-to-core mentality stuck.

The recent spike in oil prices highlights "continuing challenges" faced by the aviation industry and presents evidence of recessionary pressures "still being experienced," Iain Lachlan, divisional senior vice president of aircraft maintenance for Emirates, said in his opening remarks at Aviation Week's

MRO Middle East conference here Feb. 1.

Over the last three years, the global economic downturn has accelerated trends taking root at airlines to focus on the primary business of transporting passengers. Inventory destocking, outsourcing and cutting costs (including labor) take priority, even as airlines order new aircraft to stay fresh and competitive in their markets. For maintenance and engineering departments and MRO providers, this means supporting more component work, facing increased competition for contracts and developing new ways to package services.

A surge in fuel costs gives these issues new urgency. Conversations springing from the fuel uptick at the end of January highlight just how pervasive and crucial lean outsourcing strategies have become for operators. In response, airline engineering and maintenance departments and MRO providers here in the Middle East, where investment activity remains vibrant, continue to develop their services with these pressures in mind.

Beirut-based Masco, a maintenance provider linked to Middle East Airlines, derived 70% of its revenue in the last year from lease handback work.

An often-cited figure here is 18.3%—the passenger traffic growth rate the International Air Transport Association (IATA) pegs to the Middle East, compared to the global rate of 10%. Companies based here such as Emirates and Mubadala Aerospace, and those heavily invested here such as Goodrich Corp. and Lufthansa Technik, are quick to point out how the region's growth nearly doubles the average rate for the rest of the world.

Growth in the regions surrounding the United Arab Emirates bolsters its market position. TeamSAI's Chris Doan calls this part of the world "the growth engine of the future." He notes that while profits have been "pretty elusive" for aftermarket companies so far, "a lot of positive developments [have taken place] here, recognizing the growth that will exist."

In the next 10 years, the total aftermarket spend base in the region (including military and business aviation work as well as civil helicopter and air transport) is expected to grow substantially, with 5.3% annual increases driving the total to \$11.2 billion in 2019 from \$7 billion in 2010, according to AeroStrategy figures.

Based on this growth pattern, MROs and airline maintenance organizations continue to add capabilities based on rising demand. The volume of work is here, but much of it is divided among existing stakeholders. Lufthansa Technik's Walter Heerdt, senior vice president of marketing and sales, explains his company's strategy as sizing the accessible market. "The accessible market is here," he says, "but it is not as big as you might think." For that reason, partnerships with existing players and OEMs mainly drive developments.

Emirates' Lachlan stresses the same strategy: Opportunities in the aviation aftermarket are plentiful in the Middle East, he says, "but these can only exist through partnerships."

Lufthansa Technik, for one, is in the middle of solidifying such an arrangement with Oman Air, stemming from a 2009 strategic partnership. The agreement would see a new hangar erected at Muscat International Airport for base maintenance up to C checks on as many as two widebody and two narrowbody aircraft simultaneously. Heerdt says his company and Oman Air have not made a final decision yet, though he is "very confident that [it] is doable."

Mubadala Aerospace also is working its partnership via subsidiary Abu Dhabi Aircraft Technologies (ADAT) with General Electric and the Engine Alliance on GE90, GENx and GP7200 engine maintenance. This will bring the first network overhaul provider approved by the OEM

to the region. Groundbreaking for this facility in Abu Dhabi is planned for the first quarter of this year, and operational launch for early 2013. Abdulla Shadid, senior business development manager for Mubadala Aerospace, calls the project "a natural win-win, with so many GE engines flying in the region."

The Mubadala-GE-Engine Alliance venture is an example of what David Stewart, principal at AeroStrategy Management Consulting, identifies as today's movement toward an "OEM-centric supply chain." In identifying trends driving MRO, Stewart emphasizes that companies "need new relationships" with manufacturers and suppliers—especially independent MRO providers that want access to new programs.

In addition to collaboration with industry partners, OEMs and MRO organizations in the Middle East continue to stress a focus on fleet performance. This marks a new direction for many MROs, as Uwe Jakob, vice president of planning and technical services for ADAT, points out. "If you are honest, [fleet performance] was not the driving focus for MROs in the past," he says. Today, downtime sways contracts.

To that end, ADAT is developing a fleet monitoring office tied to its engineering department, for which it plans to break ground in July. Like other real-time OEM and MRO offerings, such as GE's myEngines software suite and the customer response center Hamilton Sundstrand opened in November 2010, the ADAT

Competing for Talent

DUBAI

Sam Sayani, deputy managing director of Pakistan International Airlines Engineering/PK MRO, points out the interesting conundrum his company faces today. With what he calls tremendous revenue growth in 2010 (23%), PIA is happy. But its costs have risen 12%, he says, surpassing its 7% year-over-year growth.

As is often the case, expansion costs money. And labor is one of an airline engineering organization's largest cost centers. Looking ahead at fleet growth in the next decade, Sayani says airline engineering departments and MROs should be planning for these expenses now.

The Middle East, for example, will require 40,000 technicians in the next 10 years, Sayani says. But at present, the region only has the capacity to train about 10,000 people in that time frame.

"We can see that we can meet the needs of tomorrow, but the industry needs to wake up," Sayani says. "It is a very acute situation." ☛

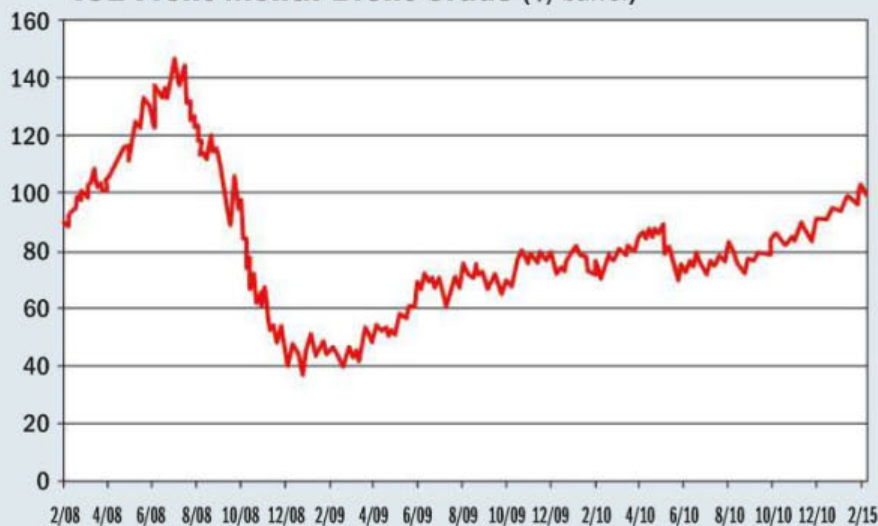
office would aim to give customers a constant, mobile view of service work occurring on their aircraft or engines.

Goodrich's Jebel Ali campus, which does work for the major UAE flag carriers, Oman Air and Saudi Arabian Airlines, among others, also names its short-term goal as "[working] very closely with each operator, to help them to match their requirements," says Joel Haldemann, Goodrich vice president of MRO for Europe, the Middle East and Africa. Speaking to the Dubai campus's pool of customers, Haldemann says about half send work to Goodrich under total support arrangements.

Customer service counts, since occasionally it can undermine cost, notes Pierre Reveille, vice president of Airbus Services Solution, who manages the aircraft maker's contracts with its MRO network. "Sometimes we do go for a higher price, taking into account quality," says Reveille, though he notes that the margin would never be more than 5-10% higher.

As airline customers demand more

ICE Front-Month Brent Crude (\$/barrel)



Source: Intercontinental Exchange

Brent North Sea crude oil prices spiked at the end of January, then hit another peak on Feb. 14, reaching levels not experienced since the fall of 2008.

MAINTENANCE, REPAIR & OVERHAUL

comprehensive solutions at a competitive cost, they also demonstrate a need for new services from third-party suppliers. Component maintenance is a traditional MRO revenue base that continues to see growth, particularly for new types of value-added service agreements.

Lufthansa Technik's Walter Heerdt says his company sees a growing customer base for component repair and logistics globally. "Worldwide, as this is not only true for here in the Middle East, we see that there is a demand for cooperating with us [on component management logistics]," he says. Lufthansa Technik has more than 2,100 aircraft under component support arrangements.

Component repair management, especially for larger rotables such as landing gear, forms a big part of the growth plan of Pakistan International Airlines Engineering. The entity, which recently was rebranded as PK MRO, hopes to break ground by the end of March on a new landing gear facility, says Deputy Managing Director Sam Sayani. Right now, PK MRO is the only facility in the region that can work on Airbus A300B4 landing gears; it also overhauls them for



EMIRATES

Emirates is investing in its own MRO facilities to service the A330s and other Airbus aircraft in its fleet, including the 90 A380s it plans to operate eventually.

ponent rotables—this is what has been challenging for airlines," says Shadid.

Sanad sees a market for another \$10 billion in spare components and engines in the next decade, says CEO Troy Lambeth. Current rotatable and spare engines holdings equal about \$34 billion, based on AeroStrategy projections. The in-service

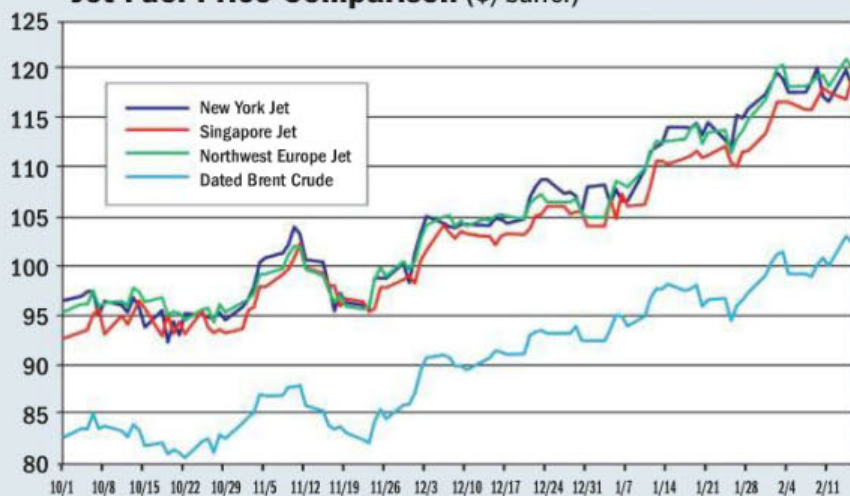
more conservative estimate of 5,000 aircraft to assume a \$7.5-9 billion addition to the value of required spares, using today's \$1.5 million requirements-per-aircraft figure. Taking into account newer technologies, more widebody deliveries, new spares requirements and new-generation engines, Lambeth thinks another \$10 billion is a conservative estimate.

Aircraft appearance work placement also serves as a market indicator. For example, Emirates, which eventually will have a fleet of 90 Airbus A380s in addition to its A330s, A340-300s and Boeing 777s, recently invested in a huge new paint facility, says Lachlan. Last year, Emirates commissioned the building, which closely resembles Airbus's own facility, and it is installing six aerial-mounted platforms of its wing-docking system. This investment came alongside design changes Emirates made to its airframe maintenance facilities to accommodate the new type.

Like Emirates, Qatar has plans to grow its A380 fleet. "We're a hungry beast that just can't wait for these new aircraft to arrive," says Tony Hughes, Emirates senior vice president for the Americas. Hughes says Qatar CEO Akbar Al Baker has indicated he plans to add more A380s to the five on order.

While new deliveries fuel growth, so does lease hand-back activity. According to M. Yassine Sabbagh, executive director of Mideast Aircraft Services Co. (Masco) in Beirut, work for lessors has made up the majority of Masco's revenue in the last two years. In 2010, he says 70% of work was painting and performing C checks and bridging checks for lessors such as International Lease Finance

Jet Fuel Price Comparison (\$/barrel)



Source: Platts

Jet fuel prices have increased alongside crude oil, with prices in Northwest Europe breaching \$121 per barrel on Feb. 14.

Boeing 737s and Airbus A310s. Plans call for adding in-house capability on Boeing 777 auxiliary power units, Sayani says.

Component financing programs cater to many of the same airline pain points but also provide liquidity. Mubadala Aerospace has launched subsidiary Sanad Aero Solutions to capture its share of that market. "Com-

fleet equals more than 22,000 aircraft. That is a simple average of slightly more than \$1.5 million in spare components and engines per aircraft, Lambeth says.

In terms of aircraft, the next decade will see about 12,000 deliveries, based on current orders, and the projected retirement of 6,000 aircraft for a net increase of about 6,000 aircraft. Sanad uses a

PMA Penetration

DUBAI

In discussing trends for the next decade, neither AeroStrategy's David Stewart nor TeamSAI's Chris Doan mention parts manufacturer approval (PMA) components.

"Maybe it's not a trend anymore," explains Stewart, a principal with AeroStrategy. "Maybe it's established behavior."

TeamSAI President/CEO Doan nods in agreement. "[PMA] is becoming more mainstream, I agree with that."

Stewart notes that PMA penetration is increasing rapidly in cabin interiors, where there is "less of a safety issue." He says PMAs are seeing "so-so" growth in the components area.

Engines continue to be an area of contention. PMA penetration on engines is decreasing due to successes by CFM International and GE Aviation, Stewart notes, and Rolls-Royce has never seen much competition from PMA parts.

Rivalries are intense for the remaining engine PMA parts market. "At an engine conference, you've still got people throwing things at each other," Stewart quips. ☺

Corp. Sabbagh adds that, like TeamSAI's Doan, he sees growth in technical services or consulting work. Masco provides airlines with assistance in acquisition consulting and aircraft customization from the assembly line through delivery and lease handback, Sabbagh says.

The frequent changing of hands in the leased aircraft market foreshadows another trend—greater numbers of aircraft being parted out. Record numbers of aircraft were parked and parted out in 2008 and 2009. An estimated 15-20 aircraft are being parted out each month now, says AeroStrategy's Stewart.

In addition to price pressures, these reintroduced, airworthy parts muffle the need to restock inventories with new parts: The global MRO market should be seeing the "kick back" of airline inventory restocking in 2011 and 2012, Stewart points out, but it is being "buffered by the surplus [resulting from] parting out." ☺



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COMMENTARY

Dinner Conversation

No peace declared, but targets may be changing

Calls for more civility in Washington—along with the changing of the guard—may have resonated among aviation's alpha-betters. A nice selection of California wines probably helped.

There has long been a feud in the capital between the Air Transport Association (ATA), which represents scheduled Part 121 carriers, and the business and general aviation community. Simply put, the airlines want to offload several billion dollars in federal taxes onto the latter group.

The carriers argue that they pay a disproportionate share for the federally operated air traffic control system or, conversely, that the unscheduled crowd is underpaying while their aircraft add congestion to the system. The way to put things in balance, the carriers posit, is to scrap the taxes and institute a system of fees for ATC services.

General aviation interests have vociferously opposed that, saying it would create an unwieldy bureaucracy while adding billions to their costs. They prefer to retain the fuel tax system through which, they insist, they pay their share to ATC's upkeep. If necessary, they say, those taxes could even be increased.

The two sides have slugged it out on stages, in Congress and the media, with the ATA even producing a series of ads that ran on video screens in passenger terminals lambasting corporate jets that supposedly cut ahead of passenger jets to get their "big wigs" to the golf links for their tee times.

While the airlines found a modicum of favor in Congress, their adversary managed to keep the user fees out of various FAA reauthorization bills that have died from neglect in Congress.

The latest attempt at reauthorization will likely emerge absent of user taxes, too, and the ATA has been uncharacteristically silent on the matter. That could be because President Jim May, the ATA's most ardent combatant, has



retired from the fray—actually retired altogether. His successor, Nick Calio (see photo), took a much different tactic, sitting down at the table and chewing on things with the other side. Literally.

Calio had been in office only a matter of days when Jim Coyne, head of the National Air Transportation Association, invited

him and his wife to dine at the Coyne's home in Great Falls, Va., along with Ed Bolen, Craig Fuller and Pete Bunce, heads of the National Business Aviation Association, Aircraft Owners and Pilots Association and the General Aviation Manufacturers Association, respectively, and their wives.

Much to the genav group's delight and undoubtedly the ATA staff's dismay, Calio accepted. A snowstorm forced a postponement, which ended up scratching the Bolens, but the dinner proceeded, made all the merrier by several bottles from the AOPA Wine Club (yes, a wine club in which flying vintners are celebrated).

No one has declared the former hostilities officially ended, but the diners discussed where they could join forces to promote shared interests or oppose common foes. Of the former, NextGen acceleration is high on the list. As for the latter, those pushing for federal funding of high-speed intercity rail transit had best keep on eye to the skies; an enemy air force is gathering strength. ☼

VIP IS A-OK

While the marketplace has shown little appetite for light and medium-sized business jets in the past two years, its hunger for really big birds remains hearty. The percentage of new airliners outfitted for VIP travel is small, but it is profitable enough that Airbus and Boeing have established sales units devoted entirely to serving governments, potentates, the super rich and, to a lesser degree, corporations.

Last year, Airbus delivered a record 15 VIP jets with a book value of more than \$1.5 billion to operators in Asia, Europe and the Middle East. These comprised 13 aircraft from its single-aisle family, along with two A330/A340s. In addition, it wrote orders for eight more aircraft, including one widebody.

Both the delivery and sales figures bested the previous year's and may indicate better things to come. Francois Chazelle, vice president of Airbus Executive and Private Aviation, says they signal "that the market increasingly recognizes the wider and more spacious cabins that we have to offer, as well as that sales are starting to pick up."



AIRBUS

Airbus says with an order signed early this year, its fleet of VIP airliners will exceed 170 aircraft.

Meanwhile, its Seattle rival has been busily serving this exclusive clientele, delivering 12 VIP aircraft—10 Boeing 737s and two Boeing 777s—with a list value of more than \$1.1 billion in 2010. The airframer says it booked four orders for corporate jets during the past year as well.

Prominent among the 40 VIP aircraft on backlog are eight Boeing 747-8s, ordered by six customers. Valued at \$317 million each, five are scheduled to be delivered to completion centers this year. The company says a dozen Boeing 787s are slated for VIP duty, too. ☼

The Sun Both Ways

Glory's team says there is more to climate change than greenhouse gases

MICHAEL MECHAM/SAN FRANCISCO

The A Train of Earth-observing satellites that NASA leads is set to get a new member with the Feb. 23 launch of Glory. The \$424 million mission focuses on the subtle ways solar radiance influences the planet's climate.

While climatologists have developed an increasingly sophisticated understanding of the role that greenhouse gases such as carbon dioxide play in climate change, they are less certain about how solar variability and aerosols factor into the climate-change equation.

"The range of uncertainty associated with the climate impact of aerosols is three to four times that of greenhouse gases," says Glory scientist James Hansen, director of NASA's Goddard Institute of Space Studies (GISS) in New York.

"We are trying to achieve better measurements of both aerosols and total solar irradiance in order to calculate the energy budget—the amount of energy entering and exiting Earth's atmosphere—as accurately as possible," says Glory project scientist Michael Mishchenko, also of GISS.

Orbital Sciences adapted a LeoStar bus for Glory that was originally intended for NASA's Vegetative Canopy Lidar (VCL) satellite, a larger mission with a different orbital profile that was canceled in 2000. Many VCL components had to be replaced for Glory and the spacecraft had to go through a new certification process.

Still, some satellite elements were left in place, even if they are a bit more than the downsized Glory needs. For instance, its hydrazine thrusters are larger than a mission of Glory's size normally requires and its solar arrays will have an unusual orientation, given that they were intended for VCL. Problems with one of those solar panels delayed the mission from a liftoff last November.

Along with the 1,158-lb. aluminum spacecraft bus, Orbital is providing Glory's four-stage Taurus XL 3110 launcher. Once the satellite is in orbit, the com-

pany will operate its mission control center from its Dulles, Va., headquarters.

A 2:09 a.m. PST launch from Complex 576-E at Vandenberg AFB, Calif., is planned. The spacecraft is to enter a 705-km (437-mi.), Sun-synchronous orbit inclined 98.2 deg. Once there, it will become the sixth member of the Afternoon Constellation, or A Train, satellite flotilla that concentrates on Earth-observing science.

The advantage of putting spacecraft in the same track—all of them cross the equator within a few minutes of 1:30 p.m. local time—is that they share the same orbital baseline.

The mission has a three-year nominal lifespan but a five-year goal.

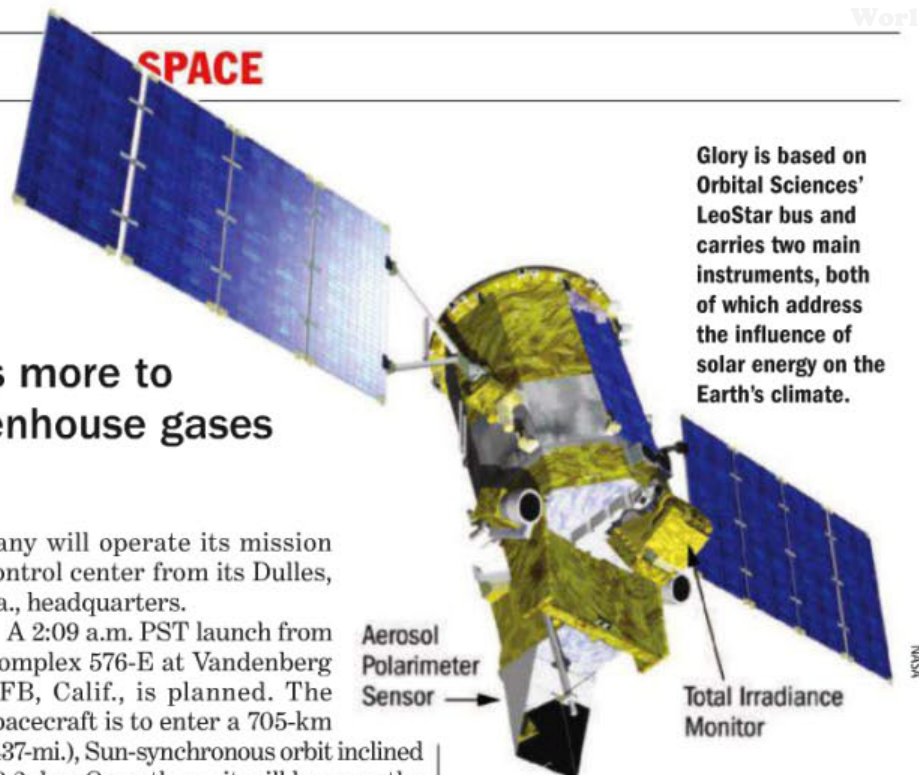
Previous satellites have established that the Sun's irradiance fluctuates by about 0.1% due to variations in solar electromagnetic activity. These variations play out in an 11-year solar cycle.

Science is unclear how much industrial and agricultural activities influence global warming as compared to natural forces.

To answer such questions, scientists have been tracking solar cycles. But the solar-cycle issue does not explain the global warming that has been measured over the past few decades, says Glory science team member Judith Lean of the Naval Research Laboratory. Still, she is quick to add, "It's possible—probable even—that longer-term solar cycles exist that could have an impact on climate."

The Laboratory for Atmospheric and Space Physics at the University of Colorado-Boulder has been tackling the solar irradiance side of the solar energy equation for years. It is flying an update of the Total Irradiance Monitor (TIM) instrument on Glory that it first put on-board a NASA satellite when the Solar Radiation and Climate Experiment satellite was launched in 2003. The newer TIM is three times as sensitive.

The second major instrument on the



Glory is based on Orbital Sciences' LeoStar bus and carries two main instruments, both of which address the influence of solar energy on the Earth's climate.

6.2 X 4.6-ft. spacecraft—Raytheon Space and Airborne Systems' Aerosol Polarimetry Sensor (APS)—is mounted opposite TIM to continuously scan Earth.

APS's heritage dates to the 1970s when Hansen began using polarized light to study Venus. By measuring the physical orientation of light waves as they twist through space, Hansen and his colleagues were able to deduce the composition of Venus's clouds.

Those same principles were applied in the late 1990s on aircraft flights taking snapshots of aerosols in the upper atmosphere. They produced unprecedented details about the planet's aerosols, of which 90% originate in nature and 10% as a result of man's activities.

APS is nearly identical to the Research Scanning Polarimeter from those flights, except that APS's 161 optical elements, including six precision-aligned telescopes, will be operating from space, where their field of view of the planet's surface is much greater. APS will offer more than 250 angles of the Earth's atmosphere. It uses nine different spectral channels that range from visible to shortwave infrared.

Like TIM, APS is the size of a milk crate. It views the planet's surface in 5.9-km ground-track bands, repeating its measurements every 16 days.

Glory also carries a cloud camera that is a rebuild of the wide field camera on Calipso, another A Train spacecraft. The camera scans clouds as they pass through the APS's sights so scientists can factor in their presence as they track aerosols. ☼

SMART, AGILE FORCE

Australia fields more pieces
of its network-centric military

DAVID A. FULGHUM/CANBERRA and WASHINGTON

Australia is integrating three new operational elements into its advanced, network-centric military—a squadron of Wedgetail aircraft, the first two squadrons of F/A-18F Super Hornets and the Vigilare theater surveillance integration system. All are designed as the backbone of a small, highly responsive force.

The country is refashioning its armed services as the core of an international force—integrating a variety of foreign participants—that will be capable of responding to military emergencies or natural disasters.

However, this cutting-edge organization was envisioned somewhat differently only five years ago. The Boeing 737 Wedgetail airborne early warning and

control (AEW&C) aircraft had a 2006 delivery date, and the Lockheed Martin F-35 Joint Strike Fighter was slated to replace the Royal Australian Air Force's (RAAF) classic Boeing F-18 Hornets as soon as they were available.

Instead, the Wedgetail's radar was hit by a two-year delay for hardware and software redesign that has stretched into more than four years. The massive task of integrating many sources, services and sensor types caused a dragging out of Vigilare's operational introduction as a surveillance fusion center. Finally, the U.S. slowed the F-35 JSF program and drove up its cost, which injected uncertainty into Australia's budget-planning process.

These delays, and a change in government, have created big political and

financial pressures for the Australian military. But it now appears that no matter how monumental the problems of the last four years have been, they are small compared to what would have happened without the program slowdowns, technology improvements and reshuffling of priorities.

Because the RAAF's Hornets are aging, Canberra approved the purchase of Super Hornets as an interim aircraft between the classic Hornet and the F-35. Aerospace industry and military officials contend that without the Super Hornet to make the task of integration incremental, the shift from Hornet to F-35 would likely have become a nightmare of increased cost, complexity and schedule overruns.

The delay of two key nodes—Wedgetail





Two Wedgetails of Australia's No. 2 Sqdn. sport their 360-deg., L-band, end-fire radars, which will offer unique capabilities such as stealth and cruise-missile detection.

BOEING

and the Vigilare air defense ground environment—rippled through the high-tech aspirations of the RAAF. Their absence meant they would not be in place for the workup of a network-centric force that could digest all of the F-35's futuristic capabilities. To compensate for that delay, the RAAF acquired the Super Hornet with its inherent net-centric capabilities to begin the integration process.

"The [Wedgetail] dilemma for me was getting something into the field quickly while making sure we could resolve the technical issues and deliver the highly developmental elements of the radar," says Air Vice Marshal Chris Deeble, RAAF manager of the program and a longtime advocate of highly integrated, net-centric operations. "I decided on an incremental delivery strategy. We took

initial delivery of the aircraft in April 2010, and we've been operating it in an initial configuration.

"That allowed us to get ahead of the game," he says. "If we had waited until final acceptance [scheduled for the end of 2011], we'd be another two years behind the eight-ball. We've also been able to address some shortfalls in performance and set a path for longer-term improvements."

The Wedgetail radar delay allowed the performance of the multi-role, electronically scanned array (MESA) long-range, 360-deg. radar to mature and new missions to emerge. Instead of making a uniform sweep at a given range as originally planned, MESA can focus the power output of the radar into limited sectors to markedly increase its range and the ability to detect small objects.

"We're going to see full use of the electromagnetic spectrum," says Bob Hendrix, chief architect for Northrop Grumman's ISR (intelligence, surveillance and reconnaissance) systems division. "With this [Wedgetail and radar combination], you see a little slice of it. L-band [radar with its lower frequency range] is good for scouting for a couple of hundred miles. You can see a long way through weather and other conditions.

"To see fine-grained images, like dismounts [people] and individual targets, requires higher frequencies" like those in the X-band radars carried by Super Hornets and Growler electronic attack aircraft, he says. "If you go even further [up the spectrum], you can do visual identification of a person at short ranges. Think about putting information

AUSTRALIAN DEFENSE

of disparate sensors into a combined picture. It's hard to imagine what it will eventually look like."

Wedgetail, Super Hornet and Vigilare lay the groundwork for an even more impressive force that is envisioned, if not funded, to include:

- The modification of 12 Super Hornets to EA-18G Growler configuration that can conduct standoff missions that include jamming and anti-electronics attack.
- The acquisition of an undetermined number of Boeing P-8 Poseidon jet-powered maritime surveillance and patrol aircraft to supplement and then replace the P-3 turboprops.
- Perhaps another two Super Hornet squadrons for precision, standoff attack.
- As many as 75 F-35-type stealth air-

ers carry X-band AESAs for precision targeting.

Also waiting in the wings will be the U.S. Navy's Next-Generation Jammer, an AESA-based electronic jamming and anti-electronics package designed for carriage in pods by the Super Hornet, Growler and F-35.

"Whatever sits in the pod, I suspect the RAAF is aware of the capability," says Ian Thomas, Boeing's president for Australia and the South Pacific. "If you look at Australia's ability to return a decision faster than others, you'll see they pay very close attention to U.S. development [efforts]. They've joined the JSF, P-8... and a host of other [projects] and put people in the program offices to keep track of where technology is going."

also set the stage for new generations of advanced technology.

"The technology is already here to produce photo-like radar images," says Egan Greenstein, Boeing's senior manager of business development for international surveillance and engagement programs. "We heavily leverage off what's going on in the fighter and air-to-ground world. We're going to be able to pick more metrics out of a radar return than ever before and overlay the physics of other sensors. The operator will see more details, and the machine will identify more unique facets of a target. The sophistication of sensors has grown to the point that we have to make sense of the intake and how to use it. That's the transition going on in the

AEW&C platform. The power and capability are there, so how do you exploit it?" he asks.

"Sensors are limited by physics, so they will [only] incrementally improve," he adds. "Throwing all that data together—using fusion, some automation and tactical decision aids—is where the big leaps will happen."

The opportunity to operate the F-35 stealth fighter and a high-performance unmanned, surveillance/strike aircraft

design that may follow it also is part of the RAAF's future.

"We will have a degree of flexibility [at the end of the F-35 buy]," Deeble says. "We will operate the Super Hornet through 2020-25, and it will be replaced by JSF or something JSF-like. That is the opportunity for Australia to consider other options, either variations on the JSF theme or things like unmanned combat aircraft."

Here again, Deeble stresses the need to continue injecting advanced technologies into the RAAF.

"In the stealth game, having a capability like Wedgetail that allows us to meld offboard sensing with onboard data to create a picture [of the combat space]—that can be sent to a stealthy aircraft operating passively to maintain low observability—is where we need to go." ☛



craft, which could be introduced in 2025. They would be used to penetrate some distance into surface-to-air missile defenses with advanced, longer-range, low-frequency radars that can detect small cruise missiles and stealthy aircraft.

• And, far in the distance, perhaps 25 penetrating, high-performance unmanned platforms that can deliver bombs or anti-electronic weapons into even the most fearsome defenses.

• All the airborne platforms will be equipped with active, electronically scanned array (AESA) radars that have two to three times the range and require perhaps one-fiftieth the maintenance of conventional radars, plus the ability to locate very small objects and conduct electronic jamming. The Wedgetail covers L-band (good for detecting stealthy designs and cruise missiles), and fight-

As for the possibility of converting 12 Super Hornets to Growlers, this is seen by a number of Australian military officials as a likely program addition.

Thomas was careful not to speculate about the RAAF's plans for such a conversion, but noted: "They didn't fit it for [conversion] by mistake. They made a conscious political and military decision to invest the money to wire the aircraft for the potential capability. Electronic awareness and electronic attack would provide Australia with the capability for a significant, non-lethal contribution to coalition operations."

Australia's network-centric systems also will link the new sensor platforms to the existing F/A-18 Hornet (which could be supplied with precision-bombing data digitally by AESA-equipped aircraft) and the P-3 maritime patrol units. They

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BUDGET TRACKER

US Defense Budget Forecast

Aircraft Procurement, Air Force



Aircraft Spares and Repair Parts

Line Item	2011	2012	2013	2014	2015	2016	2017	2018
INITIAL SPARES/REPAIR PARTS	1,256,352	1,230,842	1,187,470	1,360,576	1,310,470	1,320,168	0	0
Total	1,256,352	1,230,842	1,187,470	1,360,576	1,310,470	1,320,168	0	0

Aircraft Supt Equipment & Facilities

Line Item	2011	2012	2013	2014	2015	2016	2017	2018
AIRCRAFT REPLACEMENT SUPPORT EQUIP	91,840	127,328	73,145	40,122	48,029	50,227	0	0
B-1	6,186	5,712	1,344	525	0	0	0	0
B-2A	27,180	22,074	25,854	24,137	24,524	25,090	0	0
B-52	0	0	0	0	0	0	0	0
C-130	0	0	0	0	0	0	0	0

F-35 Funding



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Wedgetail Wizard

AEW&C chief battles technology, demographics and uncertainty

DAVID A. FULGHUM/WASHINGTON

Canberra is facing natural disasters that include epic floods in the east and large-scale brush fires in the west, plus the restrictions of a smart but small demographic and the rapid growth of industries such as mining that soak up the country's limited pool of technically talented people.

These last elements inhibit the military's efforts to field a highly integrated, joint force that exploits creative recruiting, developmental agility and sophisticated networking to make up for its small size.

In a global defense environment that is shifting its focus from kinetic weapons—guns, bombs and missiles—to non-kinetic options such as information, cyber- and electronic warfare, the Australian Defense Force may have a unique opportunity.

"The ADF is pretty joint, unlike some other defense forces," says Air Vice Marshal Chris Deeble, chief of the Royal Australian Air Force's Wedgetail airborne early warning and control (AEW&C) aircraft program. He also has been a moving force behind the RAAF's growth in network-centric, integration and cyberwarfare efforts for the last decade. "It is small enough to be much more integrated than even in the U.S. We only have about 55,000-60,000 permanent defense force personnel, which allows us to do things differently and to be a bit more agile."

There are four key issues that pace success, says Deeble: First, find smart people who can adapt and innovate. Second, create agile organizations that can devise better ways of doing business. Third, adopt a doctrine that substitutes step-function jumps for small incremental changes as a response to asymmetric threats such as terrorism. The fourth encompasses the way you "harvest technology."

"While technology is the catalyst for some of these things," he notes, "the key is the people who use it in ways that the scientists and engineers never considered. It's thinking about the way [technology] needs to be used and then letting them run with it."

As part of the RAAF's operational and intellectual reorganization, service leaders created the new specialty of air combat officer (ACO) to create a core knowledge base to which tailored training could be added for a range of aviation subspecialties such as weapon systems, electronic warfare, and both ground and airborne sensor operators. The shift was based on the reality that recruiting is going to be difficult and that if the problem was not addressed properly, there would be categories within the RAAF competing for the same raw skill set and recruiting from the same base.

"We combined the old navigator category with the old Air Defense Ground specialty," Deeble points out. "We operate ACOs in P-3s, the back seat of Super Hornets, as mission crews in the AEW&C [Wedgetail] and the Air Defense Ground Environment [Vigilare]. We're recruiting from a common base and then streaming people [into specialties] based on their capability. They also perform important roles in air combat control centers and other areas."

From this super category of ACOs, the RAAF plans to add more skill sets for command and control, data fusion and sensor operation with sub-categories for electronic warfare, electronic attack and cyberoperations.

"The next step for us will be how we adapt our doctrine to the next level," he says. "We need to create the environment for our people to innovate and learn. The danger is that we set the specifications for new programs 10-20 years before they are deployed. In that time there are fundamental changes [in technology, operations and capabilities]. We've got to get our people speaking out about what operating a decade from now is going to be like and how we need to evolve and make step-function jumps in our thinking."

RAAF leadership is also moving to change the boundaries between airmen and officers. Australia has always been known for its egalitarian attitude in the military. Distinctions are expected to be further erased.

"We're already seeing that," says Deeble. "We have airborne analysts who run electronic [surveillance] and other systems on P-3s and AEW&C. We will create paths for them to become officers. We have that in place and see it becoming more important that specialists

move seamlessly from airman to officer without the traditional barriers. This will give people new challenges throughout their careers and allow us to keep them in longer."

The air force is also experimenting with "leading-edge teams." A mix of volunteers from the ranks of corporal to flight lieutenant is put into an environment that allows more flexibility in innovating how they would like the air force to operate a decade from now.

Deeble's philosophy seems well fitted to the ADF's growing force of high-end capabilities. It also compensates for the inability for anyone to plan accurately for future demands on the military.

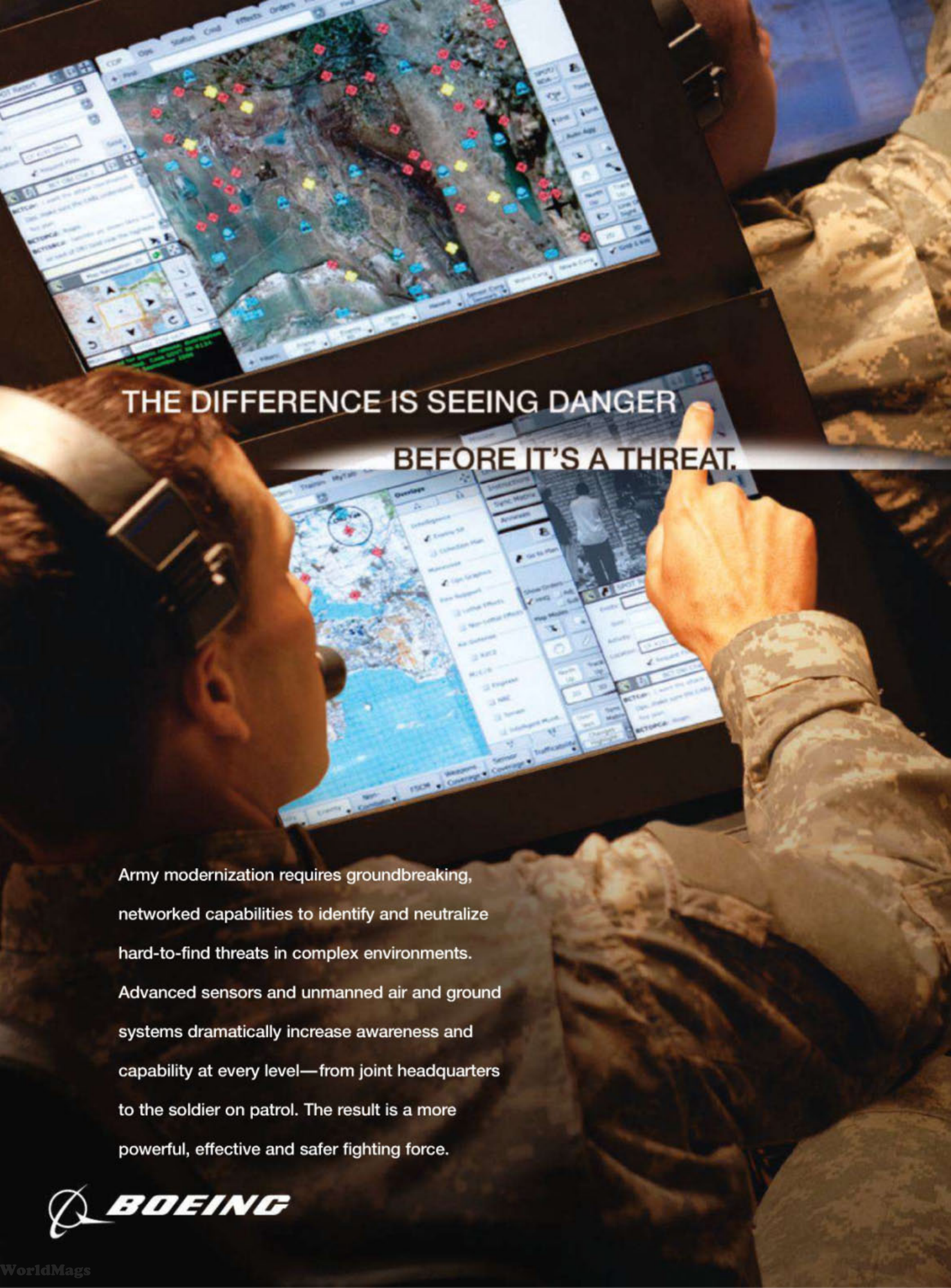
He cites the RAAF's new Wedgetail as an example of changing requirements and unforeseen capabilities. When specifications were written, the RAAF had a very classical air defense role in mind. New experiences have shown that an integrated, networked command, control and communications capability will be more important than some of the sensors on board.

"The [sensor package] will remain critical, but it won't be the operational endgame," Deeble says. Also, "we will look at the Super Hornet and our ability to start communicating and operating with it to understand its characteristics. Downstream, with the Multi-Mission Maritime Aircraft [to replace the P-3] and the changes we're making to our [Vigilare] Air Defense Ground Environment [surveillance integration and communications complex], we're on the cusp of achieving some amazing things. Given our size, we have far more agility in the way we do that." ☺



Air Vice Marshal Chris Deeble is the force behind Wedgetail development and an early advocate of network operations in the RAAF.

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Non-kinetic War

Australia's Wedgetail has potential for cyberoperations and stealth detection



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DAVID A. FULGHUM/RAAF WILLIAMTOWN

The Wedgetail airborne early warning and control (AEW&C) aircraft may already have the ability to detect stealthy aircraft and cruise missiles that are under development, and it may emerge on the world market during the next decade.

The aircraft's advanced radar also has the potential to serve as a non-kinetic weapon capable of electronically attacking enemy sensors or serving as a network-invasion node.

Moreover, there are indications that the large, low-frequency radar could locate very small targets at long range and that it has the potential to counter stealth designs such as China's J-20 aircraft and its low-observable cruise missile.

"That would be a reasonable assumption," says Air Vice Marshal Chris Deeble, chief of the Royal Australian Air Force's (RAAF) Wedgetail program. "Inherent in the radar is the capability to focus on a given sector, [conduct] ground- or aircraft-stabilized surveillance and, finally, choose high-update rates [for repeated scans of the selected area]. You can push a lot of energy into a given area, and [high-speed] processing enables you to see things you otherwise wouldn't."

The Wedgetail's mission compartment features six BAE Systems-built, multi-purpose consoles with ultra-high-resolution, flat-panel tactical displays.

The RAAF chose to equip the Boeing-made Wedgetail with a 360-deg.-scan, Northrop Grumman-designed, low-frequency, long-range, multi-role, electronically scanned array (MESA) radar. Special modes can increase its range. Northrop Grumman admits to more than a 200-mi. range for the radar. In fact, it is often limited only by the horizon. The 737-700 increased-gross-weight variant has a 15-ft. plug between the wing and tail that is replaced and reinforced to carry the 3.5-ton radar and two 12-ft.-long ventral fins added for aerodynamic stability.

"The laws of physics and L-band's characteristics against stealth targets are players here," Deeble says. "It is different from the other [airborne] radars."

The latter comment refers to higher-frequency S- and X-band radars on AWACS aircraft and strike fighters. The lower the frequency, the easier it is to detect low-observable objects.

"The integration, the MESA technol-

ogy and the frequencies we've chosen to exploit will give us capability that has utility well into the future against a broader target set," Deeble says. "I see our [Wedgetail] technology being the new benchmark for the future."

A short list of capabilities includes 360-deg. coverage, 360-deg. beam on demand, variable revisit rates, multi-mode flexibility, emphasis sectors and track beams for raid assessment. The last capability means being able to count aircraft or cruise missiles flying close together at long range. The revisit rate is programmable to meet operational needs.

"It's fast enough to keep track of maneuvering targets that you could not keep track of if the radar was taking a snapshot every 10 sec., which is the scan rate of an AWACS," says Hendrix. "Supersonic missiles are in the target set. The technology also is there to pick out individuals walking in a huge area" like the savannah of northern Australia, where drug and immigrant smuggling is big business.

"We're on track to deliver full-up [Wedgetail] capability with the electronic support measures [surveillance] and radar improvements and everything else by the end of 2011," says Ian Thomas, president of Boeing's Australia and South Pacific

AUSTRALIAN DEFENSE

subsidiary. "As we've gone through the exercises with the RAAF and as they get more aircraft for training purposes, they are finding capability that they didn't fully anticipate. They are letting the guys in back dial up the network and pull in Super Hornets and other aircraft. That's opening their minds to the long-term potential that the [Wedgetail mission system] has. It is fundamental and central to the network-enabled capability of the air force."

The RAAF emphasizes the high degree of flexibility that comes with the technologies that they have chosen.

"Anything you can envision that is in the public forum on AESA [active, electronically scanned array] technologies could be adapted and evolve to MESA," Deeble contends.

But there are concerns about what the platform can or should be designed to do in the areas of electronic attack and network invasion, for example. The laws of physics and the choice of L-band militate against using the radar for electronic attack.

"Moreover, there is a danger in mixing some of those missions," Deeble says. "Just as there is non-kinetic potential with the AESA radars on fighter aircraft [in electronic warfare and jamming], there is a similar potential in the MESA. But you have to consider the type of aircraft you want to put non-kinetic attack options on. AEW&C vulnerability [in size, speed and agility] would be a factor. You don't want to make yourself too tempting a target when you are such a critical part of the network."

Delivery of the Wedgetail started in November 2009 with initial-configuration software. The next point of acceptance is in April with the addition of electronic support measures (ESM), software updates and electronic warfare self-defense packages. The self-protection system was integrated from its initial design with a full-hemisphere, missile warning system coverage and a countermeasure capability. A series of infrared sensors provides indications of



A closer look at two of the Wedgetail's workstations shows air and sea traffic off the northern coast of Australia.

missile launch. There are chaff and flare dispensers and a laser-based Directional Infrared Countermeasures system on the aft end of the aircraft.

The RAAF's initial monitoring of the system has been encouraging.

"We finished last year with three crews trained and four aircraft delivered," Deeble says. "We're aiming for final acceptance by the end of the year. That allowed the air force to come to grips with the capability for a year. At final acceptance, they'll have two years under their belts. Incremental software

“We're finding that there are modes and inherent capabilities that we did not conceive of earlier”

deliveries will improve areas like data links, radar performance, communications and mission-computing."

The aircraft has been flown in operational scenarios, participated in Pitch Black (a complex RAAF event involving international personnel) and Rim of the Pacific (Rimpac) exercises, and demonstrated its capabilities to the broader Australian Defense Force (ADF), the U.S. and coalition partners.

"The aircraft's potential is clear," Deeble says. "There are technical challenges to resolve, predominantly software

and conformance to standards for data links and communications."

No major hardware changes are envisioned. As for the radar, the work is predominantly in software for calibration of the sensor.

"We're finding that there are modes and inherent capabilities that we did not conceive of earlier," Deeble notes. "The radar specifications called for uniform 360-deg. coverage when in fact

we will not, in the main, employ the radar that way. We will use dedicated sectors that give agility to how you revisit targets of interest to increase radiated power and improve detection capability. We've had three opportunities to employ the aircraft operationally, and we're getting much smarter about how we want the system to work and how we want the radar to evolve."

Boeing and Northrop Grumman officials agree that giving up a standard sweep in order to apply more power and dwell time to smaller sectors of interest is an easy way to improve performance.

In pre-flight planning, operators build a radar performance plan to perhaps monitor an airfield using high update rates to spot activity or look deeper into other areas. At the same time, the operator can maintain complete IFF (identification friend or foe) monitoring and enough background surveillance to keep the aircraft safe while monitoring tankers and friendly forces.

The plan is loaded into the radar, which takes over the surveillance. Whatever the aircraft does, the radar adapts so that the mission crew receives the result they want without having to manage the system.

"We can do a lot more by applying more power and dwell time in a sector," says Egan Greenstein, Boeing's senior manager of business development for international surveillance and engagement programs.

A platform-stabilized mode provides a 360-deg. sweep with emphasis on a sector to yield more range and resolution, but at some expense to the background radar picture.

A north-stabilized mode coordinates

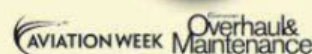


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the display with maps so that surveillance can be directed to gain a deeper look in a given direction where the targets of interest are. As the aircraft moves, the most radar power is directed into the threat axis.

"No matter what the aircraft does, the system automatically gives me a deeper look where I told it I [want] to watch more intently," Greenstein says. "If you take all of your power and put it into a dedicated sector, you roughly double your range. There is also the sector size and scan rate" to trade for even more range or resolution, he adds.

Moreover, a multi-simultaneous mode incorporates air-to-air, air-maritime and IFF sweeps, all operating in conjunction. All the sectors of interest and the tracking beams work automatically to take advantage of track-while-scan and deep-look options without the operators having to physically manipulate the sensor.

"The system responds to the operational situation," Greenstein says. "Set up the plan and then adjust it on the fly as necessary. The system responds to maintain track on targets as both they and the Wedgetail maneuver."

The Wedgetail aircraft carries a crew of 10, with two on the flight deck and up to eight in the mission compartment. There are six multi-role, multi-purpose mission consoles with high-resolution, flat-panel tactical displays.

"All the sensor and communications networks are provided to the operators in a single integrated air picture—ESM, radar, IFF, data links—that is shared with all the operators simultaneously," Greenstein says. "They see a simplified picture . . . presented in an intuitive way so that they can make rapid battlefield decisions."

"All 10 mission crewmen are clustered in the middle of the airplane," he adds. "All the loud and hot equipment is segregated in the back of the airplane so that the crew area is comfortable, and there is low noise so that the crew can communicate without the intercom. It flies for more than 20 hr. with air-to-air refueling, so there is room to bring eight [additional] crewmembers and give them room to stretch out."

The flight deck is largely the same as a 737 airliner. Keeping the Wedgetail common with commercial designs will ensure that it is not grounded for a military-unique problem at a distant airfield. However, the aircraft has all the necessary equipment for worldwide flight. ☐

Radar Renaissance

AESA radar matures and Wedgetail program speeds up as a result

DAVID A. FULGHUM/BALTIMORE and CANBERRA

The Wedgetail early warning and control aircraft, the heart of the Royal Australian Air Force's new, airborne network-centric organization, will become operational later this year. Its introduction comes after more than four painful, but perhaps technologically and operationally important, years of delay.

The Australian military was stunned in 2006 to discover that the Boeing aircraft—designed as the heart of its modern, airborne, net-centric air force—was going to be delayed by two years, later extended to more than four, because its advanced, long-range radar needed both hardware and software improvements.

The delay saga is complex, but Australian, Northrop Grumman and Boeing officials agreed to discuss with Aviation Week what happened just as the Wedgetail is nearing the start of its operational life with the RAAF's No. 2 Sqdn. and 42 Wing.

The first problem involved the "end-fire" portion of the radar that provides the fore and aft segment of its 360-deg. coverage. A long, hollow chamber atop the radar had been carefully shaped to deflect a portion of the radar's beams 90 deg. from the vertical to the horizontal, shape those beams into waves, and fire them both ahead and behind of the aircraft. The fore and aft scanning filled in the coverage between side arrays that looked left and right.

The "top hat" chamber should have acted like a well-designed opera house to carry the music undistorted to the audience in the back rows. Because the technology was new, the original chamber fitted above the vertically firing, transmitter modules (which create the fore and aft transmissions) was built 4-in. too low. The result was an electronic cacophony of distorted signals.

The RAAF had embraced development of the Northrop Grumman multi-role electronically scanned array (MESA) radar for a number of reasons. Compared to traditional mechanically scanned radars, the range of the radar could be at least doubled, cruise missile-size targets could be detected, maintenance

Northrop Grumman personnel lower a multi-role electronically scanned array (MESA), low-frequency radar into the strengthened aft body of a Boeing 737-700 AEWC aircraft.

cost would drop by 90% and, most significant, coverage could be extended to 360 deg.

Australian and U.S. officials have been scarred by the political and financial uproar that ensued. They now refer to advanced, first-of-type products as "bleeding-edge" technology.

"We learned an awful lot about the challenges of big integration projects like this," says Egan Greenstein, Boeing's senior manager of business development for international surveillance and engagement programs. "We wouldn't necessarily approach a new project the same way we did Wedgetail."

"Ten years ago when I talked to the Northrop Grumman engineers I was given ironclad assurances that the top hat had been tested and proven," says an Australian radar analyst. "They did not tell me they were building a cavity endfire, which is not a configuration you would find in any engineering text."

RAAF officials say they don't want to be the lead customer again in an all-new technology anytime soon, but they are not disappointed in the Wedgetail potential nor deterred in the quest to make the RAAF a technological marvel of well-networked, highly integrated platforms that can perform equally well in both natural and military emergencies. Moreover, the refined aircraft and radar design has now been adopted by Turkey and South Korea.

The top hat, with its end-fire array positioned atop the radar's dorsal fin, was developed specifically for the Wedgetail





BOEING

program. Consequently, engineers were inventing the theory to build the radar, which involves more than 1,000 radar signal radiators that feed the long, narrow pedestal array. The radiators assigned to fore and aft coverage point straight up from what is called the "bed of nails" (referring to the rows of hundreds of emitters on the floor of the cavity).

The antenna modeling, which was being invented during the early stages of the program, "indicated there needed to be a 10-in. separation between the radiating surface and the top of the radome cavity," says Bob Hendrix, chief architect for the Northrop Grumman Systems Div. ISR (intelligence, surveillance, reconnaissance). "This separation ultimately proved insufficient during testing, causing a partial redesign of the radome and perturbation to the program."

The end-fire design creates a traveling plane wave that grows in power as it moves forward or backward along the cavity. But because the space was so narrow, the phasing of the wave did not allow it to be strengthened and shaped properly by the subsequent rows of emitters.

"It's like an orchestra where the con-

ductor needs to make sure that each musician does not absorb or distort the sound from the others," Hendrix says.

Designers created a program to increase the outer mold line of the aircraft, but that created an aerodynamic impact on the aircraft which had to be defined and compensated for by a new series of wind tunnel tests, adding to the delay.

"These L-band T/R [transmit/receive] modules are very high power because they have to see [for] hundreds of miles in all directions," Hendrix says. "Fighters have a more limited scan [perhaps 120 deg. or less] and don't have to look that deep. Now we have very stable hardware and software so we can make many improvements—perhaps for a 10-year window—with software modifications."

"Another capability is self-healing, says Paul Kalafos, vice president of the ISR Systems Div.'s Surveillance Systems unit. "The radar has the ability to reconfigure and compensate for failed modules. Between 5-10% of the T/R modules could fail without noticeable effect on system performance."

A second, longer-lasting problem was refining the software for the baseline Wedgetail missions and capabilities that were constantly evolving as electronically scanned array radar technology matured.

"Part of what took so long was wrapped up in [tweaking the software]," Hendrix says. "We had to optimize the radar and IFF [automated identification friend or foe] processing to pull tiny targets out of cluttered backgrounds. You are always challenged by the false alarm rate. You have to reduce that for the surveillance operators."

"We also had issues with stability. The software has to be tightly synchronized, a process you normally go through as part of development. Some of the complete functionality can only be fully integrated and validated in flight test."

"As software gets more complicated there are more opportunities for errors in integration, maturation and stability to crop up," Greenstein says. "As we attempt to integrate more sensor data into one spot and present it intelligently, preserving the quality of that data is a hard thing to do. That was one source of delay on the program—getting to the point that the tracks were good and the operators had the data [that they needed]."

But again, the benefits—shrouded in classification—may be worth the wait. With enough funding, these would include software development and capa-

bilities such as focusing radar beams on a single point to serve as anti-missile weapons or generating data beams that can be packed with algorithms to invade enemy communications networks.

When the available power is focused through a smaller sector of coverage, the output goes up, allowing the detection of smaller objects at longer range. The new target set includes stealthy cruise missiles and aircraft now under development by Russian and Chinese industries for export. Greater computing power allows the easier identification of objects whether they are moving or not.

"You have the answer if you know what AESAs [active, electronically scanned arrays] are capable of," Kalafos says. "Now [with the radar problems solved] it's all about the algorithms and what you want to do operationally. We're looking to the future steps and will continue to do so beyond the next decade. Right now we're focused on Generation 2 performance [which includes enhanced] performance in clutter and improved ranges—far beyond our current baseline."

Hendrix adds more detail to the near-term possibilities.

"[Improvements will be generated] mainly through the use of software that we think has quite a future," he says. "It includes a set of algorithms that will pull targets out of deeper noise and clutter, allow multi-scan techniques and focus [the radar's] power wherever you want."

"We've been operating the aircraft since May," says Group Capt. James Hood, who leads the ground-support segment for the wing and No. 2 Sqdn. "We've been able to achieve 100% availability for 42 Wing in all months except for 93% in July. [And then] it wasn't the radar, it was the sheer volume of work that comes through a organization when it is setting itself up. We missed a couple of internal deadlines, so we lost the use of one aircraft for a day. That indicates most systems on the aircraft are easy to maintain."

"The crews are relatively happy with the radar," Hood says. "There are still some residual performance issues, but it is sufficient [for training purposes]. Almost all the issues coming through now are software-related. That's true of the mission computing system, the radar and the communications system."

The RAAF is setting up software development labs so they can keep optimizing and changing the software year-round. Upgrades are expected about every six months for the next 30 years. ☐

AUSTRALIAN DEFENSE

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Aardvark To Super Hornet

New Super Hornet squadrons stand up for training and operations

DAVID A. FULGHUM/RAAF AMBERLY

The Royal Australian Air Force's long-serving F-111s were retired late last year, but some veteran aircrews are turning their strike experience to creating the first two squadrons of the 24-aircraft F/A-18F Super Hornet force.

The F-model Super Hornet has a two-person crew, like the F-111, and a portion of the latter's navigator-bombardiers are being retrained as weapons systems officer (WSO) cadres and aircrews for the Boeing F/A-18F. WSOs will be a sub-specialty within the larger RAAF category of air combat officer (ACO), which was instituted about five years ago. If Australia decides, as planned, to turn 12 of the F-models into EA-18G Growler electronic-attack aircraft, another ACO specialty will be added for electronic warfare officers (EWO).

The second F/A-18F unit is standing up as No. 6 Sqdn., which will serve

as the RAAF's primary Super Hornet operational training unit that also supplies aircrews to No. 1 Sqdn. So far, 15 aircraft have been delivered and another are nine scheduled this year, five in July with another four in October-November.

"We take the airmen—pilots and WSOs—and turn them into functioning crews before feeding them into No. 1 Sqdn.," says Wing Commander Terence Deeth, No. 6 Sqdn.'s commander. Deeth is a former F-111 WSO who was part of the first two crews to go through the new aircrew training program. "With retirement of the F-111, there's only one place for WSOs to go. The [training process for Super Hornet] is in its infancy. At the moment, we're doing the same sorts of things as [those training for the older] classic F/A-18s. We have the capacity to do it a little bit better."

That understates the advanced capabilities of the Super Hornet, which comes

equipped with a Raytheon-made active, electronically scanned array (AESA) radar that can pull small targets out of ground clutter for precision strike attacks. It also serves as an air-to-air radar with more than twice the range of a conventional radar and the ability to find low-observable cruise missiles, for example. The design of AESA radars cuts maintenance by about 90% along with the need for support personnel. Radars are expected to last the lifetime of the aircraft without replacement or removal.

"There are many more capabilities available from the F-model within the fast-jet force air combat group than there ever was with the F-111," Deeth agrees. "We're looking to exploit those [data transfer] capabilities. It's all about network-centric warfare."

"One of the most interesting technologies we have is JHMCS [joint helmet-mounted cuing system] for both the front and back seats," he says. "It's sensational because you don't have to refer back to



Two RAAF squadrons, No. 1 and 6, are being equipped with Boeing F/A-18F Super Hornets as key new elements in Australia's net-centric defense force.

Aircrew candidates undergo pilot/WSO training and are then screened based on the RAAF's requirements and personal assessments of their skills and aptitude. A key determinate is interaction in a crew environment. Once they finish the F-model transition course, they go to No. 2 Sqdn.

"The difference between what the U.S. Navy does and what we are doing is that we are training from the first day as a crew and they go all the way through that way," Deeth says. "That comes from our experiences with the F-111."

The training program also is shaped in part by exchange programs with the U.K.'s Royal Air Force Tornado, U.S. Air Force Boeing F-15E Strike Eagle and U.S. Navy Super Hornet units.

"We threw that into a melting pot based on the classic Hornet," says Deeth who completed the transition course in November. "I made it my business to do the course from start to end so that as commanding officer, I would know the standard and the issues that might spring from the Australian context."

There are three phases to the operational conversion course:

- Airmen come straight from the introduction fighter course as a crew. They complete F-model, general flying familiarization and instrument flying in the first phase and receive a restricted instrument rating.
- Air combat maneuvering and air intercept using the radar and other sensors are included in the second phase.
- Air-to-ground operations are a large part of the final phase. That includes offensive and close air support, interdiction using the aircraft and its sensors, and both maritime and long-range strike. Cruise missiles are part of the target set.

Deeth went through the crew training paired with a classic, single-seat Hornet pilot who will serve as an instructor. The training course will start inducting trainees later this year as Super Hornet deliveries build up the force.

"As to matching a crew, we're going to do something a little different," Deeth says. "We plan to pair four student crews and then change them throughout the course—normally for the simulator sessions. When they actually fly, it will be with instructor aircrew. Occasionally, they will have solo flights with their crew buddy as wingman to an instructor crew."

So far, WSOs have come from the F-111 force, which offered a pool of crewmen with fast-jet experience. A two-crew class started training in January, and the first new WSOs also begin training early this year. Classes will provide crews for Squadrons 1 and 6.

"Aircrews are normally younger [than in the U.S.] when they go to the squadrons because they don't have to go through tertiary [university] education," he says. "We can actually recruit a guy, put him into a fast jet and [at the age of] 20-21 years old they are qualified as a WSO or a pilot."

"It takes all kinds," Deeth says. "There are left- and right-brain people in both the front and back seats. If you make a sweeping generalization, these people tend to be more analytical, but not always. They all have what we call 'tiger.'"

The future for EA-18G training is still murky and somewhat at the mercy of politics and defense budgeting.

"We haven't done any official thinking about how training will differ for EWOs," Deeth says. "There will be significant differences." The decision to do anything with Growler is yet to come. ☛

the HUD [head-up display] to see [targeting] information. We're spending a lot of time to ensure we're exploiting that capability in both the air-to-air and air-to-ground environments. We're working on who does what at any given time."

Vigilare's Victory Lap

Complex integration paced the performance of Advanced C4ISR System

DAVID A. FULGHUM/MELBOURNE

Before demonstrating success, any advanced first-of-kind military technology is guaranteed to produce cost, technology, schedule and political nightmares. Whether in Canberra or Washington, those expeditions into the unknown provide targets for budget-cutting zealots.

In the U.S., the Northrop Grumman B-2 Spirit, Lockheed Martin F-22 Raptor, Navy A-12 and now the F-35 Joint Strike Fighter prove the point. The stealth fleet is about 10% of what

it was once projected to be. Moreover, the proposed size of this unique stealth fleet continues to be whittled away just as low-observable technology is emerging in Russia and China.

In Australia, two much-criticized programs have been the Boeing Wedgetail airborne early warning and command aircraft (AEW&C)—equipped with a unique, long-range, stealth-detecting radar—and the Vigilare ground-based, network-centric command-and-control system that provides—again,

AUSTRALIAN DEFENSE

uniquely—a combined, information-packed, commercial/military, air/sea picture of Australia and the surrounding area that has not been duplicated anywhere else.

After years of delay, however, both elements are now fast-tracking their way into operational use (see p. 55). There are hints that each will have a role in non-kinetic warfare.

Boeing researchers are looking at bringing an electronic and a cyber-attack planning capability within the system so that even international users can exploit this type of data. Electronic surveillance generated by combat aircraft is translated into a common format whose picture can then be shared via links to coalition partners.

The Vigilare program is so close to reaching its operational capability at Boeing's Brisbane-based test facility that development is being dismantled for installation as the program's last field site nears completion.

It is designed to provide C4ISR (command, control, communications, computers, intelligence, surveillance and reconnaissance) capabilities over a wide geographic area. A more-limited version was installed in Malaysia to provide a

Those air-related intelligence sources are “where communications and signals intelligence and cyber capabilities could be fed in,” Davis says. “Also, there are links to the Wedgetail AEW&C, fighter and maritime patrol aircraft as well as ship and satellite connections.

“I can't speak for the air force, but certainly the cyberwarfare capability is something we are looking at,” he says. “There is a market. Other features are secure and non-secure voice and data communication with external agencies. That means the system has interoperable, multi-level security built in.”

Vigilare is designed for round-the-clock operations of the RAAF's two regional operations centers. North ROC at RAAF Base Tindal near Darwin in the north, which has been operational since July 2010 and providing primary surveillance and battlespace management coverage of Australia since Sept. 2. East ROC is scheduled to be operational in July.

The system displays data from air force deployable tactical air defense radars as well as civilian and military air traffic control radars—about 40 in all—as well as civilian air services and flight-planning data feed.

The Jindalee Operational Radar Network (JORN) is tied into Vigilare as well. The high-frequency-band, ionosphere-bouncing, over-the-horizon radar claims a surveillance area of 3,500 km. But that is deemed a significant understatement. JORN monitors air operations for East Timor, New Guinea and the Solomon Islands. Some specialists contend that JORN has detected aircraft flying near Guam.

Vigilare is designed to automatically correlate diverse sensor input to produce a recognized picture. However, all those sensors present a fusion problem that is addressed via integrated system management.

“Because of the geographic footprint of the system and the number of components involved, that [management] technology has become key for reducing operator workload and maintenance of the system,” Davis says. “It also has a redundant design for some of the core components. For example, track monitoring and air picture-generation systems are on hot standby.”

A cyberattack on Vigilare or some other disaster that damages the system can be relatively quickly repaired.

“The entire site can be rebuilt from scratch in a matter of hours” without going to the remote sites, Davis says. There is one central backup recovery system for more than 50 servers. There are two main operations centers that can run isolated or concurrently. Suites of devices can cross-map the systems and reconfigure networks on the fly if some element is disabled.

Planners are looking at three-dimensional radar concepts to improve the system with even greater detail. But even now Vigilare has achieved a unique status. It provides theater-wide situational awareness and monitors in excess of 10,000 tracks while applying automatic identifications tools so operators can focus more on refining local pictures.

“Other people have the pieces, but nobody has everything integrated like Australia,” Davis says. “Vigilare was designed by a number of engineers who also worked on Wedgetail, so its integration was part of the life-cycle development. ☐



The Vigilare system creates a unified air-sea surveillance picture by fusing the information from several key national and international sources of sensor and intelligence data.

network-centric, ground-based, air surveillance and control system for air defense. Now a much larger variant is being completed for the Royal Australian Air Force. This version will provide a continental air picture and coastal surveillance while supporting concurrent missions.

“In terms of managing the air battle, Vigilare is key [to] providing the connection between network-enabled platforms and the ground,” says Lee Davis, Boeing's director for Vigilare. “There was huge design integration between Wedgetail and the East regional operations center (ROC) at RAAF Base Williamstown near Sydney. Wedgetails, Super Hornets and Vigilare share data via Link 16.

The RAAF initially focused on a tactical, air operations center-type setup, but is morphing into an expandable, network-centric platform for the whole Australian Defense Force. The integration of new interfaces into the system has introduced a more strategic capability by linking with a number of air operations centers and intelligence organizations.

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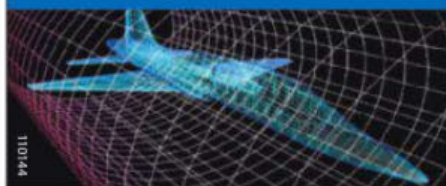
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Shrink To Fit Is Not A Good Strategy

There is a good chance that aerospace/defense again could be fundamentally reshaped in the years ahead as the industry enters a new era of flat or declining budgets following a decade of double-digit growth. Procurement chief Ashton Carter has signaled the Pentagon will not stand in the way of market forces that drive lower-tier suppliers toward more mergers and acquisitions (AW&ST Feb. 14, p. 24). Pardon us if we don't jump for joy.

The last time the Defense Department invited companies to consolidate was in the early 1990s, when there were more prime and second-tier contractors than the government could support. It was not long before the action seemed to take on a life of its own, and for awhile the pace of mergers and acquisitions grew so frenetic that you practically needed a scorecard to stay current. Whether the aerospace/defense industry and U.S. national security are better off today, all things considered, is still a matter of debate. But some of the very captains of industry who wrought this consolidation now believe the Defense Department allowed the Darwinian process to go too far.

So here we are, a decade and a half later, and the number of lower-tier suppliers—the companies responsible for most technology innovation and entrepreneurial risk-taking—continue to dwindle. A combination of consolidation within their ranks, acquisitions by much larger contractors and companies simply exiting the business is taking a toll. And now the Defense Department effectively is encouraging *more* consolidation—and generally is OK with the industrial base shrinking *even further*?

The Pentagon has a long track record of failing to heed lessons of the past, so it would come as no surprise to learn that little or no forethought went into the green light for more consolidation.

Admittedly, a case could be made for encouraging some degree of consolidation among these smaller players. With the aerospace/defense industry facing leaner times, and large systems integrators facing more stringent demands for weapons systems delivered on time and on budget, the smallest companies will suffer the most, regardless of how innovative they are. Some observers point out the amount of work available from government customers simply will not support all of them. As a result, many suppliers and their engineering talent will be put at risk.

Perhaps there is a judicious level of consolidation that might actually be desirable. But reaching that point will require a good understanding of exactly what is needed to sustain a vibrant defense industrial base. And that speaks to a larger problem—more a matter of negligence, really—which is the absence of a coherent defense industrial base policy. The fact that the Pentagon essentially has operated without one for years implies that the Defense Department takes its lower-tier suppliers for granted, with little regard for their essential role in the production capacity needed to meet many of the military's most demanding requirements.

To its credit, the Pentagon is funding some R&D solely to preserve certain capabilities, such as those of design teams for a new stealthy bomber. Moreover, it is conducting a sector-by-sector analysis to determine what other capabilities the government can-



GIN AEROSPACE

“The forces that are bearing down on the industry are not the same ones that set the stage for the massive consolidation of the 1990s.”

not afford to lose. But it is unnerving to learn that such a road map was not already in place.

While it is true that market forces have their place in helping to reshape the competitive landscape—with the spoils going to innovative, better managed, better capitalized companies—the Pentagon has been strangely silent on a salient point. The market forces that will be bearing down on the industry are not the same ones that set the stage for the consolidation of the 1990s. Then, there were numerous original equipment manufacturers and there was ample room for the manufacturing base to be sized according to the workload they could expect. There also were multiple large-scale manufacturing programs under way. Furthermore, the industry was driven by a completely different business philosophy; back then, many companies, managed largely by engineers and founders, developed products in anticipation of sales. Today, shareholder value is the driving force.

Aerospace/defense is not just another collection of companies, and if Carter and other government officials believe market forces provide the best mechanism for determining the correct size of the industrial base, that is cause for alarm. At the end of the day, it may be the law of unintended consequences that prevails. The current administration will have moved on, leaving it to successors to repair the damage, if it is repairable. ☐



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