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AVIATION WEEK
& SPACE TECHNOLOGY

DEPARTMENTS

UP FRONT

THE WORLD

U.S. BUDGET CRISIS

26

If the F-35 program is delayed or killed, the U.S. and its allies will need additional aircraft with a reduced radar signature, such as the F-15 Silent Eagle, or the ability to carry standoff weapons with enough range to penetrate sophisticated air defenses.

DEFENSE

SPACE

AIR TRANSPORT

COVER STORIES

A Royal Air Force Hawk Mk 128 (top) flies in formation with a restored T-38 painted in U.S. Air Force Thunderbirds colors and owned by the Gulf Alliance. BAE Systems photographer Jim Wilson was perched open air in the tail gunner position of a B-25 during the Fort Worth Alliance Air Show in October. BAE brought two Hawks for an air show stint in the U.S. as part of its campaign with teammate Northrop Grumman for selection of a Hawk variant in the USAF T-X program to succeed the T-38C fast-jet trainer. Our coverage of developments in the training sectors of military and civil aviation begins on page 44.

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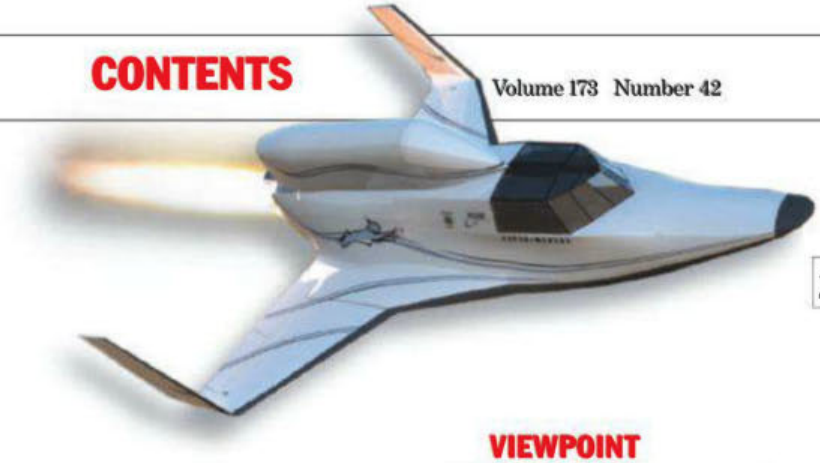

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BEN COOPER

PHOTO CONTEST

Weigh in by selecting your favorites from Aviation Week's 20th Annual Photo Contest. Winning photos and select Readers Choice images will appear in our Dec. 19/26 issue. **AviationWeek.com/photos**

HAWK FLIGHT

Senior Pentagon Editor Amy Butler flew on the BAE Systems Hawk as part of her reporting on the forthcoming USAF T-X fast-jet trainer competition. Read her story on p. 48 and go to our Ares blog for pictures and an account from the flight. **AviationWeek.com/Ares**

RAISING EYEBROWS

Our weekly Strange But True blog features bizarre, odd and sometimes downright scandalous news from the global aviation industry. Click onto Things With Wings each Friday for the latest. **AviationWeek.com/wings**

LAUNCH VIDEO

Blue Origin, the secretive startup rocket company founded by Jeff Bezos of Amazon.com fame, has released video of its latest vertical takeoff/vertical landing vehicle in a short test flight. Shortly after the video was shot, the test vehicle was lost, but Bezos says the company already is working on another one. See a link to the video in Senior Space Technology Editor Frank Morring, Jr.'s Nov. 18 post. **AviationWeek.com/onspace**

BLUE ORIGIN

PREMIUM CONTENT

Use the World Aerospace Database to find suppliers in thousands of product categories and subcategories. Its powerful advanced search tool allows you to find potential suppliers based on location, disadvantaged or minority-owned status, sales volume and more. **AviationWeek.com/awin**

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FROM THE WEB

Comments from readers on AviationWeek.com

Robert Wall wrote from the Dubai Air Show that Airbus expects to easily top its 2007 order record. COO-Customers John Leahy projects 1,650-1,700 gross orders this year.

Aircraft Man adds:

The introduction of the A320NEO has in a very short time proved to be just what the airline industry was looking for in a era of ever-increasing fuel costs, and its superb sales performance speaks for itself. Also the A380-800 is way out on its own as the Boeing 747 was 40 years ago. The A380 has no real rival and is selling steadily and to new operators, too. I look forward to American Airlines taking the wonderful A380 to heart and not being Boeing-biased.

And S.M. Husein comments:

As the Emirates CEO put it, his airline's focus is on economy-class passengers and their comfort on long-haul flights, for this is where the money actually comes from. But we are building more spacious airliners, rather than more seats, and nothing is done about the available space to the economy-class passenger for it is a real tight fit there.

Wall also reported on the United Arab Emirates' invitation to Eurofighter to bid its Typhoon for its combat aircraft replacement and how this was another swipe by the UAE at Dassault and its Rafale offering.

Taildragger responds:

What Dassault needs is a well-trained and savvy sales staff and crew that also sells airliners. Wheel and deal!

And Sufa Viper notes:

This report confirms what I had been hearing in regard to Dassault not working with UAE. I think any aircraft UAE buys will be highly specialized, much like the Block 60 F-16. That means the Block 60 could end up back in the hunt for this 60-aircraft contract.

Join the discussion at :
www.aviationweek.com/avweek

FEEDBACK

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

CAN CHINESE SAVE HAWKER?

Regarding the Up Front column "Hawker's Future in China" (*AW&ST* Nov. 7, p. 14), similar to what the Gulfstream V did for Gulfstream, Hawker Beechcraft needs a "Hail Mary" play.

Simply, it needs a monumental capital investment to create a line of blockbuster aircraft that will spark worldwide interest. The investment is not going to come from Goldman Sachs or Onex Granted, a huge Chinese investment will do Hawker a lot of good. But I'm not sure it gets the Chinese a clear path to the thriving aerospace and defense (A&D) business that they want. After all, composite fuselage technology can be duplicated easily or obtained elsewhere.

Honeywell and Rockwell Collins manufacture the avionics for Hawker aircraft, and will not be anxious to transfer proprietary information that will help establish a competing entity. The same can probably be said about the Pratt & Whitney, Williams and Honeywell engines. Take away those three items and there is not much left. If the Chinese really want to establish their own, in-country aerospace concerns, they are going to have to do it themselves. Technology transfers will play a big role, but the ultimate engineering and business case will have to come from within. The simple purchase of A&D companies does not guarantee success.

CEO Bill Boisture has assembled a world-class aircraft sales and marketing team. With the business jet environment showing little improvement, I am not sure that is enough. Hawker's best plan may be to split off its segments.

Craig Picken
WILMINGTON, N.C.

THE ADVANTAGES OF UNDERRUNS

In response to your interview with National Reconnaissance Office Director Bruce Carlson (*AW&ST* Nov. 14, p. 56), here is my perspective as a retired U.S. Air Force general/program director and a vice president/general manager at Lockheed Martin Space Systems.

What does an underrun mean to a contractor? Underruns translate to greater return on sales and profits, and higher earnings before interest and taxes. Underruns keep customers happy.

The space business, however, holds mission success, technical performance and risk minimization as higher objectives than cost performance. Sufficient incentives exist in government business regardless of contract type, since all now penalize profitability measures when cost goals are not achieved. Also, government should take advantage of improving procurement efficiencies.

Leonard Kwiatkowski
SAN JOSE, CALIF.

NO FREE VTOL LUNCH

Reader Virgil Soule is correct that a low disc-loading tiltwing would be simpler and lighter than an equivalent tiltrotor (*AW&ST* Oct. 3, p. 8). The problem occurs in trying to transition from hover to forward flight. At low speeds when the wing is upright, it becomes a huge speedbrake making it nearly impossible to attain a high enough speed for the wing to translate down enough unstall.

Tiltwings have been successfully flown, however, the transition problem was solved by using high disc-loading propellers that kept the wing immersed in high-velocity flow until it could attain enough speed to become wingborne. Unfortunately, the high disc-loading resulted in poor hover efficiency, even worse than with the classic tiltrotor. There is no free lunch in the vertical-takeoff-and-landing business.

Vaughan Askue
Sikorsky Aircraft Corp.
STRATFORD, CONN.

IT'S THE SEMANTICS

I was a little surprised by your Top 10 A&D deals table (*AW&ST* Sept. 26, p. 28). It lists Snecma as being acquired by Safran in 2005 for $6.2 billion, but in fact Safran was created in 2005 by the merger of Snecma and Sagem. Snecma was the larger company, but the merger was structured as an acquisition by Sagem. The new group subsequently sold off Sagem's mobile phone and telecommunications businesses to focus on aerospace, defense and security.

Don Siegel
PARIS, FRANCE

(It's a matter of semantics. Sagem acquired Snecma and renamed everything Safran. It was a merger but many mergers are accomplished by one company buying the other's stock—Ed,)

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WHO'S WHERE

K.L. Bedingfield

Benet Wilson

Arlene Wilson

David Surley

Nicole Goodstein

Jeff Patterson

Mark Bennett

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

Kenneth L. Bedingfield (see photo) has been appointed Falls Church, Va.-based corporate VP, controller and chief accounting officer of *Northrop Grumman Corp.*, succeeding **Kenneth N. Heintz**, who will retire next year.

Charles Schubert has been named VP-network planning and **Andrew Backover** VP-corporate communications at *American Airlines*. **Pedro Fabregas** was selected as senior VP-customer service for American Eagle. Schubert succeeds **Walter Aue**, who will retire after 37 years with the company, and Backover follows **Roger Frizzel,** who left the company. Fabregas replaces **George Hazy**, who will retire after 32 years.

Luis Gomes has joined *Surrey Satellite Technology Ltd.*, Guildford, England, as director of the Earth observation and science unit. He was head of business for the unit.

Benet Wilson (see photo) has been named director of media relations for the *Aircraft Owners and Pilots Association*, Frederick, Md. She joins AOPA from Aviation Week, where she was online managing editor for business aviation and a reporter for *The Weekly of Business Aviation*.

Matthew Greene has become VP-program management for *Safe Flight Instrument Corp.*, White Plains, N.Y. He was VP-marketing.

Arlene Wilson (see photo) has been appointed program assistant for the *University of Central Florida Business Incubator* at Daytona International Airport, Daytona Beach, Fla. Wilson held an administrative position for ITT Community Development Corp.

William Cikos has become director of finance and administration for *Purolator International*, Jericho, N.Y. He was director of finance responsible for Europe, Middle East and Africa for the Estee Lauder Companies.

Mason Peck has been named *NASA's* chief technologist through an intergovernmental personnel agreement with Cornell University, where he is an associate professor in the School of Mechanical and Aerospace Engineering. He succeeds **Robert Braun**, who returned to his teaching and research positions at the Georgia Institute of Technology.

David Surley (see photo) has joined *Cambridge Airport* in England as senior business manager. He was head of customer services and route development at London Oxford Airport.

Bryan F. McCreary has become VP-fluid and business development for *Integrated Deicing Services*, Manchester, N.H. He was North American business manager for Clariant Corp.

Amir Neeman has been appointed VP-government business of Palo Alto, Calif.-based *Qylur Security Systems*. He was a director at LeighFischer.

Nicole Goodstein (see photos) has been named director of Global Total Rewards for *Gulfstream Aerospace Corp.*, Savannah, Ga. She was director of Global Benefits at Cisco Systems. **Jeff Patterson** has become a senior manager for product support sales and **Mark Bennett** manager of community relations. Patterson was technical sales manager at West Star's Dassault Falcon facility, and Bennett worked for Alabama Power Co. and Delta Air Lines.

Johnson Yan has joined *Quantum3D*, San Jose, Calif., as VP-engineering. He was senior VP-sales and business development at Jile Systems and VP-marketing and business development at Silicon Motion.

Derek Sharp has become president and managing director for the Americas at Atlanta-based *Travelport*. He comes from Electronic Data Systems/HP Enterprises Services.

Eliot (Lee) G. Sander has been appointed president/CEO of New York-based *HAKS Group*. He was CEO of the Metropolitan Transportation Authority of New York.

Antoine Marez has been named director of strategic purchasing of *Revima APU*, Caudebec-en-Caux, France. He headed Pratt & Whitney Canada's Aftermarket Management Div. and was general manager of Chromalloy France.

HONORS AND ELECTIONS

David Neeleman, chairman of Azul Linhas Aereas Brasileiras, has received the 2011 Federico Bloch Award, given by the Rio de Janeiro-based *ALTA, the Latin American and Caribbean Air Transport Association*. The award honors a leader in Latin America and Caribbean aviation who exemplifies the leadership, courage, character and vision of TACA's late CEO, Federico Bloch. **Mauro Kern**, Embraer's executive VP-engineering and technology, received the Rolim Amaro Award for emulating the customer-focused standards of Rolim Amaro, CEO and founder of TAM Airlines.

New members of the board of directors of the New York-based *World Teleport Association* are: **Adrian Ballintine**, CEO of Newsat of Australia; **Tomaz Lovsin**, managing director of STN of Slovenia; and **Bill Tillson**, president and chief operating officer for U.S.-based Encompass Digital Media.

Michael W. McCormick, executive director and chief operating officer of the Global Business Travel Association, Alexandria, Va., has been named to the Aviation Security Advisory Committee of the *U.S. Transportation Security Administration*.

Mary L. Zuckerman has been elected chair of the Detroit's *Wayne County Airport Authority*. She is executive VP and chief operating officer for the Detroit Medical Center.

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BY JOSEPH C. ANSELMO

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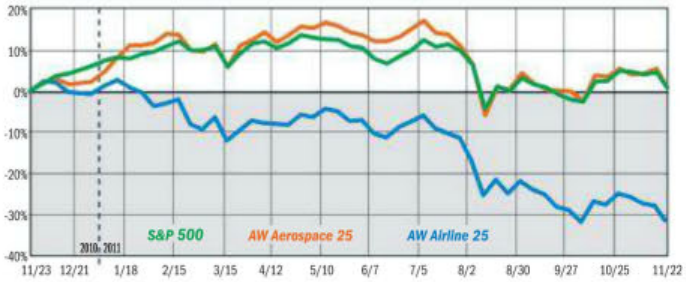
AW&ST/S&P Market Indices

(as of 11/22/2011) PERCENT CHANGE

MARKETS	INDEX VALUE	WEEK AGO	YEAR-TO-DATE	YEAR AGO
AW Aerospace 25	1254.2	-4.7% ▼	-1.9% ▼	0.7% ▲
AW Airline 25	730.9	-5.3% ▼	-32.2% ▼	-31.9% ▼
S&P 500	1188.0	-4.0% ▼	-5.5% ▼	0.6% ▲



Weekly Market Performance

Closing Prices as of Nov. 23, 2011

Company Name	Current Week	Previous Week	Fwd. P/E	Tot. Ret. % 3 Yr.	Tot. Ret. % 1 Yr.	
AEROSPACE & DEFENSE						
AeroVironment Inc.	30.43	33.07	21.6	-6.1	26.4	▲
Allegheny Technologies Inc.	45.37	50.00	13.9	183.4	-8.6	▼
Alliant Techsystems Inc.	56.61	60.27	6.8	-24.6	-22.5	▼
BAE Systems plc	4.05	4.50	6.3	-1.4	-18.8	▼
Boeing Co.	64.35	67.94	13.9	77.4	3.7	▲
Bombardier Inc. 'B'	3.79	4.21	8.0	2.5	-15.8	▼
Cobham plc	2.65	2.86	8.2	13.9	-10.8	▼
Curtiss-Wright Corp.	30.72	32.97	10.8	10.6	1.8	▲
DigitalGlobe Inc.	15.40	16.94	24.2	....	-49.4	▼
EADS NV	27.77	29.70	13.6	98.1	24.6	▲
Eaton Corp.	42.56	46.44	9.7	124.5	-8.6	▼
Elbit Systems Ltd.	40.36	42.82	7.6	-0.5	-13.6	▼
Embraer-Empresa Brasil ADR	24.67	26.74	....	98.6	-10.2	▼
Esterline Technologies Corp.	51.36	57.66	9.9	75.9	-11.0	▼
Exelis, Inc	9.46	10.23	....	....	....	
Finmeccanica SpA.	4.06	4.83	-12.5	-61.9	-63.8	▼
FLIR Systems Inc.	24.61	26.36	14.9	-12.9	-6.8	▼
General Dynamics Corp.	63.62	65.99	8.5	32.5	-1.7	▼
General Electric Co.	14.99	16.20	10.3	20.6	-1.7	▼
GKN plc	2.66	2.97	7.3	260.4	-6.6	▼
Harris Corp.	34.47	38.31	6.5	22.9	-22.6	▼
Hexcel Corp.	22.99	25.05	17.4	281.9	39.0	▲
Honeywell International Inc.	50.96	54.78	11.9	119.5	5.4	▲
Kratos Defense	5.16	5.42	25.4	-62.1	-51.8	▼
L-3 Communications Hldgs. Inc.	63.77	68.83	7.3	6.2	-7.9	▼
Lockheed Martin Corp.	74.47	77.85	9.8	13.7	13.5	▲
Moog 'A'	38.32	40.12	11.6	43.1	6.9	▲
Northrop Grumman Corp.	54.40	59.45	8.0	74.9	1.0	▲
Orbital Sciences Corp.	14.15	15.58	14.5	-14.7	-14.1	▼
Parker-Hannifin Corp.	78.03	85.33	10.5	139.4	-0.6	▼
Precision Castparts Corp.	154.51	164.60	16.3	200.4	14.4	▲
Raytheon Co.	43.46	45.59	8.4	-0.7	-3.0	▼
Rockwell Collins Inc.	52.37	55.12	11.7	82.3	-3.5	▼
Rolls-Royce Group plc	10.61	11.47	13.9	162.3	13.3	▲
Safran SA	28.24	29.63	10.8	152.3	-9.9	▲
SAIC Inc.	11.52	12.47	8.5	-36.3	-25.3	▼
SIFCO Industries Inc.	19.53	18.90	....	362.2	44.6	▲
Singapore Technologies Eng.	2.09	2.20	15.1	46.2	-13.4	▼
Spirit Aerosystems Holdings	18.61	19.93	8.6	138.6	-1.7	▼
Textron Inc.	18.01	18.73	12.1	41.1	-16.0	▼
Thales	30.53	33.05	9.2	-17.6	-13.5	▼
TransDigm Group Inc.	92.82	98.40	16.5	296.2	36.9	▲
Triumph Group Inc.	54.90	58.37	11.4	266.4	32.7	▲
United Technologies Corp.	73.05	79.33	12.5	68.8	0.8	▲

COMMENTARY

Congress's Super-Failure Puts Contractors On Edge

Fred Strader, the president and CEO of defense contractor **Textron Systems,** held out hope to the end that a congressional Super Committee would strike a bipartisan deal on how to cut $1.2 trillion from the U.S. budget deficit during the next 10 years. Under a law passed earlier this year, failure to agree to a plan by last week would trigger automatic cuts equal to that amount, with $600 billion coming from defense funding. "It's illogical that they would allow it to get to that point," Strader says.

But logic doesn't matter in the 112th Congress, where "compromise" is a dirty word, particularly among the tea party contingent. Sixteen weeks after it was created, the Super Committee folded on Nov. 21 without a deal. True, those automatic defense cuts are not scheduled to take effect until January 2013, leaving time for Congress to salvage a deficit agreement or rescind the automatic reductions to military spending. But if that doesn't happen soon, the Obama administration will be forced to submit a fiscal 2013 budget request in February that assumes a worst-case funding outcome. "It's a bit of a cataclysm that starts playing out now," says consultant Steven Grundman, a senior Pentagon acquisition official in the 1990s. "It's going to be ugly."

U.S. Defense Secretary Leon Panetta estimates that the $600 billion in automatic cuts, combined with reductions made earlier this year, would force the Pentagon to slash its discretionary spending by 23% across the board. That includes funding to buy hardware, such as the unmanned aircraft, surveillance systems and precision weapons manufactured by Textron. While contractors have long been preparing for a downturn, none of their playbooks imagined a 23% cut. "It's sort of the nuclear option, and it's hard to say what you do or how you respond to something that draconian," Strader says. "This is not a process that any of us would intelligently design for running our enterprise."

It did not have to come to this. Unlike Europe, where the financial system has been shaken by a multi-nation debt crisis that threatens to spiral out of control, Washington's deficit problem is a political crisis. It is entirely solvable with courage, compromise and a willingness to make tough choices.

There is plenty of blame to go around: Republicans, who refuse to let unaffordable Bush-era tax cuts expire; Democrats, who oppose any spending cuts to costly entitlement programs; and President Barack Obama, who could have used the clout of the Oval Office to push harder for a deal. And then there is that Super Committee. Remember these names: Reps. Jeb Hensarling (R-Texas), Xavier Becerra (D-Calif.), Dave Camp (R-Mich.), James Clyburn (D-S.C.), Fred Upton (R-Mich.) and Chris Van Hollen (D-Md.) and Sens. Patty Murray (D-Wash.), Max Baucus (D-Mont.), John Kerry (D-Mass.), Jon Kyl (R-Ariz.), Rob Portman (R-Ohio) and Pat Toomey (R-Pa.). They let their country down.

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

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THE WORLD

AIR TRANSPORT

Chinese Bank Orders C919s

The Bank of Communications has joined the lineup of Chinese state companies that are signing contracts for Comac C919 airliners, announcing an "order" for 30 of the 158-seat aircraft. The deal was signed by the bank's leasing arm and follows contracts announced last month covering 20 C919s for Sichuan Airlines and 45 for the Industrial and Commercial Bank of China. Comac now has contracts for 195 C919s. While Dow Jones quotes Comac as saying the orders are "intended and confirmed," care must be taken in interpreting such announcements from China. Comac has listed options as orders, and in November 2010 it announced a pile of "orders" that industry officials later said were not effectively binding.

Rapid Growth Plan Outlined

Hong Kong Airlines and subsidiary Hong Kong Express will over the next four years receive 51 aircraft, almost three times the 18 they now operate, including 21 of 30 Airbus A320s ordered in 2007. The remaining aircraft to arrive will be 30 widebodies. Setting out its fleet plan, the HNA Group says that in 2012, it will receive 14 aircraft (six A330s and eight A320s). In 2013 a further 18 aircraft will arrive: eight A330s, eight A320s and two A380s. Deliveries will slow to 11 in 2014 (six A330s, three A320s and two Boeing 787s) and eight in 2015 (two A380s, two A320s and four 787s). The company does not say what it will do with its 10 leased Boeing 737s. The other eight aircraft in the existing fleet are A330-200s. Hong Kong Airlines has also ordered 15 A350s. In March, it said it would buy 32 Boeing 787s and six 777 freighters.

AEROSPACE BUSINESS

Finmeccanica Board Rocked

Finmeccanica plans to hold a previously unscheduled board meeting as soon as this week, following news reports of a corruption inquiry that involves one of its highest executives. Lorenzo Borgogni, group external relations director and one of the closest advisers to company Chairman Pier Francesco Guarguaglini, is accused of bribing an Italian politician using company money. As of last week, he had stepped aside. Meanwhile, a manager at Finmeccanica subsidiary Selex Sistemi Integrati has been arrested on charges of accounting fraud. Guarguaglini has denied any wrongdoing, as has his wife Marina Grossi, who is Selex's CEO. Giuseppe Orsi, Finmeccanica's CEO and a rival of the chairman, has suggested Grossi resign to protect the company, but she had refused as of late last week.

DEFENSE

Fast Crash Probe Expected

An investigation into the crash of the first prototype of the Alenia Aermacchi M-346 Master advanced jet trainer should be relatively swift, since both crewmembers survived and the aircraft's wreckage has been found in fairly shallow water. The aircraft hit the water near Dubai on Nov. 18 while flying from the air show. The M-346 was apparently still climbing or had just reached initial cruising altitude.

Third Sukhoi T-50 in the Air

The third prototype of Sukhoi's T-50 fifth-generation fighter made its first flight Nov. 22 in Komsomolsk-on-Amur, in Russia's Far East. According to Sukhoi, the flight lasted a little more than 1 hr. and was in full accordance with the flight plan. An aircraft stability test was conducted, and the powerplant systems' performance was evaluated. After several factory trials, this prototype should join the other two T-50s for the flight-

Station Crew Back on Earth

If it holds true that any landing you walk away from is a good landing, then the Soyuz 27 mission crew has little to complain about—even if their Soyuz TMA-02M capsule landed on its side.

The spacecraft carrying American Mike Fossum, Russian Sergey Volkov and Japan's Satoshi Furukawa landed by parachute north of Arkalyk, Kazakhstan, at 8:26 a.m. local time on Nov. 22, to end their 167-day Expedition 29 duties aboard the International Space Station.

NASA/BILL INGALLS

The astronauts appeared weary but fine as they were transported from the landing zone to Kustanai, Kazakhstan, for further evaluation, says NASA spokesman Josh Byerly, who was with the recovery team. Fossum and Furukawa headed to NASA's Johnson Space Center in Houston aboard an agency jet to begin their rehabilitation from long exposure to weightlessness. Volkov headed for Star City, Russia.

Fossum, Volkov and Furukawa served as commander and flight engineers, respectively, during the 5.5-month mission that hosted NASA's final shuttle flight in July and marked the 11th anniversary of continuous station staffing on Nov. 2. Russian space agency Roscosmos's rapid recovery from the Aug. 24 failure of the cargo version of the Soyuz launcher, which is also used to transport crews to the orbiting science lab, prevented Soyuz 27's departure from marking the start of a temporary evacuation.

test program. The first two aircraft have conducted 100 flights since the start of the program in January 2010.

SPACE

First Contact

Two weeks had passed since Russia first attempted to communicate with its Phobos-Grunt spacecraft after the unmanned Mars moon probe became stranded in low Earth orbit. It was not until Nov. 22 that a European Space Agency (ESA) tracking station in western Australia made contact with the mission after modifying a 15-meter-dia. antenna, according to ESA officials. As a result, engineers at Russian space agency Roscosmos were able to issue commands to the spacecraft over several minutes via ESA ground controllers in Germany, turning on the spacecraft's transmitter and receiving a signal.

BUSINESS AVIATION

Provisional G650 Certificate

The FAA has issued provisional type certificate for the Gulfstream G650. The approval earlier this month enables Gulfstream to begin interior completions for initial customer deliveries in the first half of 2012 while continuing development of the aircraft's promised capabilities, including a takeoff field length of less than 6,000 ft. at maximum takeoff weight. The agency has imposed several special conditions that Gulfstream must satisfy to earn final certification for the G650, but it is not known whether any of these challenges have been resolved.

PROPULSION

Scramspace Slide

Australian researchers working on an ambitious scramjet-based access-to-space project have pushed back the launch target to early 2013 after electrical systems development proved slower than expected. Scramspace 1 is the first step on the road to what Australia's fledgling space business says could be an affordable, reliable and repeatable launch system based on combined air-breathing and rocket propulsion. The effort is aimed at free-flight tests of a Mach 8 scramjet concept originally targeted at a launch attempt in October 2012. The next launch slot on Australia's Woomera test range is in March 2013.

REUTERS/LANDOV FILE PHOTO

OBITUARY: Theodore J. Forstmann, a private investor who spearheaded the turnaround of Gulfstream Aerospace in the 1990s and then sold it to General Dynamics at an enormous profit, died at home in New York on Nov. 20 from brain cancer. He was 71. His firm, Forstmann Little & Co., teamed with Gulfstream veteran Allen Paulson to purchase the business jet builder from Chrysler in 1990 for $825 million. While many believed Forstmann would flip the Savannah, Ga.-based operation for a quick profit, he instead took a hands-on role, becoming chairman and CEO. Forstmann restructured the management team, bringing in Bill Boisture as president, tapping GE veteran Fred Breidenbach to curb costs and boost aircraft production, and luring Bryan Moss from rival Bombardier to head sales and marketing. Gulfstream expanded from a single-model company with the addition of the Gulfstream V, one of the first ultra-long-range business aircraft (see photo from 1997). Forstmann drummed up sales from his business contacts, helping the company quadruple its backlog. He also spent $250 million to acquire three K-C Aviation facilities to alleviate a bottleneck in completions. Forstmann Little bought out Paulson in 1992 and sold Gulfstream to General Dynamics in 1999 for $5.6 billion. Forstmann was chairman and CEO of sports business firm IMG at the time of his death.

H80-Powered L410 Flies

General Electric's long-term plan to develop the H80 turboprop into a challenger to the Pratt & Whitney Canada's PT6 has taken another step forward with the first flight of an H80-powered Aircraft Industries L410-UVP-E20 commuter aircraft. The 40-min. flight took place in Kunovice, Czech Republic, on Nov 16. Certification for the H80-powered L410 is expected in the third quarter of 2012, paving the way for a new production-standard offering as well as an upgrade for operators of M601-powered L410s.

Aerojet Clinches SM-3 Deal

Raytheon Missile Systems has selected Aerojet to complete the development of the Throttling Divert and Attitude Control System (Tdacs) for the U.S. Missile Defense Agency's Standard Missile-3 (SM-3) Block IIA program. The solid-fuel Tdacs provides propulsion and maneuvering control for the missile's kinetic warhead once it has detached from the third-stage rocket, and is a scaled-up version of the system used on the SM-3 Block IB. With preliminary design review due by year-end, the development contract will extend through 2016.

Corrections: *An article in the Nov. 21 issue (p. 39) incorrectly stated the cost of the Mars Science Laboratory mission. It is $2.5 billion.*

In the Nov. 7, issue, the article "Teaming Done Here" (p. 78) incorrectly identified the manufacturers of the Airbus A380 nacelle and the acoustic inlet for the Rolls-Royce XWB engine for the Airbus A350. Aircelle supplies the nacelle, and Airbus provides the inlet.

BY MICHAEL MECHAM

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COMMENTARY

Seeking a Program

California company protects C5ISR devices

As 2011 closes out with uncertain prospects for U.S. defense spending, suppliers are understandably uneasy. The 2008-09 recession forced many to retrench. While those with commercial aviation accounts are benefitting from that sector's boom, the products and services of many small suppliers are so specialized that they may not.

PLASMA RUGGEDIZED SOLUTIONS

Plasma Ruggedized Solutions (PRS) of San Jose, Calif., is one of those small manufacturers scrambling in the depressed economy, as Congress continues to be incoherent on defense spending. The company coats and encapsulates electrical and mechanical devices against the savagery of grit, humidity, vibration, shock, and electro-magnetic or electro-mechanical interference.

President and Chief Executive Jim Stameson changed the business plan when he and a group of investors acquired PRS in 2008, placing a greater emphasis on improving the performance of electronic warfare systems that operate in harsh environments, whether aloft in a fighter or in the sand with a soldier.

PRS provides potting/encapsulation, conformal coatings and ball-grid array underfills for computer boards. It also performs plasma etchback and desmear operations as well as engineering, design and prototyping. It can process 20,000 printed circuit boards a month, but Stameson says he wants to think no job is too small to let walk out the door. The company has 2,500 customers though only 300 are active. "They come and they go," he says, shrugging his shoulders. While PRS is profitable, he declines to provide specifics, saying only that its revenues are under $20 million.

Stameson's academic background is in finance and business administration, although he has done post-graduate work in manufacturing and engineering. He has managed major programs, including a $1 billion services contract for Saudi Arabia's navy while he was with Hughes Aircraft. At Parker Hannifin Corp., he learned electromechanical production for aircraft, missile and UAV applications, and he later managed a $100 million division for Vickers, providing servo systems for defense and commercial aircraft. Since the late 1990s, he has focused on consulting, venture capital and finance.

There is a fine line in knowing how to tell a customer what you think he needs and accepting that he is set on what he will buy, Stameson's background taught him. PRS's biggest competitors are its customers, especially large contractors such as Lockheed Martin, Raytheon and Northrop Grumman. They seek the company out for discrete problems but will develop their own capabilities for the volume work Stameson seeks. "We're trying to get on a program rather than a project," he says.

PRS does some major program work, but 12-18-month-long contracts are less frequent than those measured in days or weeks. As harsh as military environments can be, Stameson's company knows the human body presents its own "must work" demands, such as insulating pacemaker electronics from bodily fluids. And, as the world watched the Deepwater Horizon oil spill in the Gulf of Mexico in 2010, he could appreciate the rigors of the Schilling Robotics systems working the ocean floor because PRS ruggedized their electronics against the atmospheric pressures and sea water corrosion of the deep.

PRS pots, coats, underfills and etches electronic components to protect them in unforgiving environments.

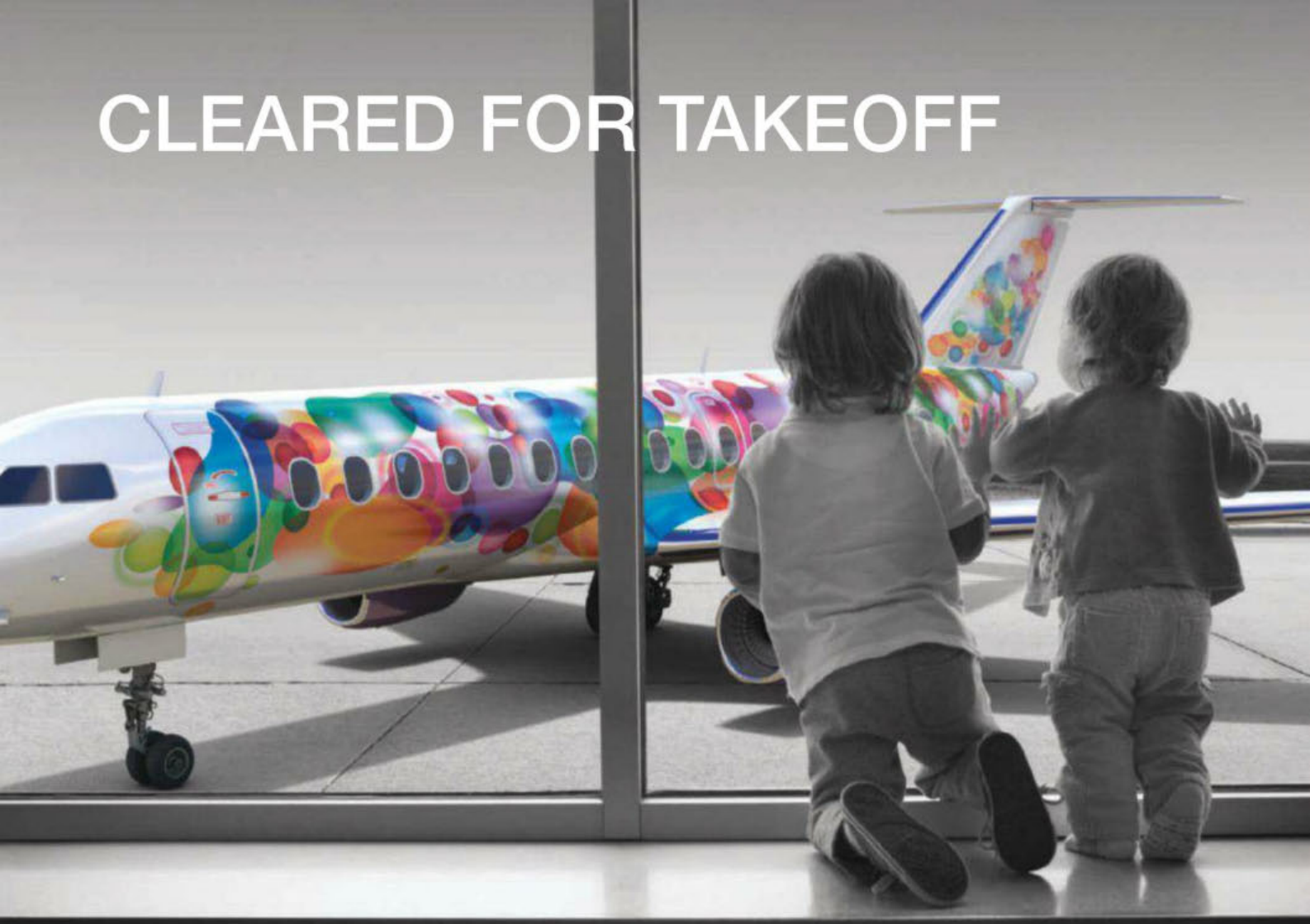
PRS's client base is so diverse that only about 20% of its revenues "officially" come from defense. But the purpose of many jobs is undisclosed, and PRS engineers say the true defense portion runs as high as 35%. With defense budgets under threat, Stameson is counting on growing through the continued strength in unmanned aerial systems and C5ISR (command, control, communications, computers, combat systems, intelligence, surveillance and reconnaissance) markets.

Assuming the company will live or die by the quality of its results, Stameson looks for engineers with strong manufacturing backgrounds and quality-inspection experience.

Besides its 40,000-sq.-ft. plant in San Jose, PRS has a 15,000-sq.-ft. facility in Huntington Beach, Calif., and may open another in Phoenix to be closer to customers in Arizona, New Mexico and Texas.

While his customers are sometimes secretive, Jameson wants PRS to be as open as possible about its capabilities "We have an 80-page website coming," he says, to illustrate its strengths. The upgraded site (plasmarugged.com) will be aimed at engineers and feature an interactive question-and-answer portal introducing PRS's technical services.

CLEARED FOR TAKEOFF



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COMMENTARY

Jets for Vets

Rx with wings for wounded service personnel

Walt Fricke returned to the U.S. in 1969 in a bad way. The 19-year-old Army warrant officer's left foot had been severed, save for his Achilles tendon, when one of the rockets on his Huey gunship exploded as he was letting down into a hot LZ in Vietnam. The field doctors wanted to amputate, but he dissuaded them. Once stabilized, he was transferred to a hospital in Fort Knox, Ky., 600 mi. from his family and fiancee, Julie in Traverse City, Mich.

CESSNA AIRCRAFT

Alone, severely wounded, and still a long way from home, he was so worried about the reaction to his condition by his family and Julie that he couldn't eat or sleep—"I was a basket case," he says—and shed 50 lb. from the anxiety. But once his people finally made it to the hospital a month later, their collective reaction was of such relief and joy that Fricke felt a burden lift, and he started to improve. He walked out of the hospital six months after being wounded, and then down the aisle with Julie.

A career in finance followed, during which he accumulated enough wealth to retire in his 50s. Eager to give back, he considered transporting wounded veterans in his Beagle twin, but then recalculated: Why not create a national network to transport wounded vets?

Fricke had been involved in a program to protect soldiers and their families from foreclosure on their houses and became acquainted with some military brass in the process; he shared his airlift idea with them. Then, one day in November 2006, the Defense Department called to say a wounded Marine had just traveled from Melbourne, Fla., to Camp Lejeune, N.C., on frequent-flier miles to attend an award ceremony. The 430-nm trip had taken 13 hr., and involved something like five different flights. Having to use a wheelchair and crutches at each stop, the young man arrived so exhausted he could not enjoy the ceremony. The question: Could Fricke get him home?

He called five pilots he knew in the region, and every one of them said they would do it. The following day. the wounded Marine was home in 2.5 hr., door to door. The Veterans Airlift Command (VAC) was in business.

VETERANS AIRLIFT COMMAND

Since then VAC's network of 1,900 volunteer pilots and a like number of aircraft have transported 4,500 wounded veterans and their families—one third of them in this year alone—to reunions, events and treatment centers throughout the U.S. The number of missions keeps increasing, and Fricke hopes to double the fleet in the next few years, with an emphasis on turbine-powered, all-weather aircraft, and complement it with flight hours donated by fractional aircraft owners.

VETERANS AIRLIFT COMMAND

Walt Fricke

Two recent additions to the VAC fleet were particularly noteworthy. An anonymous veteran donated an Eclipse 500 light jet to the effort, free and clear. That aircraft is undergoing some upgrades now and Eclipse Aerospace has agreed to help underwrite the cost of bringing it to the Total Eclipse standard. And Scott Earnest, Cessna Aircraft's new CEO, was so impressed with VAC's mission that he has dedicated a Citation Mustang to it and had the "American Patriot" painted accordingly (see photo).

Although VAC is essentially an online operation, it has three employees and Fricke says it costs about $400,000 to run the program annually, including buying airline tickets when necessary.

Bruce Rose, CEO of Carrington Holding Co., whose aircraft are part of the VAC network, weighed in this year by hosting a California golf tourney that raised $350,000 for the cause.

Window World, another VAC supporter, sponsored the creation of a custom Orange County Chopper motorcycle (see photo) that brought $340,000 at a VAC auction, and then was donated back to the organization. Fricke plans to put it on display at the Signature FBO at Washington Dulles International Airport and at other aviation and medical centers around the country.

Even though it seems the project "is getting out of hand" at times, Fricke says the effort is well worth it: "The reward of seeing these wounded kids finally welcomed home or reunited with the men in their units is just unbelievable and keeps us going."

BY DARREN SHANNON

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COMMENTARY

History Repeats

After abject failure 10 years ago, North American airlines reconsider LCC operations

Derided just a few years ago as an ill-conceived concept unsuited for a mature market, a few North American legacy carriers are once again attempting to integrate low-cost operations into their mainline networks.

The concept was most recently adopted by North American operators some 10 years ago, when so-called low-cost subsidiaries emerged as the apparent salvation for mainline carriers fixated on retaining leisure passengers after the lucrative business sector all but disappeared in the wake of the 9/11 attacks.

But there was a problem with that solution: It simply did not work. Attempts to emulate new entrants failed to impress passengers and staff alike, diluted troubled brands further, and, most importantly, did not achieve the basic goal of being low-cost as expenses inherent in a mainline operation encumbered the new subsidiaries.

Low-cost, a definition that has lost much of its tarnish as legacies trim more and more of their non-fuel expenses, is difficult to define. It is not simply achieved through lower wage rates, although that is a powerful contributor at the beginning of a venture, nor is it about single configurations, single fleet types, point-to-point networks, simplified fares or even random capital letters. In fact, LCCs as they have become known are more easily defined by what they are not: and that is a mainline carrier.

That difference was the key definer a decade ago, when the likes of Delta Air Lines and United Airlines dabbled with such ideas, and while Ted failed to end United and Song merely dulled Delta's tune, they highlighted the risk of using a legacy company with legacy fixed costs as the foundation of a new venture. Eventually both dropped the LCC concept, opting instead to tighten their third-party feeder contracts and shift as much domestic capacity as possible to their regional partners.

Air Canada bit twice on the LCC apple but the only lasting effect of its Zip and Tango ventures was a promotional fare type. But now the airline is back for a third helping.

The dynamics are somewhat different, if the rhetoric is to be believed, and interestingly Air Canada this time is using Asia's foray in the LCC market as a springboard for its new venture, with CEO Calin Rovinescu claiming the rash of new subsidiaries is "a movement" that cannot be ignored.

Regardless of Asia's current business practices—and there is sufficient warning in the annals of North America's airline industry to avoid the sheep mentality—Air Canada is again attempting to hold onto leisure passengers attracted to low fares and sun during the long winter months. But Tango tried that, and ultimately failed. This time, Rovinescu is hoping his new subsidiary will be without a major fixed cost: defined-benefit pensions. Air Canada's unions, though, are unimpressed, and while Canada's labor regulators may ultimately push through a deal, no business has ever succeeded with a disaffected workforce.

American Airlines, meanwhile, is choosing a different tactic. While details are still sparse, it appears the airline is contemplating a sizable fleet of Airbus A319s operating within the mainline network but crewed by pilots working with different pay rates and work rules than their mainline colleagues. The payoff, says American, is the retention of a stringent scope clause that will guarantee it does not follow Delta and United into outsourcing large segments of its domestic network.

It is too early to say if either concept will work, although American's pilots are not completely adverse to the idea so long as the A319 fleet remains small and under the auspices of their mainline contract. But it appears we are again witnessing an experiment with LCC in North American; maybe this time it will bear fruit.

Air Canada and American Airlines hope to avoid the pitfalls that destroyed low-cost concepts like United Airlines' Ted.

JOEFRIESAVIATION.NET

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COMMENTARY

Free Flight

Drawing set for free suborbital research flight

XCOR Aerospace and Southwest Research Institute (SwRI) will give an adventurous—and lucky—scientist a suborbital research spaceflight on XCOR's Lynx Mark I spaceplane, once the Lynx is up and running. Worth $95,000, the prize will be awarded with a random drawing of registered participants in the 2012 Next Generation Suborbital Researchers Conference in Palo Alto, Calif., next February.

XCOR AEROSPACE

"This XCOR flight can be a career-changing event for the winner," says Alan Stern of SwRI, one of the organizers of the researchers conference, who is preparing for suborbital research flights of his own.

Winners must supply an experiment, and can operate it from the single passenger seat in the two-seat Lynx, or designate someone else to do it. They will also have the option to use the cabin space for an autonomous experiment, provided it meets XCOR safety standards.

Less costly than the $200,000 Virgin Galactic seats, the right seat in a Lynx also may be better for researchers who prefer not being distracted by space tourists or other scientists in the six-seat SpaceShipTwo. The Lynx can be equipped with an experiment pod atop the fuselage (see illustration) for telescopes or outsized experiments.

For its part, Virgin has booked its first dedicated research and education flight to avoid potential problems for busy scientists from excited space tourists during the 4-5 min. of microgravity that suborbital flights will offer. Paying customers include SwRI, Space Florida/University of Central Florida, Purdue University and the Challenger Center.

Scientists backed by research grants may ultimately be a better market for the suborbital "spaceflight participant" market than wealthy thrill-seekers. SwRI has reserved researcher seats for Stern and his colleagues on future Lynx and Virgin Galactic SpaceShipTwo suborbital spaceflights, and the group is one of at least two prepared to fill in for researchers who cannot make a flight themselves for liability or other reasons (*AW&ST* Oct. 3, p. 54).

ORION ABORT TEST

Engineers on NASA's multi-purpose crew vehicle (MPCV) want to fly an ascent-abort test before sending their capsule around the Moon on the first flight of the heavy-lift Space Launch System (SLS) in 2017, according to Michael Coats, director of Johnson Space Center in Houston, where the Orion-based deep-space crew vehicle is managed.

But first they must find another $163 million to fund the recently announced flight test of its planetary reentry system in 2014. Coats tells the Senate Commerce science and space subcommittee that the program still has not identified the entire $372 million cost of the 2014 flight. That test, announced this month, will subject the vehicle's advanced heat shield to temperatures and loads approaching those it will experience on a direct return from the Moon or beyond. Tentative plans call for the test to reenter at 84% of lunar reentry speed.

"We're not going to go into deep space, but we're going to go way out there and come back in at a high speed to test a lot of things we can't test with a normal LEO reentry," Coats says, adding that the reentry will test 10 of the 16 items on the MPCV program's high-risk list.

Coats confirms that the capsule—which Lockheed Martin started developing under the old Constellation program and will continue under the new MPCV approach—will be launched on a Delta IV rocket. Lockheed Martin plans to refurbish the first ground-test MPCV article for the flight test. "We got a pretty reasonable deal from the contractor on that rocket," Coats says.

Even so, the MPCV program has not identified the full cost of the test in its budget. Provided more funding is available, program managers also would like to fly an ascent-abort test around 2016, he says. The Orion launch abort system already has demonstrated a simulated pad abort.

"The earlier you can test things and discover problems, the more money you're going to save," Coats says.

Robert Cabana, director of Kennedy Space Center, says the 2014 test flight will give recovery crews based at his Florida launch center a chance to check out procedures they are developing to recover the capsule at sea. NASA's initial plan for the 2017 flight would use an early version of the SLS to send an unmanned capsule on a lunar flyaround to conduct additional testing of the thermal protection system. A second flight with a crew is scheduled in 2021.

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COMMENTARY

Can We Talk?

Embraer awaits Light Air Support news as Hawker Beechcraft starts protesting

Hawker Beechcraft Corp. (HBC) has filed a protest with the Government Accountability Office (GAO) requesting a review of the U.S. Air Force decision to exclude it from the Light Air Support (LAS) competition to provide 20 light-attack/advanced-trainer aircraft to the Afghan air force. "HBC's exclusion from competing for this important contract appears at this point to have been made without basis in process or fact," claims the Wichita-based company.

The rival team of Sierra Nevada Corp. and Embraer says it has heard nothing about its bid from the Air Force. Ruling out HBC appears to leave Embraer's Super Tucano as the sole candidate. The Air Force had been planning to buy another 15 aircraft for itself, to use in training allied forces under the companion Light Armed Aerial Reconnaissance (LAAR) program, but lawmakers have moved to cut funds and top brass may sacrifice that program in light of major budget cutbacks.

Still, the whole affair has become increasingly political, with growing "Buy American" opposition to the possibility that Brazil-based Embraer could win both the LAS and LAAR contracts. While U.S.-based Sierra Nevada is the prime contractor for the Super Tucano bid and the aircraft would be assembled in Jacksonville, Fla., Kansas Rep. Mike Pompeo (R) has asked Defense Secretary Leon Panetta to intervene following Embraer's recent disclosure of a Securities and Exchange Commission investigation into possible violations of the U.S. Foreign Corrupt Practices Act in three countries.

Meanwhile, the Air Force says it "continues to be in close contact with all offerers of the LAS competition" but will not comment on the status of the proposals while it is still in source selection. "We anticipate awarding the contract late November/early December," the service says.

HAWKER BEECHCRAFT

The Air Force 'continues to be in close contact with all offerors'—or not.

MONEY MUSCLE

Negotiators on the FAA reauthorization bill are drawing campaign donations from opposite sides of a key labor battle. In talks to resolve differences between the House and Senate versions of the bill, House Republican leaders are trying to kill an existing rule that makes it easier for airline employees to unionize. The GOP's top two leaders also happen to be among the top recipients of cash from the air transport industry, which wants to make it harder for their workers to organize. Majority Whip Rep. Eric Cantor (R-Va.) received $50,500 in this election cycle, while House Speaker John Boehner (R-Ohio) brought in $46,400, according to the Center for Responsive Politics. The unions in turn have showered cash on two key Republican intermediaries in the talks on the bill, Reps. Steven LaTourette (Ohio) and Frank LoBiondo (N.J.). LaTourette, who bucked his leadership's push to scuttle the pro-labor rule, has received $56,000 from transportation unions, while LoBiondo, whose district is home to the FAA's William J. Hughes Technical Center, raked in $52,500.

WAIT UP

Prospects are dimming that defense appropriations for fiscal 2012 will wrap up by a Dec. 16 deadline. The Pentagon—along with most of the federal government—is being funded through a continuing resolution at fiscal 2011 levels until then. "It's likely that the continuing resolution will be extended further, perhaps into January," says Todd Harrison, a senior fellow with the nonpartisan Center for Strategic and Budgetary Assessments. Congress returns from the Thanksgiving holiday break this week, leaving little time for debate on most bills, even the must-pass defense spending measure. In addition to a delay in passing a spending bill, one industry lobbyist believes the Senate version may skip full, customary consideration by that chamber altogether. Instead, the House bill would be reconciled with the version passed by the Senate Appropriations Committee and then tacked on to another bill as an amendment to pass in both chambers. Such a move could protect controversial items such as Lockheed Martin's Medium Extended Air Defense System. Ranking Senate Armed Services Republican John McCain (Ariz.) is seeking to kill the tri-nation missile defense system early via his panel's defense authorization bill, and he would likely try to do the same in the Senate's defense appropriations bill, if it were easier to amend.

AFTERSHOC

Lawmakers' failure on deficit agreement wreaks havoc on the Pentagon's plans

JEN DIMASCIO/WASHINGTON

Now what? In August, it seemed as if the U.S. Congress might finally be coming to its senses, putting together an agreement to force itself to reduce the massive U.S. budget deficit. But at the first opportunity for success, a bipartisan panel created to save lawmakers from themselves bolted, leaving the defense industry holding the bag.

Last week's failure by the so-called Super Committee to find at least $1.2 trillion in deficit reduction means that the Pentagon's budget will automatically begin to be slashed by $600 billion over 10 years starting in January 2013. But the committee's failure will begin reverberating across the industry almost immediately—possibly taking out the nation's biggest weapon system—the Lockheed Martin F-35 Joint Strike Fighter (JSF).

While lawmakers such as Senate Armed Services ranking member John McCain (R-Ariz.) and House Armed Services Chairman Buck McKeon (R-Calif.) have vowed to intervene to stop the automatic cuts, the Obama administration has threatened to veto a reversal. If the Budget Control Act (BCA) remains in effect, the Pentagon—which plans its future budgets years in advance—will be faced with the prospect of submitting a fiscal 2013 budget by February that assumes the maximum level of cuts. And that means contractors could face terminations of signature weapon programs that may, or may not, come to pass (see graphic).

"In order to meet the timeline of the BCA and make the required cuts to comply with spending caps, the [Defense Department] will begin cuts immediately," notes the House Armed Services Committee. "The [Defense Department] will have to frontload many of the cuts because of high short-term costs such as separation payments and penalties for

TEN TEMPTING TARGETS

Joint Strike Fighter
Biggest defense acquisition program ever makes for the biggest target.

V-22 Osprey
Marine Corps' perennial target faces new challenge in era of needs-versus-wants.

Next-Generation Bomber
Key to maintaining a nuclear triad this century–unless it becomes two legged.

Ground-based Midcourse Defense
Legacy ICBM-based missile defense system has seen its star fall in political circles and in test failures.

Ford-class aircraft carriers
These flattops and new submarines could break the bank in shipbuilding.

Ground Vehicles
What exactly do the Army and Marines need after Afghanistan and Iraq wars?

C-27 light transport aircraft
Has few cheerleaders in the Pentagon outside the National Guard.

DDG-51/DDG-1000 destroyers
If Arleigh Burkes are so expensive to upgrade, why not build Zumwalts?

Littoral Combat Ship
Long-sought backbone of U.S. naval forces remains largely out of commission, except as a large-budget target.

Helicopter modernization
Wars sidelined earlier efforts and planning. Will budgets do the same?

Source: Aviation Week Intelligence Network

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U.S. DEFENSE DEPARTMENT FILE PHOTO

Defense Secretary Leon Panetta is in the uncomfortable position of decrying cuts to defense spending and supporting the president's insistence on abiding by the Budget Control Act.

canceling contracts. Even if the Congress were to amend the sequestration triggers in the next year, some decisions would be irrevocable."

President Barack Obama has put himself in a box, says a Democratic congressional aide. After the Super Committee's failure, Obama has taken a stance against efforts to undo the automatic cuts and effectively gave Congress another year to dither. "The only way these spending cuts will not take place is if Congress gets back to work and agrees on a balanced plan to reduce the deficit by at least $1.2 trillion," Obama said on Nov. 21. "That's the job they promised to do. And they've still got a year to figure it out."

Obama's statement also forced Defense Secretary Leon Panetta to contort himself in a statement issued Nov. 21, shortly after the Super Committee's inaction was announced. While Panetta had to press Congress to take another stab at deficit reduction, he simultaneously decried the cuts "that will tear a seam in the nation's defense."

There's a risk in hyping the dangers of sequestration too much, says Todd Harrison, a budget analyst for the Center for Strategic and Budgetary Assessments, a centrist think tank. "It could undercut the veto threat," Harrison says. He adds that the Pentagon is unlikely to submit a fiscal 2013 budget in February that aligns with the BCA's spending caps, because the Pentagon did not plan for the sequestration penalty.

Rather than submitting a doomsday budget, the administration may offer a plan for fiscal 2013 that exceeds spending caps under the BCA in February with the intent to amend it before the January 2013 deadline. Why? Because the Pentagon, renowned for its contingency planning, did not take the sequestration penalty into account and is already well into planning its 2013 request.

The unintended consequences of steep cuts in an official request could be numerous. What if lawmakers try to call the bluff—if it is one—and push to enact it, or worse, do that and start enacting immediate rescissions from targeted programs such as has been happening with the Medium Extended Air Defense System this year? And what do program managers and their bosses do in regards to planning for activities like long-lead acquisition or staff additions?

All this uncertainty may serve as a way for both sides to score campaign points in a presidential election year, notes Steven Grundman of Grundman Advisory. "You would expect that this is a straw-man budget," he says of the worst-case scenarios.

Sequestration's full effect almost demands cancellation of the JSF, says Grundman, who was an acquisition official in President Bill Clinton's Pentagon. If officials actually follow through on capped levels of spending under sequestration, in a fiscal 2013 budget request to Capitol Hill, program managers may have little alternative than to plan only to shut the fifth-generation fighter program down.

Defense executives are bracing for the storm. Contractors may have spent the last few years preparing for a downturn in budgets, but none of them envisioned anything as drastic as the 23% across-the-board cut that would be imposed on the Pentagon if sequestration is triggered.

In a Nov. 14 letter to McCain and Graham, Panetta outlined a series of weapon system cuts and program delays that add up to $200 billion in savings. Panetta's doomsday list opens up a Pandora's box of potential lobbying arguments.

Knife fights are already breaking out behind the scenes, as contractors and generals hone their pitches to "buy mine" and "cut theirs."

"It's three-level chess," one defense insider says of the machinations inside the Pentagon. Strategically, officials will begin to plan for big cuts. Underneath that there will be the strategy of using big cuts to save individual programs. Tactically, it will evolve into attacking individual programs. "Whack the other guys," he says.

With a dagger hanging over the head of the nation's fifth-generation fighter jet, one that has collected international partners to make the costly aircraft more affordable to all, the department's potential "no" vote gives the Boeing F/A-18 and other legacy fighters a window for program officials to push for upgrades. That argument holds true for other programs on the Pentagon's hit list.

Plans to rewrite the rules have prompted Wall Street analysts to downplay the impact of sequestration on de-

fense stocks, arguing that pro-defense lawmakers were unlikely to let that come to pass.

Morgan Stanley analyst Heidi Wood says, "The real question is by how much and [the] timing. The president's $400B request clearly was the opening salvo." A realistic final range could be $800 billion to $1 trillion in cuts over the next decade, she adds. "Actual cuts are likely less."

And while budget hawks concede that the sequestration penalty of across-the-board cuts is a poor way to plan a budget, they do not see steep reductions in what the Pentagon expected to spend as outlandish.

"Even with these reductions, and after adjusting for inflation, U.S. defense spending in [fiscal] 2018 would be well above the Cold War average," wrote Gordon Adams and Matthew Leatherman of the Stimson Center nearly one year ago in *Foreign Affairs*. "By choosing to undertake only tailored missions and to fund them with disciplined budgets, the Pentagon would also be contributing vitally to the country's broader fiscal health."

But a change in the nation's approach to the defense budget is now becoming more a reality than an academic exercise.

Defense experts are sorting out what policies the penalty may alter at the Pentagon. Rather than just calling for a strategy to underpin new budget choices, the changes are coming into view.

Michael O'Hanlon of the Brookings Institution recommended during a Nov. 21 panel discussion that the Pentagon begin considering some significant changes in its mind-set: for instance, scrapping the requirement for the capability to fight two major wars at once in favor of a one-war requirement along with the ability to handle two long-term contingency operations.

And he's also suggesting a move that could shake up the Navy: sharing ships. The foreign policy research director says he would think about keeping cruisers and destroyers forward-deployed for one or two years and rotating crews of 300 people, as a way of releasing the Navy from its grip on a 313-ship construct.

"Earth to Navy, it's not going to happen," O'Hanlon said. "We need to find ways to be more innovative and creative. And with this kind of an approach, you can go below 284 ships and still sustain the kind of presence we have."

It may be premature to say the future of U.S. strike aviation will be the first casualty of the U.S. budget crisis, but there can be little doubt that it is in jeopardy—compliments of the congressional Super Committee's abject failure to agree on a plan for reducing the federal deficit by $1.2 trillion. Whether there are adequate alternatives to the F-35 is debatable if the program is delayed, reduced or killed.

Termination of the U.S. Air Force's F-35A would kill the program. But it also could be delayed, or full-rate production could be cut from the current goal of 80 aircraft a year. The Navy's F-35C and the Marine Corps' F-35B are subject to any of the same outcomes. Adding to the clouded outlook for the F-35, and more broadly to that of U.S. strike aviation, is that the Pentagon and the program's leadership have yet to produce firm guarantees about the Joint Strike Fighter's initial operational capability dates, as well as procurement and support costs.

Meanwhile, U.S. and international groups are working on plans to sustain in-production fighters, such as the F-15, F-16 and F/A-18, along with European fighters, through mid-century. Supplementing all of those less stealthy aircraft will be unmanned strike designs, standoff weapons, electronic attack and signature-reduction packages.

Vastly complicating the uncertainty surrounding the F-35 is the role of international partners. Individually, none of the eight nations is expected to take even 5% of the planned production run. But they need aircraft early. Currently, the F-35s they have agreed to purchase in the low-rate initial-production phase are comparable to those of the Air Force. From the start, large orders have formed the basis for the F-35's affordability. The following stories examine possible options if the program falters.

Super Options

Boeing offers a catalog of new capabilities for its F/A-18 variants

DAVID FULGHUM/ST. LOUIS

Future aerial combat that pits the U.S. against advanced aircraft, missiles and air defenses—produced by what many defense officials contend are near-peer nations, such as China or Russia—could require more stealth aircraft than the U.S. can muster.

The shortage might be the result of shrunken defense budgets in coming decades, and it also may be driven by the inability to transfer aircraft to some distant battlefield in time to deter military adventurism in Asia, Africa or the Middle East. Such a deficiency kept U.S. F-22 units based on the East Coast from participating in the Libyan campaign.

Stopgap measures could include upgrading less stealthy, conventional aircraft such as the F-15, B-1, F/A-18EFs, F-16s and EA-18Gs to penetrate further into a foe's most lethal threat rings. To avoid making such a foray a suicide mission, those aircraft could combine reduced signatures, electronic attack, directed-energy weapons, cyberoperations and standoff missiles to increase their striking range and penetration capabilities.

Lockheed Martin and other proponents of the Joint Strike Fighter claim that the F-35 performs that mission, noting that it is the only true "fifth-generation" fighter designed from scratch to meet the requirements the U.S. Air Force insists will be needed in the most lethal threat environments.

But legacy fighter manufacturers, and Boeing in particular, have been trying to counter the argument that there is no adequate substitute. And with the JSF almost certainly among the top 10 targets for congressional budget-cutters, rivals to Lockheed Martin may have a fighting chance to try to make their case.

Evidence of the search for stealth alternatives is emerging as new standoff weapons—such as Boeing's Champ missile that carries a Raytheon Ktech-built high-power microwave warhead—near operational readiness.

In addition, Boeing is offering a line of upgrades for international variants of its F/A-18E/F Super Hornets and F-15C/Es that the U.S. military will envy and may well adopt as its budgets shrink.

Among those options for the Super Hornet is a stealthy weapons bay that can be attached to the exterior of the aircraft, says Mike Gibbons, Boeing's F/A-18 and EA-18 programs vice president. Historically, any exterior payload—fuel tanks, weapons or sen-

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sors—damaged the stealth signature of an aircraft. This stealthy, 17.5-ft.-long weapons pod does not, he says.

In fact, the uniquely shaped bay hung under the aircraft between the engines, creates a radio-frequency trap that either deflects radar signals away from the enemy sensor or sends them bouncing around a series of treated surfaces on the nose, engine nacelles, belly and bay itself, say stealth specialists. After as few as two bounces, the radar signals are rendered too weak to be useful.

The weapons bay doors can open at speeds up to Mach 1.6, which, combined with high altitude, can increase standoff range by 70-80% for some weapons. The low-drag, low-radar-cross-section weapons pod can carry four Amraam air-to-air missiles, six Small-Diameter Bombs and two Amraams, or two 500-lb. bombs and two Amraams. "Any store can be ejected from any position in the pod using an all-position ejection system," says Mark Gammon, program manager of the Super Hornet International Roadmap. A full-scale radar-cross-section test was completed in May.

Moreover, the latest Block 2 version of the E and F models has a signature even smaller than that of the initial Super Hornet design, which incorporated grill work in front of the engine face to block radar as well as shaping, specialized materials and new coatings to reduce radar reflections. The manually scanned radar dish on the initial Super Hornets created radar glints from the flat emitter face and movements of the radar. An active, electronically scanned array (AESA), long-range radar in the Block 2 Super Hornets eliminates both those problems with an upward-slanting radar face and no moving parts, say stealth specialists.

Conformal fuel tanks attached over the wing roots add 110 nm of combat radius, Gammon says. Wind tunnel testing shows that at cruise and loiter speeds, there is no performance penalty for the conformal tanks, and at Mach 0.6-0.75, there is actually improvement over baseline performance, he says.

Yet another international option is General Electric's enhanced performance F414. A new compressor fan and core give it 20% more thrust than the standard F414. Analysts predict a longer engine life due to improved tolerance to high temperatures and foreign object damage. It also supplies more bypass and bleed air, and fuel savings have the potential to reach 2-3%, according to some analysts.

The engine thrust profile is designed to decrease the amount of time it takes the Super Hornet to go from a combat air patrol cruise speed of Mach 0.8 and an altitude of 30,000 ft. to a beyond-visual-

Beat the Budget

Upgrades to weapons and sensors add new life to F-15 family

BOEING

An F-15 with the Silent Eagle's conformal weapons bays demonstrates an Aim-120 Amraam launch from reduced-stealth design.

DAVID FULGHUM/ST. LOUIS

Even with the F-22 on the ramp, if the F-35 program is delayed or killed, the U.S. and its allies will need more aircraft with a reduced radar signature or the ability to carry standoff weapons at a range to penetrate sophisticated air defenses.

The other requirements for these improved legacy aircraft are the ability to carry conventional and directed-energy weapons, advanced electronic warfare (EW) capabilities and a price tag that is a fraction of a specialized stealth design.

Proponents of the Joint Strike Fighter—including F-35 manufacturer Lockheed Martin—doubt whether legacy fighters, such as the F/A-18 and F-15 built by rival Boeing, or even Lockheed's own F-16 could be modified to match the capabilities that the JSF delivers.

Indeed, U.S. Air Force leadership remains adamant about maintaining the ability to take apart sophisticated air defenses, and few officials believe there is any substitute for specialized stealth designs such as the F-22 and F-35.

"To not incorporate the technology that is available to the U.S.—and growing in other nations around the world—does not keep pace with the requirements of today's fight," Gen. Gary North, commander of U.S. Pacific Air Forces tells Aviation Week. "What most people don't understand is the growing increase in land- and maritime-based, surface-to-air missiles [which drive the requirement] to have stealth or reduced-radar-cross-section platforms in today's world.

"As air-to-air missiles develop longer ranges, the abilities to see an adversary [earlier in an engagement] and to work in an intensive electronic warfare attack environment are critical. Every nation has to decide what it needs for self-defense and how much they are willing to contribute to it," North says.

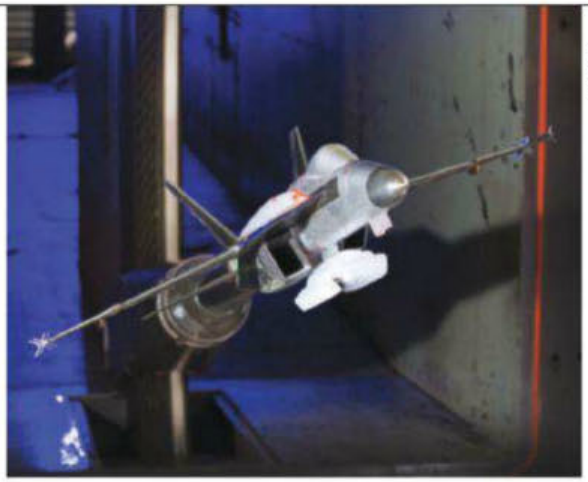
But if the stealth fleet becomes too small, it has to be supplemented. That is the niche market being worked by Brad Jones, Boeing's director of F-15 mission systems. The program spans specialized, low-signature variants such as the Silent Eagle for international customers and upgrades to existing F-15C and F-15E aircraft for the USAF. A shrinking U.S. force structure also is part of the formulation, as is the need for international customers to fly interoperable aircraft in short-notice military emergencies such as the NATO-led Libyan campaign.

A first-order question is whether the F-15 is going to be around long enough to purchase new aircraft or upgrade the

range (BVR) intercept speed of Mach 1.4 and altitude of 40,000 ft. in 2.5 min. with a full combat load, Gammon says. The additional performance also allows an improvement in BVR engagements.

After missile launch, an up-engined Super Hornet could turn away from the approaching foe and extend—fly away from incoming enemy missiles—with greater acceleration, he says. The extra speed in afterburner also allows for a multi-pass BVR engagement, perhaps as many as three passes against some threats.

The EA-18G Growler electronic attack aircraft also will offer some new capabilities. The advanced, rear crew station has bigger glass panels, "which helps the data pull rate because it provides more on- and off-board information," Gibbons says.



BOEING

A Super Hornet wind tunnel model displays an exterior weapons bay that reduces F/A-18E/F radar reflectivity.

To show how the Super Hornet and Growler can work together, Boeing specialists took the data correlation algorithms that had been developed for kinetic warfare, increased the on-board correlation and fusion for the Growler, which has even more sensor information onboard, and focused it on the non-kinetic capabilities designed for an advanced, back-seat crew station. It also incorporates an airborne electronic attack system, communications countermeasures system, interference cancellation system and a new satellite receiver.

If the next-generation surveillance and bomber program, now called Long Range Strike (LRS), survives the new wave of defense cuts, Growlers carrying the Next Generation Jammer "certainly could be one of the adjunct aircraft operating with the LRS platform," Gibbons says. "A large part of the future is how you project [capabilities] growth off the platform."

existing fleets. The evidence suggests that U.S. F-15s, at least, will still be flying combat missions at mid-century.

With new aircraft production slowing down and being cut, a fighter-shortage "bathtub" is looming, meaning there will not be enough to fill operational and training needs. Right now, the Air Force has about 350 F-15Cs and 222 E-model, two-seat strike aircraft. And the service is trying to move quickly to extend the airframe life of both.

A full-scale, F-15C fatigue test is underway at Boeing with the goal of extending the 9,000-effective-flight-hour life expectancy to 18,000 hr.

The Air Force is now also launching a fatigue test program for the stronger-wing, bomb-truck F-15E from its current 8,000-hr. rating to an effective service life of 32,000 hr.

Boeing has contracts to modernize the aircraft with active, electronically scanned array (AESA) radars that have ranges 2-3 times that of the original 56 nm produced by mechanically scanned radar, say radar specialists. It also has raised the mean time between failures to 2,100 hr. from less than 100 hr.

The APG-82(v)1 radar provides an ability to create high-detail maps for precision targeting of long-range, air-launched weapons. Designed to compound the advantages of the radar is the advanced display core processor (ADCP II) now in development. Moreover, there is a digital EW program in the 2013 budget plan.

"So we can see the Air Force's thought process," Jones says. "The ADCP II is being loaded up with processors. That is the basis of what an aircraft needs for modernization. The Air Force is putting a foundation into these aircraft" for an extended operational future.

The F-15 can carry long-range, glide and powered weapons such as the cruise-missile-size Champ, which is critical for electronic attack. Moreover, the F-22s—operating at higher altitudes and deeper in the threat rings—can provide long-range targeting for the F-15s. The F-15s then supply a large off-board magazine of missiles for the F-22s, which can serve as command-and-control aircraft.

The ADCP II boxes, which are common to the U.S. Navy's F/A-18E/F Super Hornets, are bolted into the aircraft as structure. The core software also is the same so the services both benefit from upgrades.

Another F-15 upgrade option is the digital electronic warfare system (DEWS). It also has gigabits of data available and ports linking the radar, processors and EW systems. That provides the route for running information from DEWS to the radar and other emitters to tailor jamming and electronic attack.

"From the hardware standpoint, we're done," Jones says. "We're now talking about software upgrades. The EW system could include electronic attack and other options. All the hardware is in the array. We put in everything we can. We've added more channels in the array to do the more exotic tasks."

The possibilities are there to create a data beam, load it with algorithms and identify an enemy electronic target of interest. "All that has been thought of," Jones says. "We've put in the processing power, the channels and the data buses. So what you need is the algorithms and the data base to go in the processor."

The lower-signature F-15 Silent Eagle—with canted vertical stabilizers, specialized treatments and materials and other aids—is being proposed to South Korea for its FX-3 program.

"We've already installed the AESA, incorporated the DEWS and put in fly-by-wire," Jones says. "All we're doing extra for [South] Korea is adding a large area display and a conformal weapons bay [for a decreased radar cross section]. But it gives your fighter Day 1, forward-sector stealth. In three hours, you can put the pylons, weapons and fuel tanks on, do your checks and be ready to go. After the special missions are done, you can return to carrying exterior payloads.

"We now have conformal weapons bays," Jones notes. "The engine face has been considered in the changes. We did not change the engine intakes because that would require changing big structure. An option is grill work over the turbine face that is similar to what like was done with the F/A-18 Super Hornets. For a relatively low amount of dollars you can get a certain reduction in signature."

ISRAEL DEFENSE FORCES

IAF officials are opting to upgrade aircraft like the F-16D, shown here, while they wait to receive F-35 Joint Strike Fighters which have been delayed by schedule slips.

Doubling Down

Israel reaffirms plans to take F-35 before USAF declares it operational

ALON BEN-DAVID/TEL AVIV

Israel stands behind the F-35.

The Lockheed Martin Joint Strike Fighter program may face a lot of uncertainty in the U.S., but the Israeli air force (IAF) is fiercely rejecting any suggestion that it explore other alternatives to the new fighter jet and is closing around plans to take deliveries of the F-35 "at the earliest date possible." The IAF is scheduled to receive its first F-35s for training in the U.S. in late 2016, with plans to deploy them in Israel the following year. "We will deliver Israel a fully capable Block-3 F-35A," Dave Scott, Lockheed Martin's F-35 business development director tells Aviation Week. Yet, with the U.S. Air Force declaring that the JSF will become operational only in 2018, it is not clear whether the first aircraft for the IAF will have full JSF software or will only allow for flight training.

Moreover, unlike most program partners, who plan to procure a limited number of aircraft from the low-rate initial production (LRIP) line while deferring massive procurement during serial production, Israel's first squadron of 19 F-35s will be fully procured out of the LRIP line. Five aircraft in LRIP 8 are to be delivered in 2016, seven in LRIP 9 in 2017 and seven more in 2018 out of LRIP 10.

"Procuring an LRIP aircraft is like buying a prototype," one senior Israeli defense source tells Aviation Week. "You have to assume that these aircraft will suffer from childhood diseases and will require future changes."

"It will not be different from the F-15As that Israel received in 1976," notes a senior air force officer. "They also had some problems of an early version but provided Israel with a critical qualitative edge over its neighbors, just like we need now with the F-35."

Israel is still negotiating the contract for developing the unique capabilities it requires for its first F-35 squadron under a $2.75 billion budget. Those include the installment of Israel's Blue Cedar C4I system, as well as rewiring to accommodate Israeli electronic warfare (EW) systems in Apertures Band 2 and 5 in the belly and wings of the JSF. Israel also is planning to install an external EW pod on its F-35s.

Additional Israeli requirements, such as installing Rafael's Python-5 air-to-air missile and Spice air-to-ground bomb in the F-35s internal weapon bay were deferred as costs of adjusting the aircraft and weapons to fit together were enormous. Israel also postponed its requirement to add a 600-gal. external fuel tank. The final contract for the first F-35 squadron should be inked by mid-2012.

As with much of Israel's defense spending plan, developments in Iran are believed to be a consideration. Reportedly, Israeli leadership considers 2012 as the last window of opportunity to stop Iran's suspected ambitions to develop nuclear weapons. But if the IAF is sent to launch a strike on Iran's nuclear facilities then, it is clear the F-35 would only reach Israel after the showdown, which many experts believe could trigger a regional war.

Yet, the IAF persistently refuses to consider buying a different fighter like Boeing's F-15s in the interim to bolster its capabilities despite repeated pleas from other defense officials. "The only potential fighter is the F-15 and it costs almost like an F-35," said the IAF officer. "In any case, even if we place an order for new F-15s today they will arrive no earlier than the F-35."

Instead, the IAF will upgrade its fleets of F-15A/B/C/Ds and Lockheed Martin F-16C/Ds to improve their capabilities and extend their lifespan. It will be forced to decommission its aging F-16A/Bs, as maintenance costs are skyrocketing. While the IAF is eager to start earmarking the budget for its next F-35 squadron, Israel is not ready to commit to another buy with uncertainty surrounding the future of U.S military aid to the country.

Still, beckoning Israel is Lockheed Martin's carrot in the form of proposed contracts for Israeli industry in the F-35 program, totaling $4 billion, and the stick of canceling them. Elbit Systems' share, in developing and manufacturing the helmet-mounted displays for the F-35, appears secure, unless the company cannot overcome the technical difficulties that recently emerged during development. Lockheed's suggested contract with Israel Aerospace Industries—to manufacture 811 outer wings for the JSF—is more in jeopardy.

"Clearly we will not start a production line at IAI to manufacture wings for only the 19 Israeli aircraft," said Scott. "Our proposal has the prospect of more than 15 years of IAI participation in the program."

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Buckling Down

Auditors suggest further refinement of CCDev contracting vehicles

MARK CARREAU/HOUSTON

NASA is signaling more restrictive use of Space Act Agreements (SAA), development-oriented contracting vehicles the agency has employed since 2006 to hasten development of commercial cargo and crew transportation services to support post-shuttle activities aboard the International Space Station.

The coming shift is just one of the challenges to emerge this month for commercial spaceflight providers and their proponents. Recently, key appropriators agreed to fund just $406 million of the Obama administration's $850 million fiscal 2012 request (*AW&ST* Nov. 21, p. 39). The SAA changes came in response to a Nov. 17 audit by the Government Accountability Office (GAO), the investigative arm of Congress.

A flexible feature of the National Aeronautics and Space Act of 1958, SAA initially enabled the agency to reimburse or share costs with nongovernmental partners to further its mission outside traditional contracts, leases and cooperative agreements. In 2006, NASA upped the ante with a third use of SAA—funded agreements with multiple traditional aerospace entities, as well as new space companies.

Over the past five years, NASA has spent or committed in the near-term more than $1 billion through flexible SAA on Commercial Orbital Transportation Services and Commercial Crew Development (CCDev) initiatives. The strategy is intended to stretch NASA's post-shuttle resources to provide for the development of the Space Launch System and Orion/Multi-Purpose Crew Launch Vehicle through traditional development contracts. With tight budgets looming for the foreseeable future, it is unclear whether the strategy will be successful, given NASA's desire to assure a competitive environment by nurturing at least two U.S. domestic suppliers of cargo and crew transportation services.

In the 18-page GAO report, "NASA: Key Controls NASA Employs to Guide Use and Management of Funded Space Act Agreements Are Generally Sufficient, but Some Could Be Strengthened and Clarified," auditors urged NASA to put more rigor into its use of SAA.

In an unpopular course change, NASA has already informed its CCDev Round 2 participants of plans to revert to traditional Federal Acquisition Regulation

Size and Altitude

IR imaging from stratosphere pays off in Sofia's star hunt

MICHAEL MECHAM/SAN FRANCISCO

New high-resolution images of a massive star formation taken aboard NASA's Stratospheric Observatory for Infrared Astronomy (Sofia) aircraft demonstrate the power of flying a 100-in. IR telescope high above Earth to escape the dust- and pollution-laden troposphere.

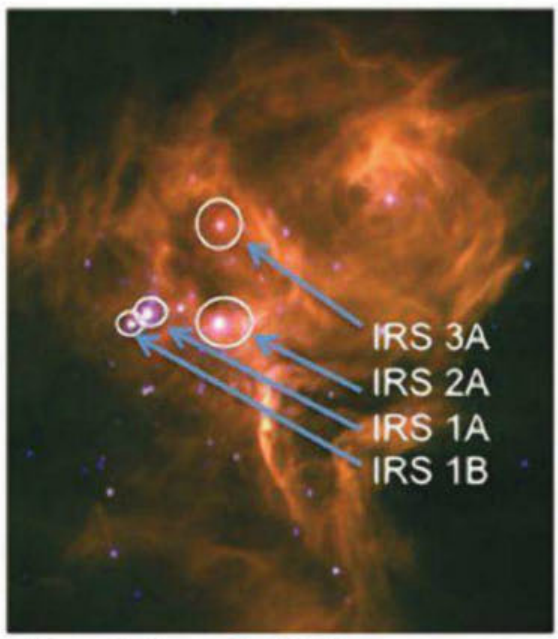
The images are of the W40 star formation 1,700 light-years from Earth, obtained on a May 18 mission. W40 is one of a handful of regions—Orion is another—that attract astronomers studying star formation because they are relatively close to the Sun. Evidence suggests our Solar System was formed in just such a cluster 5 billion years ago.

The 10-hr. flight originated from NASA's Dryden Research Center in California and followed a ground track extending from Texas to Nevada. W40 was one of eight objects observed during the flight, notes Terry Herter of Cornell University.

Sofia is a converted Boeing 747SP that exposes its IR telescope chamber just forward of its aft bulkhead on flights with altitudes of 38,000 ft. or more. After about 7 hr., enough fuel had been burned to bring Sofia to 42,000 ft. and the W40 observations began. This took 75 min. and involved several filters.

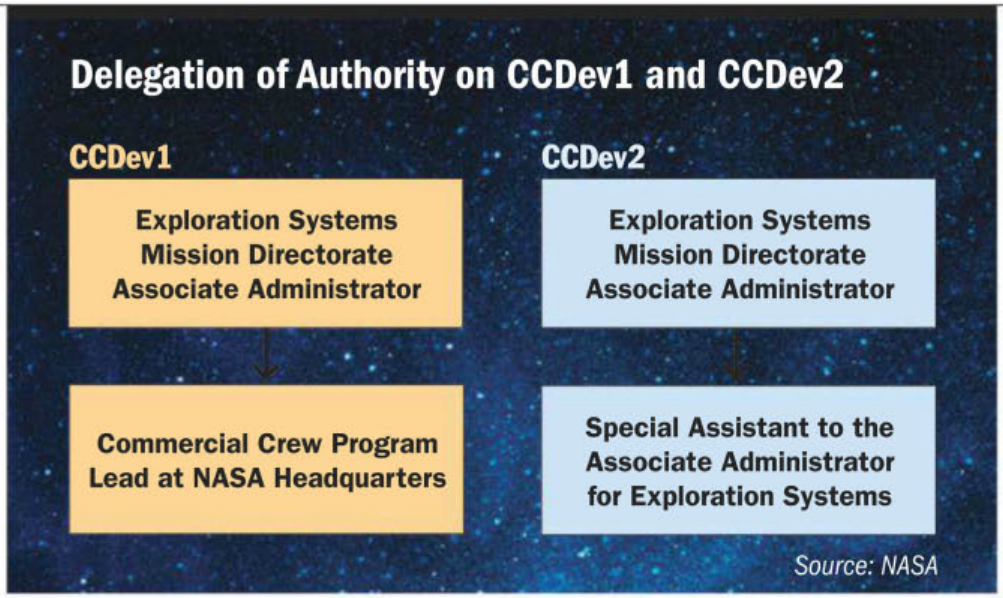
Raising Sofia's altitude pays dividends. "The higher you can do, especially in longer wave [IR] lengths, the better it is," says Sofia scientist R.Y. Shuping. "When in the stratosphere, even a small increase in elevation—say from 39,000 to 41,000 ft.—really gives you a big increase in [instrument] sensitivity."

The W40 observations were made with the Faint Object Infrared Camera for the Sofia Telescope (Forcast) from



NASA/SPITZER

Near-infrared – Spitzer mosaic



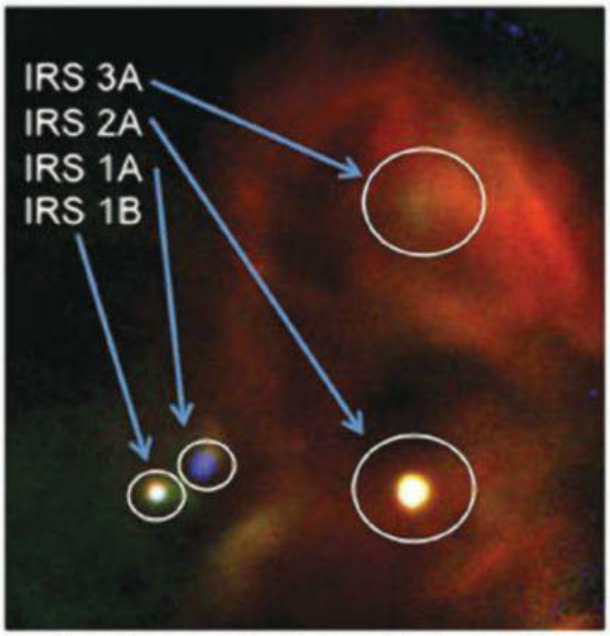
agreements for further development activities and service agreements. The switch to fixed-price contracts for the third round mirrors a shift in the program from generic technical capabilities for orbital human spaceflight to the specific capability of reaching the space station, Phil McAlister, director of commercial spaceflight development at NASA Headquarters, told Aviation Week earlier this year (*AW&ST* Sept. 26, p. 40).

GAO recommends even more changes to address several shortcomings. Those include a lack of documentation justifying the agency's use of the less-restrictive SAA rather than traditional contracts for services, as well as the agency's level of financial commitment; insufficient clarity on how extensively agency officials are to consult the broader acquisition and risk-management policies of the agency when considering an SAA; and the absence of training for agency personnel responsible for executing SAA.

Indeed, NASA's policy states that either the mission directorate associate administrators, or the officials in charge of headquarters offices, or the directors of NASA centers—depending on where the agreement is initiated—have the responsibility for the negotiation, execution, amendment and termination of funded SAA. It also says these individuals may delegate agreement execution authority to signing officials [see chart].

GAO's assessment, prepared for the leadership of the Senate and House committees authorizing NASA expenditures, included a comparison with the more demanding restrictions required under similar agreements exercised by the Defense and Homeland Security departments.

In response to the GAO report, NASA General Counsel Michael Wholley acknowledged the need to remedy shortcomings. Said Wholley, "NASA's goal is to implement all recommendations during fiscal year 2012."



NASA/DLR/SOFIA

Sofia's 100-inch IR telescope captured these massive infrared sources (IRS) in the W40 star formation. IRS 3A and 1A are "normal" stars while 2A and 1B are protostars.

Cornell. A mid-IR instrument, Forcast imaged the star field at wavelengths of 5.4, 24.2 and 34.8 microns.

The composite images it produced were higher-resolution and more distinct than the previous best mosaic of the same portion of the star field made by NASA's 33.5-in. Spitzer Space Telescope. Spitzer's clear images greatly magnified the standard view that ground observatories such as the Palomar Observatory had been able to obtain looking in the visual range. But the Sofia/Forcast combination has advantages over Spitzer because the aircraft's telescope is three times larger and the Forcast camera works in mid-range IR, which penetrates W40's clouds better.

The two imaged the same four "infrared sources" (IRS). Sofia's images show color variations that help astronomers understand them better because dust shows up as red and green but not as blue. All four are 8-15 times more massive than the Sun.

Two sources, IRS 2A and 1B, are protostars, meaning they are contracting masses of gas and dust on the way to becoming stars. A third, IRS 1A, is a "main sequence" star like the Sun. It is the most massive in the cluster, its blue color a tipoff that it has little dust and is a normal star. The fourth, IRS 3A, also appears to be a normal star, Shuping says.

Thousands of stars may be in a formation, but W40's count is more likely in the low hundreds. Its cloud has so obscured astronomical viewing that mapping its entire area is a goal for subsequent Sofia flights, which also aim to search deeper into the W40 cloud.

"The Forcast field of view is very small," says Shuping. "We need to move the telescope around and image different parts of the field to look for different sources [stars]." Already, astronomers see indications that there is a hidden source to the southwest of IRS 2A, but they need confirmation.

AIRBUS CONCEPT

Engine makers are preparing for a neck-and-neck race to power American Airlines' A320NEOs.

Power Broker

American's surprise Airbus engine choice sets stage for NEO power battle

GUY NORRIS/LOS ANGELES

American Airlines will power part of its new Airbus fleet with V2500s—an unexpected selection likely tied to the recent restructuring of International Aero Engines (IAE) and Pratt & Whitney's bold strategy to bolster sales campaigns of its geared turbofan on the A320NEO.

Though the Nov. 21 deal covers an unspecified number of current-model A321s that American will lease from 2013 onward, the newly dominant position of Pratt within IAE means the decision could also strongly influence American's engine choice when it comes to the A320NEO. Both the NEO and current A320 family were selected along with the Boeing 737 Next Generation and 737 MAX in a mammoth fleet transformation plan revealed by the airline in July.

CFM International is already in the driver's seat for the bulk of the American deal with the CFM56-7B and Leap-X1, which are due to power the 737 and 737 MAX, respectively. The CFM56-5B has also been selected for the A319s, making up the balance of the current-model A320 order. However, the airline says no NEO engine choice has yet been made.

The selection of the V2500 is therefore seen as an intriguing test case for IAE, and possibly the first fruit of Pratt's strategic gambit to buy out partner Rolls-Royce and reinforce its campaigns for the PW1100G geared turbofan. The move, which stunned the commercial aviation world when it was revealed in October (*AW&ST* Oct. 17, p. 22), saw Rolls sell its equity and program shares to Pratt for $1.5 billion.

This ceded commercial control to Pratt, which enables it to offer more competitive agreements against CFM's Leap-X 1A as part of combined V2500 and PW1100G deals. "Under the new configuration you can buy an engine for new NEO and standard A320s. It's one-stop shopping," comments IAE.

The restructuring of IAE, which included the associated birth of a new joint venture with Rolls aimed at next-generation engine developments, is the latest twist in a year that has seen the playing surface tip backward and forward in favor of Pratt, then CFM. Initially Pratt held the marketing advantage and its PW1100G became the launch engine for the A320NEO thanks to better performance estimates from Airbus based on a significantly larger available fan diameter of 81 in. Then early in 2011, CFM increased its fan diameter to 78 in., which boosted cruise bypass ratio (BPR) to 10.6:1 and closed the gap on the 12.2:1 BPR PW1100G.

With overall performance predictions for the two engine types much closer as a result, the summer saw the market tipping in favor of CFM. As of mid-November, CFM has booked orders and commitments for 930 Leap-1As to power 455 NEOs. Thanks to deals secured at the recent Dubai Air Show, and no doubt bolstered by the changing face of IAE, Pratt has made some late gains to grow its firm order backlog to 740 engines to power 370 NEOs. With around 1,200 NEO commitments booked by Airbus to date, this leaves engines yet to be selected for around 375 aircraft, 130 of which are destined for delivery to American from 2017 onward.

Although only a handful of operators, most notably Lufthansa, have mixed CFM and V2500-powered A320 fleets, the performance of the IAE engine makes it a popular option for the A321. According to IAE, for a typical 2-hr. flight, IAE estimates 2.5-4% lower fuel burn than the equivalent CFM56 on the A321. This appears to be borne out in terms of utilization and backlog. Of the three A320 models, the V2500 has seen the most success on the stretched Airbus with roughly 65% of the combined in-service fleet and backlog, against 48% for the A320 and only 40% for the A319. Overall, 6,800 V2500s have been ordered of which 4,800 have been delivered.

The engine selected for American's A321 fleet will be the upgraded "Select Two" V2533-A5 standard, while the A319s will be powered by the CFM56-5B Performance Improvement Package configuration, the first of which entered service on a LAN Chile aircraft this month.

The A321s will replace some of American's long-serving Boeing 757-200s, of which 124 are now in operation as well as several 767-200s. The A320s and 737s, which could conceivably include the -900 variant as well as the -800s already flying, will also provide the bulk of the mainline capacity as the airline retires its MD-80s. It is unclear how the A319s will be integrated into the fleet.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Moving On Up

Competition in Asia's dynamic aviation sector is set to increase dramatically

LEITHEN FRANCIS/SINGAPORE

The champions of Asia's low-cost carrier (LCC) business model are now preparing to move into the premium segment, but their strategies will be very different.

Indonesia's largest LCC, Lion Air, has applied for an air operator's certificate for a new premium carrier, which will fly Boeing 737s in a two-class configuration—economy and business—and will be branded Space Air.

Lion executives say their president director, Rusdi Kirana, wants the new premium outfit to compete directly against Garuda Indonesia and that the move is partly in response to Garuda's Citilink moving into the LCC market.

Rusdi can also see that in Indonesia there is relatively little competition in the premium segment. Garuda is the country's only premium airline, so margins are higher. "In Indonesia there is a large, wealthy population. There are a lot of Indonesians who simply will not fly an LCC. So [Rusdi sees] there's a lot of business that goes to Garuda," says an industry executive familiar with Indonesian carriers. "There's also a lot of wealthy Indonesians who fly Singapore Airlines [SIA] when traveling internationally, and that is why SIA still has a 'first-class' cabin on its Jakarta route," he adds. SIA charges $1,300-1,600 for a first-class round-trip ticket for Jakarta-Singapore, a 90-min. flight.

Lion has plenty of 737s it can use for this new business, because on Nov. 18 it agreed to order 201 Boeing 737 MAX aircraft and 29 737-900ERs. Prior to this agreement, Lion had 114 737-900ERs and 12 737-800s on order, according to Boeing's figures. A Boeing spokesman declines to say how many of the aircraft from the earlier order will be canceled as a result. "This is an agreement to order. Boeing and Lion Air are [still] working to finalize the details," he says, adding that once it is finalized the numbers will be posted on Boeing's order and deliveries website.

Industry executives say the new deal will replace some of the earlier aircraft orders. There is no way Lion can make use of 143 new 737-900ERs, on top of the 52 it has already taken delivery of, they assert. Signing a new aircraft deal with Boeing allows Lion to delay deliveries and get the more fuel-efficient 737 MAX, so it can remain cost-competitive.

Rusdi's move comes after LCC arch-rival AirAsia signed a firm order in June for 200 Airbus A320NEOs. The airline is using these aircraft for its new AirAsia-branded LCC joint ventures throughout the region. AirAsia founder Tony Fernandes, like Rusdi, is also eyeing premium travelers, but his approach differs markedly from Rusdi's.

Fernandes and his business partner Kamarudin Meranun now own 20% of Malaysia Airlines (MAS) as part of a share-swap deal announced in August with the Malaysian government's investment arm. As a consequence, Fernandes can ill afford to be seen competing head-to-head against MAS.

Rather than establish a traditional full-service carrier, Fernandes is investing in business jets and plans to call his new venture Caterham Jet. Caterham is the name of the British sports car company Fernandes bought this year to synergize with his Team Lotus Formula 1 outfit, which is also set to be rebranded Caterham.

Fernandes's partner in Caterham Jet is Peter Leiman, a Harvard Business School graduate and the co-founder of U.K.-based air taxi operator Blink, which flies Cessna Citations.

Fernandes has spoken publicly only once about the new venture. On the sidelines of an event in Kuala Lumpur on Nov. 14, journalists asked him to explain the rationale behind Caterham Jet. He responded: "I think there is a wonderful opportunity for people who don't want to queue when checking in, want a different flight experience and are willing to pay for it. If you have the right business model, there is tremendous upside, and equally for full-service carriers, it is about focus, right-sizing the business and creating a product. For the large number of people who are flying on LCCs, there is equally a large group of middle class . . . who want full service and first- and business-class service."

Industry executives say Caterham Jet will be based at Kuala Lumpur's Subang Airport. The venture will serve various Southeast Asian destinations such as Singapore, Jakarta and Bangkok, say industry executives. The fact that it will be flying as far as Bangkok and aims to offer business travelers a high-frequency service indicates that Caterham Jet will have more than 10 aircraft, they add.

One attraction for Fernandes is that this new airline will allow him to unlock the value in Southeast Asia's secondary airports, something AirAsia was never allowed to do. Fernandes wanted to base AirAsia at Subang Airport, but could not, because scheduled passenger jets as large as an Airbus A320 are barred. But aircraft deemed to be business jets are allowed. Subang is closer to the city than Kuala Lumpur International.

BOEING CONCEPT

That is also the case with Bangkok Don Mueang Airport and Jakarta's Halim Perdanakusuma Airport.

Association of Asia Pacific Airlines (AAPA) Director General Andrew Herdman says Fernandes and Rusdi can see there is enormous revenue to be gained by targeting premium passengers. The LCC market is growing fast but remains a relatively small segment, he notes. Commercial airlines in East Asia and Australasia had combined revenues of $144 billion last year, of which LCCs accounted for only $5 billion, says the AAPA. LCCs emphasis is on passenger numbers, when calculating market share; but when revenue passenger kilometers is used as the measurement, it's clear that the big revenue numbers come when airlines operate long-haul or start targeting premium traffic, Herdman observes.

By establishing new stand-alone airlines, with distinctly different brands to their LCCs, Fernandes and Rusdi are minimizing the risk of the full-service outfit adding to the LCC's cost base. Having distinct brands also signals to consumers what each airline stands for.

To win over business travelers, "airlines have to do corporate deals and offer reliability and on-time performance," says Herdman. They also have to decide whether to have airport lounges and frequent-flier programs and allow ticket refunds, says Herdman, who cites the lesson from the 2008 collapse of Oasis Hong Kong Airlines. Oasis thought it could compete against Cathay Pacific Airways. It based its assumption on Cathay's advertised price for business-class seats, which was very high. What Oasis failed to realize, until it was too late, was that Cathay works behind the scenes offering attractive discounts to corporate accounts that generate sizable business for the airline, says Herdman.

The importance of winning over corporate accounts may explain why Fernandes wants MAS involved. If his new airline can use MAS's frequent-flyer program and tap MAS's corporate customer base, it would help bolster the new venture.

The approach to yield management is another issue to be addressed. LCCs sell all aircraft seats as soon as they can by offering cheap fares very early on. "LCCs don't hold back seats for the late-booking crowd, which is businessmen," says Herdman. But "if someone makes a late decision to fly business and you've got no seats available, then that is a revenue opportunity lost."

Fickle demand will also be an issue, particularly for Caterham Jet. "What are you going to do with the aircraft on weekends or during public holidays, when business travelers are not flying?" Herdman asks rhetorically. This may explain why Fernandes has chosen Bombardier CRJ200s, which can be bought for $2.5-4.5 million second-hand. The low capital cost means he can afford to have the aircraft parked on weekends.

Lion is establishing a full-service carrier, partly so it can find a home for all the 737s it has on order, including -900ERs.

Survival of the Fittest

A number of smaller LCCs will falter as overcrowded field takes its toll

LEITHEN FRANCIS/SINGAPORE

The success of industry heavyweights such as AirAsia, Jetstar and Lion Air will eventually crowd some of the smaller players out of East Asia's low-cost carrier (LCC) market.

In Indonesia, there are already signs that competition from the country's largest privately owned carrier, Lion, is making it increasingly difficult for other airlines to survive. Kartika Airlines and Riau Airlines stopped flying this year, and leasing companies—which have traditionally been very supportive of Indonesian carriers—are starting to lose faith in some. Dutch lessor AerCap, for example, recently took back its two Airbus A319s from Batavia Air, a second-tier Indonesian airline that has 36 aircraft in operation, according to research firm Ascend.

Mandala Airlines, an Indonesian carrier that went into bankruptcy earlier this year, plans to resume operations in January now that it has new owners—Indonesian venture capital firm Saratoga Group and Singaporean LCC Tiger Airways. But Tiger Airways, which will effectively be running Mandala, has yet to prove itself.

Tiger Airways Holdings posted an operating loss of S$50 million ($38 million) for the three months ending Sept. 30. Tiger attributed the record loss to the Australian Civil Aviation Safety Authority's grounding of Tiger's Australian airline subsidiary for five weeks. Tiger's Singapore carrier, however, also posted an operating loss in the quarter of S$5 million, which it attributed to higher fuel prices.

Lessors are very skeptical about whether Tiger can make a success of a Mandala, as it will be competing against Lion. No one in Indonesia, other than Garuda Indonesia, has the "economies of scale" of Lion, which operates 67 jet aircraft—mostly new Boeing 737-900ERs. Earlier this month, Lion agreed to order 201 737 MAX and 29 737-900ER aircraft, even though it already has 114 737-900ERs on order. "Lion doesn't really leave much room for the other guys," says one lessor, summing up the general mood in the leasing community.

Also, Lion effectively muscled AirAsia out of the Indonesian domestic market. Indonesia AirAsia started operations in 2004, but following consecutive losses—caused by intense price competition from Lion—it largely stopped serving Indonesian domestic routes and instead focused on international services.

Lion, possibly emboldened by its success in Indonesia, did have a tentative deal with Malaysia's Berjaya Group. The two sides announced in early June that they planned to transform Berjaya Air, a small turboprop operator, into an LCC using 737-900ERs. Lion was to own 49% of the airline. But Berjaya Group disclosed in mid-October that the deal had been terminated. In a statement to

the stock exchange, Berjaya failed to give a reason, except to say that both parties were unable to finalize the terms of the agreement.

However, industry executives close to Lion say the collaboration accord announced in early August, in which

BOEING

U.S. President Barack Obama (standing, right) watches as Boeing Senior Vice President Ray Conner (seated right) and Lion Air Chief Executive Rusdi Kirana (seated left) sign an agreement in Bali to order 737 MAXs and 737-900ERs.

AirAsia and national carrier Malaysia Airlines agreed to work together to shore up the Malaysian market, was a factor that led Lion to think twice about entering Malaysia. It is clear that AirAsia is now influential in government circles, something an outsider like Lion could never hope to match.

Australian-based LCC Jetstar is also learning the benefits of working with national carriers and governments in Asia. It recently disclosed it is in negotiations with the Vietnamese government with a view to letting Vietnam Airlines buy the 70% stake in Vietnamese LCC Jetstar Pacific from Vietnam's State Capital Investment Corp.

Jetstar Group CEO Bruce Buchanan suggests that the Asia-Pacific LCC market will come to be dominated by AirAsia and Jetstar. He told journalists in Singapore in July that the LCC sector had fundamentally changed. The smaller players lack a strong international brand and, as a consequence, it is becoming increasingly difficult for them to compete, he says.

One market where Buchanan's assessment may ring true is South Korea. The country has five LCCs—Air Busan, Eastar Jet, Jeju Air, Jin Air and T'way Airlines—and each has very little brand recognition outside South Korea. Full-service carrier Asiana Airlines owns 46% of Air Busan, which is based in and derives it name from the South Korean port city.

At a recent media briefing at the Association of Asia Pacific Airlines annual general meeting, Asiana Senior Vice President of Strategic Planning E Bae Kim said LCCs in South Korea may experience financial difficulties in the coming years because the short-haul operations of Asiana and Korean Air (KAL) are already price-competitive due to greater economies of scale. He also says that "LCCs have difficulty finding new routes. With the exception of Bangkok, they are quite limited . . . and are, for example, not able to make inroads into Japan." Kim says he anticipates that Korean LCCs will fail to experience much growth.

Flying Through Mountains

Boeing, Airbus help introduce performance-based navigation in Indonesia and the Philippines

LEITHEN FRANCIS/SINGAPORE

Two countries on air safety blacklists are adopting performance-based navigation (PBN) to improve safety at terrain-constrained airports, ease airport congestion and provide fuel savings for airlines.

Boeing Flight Services (BFS) is working with Indonesian carrier Lion Air, Indonesian airport operator and air navigation services provider Angkasa Pura I and Indonesia's Directorate General of Civil Aviation (DGCA) to introduce PBN at select airports, says BFS's director for navigation service, Charles Steigerwald.

BFS has designed pre-approved flight paths for Ambon's Pattimura Airport and Manado's Sam Ratulangi International Airport, and Lion has performed validation flights to test Required Navigation Performance Authorization Required (RNP AR) procedures at them, Steigerwald says. The DGCA is due to approve them in mid-December, he adds.

Thereafter, these procedures will be used by nearly all aircraft flying into those airports, says BFS's program manager for navigation services, Alex Fecteau. Ambon and Manado were chosen first because they are fairly busy and surrounded by challenging terrain. At Pattimura, for example, departing aircraft have to clear a nearby mountain soon after takeoff, so payload restrictions have been applied. But with PBN, Steigerwald says, aircraft will no longer have to clear the mountain and will instead be able to fly a curved departure route through a valley and carry 10,000 lb. more payload.

Fecteau says BFS has provided training on PBN procedures to air traffic controllers at Ambon and Manado. "It is just a question of getting familiar with the new ground tracks and shorter flight distances," he says. With PBN, there is no need to invest in expensive ground equipment, he notes. "These RNP approaches are GPS procedures pulled

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out of the flight management computer rather than ground-based sensors."

Even though PBN provides obvious benefits, many countries have been slow to introduce it.

"There has to be a plan in place" to implement PBN, says Fecteau. "It is more difficult for legacy systems to rearrange their whole air route structure."

Air traffic controllers must be trained in the new procedures, too. A problem that can arise particularly in developed countries is that air traffic controllers familiar with sensor-based navigation may give precedence to aircraft using it rather than those making RNP approaches, says Fecteau.

Some countries might also hesitate to embrace PBN because of opposition from constituents living near the airport. While PBN can reduce aircraft noise pollution overall because it involves changes to flight paths, some residents may be worse off. That vocal minority may be loud enough to stop flight path changes.

Steigerwald says PBN appears to be most readily adopted in the less-populated and mountainous regions of the world.

PBN improves safety at terrain-constrained airports because "you have a stabilized aircraft and stabilized approach," says Fecteau. It is also more economical because the aircraft has a continuous descent in which the vertical profile is reduced, allowing the engines to idle and thus ensuring lower fuel burn, he points out. "We're saving 5-17 track miles per approach," he says.

In addition, more precise approaches will mean that when BFS and the Indonesian DGCA start rolling out PBN at busier airports, they will be able to reduce the separation between aircraft, ultimately increasing airport capacity and slot availability. This in turn will help ease airport congestion.

Lessening slot constraints is one of the main benefits that airlines in the Philippines are hoping to achieve with PBN at airports such as Manila Ninoy Aquino International Airport. "The thinking [within the Civil Aviation Authority of the Philippines] is that rotations should be capped at 40-45 per hour," says Cebu Pacific Air's chief executive adviser, Garry Kingshott. "So, based on that thinking, Manila is not allowing any more additional slots." But the transport ministry is targeting 60 rotations per hour, he says, and the ministry defines maximum capacity as 73. "There's quite a lot of work that's being done with air traffic," he says.

France's Directorate General for Civil Aviation (DGAC) and Airbus subsidiary Quovadis are helping to redesign approaches and introduce satellite-based navigation, Kingshott says. In March or April of next year, airlines at Manila will be switching to PBN. "The result will be a reduction in flight separation at Manila," which will create more slots, he says.

Quovadis's head of sales and marketing, Sebastien Borel, says there are 12 airports in the Philippines where PBN will be introduced. Besides Manila, the others are: Iloilo, Butuan, Legazpi, Dumaguete, Puerto Princesa, Zamboanga, Cagayan de Oro, Clark, Kalibo, Tacloban and Bacolod. Four of these will begin using PBN early next year and the others by the end of 2012, Borel says.

Quovadis has been collecting information such as obstacle data in order to devise the flying procedures, says Borel. The next step is to "properly validate the fly-ability of the procedures" using full-flight simulators, he says.

Philippine Airlines, Cebu Pacific and Zest Air have partly funded Quovadis's consulting work, Borel says, and he anticipates the three will do some of the demonstration flights. "You are usually supposed to do a demonstration flight using the procedures, but in visual conditions," he notes.

Quovadis is also helping train air traffic controllers in the Philippines, as is France's National Civil Aviation College, which is connected to France's DGAC.

Borel says one of the many benefits of PBN is that is sets new minimums, which means aircraft will be permitted to land in almost all weather conditions, reducing the numbers of flight cancellations and diversions.

The Philippines and Indonesia have had a number of accidents and safety incidents over the years in which bad weather was cited by local safety investigators as a contributing factor. Both countries have poor safety records that have led the U.S. FAA and the International Civil Aviation Organization (ICAO) to downgrade them. PBN is being introduced into the countries in accordance with ICAO standards in the hope that its adoption will help them improve their FAA and ICAO ratings.

CEBU PACIFIC AIR

Cebu Pacific Air and other Filipino carriers are hoping performance-based navigation will relieve congestion at Manila Ninoy Aquino International Airport.

On the Block

As its troubles deepen, Air Berlin seems to be seeking a strategic investor

JENS FLOTTAU/FRANKFURT

Air Berlin's ambitions were huge. The former German charter carrier wanted to take on the big guys. Now it appears the airline is up for sale.

Several industry executives tell Aviation Week that Air Berlin has approached other airlines about becoming a strategic investor in it, Germany's second-largest airline. Etihad Airways, Hainan Airlines and Emirates are understood to be among the carriers that have been contacted. The response has apparently been lukewarm so far, and it is uncertain if a deal will be struck. Air Berlin declines to comment.

The airline has not made a profit since 2007, and 2011 is turning into another "bad year," concedes CEO Hartmut Mehdorn. In the first nine months, Air Berlin had an operating loss of €123.7 million ($166 million), which will undoubtedly widen, given seasonally weak demand in the fourth quarter. Mehdorn also says he has so little visibility on forward bookings in 2012 that he no longer confirms the company's previous financial guidance for next year. Air Berlin had said it wanted to return to an operating profit in 2012. The company's equity stood at €368 million at the end of September, compared to €574 million a year earlier.

Mehdorn, a 69-year old former Airbus executive, took the reins at Air Berlin after founding CEO Joachim Hunold stepped down in August, and he launched a restructuring program aimed at improving results by €200 million. While he is confident that the airline will achieve that target, it may no longer be enough to reach profitability.

Air Berlin attributes its current problems mainly to Germany's newly introduced air passenger tax, saying it would have made a small operating profit of €2.3 million without the tax in the first three quarters. Still, the airline would have been far from earning the cost of capital. Critics say its business model is too complex, its resources were overextended by the rapid growth to a fleet of 160 aircraft, and it needs to refocus on what it does best. Mehdorn makes clear, however, that he does not see a need for a strategy change.

Instead, his strategy seems to be to sell the airline as it is. Given its €231 million market capitalization (at the end of September), Air Berlin would be cheap initially. But the company carries a huge debt burden consisting of €972 million in long-term and €1.2 billion in short-term liabilities.

Foreign ownership restrictions are a limiting factor. Because Turkey-based ESAS Holding (parent of Pegasus Airlines) already owns 16.4% of Air Berlin's shares, any new investor could likely buy no more than 30% at first to allow Air Berlin to retain its international traffic rights. In the similar case of Lufthansa's takeover of Swiss International Air Lines, Switzerland's bilateral air services had to be renegotiated before Lufthansa was able to take full control of the airline.

The efforts to sell Air Berlin are themselves a sign of how serious the situation is, as its stock price has plummeted. Air Berlin shares trade at €2.50 these days, down from a high of €20.45 in May of 2007.

The carrier built a sizable domestic and European network from Germany, which made it an attractive candidate for the Oneworld alliance. Air Berlin is expected to join the group in early 2012, but it seems highly unlikely that any of its new alliance partners will be interested in investing in it.

To make the network fit better with those of its new Oneworld partners, either Air Berlin would have to invest massively in changing it, or the other carriers would have to move long-haul flights from Frankfurt to Dusseldorf and Berlin, its two strongest bases. That process is progressing more slowly than some had hoped, although Air Berlin has bilateral cooperation agreements

Air Berlin reduced its A320-family fleet by four to help cope with losses.

AIR BERLIN

with British Airways, American Airlines and Finnair, among others.

Etihad Airways considered buying Air Berlin in 2008 but backed off at the last moment. There are conflicting views on whether Etihad would acquire it now. One senior industry executive says that CEO James Hogan is under so much pressure now to improve Etihad's financial performance and finally move it into profitability that Abu Dhabi's ruling family would not approve investment in another airline at this time. Meanwhile, another airline official says Etihad is still pursuing investment opportuni-

Hawaiian's Horizons

Boosting aircraft orders helps airline target long-haul growth

ADRIAN SCHOFIELD

While many airlines are hunkering down in the face of global economic woes, Hawaiian Airlines is taking the opposite approach. The carrier is accelerating its fleet growth as it looks beyond its traditional markets to tap into new long-haul opportunities.

Faced with stiff competition in its core U.S. West Coast markets, Hawaiian is increasingly focusing on new destinations in Asia and now the U.S. East Coast. Hawaiian is aided by favorable geography that puts it much closer than other U.S. carriers to key Asia-Pacific markets. But it has also taken astute leadership to recognize where best to broaden its base.

Hawaiian's strategy is enabled by the Airbus A330-200s that the carrier is adding to its fleet. The airline has taken delivery of five A330s since April 2010, with another 17 on order. It placed a further five orders on Nov. 17, giving Hawaiian more flexibility to add long-haul routes and speed up the retirement of its Boeing 767s. The A330s have greater passenger and cargo capacity as well as longer operating range.

The arrival of the A330s allowed the airline to begin its Asian expansion by launching Tokyo flights in November of last year, and services to Osaka, Japan, and Seoul—initially using 767-300ERs—earlier this year. Flights to Fukuoka, Japan, will begin in April 2012.

Hawaiian's latest move has been to announce a nonstop A330 route between Honolulu and New York, which will begin on June 4 and marks the carrier's first scheduled flight to the East Coast. The airline will in the future look to reach an agreement with another U.S. carrier to provide East Coast feeder traffic to the Honolulu-New York route.

The growing international and long-haul network is achieving Hawaiian's goal of diversifying its operations. Flights between the U.S. West Coast and Hawaii still comprise the largest part of the airline's business, but its reliance on this market is shrinking. The third quarter marked the first time since 1993 that passenger revenue from Western U.S.-Hawaii routes accounted for less than half the total. This is a considerable change from the same quarter last year, when this market accounted for 60% of total passenger revenue.

Morgan Stanley analyst William Greene says Hawaiian's long-term strategy to diversify into key Asian markets is a "strong positive" for the airline. In-

Hawaiian Airlines Fleet

AIRCRAFT	IN SERVICE	ON ORDER
Airbus A330-200	5	17
Airbus A350	0	6
Boeing 717	15	0
Boeing 767-300	4	0
Boeing 767-300ER	12	0

Source: Hawaiian Airlines

Increasing the pace of A330-200 deliveries is allowing Hawaiian Airlines to ramp up growth plans.

AIRBUS/H. GOUSSE

ties elsewhere. The Persian Gulf carrier did not reply to requests for comment.

According to another industry executive, Air Berlin has also been in touch with Hainan Airlines' parent, the HNA Group. The Chinese travel/tourism conglomerate has been seeking investment opportunities in Europe and is understood to have looked closely at Malev Hungarian Airlines. HNA is also among the bidders for Hochtief's airport business, Hochtief Concessions, which is for sale and has shareholdings in six airports in Dusseldorf, Hamburg, Sydney, Athens, Budapest and Tirana, Albania.

ternational markets are generally better positioned for revenue growth than domestic routes, and the "robust customer response" Hawaiian has seen in Japan and South Korea hints at what could be achieved by tapping into the Chinese market, Greene says.

Hawaiian says its new Japanese routes performed strongly during the third quarter. This marked a rebound from a weaker second quarter, which was affected by the demand downturn following the earthquake and tsunami in March. The swift recovery justified Hawaiian's decision not to cut capacity to Japan and to go ahead with the launch of the Osaka route, CEO Mark Dunkerley told investors during a briefing last month.

But while international markets are soaring, U.S. West Coast flights are still the carrier's bread-and-butter. And these routes are becoming a lot more challenging for Hawaiian due to strong competition from other U.S. airlines. Alaska Airlines, for example, has been pushing more aggressively into the California-Hawaii market, and in April will add daily flights from San Jose and Oakland to Honolulu.

Greene notes that this trend could increase next year, as new entrants like Allegiant Air look to launch Hawaii flights. Allegiant is successful in the low-cost leisure market, although it is likely to serve mainland destinations that Hawaiian does not.

Hawaiian uses its Boeing 767-300s and -300ERs on Western U.S. and international routes, but many of its 767s will be retired as A330s arrive. Of the 17 A330s still to be delivered, four are due next year, five each in 2013 and 2014, and three in 2015. Three of the A330s currently in the fleet are leased, and one of the 2012 deliveries will also be leased. Eventually, Hawaiian plans to have a long-haul fleet of A330s and A350s; it has ordered six of the latter type.

The four 2012 A330 deliveries are fully committed, but Hawaiian still has the ability to add more flights next year, a company spokesman says. According to a statement from the carrier, additional new services are expected to be announced in the coming months.

Knowledge Capital

Ameco Beijing wants to expand with more efficiency, rather than more plant

BRADLEY PERRETT/BEIJING

The Chinese call it "daxing tumu"—being keen on large-scale construction. It seems that wherever one looks in this country someone is building a mighty new bridge, office tower, airport, freeway or aircraft hangar, more physical capital for the roaring economy.

But there is also knowledge capital, and that is what Ameco Beijing is keen on as it considers how next to expand. The company is turning its attention to know-how and efficiency instead of physical investment as a way to drive up capacity and, more than incidentally, to offset rapidly rising labor costs.

Ameco, China's largest aviation maintenance provider, has not launched a major expansion since it began building an A380-height hangar in 2006, and will not build another hangar for at least two years, says Chief Executive and General Manager Andreas Heizner.

"The focus now is to use our assets better, and I see a lot of opportunities to get more slots available from these hangars," he says.

Successful efficiency drives at Lufthansa Technik operations in Germany have inspired Ameco—or at least shown how much can be achieved and how. The German operations last year reported 20-30% reductions in labor and turnaround times as a result of an efficiency drive.

"So my assumption is that it should be possible" at Ameco, Heizner says. "For normal [heavy airframe] checks, I am convinced we can reduce turnaround times," although there will be challenges in implementation.

In large part, the planned methods are familiar to managers who have studied how to streamline workshop and factory operations over the past few years. The reorganization will involve moving things closer to where mechanics work, reducing the time they spend walking. "What we want to do is to eliminate wasted time in working on the aircraft, with documentation, tools and material all at hand," says the chief executive. "It is not to force our people to work faster or harder."

The target is to get the same 20-30% increase in efficiency within two or three years. Consistent with that, the company—60% owned by Air China and 40% by Lufthansa Technik—expects to only slowly increase its current staffing level of about 6,000 over the next few years.

This is not the first time that Ameco Beijing has tried to drive up efficiency with better placement of tools, materials and so on. The current effort is the latest in a push that began in 2007. In 2009 the company said it had already achieved considerable efficiency improvements with better planning and stores management providing mechanics with kits of everything needed for their tasks.

Proof that Ameco still thinks it can improve markedly—or that, amid rapidly rising Chinese wage costs, that it must—is the current heavy utilization of its facilities. In the slack months of the northern summer, when airlines maximize flying rather than maintenance, the company has in recent years generally used 70-80% of capacity; in 2011 it reached 85%. In booming Chinese aviation, being so busy means having to plan for more capacity—in the usual "daxing tumu" fashion—yet Ameco has no immediate construction proposals.

Indeed, capacity gains of 10% a year from the efficiency drive would not keep up with growth in the local airline industry and the fleet of base customer Air China, notes analyst Dennis Ling of consultancy ICF SH&E. Ameco's business in heavy maintenance for foreign airlines should also be growing faster

than 10%, given the cost advantages that Chinese maintenance providers still enjoy, despite rapidly rising wages.

Ling suspects that part of the answer is Air China's plan, now under negotiation, to merge its fully owned maintenance arm, Air China Technics, into Ameco. Since Air China Technics, as part of a Chinese state airline, is likely to be less efficient than Ameco, considerable further gains in capacity should be available from improving its work practices. Yet there is a danger there for Lufthansa Technik, especially if such a merger reduces its holding in Ameco, because Air China aims to become a global player in aircraft maintenance. In transferring know-how to Ameco from Germany, Lufthansa Technik could be teaching a future competitor how to compete.

Air China Technics, which specializes in Airbus A320 and Boeing 737 narrowbody overhauls, would fit well with Ameco, which concentrates mainly on widebodies.

Heizner declines to comment on the possibility of the merger.

When construction of the A380-height hangar began in 2006, Ameco Beijing said it would construct a second building of the same size and shape in the next few years and had gained shareholder approval to do so. Asked about that plan now, the company notes that its undercover space has approximately doubled with the completion of the A380 hangar and a painting and overhaul hangar.

The A380 hangar is used for line maintenance; it can be equipped for overhauls later. It is also used for what Ameco calls special projects. The company will not say what they are, but these probably include work on Air China's VIP aircraft, which are used as government transports but painted in standard airline colors to create the appearance that top Chinese leaders fly on ordinary airliners when they travel.

Ameco has the most hangar space of any maintenance provider in China, with room for more than 20 aircraft: six widebodies and four narrowbodies in the A380 hangar; four widebodies and four narrowbodies in the main heavy-maintenance hangar; one widebody and one narrowbody in a dedicated painting hangar; and at least one widebody and one narrowbody in the painting and overhaul hangar.

Although rival Gameco at Guangzhou in the south of China has decided to set up a new base at Chongqing in the west, Ameco plans to keep everything except line maintenance at its Beijing site. Having a second site requires wasteful duplication, says Heizner. Gameco sees its second site as an opportunity to raise efficiency, because the Chongqing base will specialize in A320s.

While not adding hangars, Ameco does want to add services. "We are looking for new products," says Heizner. In engines, the company has the capability to overhaul Rolls-Royce RB211-535s and Pratt & Whitney PW4000s, but that is not enough, especially since the Rolls-Royce turbofan is used only on a declining population of Boeing 757s. "We need a new engine," says Heizner, declining to suggest what it might be. Two seem to be good prospects: the International Aero Engines V2500 and the General Electric GEnX. Air China uses the V2500 on its A320s; the GEnX will power 747-8s it has ordered. Of the two, the V2500 seems more likely, given that the airline already has 23 A320s with the engine and another 12 on order. The smaller engine would also demand less investment by Ameco. Moving into the Chinese V2500 overhaul market would bring Ameco into competition with MTU Maintenance Zhuhai.

Ameco has been thinking for a few years about the need to move into overhauls of a different engine type. Heizner's predecessor, Andreas Meisel, raised the issue publicly in 2009.

Ameco will boost efficiency by moving tools, materials and documents closer to where its mechanics work. Here they are fitting a winglet to a 767.

AMECO/LI KAIYAN

Profit Plan

Review aims to restore Air New Zealand's international operations to financial health

ADRIAN SCHOFIELD/AUCKLAND, NEW ZEALAND

Air New Zealand is planning a major shake-up of its international operations next year, and it will implement changes as quickly as possible to stem the flow of red ink from its long-haul business.

The airline is scrutinizing its international services in a review it expects to complete in the first quarter of 2012. "All options are on the table," including changes to routes, alliances and cabin configurations, Air New Zealand's general manager for international operations, Christopher Luxon, tells Aviation Week.

Although Air New Zealand is consistently profitable overall, its international operations are running at a loss. CEO Rob Fyfe says this part of the business has been losing about NZ$1 million ($750,100) a week this year, which has injected urgency into the review process.

While some changes identified will take longer to implement, others will be rolled out straight away, Luxon says. The longer-term actions will be those that involve other stakeholders and those that require more work "to get the execution right," he says.

The goal is to achieve sustainable profitability, which will be the "enabler" for the addition of new routes and new aircraft, Luxon says. He notes that similar reviews have proven successful for the carrier's domestic and Australian networks.

Any network changes will support Air New Zealand's strategy of serving Australasian and Pacific Rim markets with point-to-point flights. The carrier sees growth opportunities in North American destinations beyond the West Coast, and in China, the rest of Asia and South America, says Luxon.

However, it is very unlikely there will be any additional ultra-long-haul one-stop destinations. Such routes beyond the Pacific Rim nations are "quite challenging" to fly profitably, Luxon says. The current one-stop flights to London, via Hong Kong and Los Angeles, are likely to remain for now. But in a recent memo to employees, Fyfe says the future of these routes depends on "being able to achieve improved operating efficiencies and building partnerships to ensure these services can be operated profitably."

Air New Zealand will have to wait to implement most of its new international route plans until its Boeing 787 orders start arriving. However, Luxon says, "there are still markets we should be exploring" before that.

Alliance arrangements will also be a large part of the review, and Air New Zealand is examining its current partnerships to make sure it has the agreements that best suit its strategy.

The carrier will investigate potential new partners, both within and outside the Star Alliance, Luxon says. It will be looking for airlines with "strong home markets that [can] provide good feed" to the Air New Zealand network. Fyfe has previously said the airline will consider "different or additional" alliances.

The 787 remains a key element of the carrier's planning, and it is the launch customer for the 787-9 variant. Boeing recently announced another delay for the -9, with Air New Zealand now expected to take delivery of the first of its eight aircraft in early 2014 rather than December 2013, as previously scheduled.

Luxon says that while "any delay is frustrating," the airline will not have to make further adjustments due to the latest timetable slip. It had already been basing its plans on the first 787-9 entering service in the first half of 2014. The carrier is keeping Boeing 747s and 767s in service longer than intended to bridge the gap.

Meanwhile, Air New Zealand received its fourth Boeing 777-300ER this month, and the fifth and final aircraft in this order is due in early January. The addition of these two aircraft will allow the airline to use the -300ERs on all of its Auckland-Los Angeles and Los Angeles-London flights.

Even though Air New Zealand will not be altering its firm orders during the review, Fyfe says the carrier can still "look very closely at our [long-haul] fleet strategy." The airline has flexibility through options, leases and retirements, Fyfe noted during a recent analyst briefing. Air New Zealand will consider whether its long-term plan has the appropriate balance between 787s and 777s and if the retirement rate for 767s and 747s needs to be tweaked.

In addition to the international review, Fyfe has launched a broader initiative to identify cost reductions and new revenue opportunities. For the amount of capital invested in the company, it should be consistently making a pre-tax profit above NZ$300 million, Fyfe says. But it has not risen above NZ$200 million for the past three years.

The New Zealand government is still the major shareholder in the carrier, although the incumbent National Party was considering selling down this 73.8% stake if it were to win a Nov. 26 general election. It intends to keep the government holding at more than 50%, however.

AIR NEW ZEALAND

Air New Zealand's new Boeing 777-300ERs will play a key role in its fleet strategy.

PUSH FOR SAFE

Industry moves to close pilot training gaps exposed by growing loss-of-control accidents

GRAHAM WARWICK/WASHINGTON

Now the leading cause of airliner hull losses and fatalities, loss of control is driving improvements in training to help pilots recognize and recover from aircraft upsets in flight.

Including Colgan Air Flight 3407 and Air France 447 in 2009, loss of control in flight (LOC-I) killed 1,841 people from 2001-10 in 20 commercial jet accidents worldwide. This compares with 1,007 fatalities in 17 crashes caused by controlled flight into terrain (CFIT), which was the biggest killer until the installation of enhanced ground-proximity warning systems (EGPWS) was mandated.

"CFIT was the number-one cause, but has been tackled by EGPWS and was down in 2001-10 while LOC-I was up," says Sunjoo Advani, chairman of the International Committee for Aviation Training in Extended Envelopes (Icatee), organized by the Royal Aeronautical Society. "Stall is the number-one cause of upsets leading to loss of control. Pilots are well trained, aircraft have protection systems and yet we are still getting upsets. Why?" he asks. "Because loss of control in flight is rare, unpredictable and catastrophic—and pilots are not adequately trained."

Icatee is in the final stages of developing new tools and guidelines for upset prevention and recovery training (UPRT) to address concerns raised by LOC-I accidents including Colgan Air 3407 and AF447. Fifty people were killed in the Colgan Air crash, 228 in the Air France accident, bringing a sense of urgency to mitigating the threat. "The likelihood of a LOC-I accident is very low, but the likelihood of recovery from a significant upset is extremely low," Advani says.

On Colgan Air 3407, the stickshaker activated on the approach to warn the crew of low airspeed and impending stall, but instead of pushing forward on the control column to lower the nose, the pilot pulled back, increasing angle of attack (AOA). This caused the wing to stall and the stickpusher to activate, to force the nose down, but the pilot pulled back on the column, fighting the stall-protection system's attempt to decrease AOA. The NTSB cited the probable cause as the pilot's "inappropriate response to the activation of the stickshaker."

The final report on the investigation into AF477 will not be released before year-end, but in their July interim report French accident investigators noted that the copilot flying made continued nose-up control inputs after the stall warning sounded. "Neither of the copilots had undertaken any training in manual handling of the airplane on approach to stall or on stall recovery at high altitude," the investigators said.

One contributing factor is the increasing automation in aircraft. As pilots become system managers, their manual flying abilities can degrade over time. Also, up through the 1990s, airlines could draw on ex-military pilots with all-attitude/all-envelope flying experience. But that pool is drying up and most commercial pilots now come through the general aviation pipeline, where training does not include exposure to full stalls.

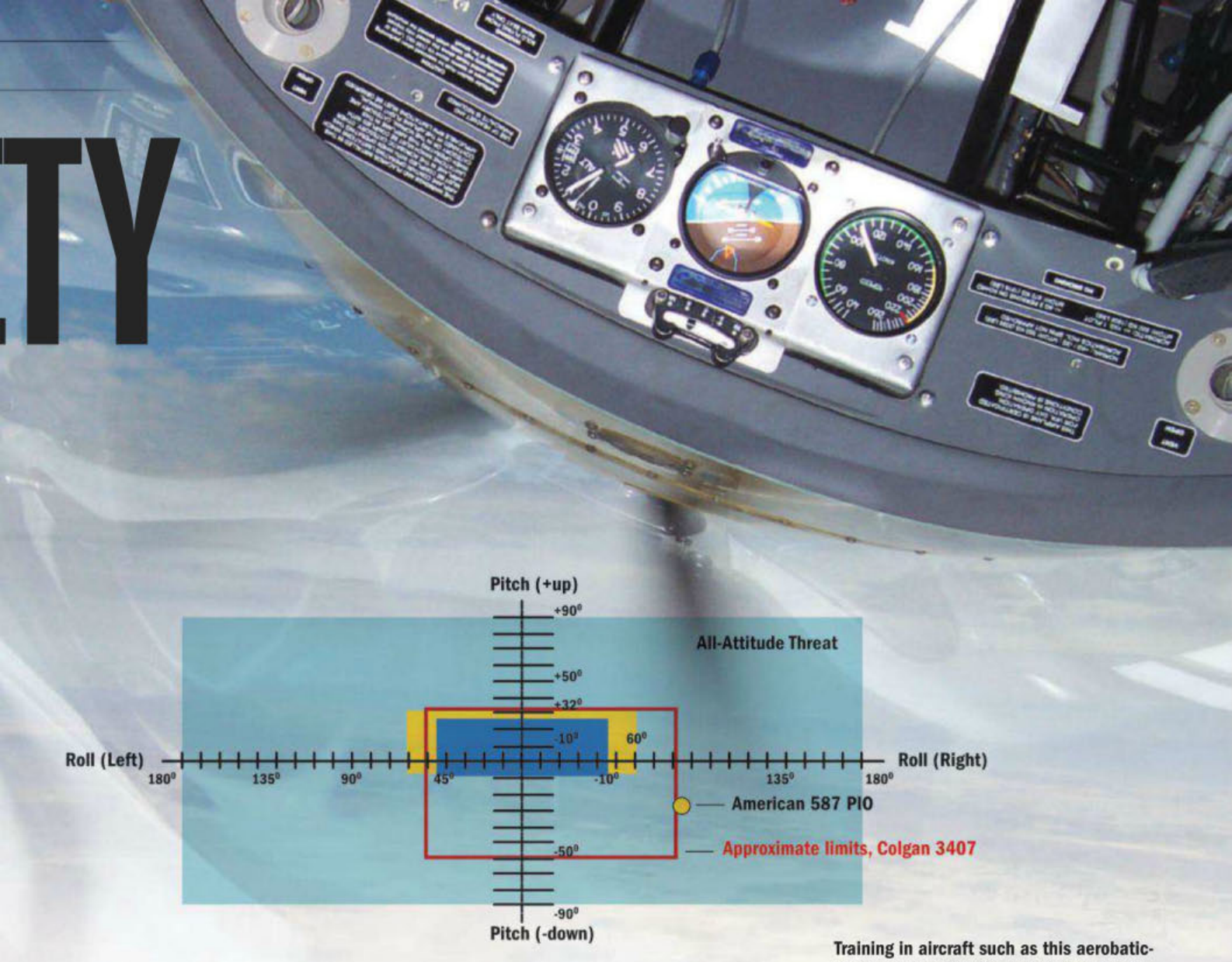
"We moved away from aerobatic training in the 1980s," says Advani. And the training pilots do receive can teach the wrong response. Until recently, the accepted rule in stall training was to recover with less than 100 ft. of altitude loss. This often required back pressure on the stick to keep the nose up, and not forward pressure on the controls to reduce angle of attack.

"It was drilled into them to minimize altitude loss to avoid hitting the ground—to pull, and not push," he says. "The biggest fear of pilots is hitting the ground, but it really should be stall and loss of control. We have to get rid of that rule." In 2010, the FAA revised its test standard to allow altitude loss during a recovery.

Icatee has identified limitations imposed by four unwritten assumptions built into today's pilot training. "We assume the aircraft is within its normal operational envelope and not in agitated flight, that the pilots have good situational awareness, that licensing training has provided them with good aircraft-handling skills and that their psychological and physiological reactions are predictable and reliable," says Advani. If one or more of those assumptions is violated, specialized training is required, the group concluded.

Aircraft are normally operated to their maximum lift-to-drag ratio, well before the stall, and back again. "Pilots are trained to go to the initiation of stall in a light aircraft, but never into a fully developed stall," Advani says. "There are two things wrong with that: They are not in a representative aircraft and they never train in a full stall. How will they ever know how to react? It is blatantly obvious that you push the nose down, but why does it not happen, again and again?"

Icatee believes LOC-I happens because those assumptions on which training is built no longer apply. In an upset "the aircraft is outside its normal operating envelope and agitated," he says. "There are many cues going on—visual, aural, tactile, vestibular, g-loading. In training the pilot experiences them one at a time. Now many things are hap-



Training in aircraft such as this aerobatic-capable Extra 300 flown by APS will take pilots well outside the flight envelope for normal airliner operations (blue box) or commercial pilot licensing (yellow box) to help them recognize and recover from upsets such as the Colgan Air 3407 stall.

pening at once, and we have not trained the pilot to deal with that and correlate all the stimuli accurately," he says. "The Colgan Air pilot did not recognize the stall and fought against the automation. That shows the limitations of the training," he says. "We want to train pilots to be prepared for the unexpected, and not to panic. Pilots are even overpowering the aircraft protection systems—we need to teach them how to use them."

An upset is defined as a pitch attitude beyond 25 deg. up or 10 deg. down, a bank angle exceeding 45 deg. or inappropriate airspeed. The normal operating regime within these limits represents just 4.9% of the "all-attitude threat envelope," which extends out to ±90 deg. pitch and 180 deg. bank (see graphic). Commercial pilots are trained to a maximum 11.1% of the threat envelope (±30 deg. pitch and 60 deg. bank), but actual upsets such as Colgan Air "exceed training limits significantly," says Advani.

Icatee has concluded that integrated academic, inflight and simulator training is required to teach pilots the correct recovery technique, which is to reduce angle of attack to unload the wing at the first signs of an approaching stall. "A modern simulator can do almost 100% of normal operations, but upset prevention and recovery training cannot be done in any one medium," he says. Academic training, introduction to generic recovery skills in aerobatic-capable training aircraft and development of type-specific skills in flight simulators are required to provide pilots with a mental model that prepares them to handle unexpected events safely, the group believes.

A key goal of UPRT, as defined by Icatee, is teaching the pilot to recognize the signs of stall, including possible buffet and reduced lateral control and stability. "Our focus is not only on recovery: Prevention is 90% of the goal," says Advani. "Pilots need to learn what a full stall feels like." An aircraft's behavior in a stall can surprise many pilots, delaying their response and recovery. "How a pilot deals with startle is not predictable or reliable," says Advani. "We need to give the pilot exposure to a challenging event during training so they are better able to handle surprise in real life."

Icatee recommends that, before receiving a commercial or multi-crew pilot license, pilots should complete the

UPRT academic course and learn the aerodynamic issues of stall recognition and recovery through inflight experience in an aerobatic-capable aircraft. Recurrent line-oriented training in a qualified simulator would then reinforce the appropriate procedures throughout the pilot's working life.

In-aircraft experience will add to the cost of training pilots. "There is definitely a cost, but it should be outweighed by the benefit," says Lou Nemeth, chief safety officer of training and simulation company CAE. "It's about $3,000-4,500 for a 2½-3½-day course; but put into the perspective of ab initio training costing $100,000-150,000, you are increasing that by 2-4% to tackle the single largest cause of hull loses and fatalities."

Icatee is likely to recommend that, after receiving UPRT during licensing training, airline pilots repeat the in-aircraft experience every five years, says Paul Ransbury, president of Phoenix-based Aviation Performance Solutions (APS), which provides upset-recovery training in aerobatic-capable Extra 300s. "Recurrent training is important. At APS, the typical [corporate] flight department sends pilots back every two years, but some only do it once in their career."

For Icatee, repeating the in-aircraft training every five years to avoid skill degradation "is the best solution, but may not be economical or feasible," Ransbury admits. For that reason, in-aircraft training is likely to remain optional for airlines. "The issue then becomes doing it in the simulator alone," says Nemeth.

"One thing the simulator can't do is to address the psychological and physiological aspects of upset," says Ransbury. "It's better to do it in the air first, then the simulator. If you try to train in the simulator first, then the aircraft, pilots are unsettled by the reality—the startle factor—of the upset. That's the value of in-aircraft training, to prepare for the simulator."

Nemeth says today's Level D full-flight simulators are capable of providing effective and appropriate training to reinforce the pilot's recovery skills. "Current simulator technology is taken into account in the recommendations," he says. But simulators will be improved to help with UPRT. Upset recoveries in the simulator "can pull more gs than the aircraft can handle, so we need to improve pilot cueing," says Advani. Stall modeling, the effectiveness of buffet simulation and role of motion cueing are all being looked at. Instructor-operator stations will be modified to provide better feedback on the flight envelope, display any inappropriate control inputs and provide a wider variety of upset scenarios so pilots can still be caught by surprise.

Instructor training and standardization are pivotal to the Icatee recommendations. Both on the aircraft and in the simulator "we see and worry about instruction that is not accurate, and which could have a devastating outcome. We must set standards for how to train the trainer," says Ransbury. "There has to be instructor standardization to transfer the correct knowledge to pilots," says Advani.

Formed in the wake of Air France 447, Icatee will shortly begin delivering its recommendations to the International Civil Aviation Organization. The academic materials, an update to an upset recovery training aid published in 1988, are to be ready early next year. There will be sections for the pilot, instructor, training provider and regulator. UPRT simulation requirements, focused on high-end devices, are to follow by mid-2012.

As release of the AF447 final report approaches, there is a sense of urgency in industry. Emergence of LOC-I as the major cause of airline fatalities has exposed "several big holes in training," says Advani. "Many of the 230,000 pilots flying today have insufficient training in how to recognize, avoid or recover from upsets. That's the reason for the urgency."

CAE FLIGHTSCAPE

Flight data visualizations such as this are being used by CAE to isolate common errors in upset recovery training and develop standards for the instruction provided to pilots in flight simulators.

Taming a Killer

Why has loss of control in flight become the leading cause of fatalities in commercial aviation, and what can be done to prevent it? Senior Technology Editor Graham Warwick asks Randall Brooks (right), senior director of flight training for Opinicus; and Paul Ransbury, president of Aviation Performance Solutions. Both are members of the International Committee for Aviation Training in Extended Envelopes and the Upset Prevention & Recovery Training Association, which have a goal of reducing loss-of-control accidents through enhanced training.

AW&ST: Why are we seeing LOC-I accidents in stall-protected aircraft flown by simulator-trained pilots?

Brooks: A pilot training program designed to address LOC-I as a primary threat is much different than the system we have today. Currently there is no requirement to provide pilots with the all-attitude/all-envelope exposure and training that would help them safely handle unanticipated upsets. The correct place to begin mitigating the problem is with early pilot training and, at least in the U.S, the practical test standards related to stall recovery are being updated. The past focus on minimizing altitude loss is being changed to give primary importance to the immediate and correct management of angle of attack.

Should we worry about a degradation of pilots' manual flying skills?

Ransbury: Air transport is extremely safe because the industry has consistently addressed hazards throughout its history. Undoubtedly automation has increased safety, but it has also affected manual flying currency and skills. It can be addressed within existing training regimes and simulator resources, but not without effort. This should not be a public concern, as the industry is beginning to address the balance between automation, system management and manual flying skills.

It is better to say LOC-I is a failure of training, and not pilot error?

Brooks: Pilot error is not a useful term in describing systemic deficiencies. When we are not adequately preparing pilots for upset events that can escalate into a loss of control, it is not necessarily the fault of individual pilots, but of a training paradigm that is not effectively emphasizing the correct areas.

Ransbury: Pilots trust the training and licensing system. The accident record reveals that current licensing and training may not be fully optimized in addressing the unique and persistent threat of LOC-I. The good news is a pilot can be much better prepared, and industry is indicating the threat will be mitigated through enhanced training such as standardized upset prevention and recovery training (UPRT).

Should we look more closely at automation and not blame the pilot?

Brooks: Automation is only a part of the overall picture that has resulted in today's LOC-I accident rate. We need to embrace the view that automation is a tool for the persons really flying the aircraft: the flight crew. Adequate manual handling practice to retain skills is essential, and may be inadequate from line flying alone in certain long-haul operations.

Airlines may say on-aircraft training is too costly. Is it worth it?

Ransbury: On-aircraft upset prevention and recovery training is unquestionably a major mitigation for all levels of pilots, especially airline pilots. But due to the economy and practicality of on-aircraft UPRT, it is expected that an airline's participation in such a program will remain optional.

Brooks: For the next-generation pilot, on-aircraft training should occur before arriving at the airline as it is not the airlines' responsibility to teach fundamental UPRT concepts and skills. We do not expect pilots to learn to fly instruments at an airline; it is assumed they possess instrument competency when hired. Basic upset prevention and recovery skills should be a core competency for all airline pilots and as such should be trained, and tested, at the commercial pilot licensing level.

Can today's flight simulators provide realistic stall training?

Brooks: Yes, for the most part, but they should be specifically qualified for enhanced stall training in the same way they are for other training tasks.

Ransbury: The bigger problem is instructor qualification and standardization. You cannot expect someone who has never been trained for anything beyond recovery at the first indication of stall to possess all the knowledge and skills required to use the full range of a simulator's training envelope. The same is true for effectively teaching in an all-attitude environment that exceeds the confines of classical commercial pilot licensing.

How do you ensure UPRT training is done correctly?

Brooks: It is essential that proper training and experience is provided, and in the correct manner. While there are instructor ratings for instrument, multi-engine and glider skills, there is no standard for teaching UPRT despite the fact there is more specific knowledge and skill required than in any of the other three areas of instruction.

Ransbury: It will be a very important step for industry to assign instructional standardization and quality-assurance guidelines to ensure all training is as expected by the airlines and manufacturers. This is pivotal to the implementation of enhanced UPRT.

Finally, what is the golden rule of stall prevention and recovery?

Ransbury: Reduce the angle of attack immediately and sufficiently to return to the positive stability and control region of the flight envelope below maximum lift coefficient or critical angle of attack. For decades, we have been teaching pilots to minimize altitude loss in stall recoveries. This often requires back-pressure, not a relaxation of back-pressure or even forward pressure on the controls. In that light, the pilot responses in the Colgan Air 3407 and Air France 447 [accidents] are easier to understand.

Blue Sky Training

Money permitting, USAF could use simulator advances to rethink fast-jet training with T-X

AMY BUTLER/WASHINGTON and NAS OCEANA, VA.

Training and simulation technologies have evolved dramatically since the Pentagon purchased its last fast-jet trainer in the 1960s. This opens a world of possibilities for the U.S. Air Force with its forthcoming T-X to fundamentally overhaul how it prepares pilots for the F-22 and F-35.

But the budget drama unfolding in Washington could mean the Air Force will find itself short of the money to take full advantage of these advances for a T-38C replacement in the near term.

Several indicators point to a delay in the T-X project to develop the next fast-jet trainer. Gen. Edward Rice, who heads the Air Force Education and Training Command (AETC), said in September that the service has some "flexibility" in how long it can wait to start a new program. Though his predecessor, Gen. (ret.) Stephen Lorenz, had acknowledged this fact, he also pushed more aggressively for the T-X program to begin soon because of the risk of a catastrophic failure on the Northrop Grumman T-38C, a fleet averaging 43.5 years in age.

Rice, by contrast, opened the door to supporting a delay. He was likely preparing the Office of the Secretary of Defense, Congress and industry for an inevitable slip to the T-X due to pressure to cut programs and produce near-term savings to support federal debt reduction. However, one former service official notes that "every time we push it to the right, we are assuming more risk" of a failure or safety issue on the T-38C.

In addition, in October, a scheduled Defense Acquisition Board review of procurement strategy options for the T-X was tabled indefinitely, pending more work to determine the depth of cuts to be undertaken by the Pentagon. The Air Force has, however, conducted an analysis of alternatives to support a T-X procurement and senior service officials are pushing to take advantage of available technologies rather than pursuing a clean-sheet design.

Despite wrangling over funding and timing, the T-X program represents a significant opportunity for the Air Force to reimagine fighter-pilot training because of the introduction of new aids, such as immersive simulators, and networking tools that allow for real-time assessments of student performance that have not been possible with the T-38C system and its ground-based adjunct.

Ultimately, these new technologies would allow the Air Force to change how it uses the simulator. Today, it is mostly a tool to prepare students for time in the T-38C cockpit, but a new approach could call for students to actually develop and practice some skills almost exclusively in the simulator, says John Gillis, undergraduate flying training pipeline manager at AETC.

"If you put together a product with a lower amount of flight hours [needed], enabled by the latest technology and high-fidelity simulators, . . . in a future state, you spend less dollars per pilot coming through," says Col. Kenneth Griffin, chief of the flying training requirements division at AETC. But the graduate is "a more capable, highly trained pilot." Some skills that could be taught mainly in a high-definition simulator are basic formation flying, night-vision goggle use and flying low-altitude routes.

If the Air Force opts to begin the T-X sooner rather than later, there could be an unprecedented and unintended effect for the winning contractor team. The international coalition knitted together to develop and buy the F-35 could unify the Joint Strike Fighter nations that have yet to commit to a new trainer around a more like-minded approach based on the USAF decision. This could allow partners to capitalize on economies of

USAF/RICH MCFADDEN

Though the average age of a U.S. Air Force T-38C is 43.5 years, the service is wrangling with when it can afford to begin a program to replace the fast-jet trainers.

Recent Fast-Jet Trainer Sales

Competitions are pending in the U.S., Poland and Israel


ALENIA AERMACCHI


AMY BUTLER/AW&ST


LOCKHEED MARTIN

Alenia Aermacchi M-346		BAE Systems Hawk Mk. 128*		Lockheed Martin/KAI T-50	
First Flight	*July 2004*	*First Flight*	*July 2005*	*First Flight*	*August 2002*
Italy	**15**	**Australia**	**33**	**South Korea**	**142** (including trainer, flight demo and light combat versions)
Singapore	**12**	**Canada**	**22**		
United Arab Emirates	**48** (contract pending)	**South Africa**	**24**		
		Bahrain	**6**		
		U.K.	**28**	**Indonesia**	**16**
		India	**123**		

**968 Hawks have been sold, including earlier versions.*

Source: AW&ST

scale and ensure uniformity for training pilots headed for service in the F-35. One interesting dynamic, however, is that two of three expected T-X bidders are from F-35 nations already embarking on new fast-jet training programs: Italy, buying the Aermacchi M-346, and the U.K., purchasing the BAE Systems Hawk Mk. 128.

Movements in industry to further define the teams vying for the contract are unlikely to take place while the Air Force struggles with the larger budget questions. BAE has selected Northrop Grumman to be its stateside manufacturing lead in offering a system based on the Hawk. A Lockheed Martin/Korean Aerospace Industries team is offering a T-50-based proposal, and Alenia is planning to propose an M-346-based concept.

As affordability is paramount for the T-X—the former service official hopes for an aircraft that will cost less than $25 million apiece—the Air Force is weighing the cost and benefits of buying various technologies in today's constrained budget environment. At issue is how many expensive flight hours would be needed to train a student versus how much work can be done in ground-based simulators and classrooms.

Advances in immersive simulation technology give the service at least the option of handling more skills-training on the ground than ever before for this mission area. This is part of the reason the Air Force is able to replace 433 T-38Cs with roughly 350 T-X aircraft, the former Air Force official notes. Additionally, though, the Air Force is shrinking its fighter force structure, reducing the demand on pilot production.

While simulators are expensive to buy up front, the former Air Force official notes that with the T-X's life expected to be at least 40 years, the benefit will come over time in reduced operations cost. Today, T-38C training is tilted roughly 71% in favor of cockpit time, with 95.7 hr. required; only 38.2 hr. are required in a simulator.

"The more mature simulation gets and the more real it gets, the more opportunity you have to save money and to more cost-effectively train," says Robert Wood, who is leading BAE's Hawk campaign.

Some skills, however, such as executing high-g maneuvers, conducting air-to-air refueling and using night-vision goggles, can be honed on the ground but must ultimately be tested in the cockpit, and these are among the key parameters for the aircraft portion of the forthcoming T-X bids.

Companies vying for the work agree that pilots graduating from a T-X course will be better trained and more prepared to take on the challenging task of piloting F-22 and F-35 aircraft, which demand a new level of mental acuity, dubbed an "information management" requirement by the Air Force, to manage an unprecedented amount of data being piped into the cockpit. This higher level of preparation is largely due to the training and simulator technologies that, while used in civil aviation for years, will be new to Air Force fighter-pilot students.

Among these new technologies is a networked environment, which is ubiquitous in everyday life today but postdates the older training environment fighter-pilot students still use.

However, the technology can dramatically impact how training courses are taught, how students are assessed and even how syllabi can be improved over time, says one industry executive. "Today, with the learning management tools we are using, we can see how a student is responding to the instructional material, how the group is responding to the instructional material and how effective the instructional material is," says another executive.

An example on the ground is a basic takeoff in a desktop tool; the courseware grades in real time how well the student is following procedures and gives real-time feedback on performance. In the more complex cockpit setting, data links connecting aircraft allow for students to conduct live air-to-air engagements and, without the use of a radar, to train as though an onboard radar and radar-guided weapons are in use. The system uses a database to assess the engagement and determine if a kill took place immediately, according to BAE officials. This allows for students to retrain to a scenario immediately while in the air if needed. In the T-38C, much of the assessment work takes place on the ground after landing.

Finally, the overarching T-X information backbone can track the progress of students and the courseware in a quantitative fashion, the first industry executive says. If a course appears to trip up students consistently in a particular spot, instructors can rework it to improve the instruction.

Another benefit of networking is that upgrades can be inserted into the system holistically. Today, some T-38C ground-based coursework uses more modern versions of what is available in the aircraft.

BAE's contracts and subcontracts director, Raymond Piselli, says his company prefers to refer to the database capability as "emulation" for pilots rather than simulation. The database would allow for instruments in the cockpit of the Hawk, for example, to produce the symbology that a pilot would see in a fighter; this would be tailored for the U.S. to work with the F-22 and F-35 symbology.

This capability was on display during a two-ship training flight this month at NAS Oceana, Va., in which this Aviation Week reporter witnessed several long- and short-range air-to-air scenarios from the backseat of a Hawk Mk. 128 emulating a MiG 29 Fulcrum—the opposing aircraft emulated a Typhoon. During the engagements, a radar picture was displayed without an onboard radar; it was crafted using GPS locations relayed via data link and the use of data that depicts how both aircraft and their respective air-to-air weapons operate. Andy Blythe, who piloted the emulated Fulcrum, said the real-time kill assessments allow for more immediate learning for the pilot as opposed to having to recreate a scenario after an engagement to determine which skills need improving.

Each of the contractors say this technology is available in their offering, and Griffin says it is of interest to the Air Force. While Alenia and BAE are outlining their simulators and tools, Lockheed Martin officials are holding off on decisions about training devices until the actual request for proposals (RFP) is out, says Tom Quelly, global training and services director for Lockheed Martin. The company is providing the full-mission simulators for F-35 pilot training at Eglin AFB, Fla. But the system is very high-end and may exceed what the Air Force is willing to budget for the T-X. Quelly says Lockheed Martin will draw from work on the F-35 and C-130, as well as its experience with Babcock International in the Ascent joint venture that provides ground-based training for the Royal Air Force's recent Hawk buy. (The aircraft and ground-based portions were procured separately.)

BAE plans to announce its ground-based training system subcontractor soon.

Boeing is on a team with Alenia under Singapore Technologies Aerospace to provide an M-346 training system to Singapore's air force. CAE Inc. is on Alenia's team for the Italian delivery and is supporting the company's U.S. marketing plans; a formal announcement on the team is likely to come after the Air Force issues its RFP.

Lockheed Martin's aeronautics sector is leading the company's bid, backed by the global training systems sector with the ground-based training work.

Higher-fidelity training, especially simulation of cockpits employing sensors (radars and targeting capabilities) as well as defensive systems, could also help the Air Force "download" some training from the F-22 and F-35 units, says Ted Thompson, F-15 and F-22 training program manager at AETC. Some skills associated with the F-22 cannot now be replicated in the T-38C, forcing the service to use the F-22s, which have high per-hour flying costs, for proficiency development.

"Today's pilots don't see advanced sensors until they get to the F-22," Griffin says. The T-X aircraft will not be required to contain those sensors, but pilots will become familiar with using them because of the simulation technology advances.

To address this shortfall in the near term, the Air Force took the unusual step in 2009 of contracting with Lockheed Martin to form a "bridge course" of F-16 work designed to fill the capability gap between the T-38C and F-22. The course includes eight flights in the F-16, says Thompson. The service has spent millions on this capability to date and expects to keep the contract active until the T-X is fielded.

ALENIA AERMACCHI

Immersive simulator technology, such as this system developed by Alenia Aermacchi for the Italian air force, could allow the U.S. Air Force to off-load some training requirements from the T-X aircraft to ground-based training tools.

Ultimately, however, shifting training from the F-22 and F-35 to a T-X would be a significant change for the Air Force. An example of this is taking place now in South Korea, which is fielding the T-50. Quelly says the air force there plans to shift about 50% of the training hours now handled on the F-16 into the T-50. Blythe says the U.K. is doing something similar in fielding the Hawk.

The T-X is expected to relieve some pressure on the F-22 force and the F-35 once it is fielded, allowing those fleets to spend training time on more exquisite skills or, possibly, recode more aircraft for combat rather than training. With no future dual-seat fighters planned, students must be as skilled as possible before taking the controls of an F-22 or F-35.

Griffin says the Air Force is continuing to refine its plans for fielding the T-X, and the fiscal 2013 budget going to Congress in February will "clarify" the way ahead for the T-38C replacement's timing.

Close Encounters

Group crafts risk-warning and management blueprint to counter asteroid threat

GUY NORRIS/BOULDER, COLO.

Concepts for communicating the risks and managing the threat of asteroid impacts will be considered by the United Nations following an expert working group meeting in Colorado.

The Near-Earth Object (NEO) media/risk meeting came within days of a 300-meter (984-ft.)-plus-dia. asteroid passing between the Earth and the Moon on Nov 8, and as NASA closed on additional congressional funding of more than $20 million for an ongoing survey mission aimed at finding objects posing a potential collision threat.

Although acknowledged as a statistically rare, low-probability event, asteroid impacts are seen as potential global catastrophes. Now, with 1,265 asteroids currently listed as potentially hazardous to Earth and with around 100 or more new potential impacts currently being flagged each month by the NASA Jet Propulsion Laboratory's automated collision-monitoring Sentry system, the threat is being taken increasingly seriously by governments and space agencies.

Discoveries of near-Earth asteroids have increased exponentially over the past decade since surveys became organized.

According to NASA, as of Nov 3 8,421 NEOs have been discovered, of which 830 are asteroids with a diameter of approximately 1 km or larger. A NEO is an asteroid or a comet with an orbit close to that of Earth in which the perihelion (or nearest point to the Sun) is less than 1.3 astronomical units (1.3 times the distance from the Earth to the Sun). Potentially hazardous NEOs are 500 ft. or so in diameter and follow orbital paths that come within 4.65 million mi. (7.48 million km) of Earth.

The meeting, held at University of Colorado's Laboratory for Atmospheric and Space Physics, was organized by the Secure World Foundation and aimed at a draft report for the U.N. Action Team 14 working group on NEOs. The team forms part of the U.N.'s Committee on the Peaceful Uses of Outer Space Scientific and Technical Subcommittee, and will present guidance to the U.N. working group at a NEO-mitigation meeting in Vienna, in February 2012.

Following a review in June next year, final recommendations will form the blueprint for possible U.N. action from 2013 onward. The working group is studying setting up an information, analysis and warning network (IAWN) to coordinate data about NEO detection, orbit analysis, impact prediction and notifications. The Colorado meeting was focused on IAWN communications, including protocols used by similar warning nets dealing with natural disasters such as hurricanes and tsunamis, as well as improving public education on the NEO phenomenon.

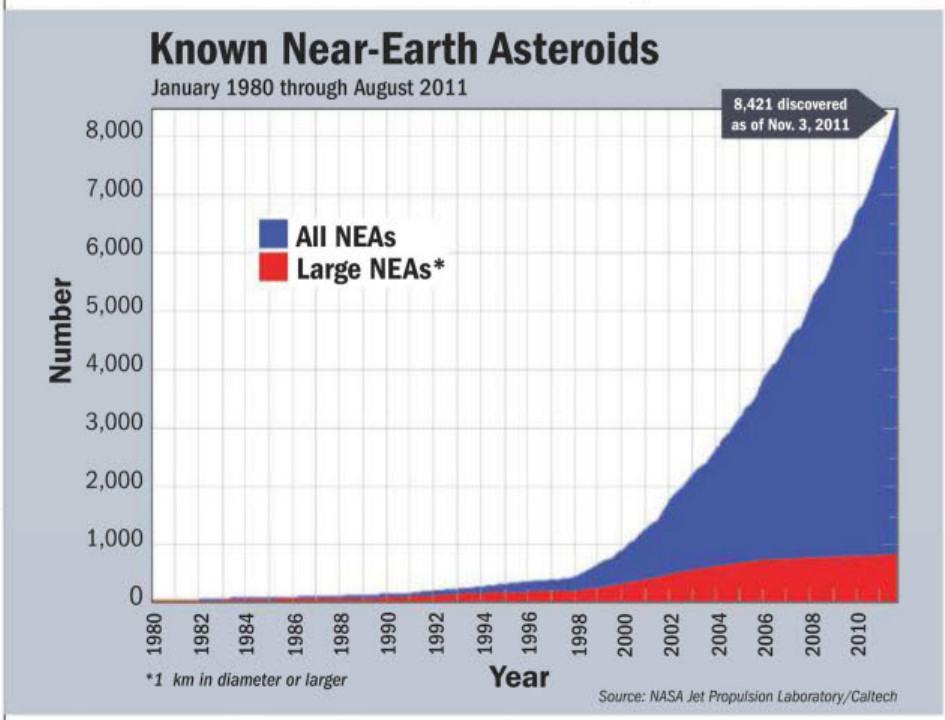
Parallel work is underway to set up a NEO Mission Planning and Operations Group (MPOG) that will coordinate international space agencies on the planning and conduct of missions to threatening asteroids. The MPOG will be modeled on the inter-space agency group established to monitor space debris.

The conference included discussion of communication strategies for events ranging from those with almost no warning such as the TC_3 asteroid which exploded over southern Sudan in 2008 less than 21 hr. after being detected, to decades-long scenarios such as the Apophis asteroid which could potentially impact Earth in 2036.

In particular, the meeting focused on effective ways of communicating the reality of threats and evacuation notices to predicted impact zones in short-term warning scenarios. For longer-term threats, the group weighed the geopolitical implications of potential mitigation strategies involving speeding up or slowing down an asteroid. By altering an asteroid's speed, its trajectory could be altered to either miss the Earth altogether or be deflected toward less-populated areas. Such choices inevitably involve increasing the risk to certain nations and regions, while decreasing it for others, raising enormous policy questions.

Social scientists, invited to advise the group, called for transparent debate from agencies over both warnings and mitigation strategies. Dennis Mileti, director emeritus of University of Colorado's National Hazards Center, warned "the biggest issue will not be panic but getting them to take your NEO warning seriously. Human beings need to dichotomize risk. That's how they decide to do something about it or not. Don't try and explain your science to the public."

Former Apollo astronaut and asteroid awareness trailblazer Russell Schweickart warned greater efforts and survey systems are needed. "We have many



more objects that will be discovered. We're not running out of objects, we're running out of capability of our telescopes." While roughly 94% of the largest NEOs are believed to have been located, "there are 60% still not detected in the 300-meter or so size," said Schweickart, who is co-founder and past chairman of the B612 Foundation dedicated to protecting Earth from asteroid strikes. Detection numbers are even lower for smaller NEOs between 100 and 300 meters in diameter with only 10% of the estimated population accounted for, while for the smallest ones—like the approximately 50-meter asteroid that airburst over Tunguska, Siberia, in 1908—"we're below 1% of total objects discovered. When it comes to objects that can do serious damage we're nowhere near a full inventory yet," he added.

NASA NEO Observations Program Executive Manager Lindley Johnson said securing allocated NEO funding is "critical to continuation of our existing survey programs like the radars for instance, and to do sorely needed upgrades for the Arecibo (radio telescope) in particular—that has suffered from a lack of funding over the years." Johnson added money will also support analysis "to determine what the next generation survey should be."

Options include new land-based telescope projects like the Atlas (Asteroid Terrestrial-impact Last Alert System) and Large Synoptic Survey Telescope as well as space-based systems. These could include hosted payload-type concepts in which a staring array would be mounted on the "backside of a commercial payload," scanning as it orbits the Earth. Such schemes are less capable than a dedicated survey telescope, but much more affordable. "We really need to ferret out the best solution," said Johnson.

Locating Lethality

GUY NORRIS/BOULDER, COLO.

A space-based infrared (IR) survey system is being proposed to NASA by Ball Aerospace as a low-risk, quick-start option to significantly speed up the rate at which potentially lethal asteroids can be discovered.

The NEO Survey spacecraft is designed to meet the goal of the Near-Earth Object survey program which aims to pinpoint 90% of the statistically predicted asteroids measuring 140 meters or larger by 2020. Working with ground-based telescopes, Ball says the craft would also accelerate detection of smaller, but still highly dangerous and more numerous asteroids that are harder to find during their perihelion—the point in the orbit when they are closest to the Sun.

Working with Earth telescopes, Ball estimates 90% of the larger asteroids could be surveyed in as little as 5.3 years and that almost 97% would be discovered in 10 years. Over the same 10-year period, it predicts that 93.1% of the 100-meter-plus-dia. NEOs can be tracked, while almost 80% of the smaller 60-meter-class objects will also be successfully surveyed.

"Impact mitigation is the underlying motivation for a survey where time is important," says Ball Aerospace Advanced Systems' manager for new business, Robert Arentz. "The first step is to go to a Venus-intersecting orbit where the spacecraft would be well-positioned to detect NEOs during their perihelion passage. NEOs will glow in the IR, while they reflect in the visible. As they are dark to begin with that's why they glow so brightly in the IR."

The NEO Survey would be assembled from more or less off-the-shelf solar array, thermal shield and cryogenic assembly components already developed for the Kepler and Spitzer space telescope programs. Covering the 5-9.2-micron IR range, the spacecraft would scan six 30-deg.-wide zones of the anti-Sun sky in about one month. The craft would then adjust for sky motion and rescan an entirely new field of regard, eventually completing its mission in around six years.

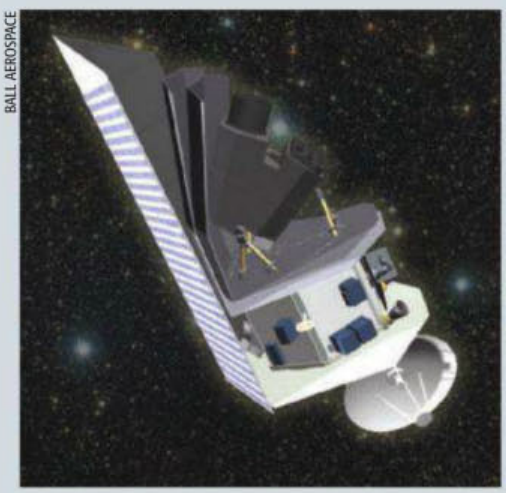
Launched by an EELV-class Delta IV, Atlas V or Falcon 9, Ball estimates the mission could be accomplished for less than $650 million. and says non-NASA support could be considered if "private funding was available."

NASA is meanwhile entering Phase B of development of an asteroid sample-return mission, due for launch in 2016. The Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer, or Osiris-Rex mission will rendezvous with the 560-meter-dia. 1999 RQ36 asteroid in 2020 and return up to 2 kg of "pristine" carbonaceous material to Earth in 2023.

Although not considered hazardous currently, the asteroid is due to make a close path by Earth in 2062 which could influence its orbit sufficiently to put it on a collision course around 2182. The mission is also aimed at gaining expertise in navigating around an asteroid, experience which would be useful in the event of a future deflection mission.

Lockheed Martin is also engaged on an asteroid tracking mission as part of efforts to find suitable destinations for its 'stepping stones' plan to support NASA's long-term ambitions for human missions to Mars. Landings on asteroids in the 2019-29 period are key elements of the build-up, says Advanced Human Explorations Missions Principal Investigator Josh Hopkins. "Right now we are live-tracking newly discovered asteroids to see if they'd make a good target."

Using the Orion Multi-Purpose Crew Vehicle as its centerpiece, Lockheed has also identified Deimos, one of the Martian moons and a possible captured asteroid, as the preferred site as a precursor mission to a Mars landing around the early 2030s.


BALL AEROSPACE

Ball's NEO Survey would combine elements of the Kepler and Spitzer telescope programs.

Libya Lessons

Combat debutants draw lessons from Libya experience

ROBERT WALL/DUBAI and LONDON

Even if the Libyan air force and air defenses failed to mount a robust challenge to the NATO-led air campaign over the country, coalition participants are finding lessons to draw from the experience.

Communications and procedures may be the two areas that are particularly in focus, especially for the non-NATO members involved in the fighting—Sweden, the United Arab Emirates and Qatar. The issue now is to figure out "how we can develop our ability to network more effectively in the future," says Air Chief Marshal Stephen Dalton, leader of the Royal Air Force.

Command, control and communications issues are a particular area of focus for the UAE air force, which contributed Dassault Mirage 2000-9s and Lockheed Martin F-16 Block 60s in their first combat employment. "Interoperability was a showstopper in the beginning," Maj. Gen. Ibrahim Naser Al Alawi, deputy commander of the UAE air force and air defense, told the Dubai International Air Chiefs Conference on the eve of the Dubai Air Show.

Al Alawi says his service could have started flying two days after its aircraft arrived in Italy; however, "not being familiar with the NATO process and their regulations, [our participation] was delayed a couple of days before we could fly our first mission."

One key lesson from the conflict is the need for "procurement of air and ground communications systems to integrate into various command-and-control nodes," says Al Alawi.

Dalton insists that "it is possible to do firewalls and gateways at [an] agreed level of classification." But there is a need for all alliance members to procure equipment that is compliant with common standards. With many NATO members facing a period of budget austerity, he warns against cutting network-centric-warfare supporting programs because such a move could damage interoperability.

For Al Alawi, the experience also highlighted the importance of having exchange officers as well as the utility of joining exercises with NATO members. Participating in Red Flags and other aerial combat exercises in previous years "was a big asset to help integrate into the war," he says.

However, Al Alawi also had a message for NATO: "Further integration and interoperability will require increased information- and technology-sharing."

On the equipment side, one refrain has been that NATO members (except for the U.S.) need to beef up their air-to-air refueling and intelligence, surveillance and reconnaissance (ISR) capacity. Brig. Gen. Silvano Frigerio, deputy chief of air and space plans in the Italian air force and chief of the targeting directorate for NATO's Libya operations, says the conflict underscored the need for NATO to pursue programs such as the Alliance Ground Surveillance (AGS) system, which uses a fleet of Global Hawk unmanned aircraft.

But other lessons are less intuitive. Although much of the focus of Libya strike operations has been on platforms such as the Tornado GR4, Eurofighter Typhoon and Dassault Rafale, NATO should "think about the need in the future for a low-cost platform to be able to do our job, if required, in a permissive environment," says Frigerio.

"How can we manage to fly thousands and thousands of flying hours on a joint operation area looking for one armored vehicle with the sophisticated aircraft we will have in the future? Maybe we can't afford to stay there for such a long time," he declares. Already in Libya, allies were worried about the cost of the conflict, Frigerio told the IQPC's International Fighter Conference in London. Italy itself saw the difference when comparing the flying-hour cost of operating a fully loaded AMX aircraft with that of higher-end fighters.

Moreover, Frigerio points to broader topics looming ahead for the alliance. One is the need to strengthen its ISR-collection capabilities; NATO depended on U.S. assets to a high degree during the Libya campaign. Speaking of projects such as the AGS program, he recommends that "we need to continue on this way."

Nevertheless, not all of the lessons are

The Swedish Gripen detachment operated in support of NATO's air war over Libya from Sigonella, Sicily.

SAAB

equipment-related. For instance, a center of excellence needs to be established for targeting so NATO can increase the number of targeteers—trained to a common standard—who are available to support an operation. A NATO-common collateral-damage estimating methodology also is essential.

Dalton adds that mission planning "was sometimes disjointed" and differences in access to sensitive information slowed post-mission data-sharing, a problem that should be redressed.

Since every country's mission set differed, it should come as no surprise that post-conflict assessments are not uniform. Frigerio says Libya reinforced the need for smaller, low-collateral-damage weapons. But for the Danish air force, the conflict showed that it could participate adequately with its 500- and 2,000-lb. bombs.

While there is still a long-term ambition to equip the service's F-16s with a Small-Diameter Bomb, the immediate sense of urgency has actually been reduced, according to Maj. Hans Peter Bagger, head of the fighter branch in the Danish air force's tactical air command.

Sweden, in contrast, has put fielding such a weapon on its planning agenda.

Adding data links to longer-range weapons so they can be retargeted also is important, notes Dalton. The U.K. had to call off a Storm Shadow cruise missile strike in Libya moments before the weapons were fired because of an intelligence alert regarding the risk of collateral damage in the target area.

For the Swedish air force, the operation was particularly instructive, because it was the country's first out-of-area operation in 50 years and the first deployment of the JAS 39 Gripen. Swedish military officials have already pinpointed improvements in equipment and processes that should be made for future deployments of the fighter.

Although the Swedish air force is generally satisfied with its Libya experience, in which it logged more than 650 sorties, equipment and training lessons have emerged. One involves addressing a quirk in how the "Have Quick" secure radio functions on Gripen, says Maj. Anders Gustafsson, who served as the acting squadron leader for FL02, the second rotation of Gripens to Sigonella, Sicily.

Gripen pilots had to operate on an unsecure network and use code words to protect their operation. The problem was that NATO used the "training" rather than the "operational" Have Quick network, but with operational security keys. That odd mix was a challenge for the Gripen, because it is designed to switch automatically to the operational or training network depending on what security keys are provided. A remedy should be ready next year, notes Gustafsson.

Another problem plaguing the Swedish detachment was that it took extra time for them to receive the required cryptological kit, even though Swedish personnel were cleared for the equipment. Danish and Norwegian air force officers aided the Swedes in clearing that hurdle, as well as in providing access to key information such as the air-tasking order that was being withheld in the opening phase of the deployment.

Sweden also wants to add an infrared sensor to its reconnaissance pods. The pod was used heavily in Libya and demonstrated its utility, says Gustafsson, despite the fact that some operators used these pods for the first time. More than 250,000 pictures were delivered to planners.

The issue now is to figure out "how we can develop our ability to network more effectively in the future"

Overall, however, the experience validated many elements of the Gripen system. "The human-machine interface is really good," says Gustafsson, and the various inputs from the radar, laser-designator pod, electronic warfare (EW) system and other subsystems provided "really good situational awareness."

Still, other enhancements are being sought, such as expanding Link-16 functionality to the air-to-ground role, which should materialize next year. Improving situational awareness is also in the cards. This will include the fielding of a helmet-mounted display, likely late next year, and cockpit upgrades to better present information such as the air-coordination order.

Sweden also needs to verify the accuracy of its Litening III laser-designator pod on Gripen. So far, the Gripens can use the pod on their own but not to hand off targets, because the accuracy validation has not taken place.

Another goal will involve boosting competency in air-to-air refueling, says Gustafsson. To use the Gripen refueling probe, which is located slightly behind the pilot, flightcrews must undergo extra training to become comfortable with the process. Moreover, it will be necessary to have greater access to the Swedish air force's C-130 tanker, which itself was still in its demonstration phase during the Libya campaign.

As for the Royal Air Force's Typhoons, some of their experiences were similar to those of the other fighters. To support the Typhoon's first combat deployment, the U.K. moved up several development items to support the mission. Those efforts included validating the accuracy of the targeting pod, teaching personnel how to allow the fighter to use its secure communications, and modifying some displays to aid air-to-ground weapons delivery, says Wing Cdr. Dicky Patounas, the leader of 3(F) Sqdn.

Despite the absence of surface-to-air missile attacks, Patounas says the Libya mission underscored the utility of the Typhoon's EW system. In one case, it detected an SA-3 that had been hit early in the conflict, only to be repaired. The radar warning receiver information was used to strike the target again. Patounas says the Typhoons also provided an EW situation-awareness umbrella to the Tornado GR4s during some of the 650 sorties flown.

One major challenge the RAF faced early on was refreshing pilots' ability to carry out air-to-ground operations. In the end, all the pilots were able to conduct such strikes, with 50% of them approved to use the laser-designator pod. Even though the initial focus now is to regain the air-to-air experience partially neglected in recent months, Patounas says it is also necessary to ensure that some pilots remain current in air-to-ground combat to avoid the pre-Libya situation.

Even for the U.S.—which is seen as having played a largely supporting role—post-conflict assessments already have been drawn up. For instance, the EA-18G Growler's experience has prompted the U.S. Navy to conclude that it should include the electronic attack aircraft in its Distributed Targeting System (DTS) effort, which is now coming to conclusion for the F/A-18E/F. DTS matches synthetic aperture radar or ATFlir (advanced targeting forward-looking infrared) targeting pod imagery with mensurated data to determine precision coordinates that can be provided to others to strike a target. One operational lesson is to have the EA-18G's ALQ-218 emitter also work with DTS, says Cdr. David Kindley, deputy program manager for the F/A-18 mission system.

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Europe Needs Innovation Model


EADS

BY JEAN J. BOTTI

Jean J. Botti, Ph.D., is chief technical officer of EADS. He also is a member of the French Academy of Technologies, and holds 23 patents.

The new global currency of the 21st century is innovation. In order for this currency to properly appreciate, developed countries will have to cast away some common misconceptions about what it means to do good research and technology (R&T).

Many countries that trade with the U.S. and Europe are no longer satisfied with the offset model of building factories in their countries. Instead, they demand that we bring them the foundations of North American and European excellence: research, scientific know-how and our innovative management practices. Our trading partners are keenly aware that the currency of the 21st century will be the exchange and acquisition of game-changing innovation.

Parts of the current discussion concerning innovation often tend to disassociate technology from industrialization. However, they are symbiotic. Countries with overly developed service sectors such as France have lost significant ground to nations like Germany, which possess comparative technology and manufacturing advantages in mechanical engineering, automotive technology and alternative energy research.

> "Europe and the U.S. should aggressively set up joint flagship programs to develop the next generation of fuels."

Large industrial companies in such countries are important to keep the R&T landscape fertile. Often, they are better positioned to support small and medium enterprise innovation than bureaucratic public bodies.

In the U.S., there is a strong relationship between the private and public sectors. Public bodies like the Defense Department and NASA do their best to develop combinations of winning teams when large companies need to be associated with small and medium enterprises and academic institutions. The recognition that innovation occurs throughout the entire enterprise is manifested in small-business set-aside requirements for nearly all major U.S. government procurements. Further, the U.S. also has a congressionally mandated program that funds only small enterprises called Small Business Innovation Research. It provides $2 billion annually in R&T funding for businesses having 500 or fewer employees.

Europe continues to be far too politically correct in this endeavor. Its way of organizing research programs is like spreading a little piece of butter on a very large slice of bread. European R&T authorities are trying to allocate projects very thinly across too many countries and often to those that do not have any competency related to a given project.

Obviously, this does not lead to optimal results. Europe needs to define itself on the basis of the strengths and weaknesses of each country and to foster areas of excellence in each state or region. Despite all the rhetoric, the 27 EU countries will never play in the same league but they all have a chance to excel in what they individually do best.

Sometimes you can find examples of a promising long-term R&T strategy in places where you would not expect them, such as Malaysia. Its leaders realize the country is too big to be only a brain trust, which is how its neighbor Singapore has positioned itself. On the other hand, such countries are too small to be low-cost producers. This is why Malaysia has decided to build up capabilities in selected innovative technologies such as composite materials. It deliberately avoided opting to build an aerospace manufacturing chain from scratch.

The Aerospace Malaysian Innovation Center is a public/private partnership. The government contributes 50% of the funds, the private partners provide the other half, and research is pursued around topics that are of great interest for the nation and have the potential to create a complete set of new businesses. The center is setting its sights on technology to develop jet fuel from algae, new standards in aerostructure manufacturing and sustainable green aeronautic materials, and improve technologies for systems integration.

We need these kinds of flagship programs everywhere. They can help both the private and the public sectors to rally together and push for a new renaissance of innovation. Today's European situation fosters wastes of both time and money, and we will end up once more with a complicated, bureaucratic and costly scenario that will discourage small and large private actors from actively entering these types of initiatives.

Europe and the U.S. should aggressively set up joint flagship programs to develop, for example, the next generation of fuels. The geo political consequences and moral hazards associated with reducing dependence on fuel from the Middle East are obvious.

The results of this Europe-U.S. collaboration to find acceptable alternative fuels would be positive competition. Both sides of the Atlantic would benefit from the available research, technology and production know-how, which would help them to compete in the new global market.

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