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F-35 FEEDBACK

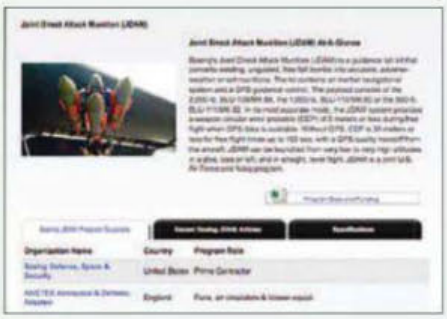
Recent comments in our Ares defense blog focused on the F-35. Three posts on congressional hearings and another on the Marines signing for the "C" version of the fighter jet garnered more than 100 comments. Add your opinion: **AviationWeek.com/ares**

RETURN OF THE TRIJET?

Will Airbus be reviving the Trijet? Has Boeing found a low-noise solution? In a March 16 blog post, Senior Technology Editor Graham Warwick takes a look at some patent applications filed by the two airframers in their quest to reduce noise. **AviationwWeek.com/Wings**

AWIN PROGRAM PROFILES

The Aviation Week Intelligence Network has expanded its database of special reports on Major Defense Acquisition Programs, adding deep coverage on 22 programs to the AWIN Major Program Profiles set. Missiles, munitions and space systems have been added, and each new program

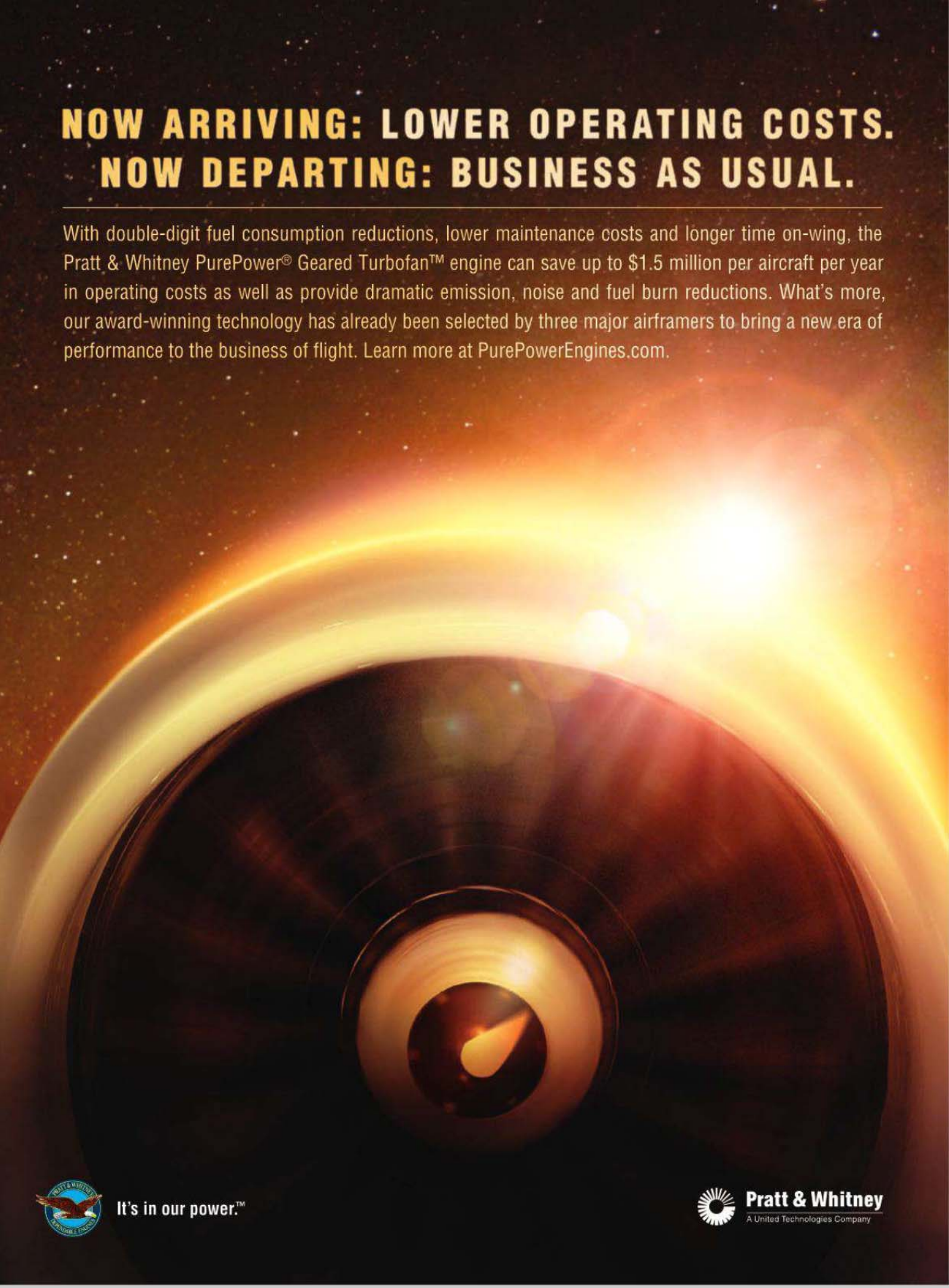


report also includes spreadsheets detailing U.S. federal budget request data. More new programs will join the list each month. **AviationwWeek.com/AWIN**

DORNHEIM AWARD

The National Press Club is accepting entries for the Michael A. Dornheim Award, named in honor of the late Los Angeles-based senior engineering editor at *Aviation Week & Space Technology*. The $2,000 award is presented annually to a working journalist reporting on aerospace, defense, the airline industry, or aerospace science and engineering. Entries are limited to work published or broadcast in 2010 and must be submitted by April 1. For an entry form and rules go to:

www.press.org/sites/default/files/2011_awards_brochure.pdf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RIGHT-MINDED

I take exception with your editorial "The Broken Branch of Government" (*AW&ST* Feb. 14, p. 58). In this indictment of Congress, you speak of "Congress's dereliction of duty" and refer to "the newly empowered tea party adherents" in a pejorative way.

Excuse me, but this Congress was elected by citizens—and this includes tea party members—to be responsible and negate the recklessness of the executive branch and previous Congress.

You quote Defense Secretary Robert Gates, while alluding to this conservative Congress, as saying "that's how you hollow out a military." Pure politics. You say: "Frankly, he's right." Well, no. Frankly he's wrong. When have conservatives done that? Never. In fact, the converse is true. Ever heard of Reagan?

But in the Market Focus column, "The Deficit That Ate the Military" (*AW&ST* Feb. 21, p. 11), Joseph C. Anselmo writes that the president's budget "is an exercise in cowardice." He further says that under the Obama plan, "the government would borrow 43% of the money it spends . . . ." Also, [the budget] "includes $240 billion for interest payments next year" and finding a solution is going to require unpopular cuts to entitlements and higher taxes. Anselmo closes with: "It's hard to see how the deficit crisis will be solved without cutting defense. But the alternative could be much worse."

Anselmo is correct. And your slamming of the current Congress is preposterous. The broken branch of Aviation Week is its editorial board.

William G. Mangan
SEATTLE, WASH.

SMALL IS BETTER

I will be saving David A. Fulghum's article "Adapt or Fail" (*AW&ST* March 7/14, p. 50) because I have seen companies succeed using precisely the principles that are discussed.

As a structural/thermal analysis consultant for the last 17 years, it has been my privilege to work with Aerojet on some highly successful spacecraft propulsion systems, including NEAR, X-38, Messenger and Sundancer. Aerojet has assembled a small group of engineers that work as a cohesive team to accomplish program objectives in a timely and cost-saving manner. This could not be done if they worked in their regular way on larger programs such as Delta and Titan rocket engines. Small groups, fewer meetings and fewer management layers are the key to success.

Monty Kennedy
TUCSON, ARIZ.

STYMIED BY STALLS

Regarding "Training Turnaround" (*AW&ST* March 7/14, p. 42), I am a retired U.S. Air Force pilot and NASA astronaut with about 5,000 hr. in jet fighters and trainers, and I was a jet instructor pilot for more than three years. With all of this background, I never knew of anyone who lost control of an aircraft and flew into the ground due to a stall. For one thing, stall recovery and unusual attitude recovery were essential parts of pilot training.

It is even more important to ask what the pilot was doing while the aircraft got


AIR TRANSPORT

Training Turnaround

Aviation safety experts push for new stall recovery techniques

into a stall. Stalls occur when the angle of attack exceeds the critical value, and that normally occurs when the airspeed becomes too low or vertical acceleration (G-load) too high. These conditions do not occur instantaneously, and there is almost always sufficient time for an alert pilot to recover with little loss of altitude.

Have we become so frugal with training time that we no longer teach pilots stall and unusual-attitude recovery? Or have pilots become so complacent that they allow the automatic pilot to fly the aircraft without human monitoring?

Don Peterson
EL LAGO, TEXAS

DON'T FORGET THE 20TH CENTURY

As to "Training Turnaround," lowering the nose in a stall is perhap Lesson 2 in Airmanship 101. Right? Or maybe that was only in 20th century America, when we used to start out by teaching people to fly air "planes" and only later allowed them to step up to air "liners."

Karl Sutterfield
DENVER, COLO.

TANKER BACK ON TRACK

I fervently hope the U.S. can finally proceed with getting a new tanker (*AW&ST* Feb. 28, p. 30). The absolute stupidity with which this acquisition was pursued is another case study in defense procurement run amok and the reason why we cannot use the broken "competitive bid" process to ensure we obtain what this nation needs to protect itself.

Why, after decades of successfully using Boeing and McDonnell Douglas products to service U.S. aircraft, we turned toward the Europeans is beyond me. I would hope we have all learned that regardless of the false notion of a "global economy," the U.S. needs to produce its own defense materials using indigenous designs and technology.

Congress needs to acquire organic objective expertise outside of market economy lobbyists (and this includes military members who seek lucrative private sector jobs) to advise it on what will and will not work. With this knowledge in hand, Congress then needs to appropriate for procurement based upon what the U.S. can support and needs, not what plays well in home districts.

Todd Fredricks
ATHENS, OHIO

SYNTHETIC FUEL FEASIBLE?

Indeed, airlines are "Over A Barrel" again (*AW&ST* March 7/14, p. 24). With the many invisible factors that impact jet kerosene prices, the only hope for stable jet fuel prices will be if the U.S. Air Force succeeds in developing synthetic jet fuels and producing them in quantity at a reasonable price. Does anyone know the estimate for synthetic jet fuel per barrel?

Michael Monahan
VIRGINIA BEACH, VA.

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WHO'S WHERE

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Kevin Knight

David Langstaff

Robert Hutchison

Charles Celli

Pritesh Patel

Paul Dolan

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.*

Geert Boven (see photos) has been appointed senior vice president-Americas for Abu Dhabi-based *Etihad Airways*. He was the carrier's executive vice president-sales and services, and previously was managing director of Amadeus Gulf. **Kevin Knight** was named Etihad's chief strategy and planning officer. He joins the carrier from United Airlines, where he was senior vice president-planning.

Jan Beseler and **Jean-Christophe Dalla Toffola** have been named executive vice presidents of *Nexcelle* of Cincinnati. Beseler was manager of nacelle integration engineering for GE Aviation engines, and Dalla Toffola was Aircelle's internal supply chain vice president.

Adrian Friend has joined *Esri UK* of Aylesbury as strategic account manager for Ministry of Defense customer Intelligence Collection Group. Formerly a major in the Royal Engineers, Friend was the lead geospatial representative within the ministry's Security Policy and Operations Div.

David Langstaff (see photo), chairman of Chantilly, Va.-based *TASC* and former CEO of Veridian Corp., has been named president and chief executive officer of the company, succeeding **Wood Parker**, who will retire and become vice chairman.

Marc Cavaliere has been appointed senior vice president-global sales development for *South African Airways*. He was the airline's executive vice president for North America and previously was vice president of sales and marketing distribution for Spirit Airlines.

Marcus Hancock has been named technical director at Birmingham, England-based *Dunlop Aircraft Tires*. He was general manager of Cooper Tire & Rubber Co.'s European Technical Center. **Ken Hutchins** is Dunlop's new technical sales manager for the Americas, based in Houston. He was an aircraft wheel and brake specialist at Goodrich and Messier-Bugatti.

Michael Kimman next month is scheduled to become vice president-information technology for the *SkyTeam* alliance in Amsterdam. He joins the airline partnership from KLM, where he is vice president/chief information officer.

Robert Hutchison (see photo) has joined the *Civil Air Navigation Services Organization* as director of communications and marketing. He was director of communications and marketing for CHEP, an Orlando, Fla.-based maker of logistics products.

Gil Jackson will fill the new position of technical business development manager for aftermarket services at *Sargent Aerospace & Defense*, Tucson, Ariz. Jackson has held numerous engineering roles at Delta Air Lines, Goodrich Aerospace-Landing Gear and American Airlines.

Peter Bowler has been appointed a senior adviser and chairman of Stamford, Conn.-based *Passur Aerospace's* Customer Advisory Panel. He retired from American Eagle Airlines last summer after a 26-year career with its parent AMR Corp.

Charles Celli (see photo) has been named vice president of *Gulfstream Aerospace's* Savannah, Ga., service center operations. Celli came from Jet Aviation in Basel, Switzerland, where he was senior vice president-completions services for Europe, Middle East, Africa and Asia.

David Billon-Lanfrey has been promoted to vice president of research and development, technology and products at Paris-based *Sofradir*, succeeding **Philippe Tribolet**, who died in November 2010. Billon-Lanfrey headed the R&D optronics characterization team at the company and was project manager for R&D and product development.

Mark Busalacchi has joined the *Lee County Port Authority*, Fort Myers, Fla., as director of properties. He came from JetBlue Airways, where he handled properties, contracts and airport affairs at 15 airports in the Midwest and Western U.S.

Steven Verhasselt, **Wim Kuit** and **Norman Hecht** have become senior consultants for the *Air Cargo Management Group* of Seattle. Verhasselt has been an aviation consultant in Hong Kong since 2003; Kuit has worked for Panalpine World Transport, Kales Airline Services and Emery Worldwide; and Hecht recently left a 37-year career at Pratt & Whitney, where he handled sales, aftermarket maintenance and strategic planning.

Pritesh Patel (see photo) has been tapped by *Circor Aerospace Products Group*, Corona, Calif., as director of information technology. He joins Circor from OK International, where he held the same title.

Tom Cooper and **Michael Moore** have been appointed to senior vice presidents at *TeamSAI* of Denver. Cooper worked for Delta Air Lines, and Moore was an executive at Northwest Airlines and Timco Aviation Services.

Paul Dolan (see photo) has been named director of military affairs for Orangeburg, N.Y.-based *Chromalloy*. He was vice president of sales and marketing at Avioserv.

Rick Sanford has been appointed chief executive officer of *Odyssey Moon Ltd.*, Douglas, Isle of Man. He was chief operating officer of Cisco IRIS and director of space and intelligence at Cisco Systems.

Pamela Keidel-Adams has joined *Landrum & Brown*, Overland Park, Kan., as managing director. She was director of aviation planning, economics and freight at Wilbur Smith Associates.

Drew James has been prpomoted to president of *SRCTec*, Syracuse, N.Y., from vice president-operations.

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BY JOSEPH C. ANSELMO

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MARKETS	INDEX VALUE	WEEK AGO	YEAR-TO-DATE	YEAR AGO
AW Aerospace 25	1323.0	-5.5% ▼	10.5% ▲	0.4% ▲
AW Airline 25	940.5	-6.6% ▼	7.0% ▲	0.4% ▲
S&P 500	1256.9	-4.8% ▼	12.7% ▲	7.8% ▲

Weekly Market Performance

Closing Prices as of March 16, 2011

Company Name	Current Week	Previous Week	Fwd. P/E	Tot. Ret. % 3 Yr.	Tot. Ret. % 1 Yr.
AEROSPACE & DEFENSE					
AeroVironment Inc.	32.40	32.48	23.2	62.0	37.3 ▲
Allegheny Technologies Inc.	60.64	62.19	19.4	-10.0	16.9 ▲
Alliant Techsystems Inc.	67.22	69.59	8.3	-33.1	-16.5 ▼
BAE Systems plc	4.91	5.35	7.2	-40.4	-10.9 ▼
Boeing Co.	67.69	72.09	16.4	-2.2	-0.1 ▼
Bombardier Inc. 'B'	6.08	6.39	14.4	24.8	6.9 ▲
Cobham plc	3.47	3.80	10.3	-7.6	-9.0 ▼
Curtiss-Wright Corp.	32.75	38.26	12.7	-12.6	-6.2 ▼
DigitalGlobe Inc.	29.11	30.09	66.9	....	14.7 ▲
EADS NV	26.15	27.89	20.7	23.6	31.2 ▲
Elbit Systems Ltd.	51.23	50.70	10.3	-0.1	-18.0 ▼
Embraer-Empresa Brasil ADR	32.48	33.88	16.1	-13.4	39.9 ▲
Esterline Technologies Corp.	67.06	72.18	14.1	30.6	37.6 ▲
Finmeccanica SpA.	11.83	12.88	6.4	-53.1	-9.6 ▼
FLIR Systems Inc.	31.19	32.01	18.0	21.6	17.0 ▲
General Dynamics Corp.	73.75	76.98	10.3	-6.0	0.9 ▲
General Electric Co.	18.95	20.63	14.1	-37.3	8.1 ▲
GKN plc	2.95	3.37	9.4	-11.2	56.5 ▲
Goodrich Corp.	80.88	85.00	14.9	45.0	14.8 ▲
Harris Corp.	43.55	45.38	9.2	0.7	-4.4 ▼
Hexcel Corp.	17.58	18.63	18.5	-7.4	30.9 ▲
Honeywell International Inc.	54.33	56.71	14.2	7.6	29.9 ▲
ITT Corp.	55.43	56.89	11.6	9.9	5.5 ▲
Kratos Defense	13.36	13.89	11.9	-14.4	-4.1 ▼
L-3 Communications Hldgs. Inc.	76.69	80.54	9.1	-24.6	-16.7 ▼
Lockheed Martin Corp.	78.41	80.48	11.1	-14.1	-4.1 ▼
Moog 'A'	41.38	44.96	14.9	-0.1	11.2 ▲
Northrop Grumman Corp.	64.94	67.30	9.4	-10.0	3.2 ▲
Orbital Sciences Corp.	17.69	19.05	19.7	-23.9	-6.8 ▼
Parker-Hannifin Corp.	85.92	85.30	13.2	45.4	33.4 ▲
Precision Castparts Corp.	137.88	141.60	16.9	44.4	15.3 ▲
Raytheon Co.	49.77	52.51	10.0	-15.4	-9.7 ▼
Rockwell Collins Inc.	61.01	64.62	14.8	16.4	2.1 ▲
Rolls-Royce Group plc	9.10	10.04	12.9	15.7	2.2 ▲
Safran SA	32.74	36.29	13.0	79.9	28.3 ▲
SAIC Inc.	16.30	16.86	12.0	-7.8	-15.4 ▼
SIFCO Industries Inc.	16.69	16.48	....	63.5	7.5 ▲
Singapore Technologies Eng.	2.46	2.55	17.7	20.8	9.7 ▲
Spirit Aerosystems Holdings	24.40	26.08	13.3	11.9	14.6 ▲
Textron Inc.	25.05	27.53	21.4	-49.3	11.6 ▲
Thales	35.66	38.91	11.6	-38.4	-10.2 ▼
TransDigm Group Inc.	77.48	81.99	18.1	151.0	48.0 ▲
Triumph Group Inc.	82.84	88.33	11.2	60.7	37.8 ▲
United Technologies Corp.	78.33	82.89	14.6	24.8	11.0 ▲

COMMENTARY

For B/E Aerospace, A Rebound With Legs

At a gala ceremony in Palm Springs, Calif., at the end of 2008, Amin J. Khoury was named one of Ernst & Young's Entrepreneurs of the Year. It was a bittersweet moment for the founder, chairman and CEO of **B/E Aerospace Inc.**, the leading supplier of seats and other interior components for commercial and business jets. As he accepted the prestigious national award, B/E's profits were in a free fall, due to a spike in fuel prices—followed by a global economic meltdown—that forced airlines to defer interior retrofits en masse. The company's stock would finish the year down 85%.

Fortunately for Khoury, the bottom was near. Shares in the Wellington, Fla.-based company nearly tripled in 2009 and were up another 58% last year. And at B/E's annual investor day earlier this month, Khoury reiterated guidance that sees 20% top-line growth in 2011 and a 37% increase in earnings per share. Most important, the rebound still appears to have plenty of running room. **Airbus** and **Boeing Co.** have announced multiple increases in their production rates, thanks to robust Asia-Pacific demand. Meanwhile, the business jet market, which accounts for a little more than 10% of the company's revenues, has stabilized and is showing signs of resuming growth by next year.

Though it operates in multiple segments, B/E's sweet spot is in widebody jets. Credit Suisse analyst Robert Spingarn estimates a widebody retrofit generates 5-10 times more revenue for the company than similar work on a narrowbody. "Increasing demand for widebody aircraft drives demand for premium seats, beverage makers, ovens, refrigeration, lighting and oxygen and has resulted in B/E's record backlog of $3 billion," he notes. And though the company's shares have rebounded smartly, they are still trading well below the historical premium during past commercial aerospace upcycles. "With 40% aftermarket revenues, we think B/E will be one of the fastest growing companies in the aerospace supply chain," says RBC Capital Markets analyst Robert Stallard, who rates the company as one of his top two commercial aerospace picks, along with **Goodrich Corp.**

So what could spoil the party? Investors are worried about a repeat of 2008, when oil prices spiked to nearly $150 a barrel and sent airlines reeling. Interior retrofits, a discretionary item, were one of the first expenses to be curtailed. Conversely, there are concerns about the supply chain's ability to keep pace with Airbus's and Boeing's production ramps. "Seats are becoming a huge constraint," comments **Air Lease Corp.** Chairman/CEO Steven Udvar-Hazy. "Some suppliers are telling us they are pretty stretched." He also worries about constraints on galleys.

Being reliant on a such cyclical industry, B/E has seen more than its share of ups and downs since it was founded by Khoury in 1987. But 24 years and 24 acquisitions later, annual sales have grown to more than $2 billion from $3 million. It may be time to bet on him again.

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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SPACE

ESA Council OKs ISS Funding

European Space Agency member states have agreed to fund the International Space Station through 2020, a move the U.S. and the other ISS partners have already taken at ESA's urging. At a meeting at agency headquarters in Paris, the ESA Council approved spending €550 million ($770 million) on Europe's share of station operations, logistics and transportation using the Automated Transportation Vehicle (ATV). Another €2 billion is promised in 2012 to fund ESA's station share through 2020, according to Bernardo Patti, ESA's ISS program manager. The station was originally funded through 2015, but the partnership agreed last year to extend it because of delays in completing assembly following the shuttle Columbia accident in 2003. Overall, Europe will spend €4 billion on the station in 2008-20, Patti says, including the €1.4 billion approved by member-state science ministers, meeting in The Hague in 2008.

AIR TRANSPORT

Haneda Routes Suspended

Delta Air Lines has suspended its services to Tokyo Haneda Airport to "maximize operational efficiency," but flights to and from its hub at Tokyo's Narita International Airport were continuing to operate as normal as of March 17. "Given recent events in Japan, it is more efficient for us to run our operations from our hub at Narita, where we can consolidate resources," the airline says. Delta plans to resume the service from Detroit on May 31 and from Los Angeles on June 2. Those also are the dates on which Delta already had planned to slash capacity on the Haneda routes by replacing 403-seat Boeing 747-400s on those routes with 271-seat 777-200ER aircraft. Delta began service on both routes on Feb. 19.

Fix Required

Russia's federal air transport agency is telling operators of Tupolev Tu-154M narrowbodies to upgrade them. The agency's chief, Alexander Neradko, points to out three major defects that need to be addressed: power failure due to battery overheating, fuel system malfunction and failure of the low-pressure compressor disk on NPO Saturn D-30KU-154 turbofans. All were involved in Tu-154M incidents in recent years. Russian airlines operated 81 Tu-154Ms at the start of the year, with UTair having the largest fleet, 15 aircraft. The operation of another Tu-154 version still in service, Tu-154B, was banned temporarily in January after a fire during takeoff in Surgut.

Indictment Issued

A French magistrate has filed a manslaughter indictment against Airbus over the crash of Air France AF447. The move comes before the French air accident investigation bureau has completed its review of the case and on the eve of a new search phase for the flight data and cockpit voice recorder of the A330-200. Air France, late last week, was due to meet with French judicial authorities. The aircraft disappeared June 1, 2009, on an overnight flight from Rio de Janeiro to Paris.

PROPULSION

Partners on Board

Seeking to reassure the single-aisle airplane community about their long-term support of the V2500 engine series for Airbus's A320 family, the four International Aero Engines AG partners have added another 16 years to their collaborative manufacturing agreement, carrying it through Dec. 31, 2044. Meanwhile, the partners—Pratt & Whitney, Rolls-Royce, MTU Aero Engines and Japanese Aero Engines—have begun testing a SelectTwo engine upgrade aimed at a 0.58% improvement in fuel burn over V2500-A5 SelectOnes. Flight testing is to conclude next year; service entry is set for 2013. SelectTwo involves no engine design or mechanical changes; it refines software for the electronic engine control unit and adds

Boeing, Engine Makers Dealing With 787 Weight Issue

Boeing Commercial Airplanes President and CEO James Albaugh acknowledges that early Boeing 787-8s will be heavier than the specified maximum takeoff weight of 502,500 lb. when initial orders are delivered.

"But I think we'll be able to meet what our guarantees are," he says. "I feel pretty comfortable that over time we'll be able to get to [the specified range]. When that date is going to be, I can't tell you."

Boeing and engine makers Rolls-Royce and General Electric are working through improvement packages "to clean the airplane up," Albaugh adds. Initially, at least, launch customer All Nippon Airways, which is expected to take the first airplane in July, probably will not call on the full range promised for the 787-8 of 7,650-8,200 nm since it is emphasizing Japanese domestic and regional routes. Another early recipient, Japan Airlines, is expected to get its first airplane in October and also is emphasizing regional routes.

As much as Boeing tries to shave weight out of the fuselage, Steven Udvar-Hazy, whose record of nearly 2,000 aircraft purchases when he was International Lease Finance Corp. CEO gives him ready access inside Boeing, expects the company will ultimately settle on an old-fashioned solution. "My gut feeling is they'll always be heavy and they'll just have more power and they'll increase the max takeoff weight," he says. He is more sanguine that the stretch 787-9 will come in on spec because Boeing has learned so much from the -8.

As for another 787 question—will it turn a profit for Boeing?—Udvar-Hazy, now chairman and CEO of Air Lease Corp., says the airplane's myriad problems and vast research and development expenditures have moved that point "far, far to the right. My guess is at least 1,500 [orders]." He softens the weight of that judgment by noting that it will be spread over a 30-40-year production cycle.

Still, just to compare, as of February, the entire Boeing 747 family—the world's best-selling widebody jet—has received 1,525 orders. And that's after 40 years in service.

BOEING

a new data entry plug. Although Pratt and Rolls could not agree on the design for a successor to the V2500, IAE President and CEO Ian C. Aitken says the partners have pledged to continue to offer performance improvement packages for the engine.

DEFENSE

Tag Team

Elbit and Israel Aerospace Industries will jointly pursue a program to provide advanced training aircraft to the Israeli defense ministry. The joint company would handle the aircraft acquisition and support of the trainer aircraft. If a contract is awarded, Elbit says the joint venture would likely seek funding from capital markets to build the required infrastructure and buy training aircraft.

Not So Fast With C-704s

The Israeli navy has intercepted a Liberian-flag vessel, the Victoria, believed to be carrying C-704 anti-ship missiles from Iran to Hamas, which controls the Gaza Strip. The vessel was heading to Egypt, but Israeli officials say they don't believe Egyptian officials knew of the arms shipment, which also included 60- and 120-mm mortar shells. "These are strategic weapons. If Hamas gets its hands on them, they would seriously damage strategic infrastructure at sea and at shore," argues Israel navy chief Brig. Gen. Rani Ben-Yehuda.

Broadband Satellite For Rural Areas Useful In Japan Now

The disruption in power and communications networks following the Japanese earthquake and tsunami have made satellites typically used for entertainment in the highly industrialized nation an important source of emergency communications in the disaster zone, when combined with ground equipment developed for rural areas.

Thaicom, which covers Japan with its Ipstar service via the Thaicom-4 broadband satellite, has deployed a system in the disaster area that takes advantage of the spacecraft's 45-gbps bandwidth to deliver cell phone service that is transparent to users—as long as they are within about 200 meters (660 ft.) of the virtual cell tower that it provides. Central to the makeshift network are lightweight, battery-powered direct-current devices called Femtocells, which link rescue workers' cell phones to the nearest Ipstar terrestrial gateway through the satellite so they can call each other directly.

In Japan, the gateway is in Saitama Prefecture near Tokyo, far enough from the epicenter of the magnitude 9.0 earthquake to have survived with its power supply intact. "In the past we deployed it in underdeveloped countries, because the power supply in those countries is unreliable," Thaicom President Nongluck Phinainitisart tells the Satellite 2011 conference in Washington. "But we never expected to use the DC version in Japan."

U.S. AIR FORCE

Nimrods, Rivet Joints, F-22s Eyed For Libya Operation

The British Defense Ministry is considering extending the in-service period for the Nimrod R1 signals-intelligence fleet by at least three months to cover use in a no-fly zone over Libya that the United Nations Security Council approved on March 17. The aircraft were to be phased out this month.

The no-fly zone is designed to protect civilians and rebels from attacks by Libya's own military. The no-fly zone is expected to include coalition forces, including U.S. fighters and surveillance aircraft such as the RC-135W Rivet Joint (see photo). This also could be the first use of the U.S. Air Force F-22 in combat because Libya has Russian-made air defenses protecting its airspace.

The U.K. is "also concerned about a gap without coverage [in Afghanistan]," says a U.S. official.

The Nimrods are flown by No. 51 Sqdn. at RAF Waddington. Their electronic and communications intercept mission is to be taken over by three RC-135Ws being modified by the U.S. Air Force's Big Safari office under Britain's "Air Seeker" program. They will have the same basic paint scheme as remaining U.S. RC-135Ws, but with Royal Air Force markings and roundels.

London's first RC-135W is in Greenville, Texas, being stripped and modified, say U.S. officials. U.K. crews are already training with their U.S. counterparts and will also operate on USAF Rivet Joints in advance of delivery of the British aircraft.

Deal on Radar Screen

Embraer has pulled the trigger on the first transaction for its defense and security business, buying 64.7% of OrbiSat da Amazonia's radar division in deal valued at 28.5 million Brazilian reals ($17 million). The deal will see OrbiSat broken into two parts, the Embraer-controlled radar activities and the electronic equipment part that is not changing hands. Embraer says executives of the new business are already in talks with the Brazilian air force and navy to develop and build integrated monitoring systems.

Changing Hands

EADS's Cassidian defense business is buying out Saab's 42.4% share in Grintek Ewation to dominate the communications electronic warfare business (12.6% remains with Kunene Finance Co.). Competition authorities still have to OK the deal that should generate a pre-tax capital gain of 120 million Swedish kronor ($18.7 million) for Saab. EADS says there are plans to increase the local shareholding in the South African business.

Correction

An article in the March 7 edition (p. 35) misstated the location of Luke AFB. It is in Arizona.

BY MICHAEL MECHAM

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COMMENTARY

From Ohio to Arkansas

Small suppliers worry about how to compete in a low-cost world

Ohio is the No. 1 U.S. supplier to EADS/Airbus ($4.3 billion in annual sales) and No. 2 to Boeing ($4.8 billion), after California. General Electric's engine works in Evendale and Peebles account for much of that, but there are thousands of other suppliers spread across the state, some dating to World War II, when the government pushed aircraft production inland to make it less vulnerable to attacks. We recently visited with Ohio's suppliers at a roundtable in Cleveland hosted by Aviation Week and the Ohio Aerospace Institute. Not surprisingly, workforce topped the list of today's pain points.

DREAMANNA PRODUCTIONS

Alcoa Forgings and Extrusions President Eric V. Roegner reports having to compete with banks and consulting companies for top college graduates. He's honed his pitch to include topics that will appeal to young professionals, such as green and sustainability. Stephen P. Johnson, director of process technology at Timkin Co., has had two senior technical positions open for two years. He also worries about how he will replace his company's aging baby boomers. And Fred Lisy, the president of tiny Orbital Research, laments that he spends time and money training young engineers, only to lose them after a few years to bigger companies.

Lisy and other small suppliers also complain about their difficulty in finding sufficient financing to sustain them through the program delays that are endemic in aerospace. Financing worried larger contractors, too. With cuts in U.S. and European defense spending, how can they take a chance on long-lead R&D investments for next-generation products that may not be funded?

Then there's China, whose aerospace market the group views with a mixture of excitement and apprehension. "If you're an engineer and you're interested in working in China, we'd be interested in speaking with you," says Christopher Farage of Parker Hannifin, a major contractor on China's new Comac C919 jet.

But Ohio's suppliers worry that the Chinese government's push to create a domestic aerospace and defense (A&D) base could one day squash them. Roegner points to Chinese investments in new forges that could compete with Alcoa. If Boeing and Airbus find viable suppliers in China, "the game is on," he says. Is the challenge China poses to U.S. technological leadership being taken seriously enough? "You kind of wish that the U.S. government would wake up," says Roegner.

But China is not the only challenge for the Ohioans. Across Lake Erie, Canada has instituted a tax credit of up to 48% for companies creating R&D jobs there. Then there are competitors springing up in lower-cost, non-union southern U.S. states. Farage says higher tax and labor costs push his company's costs 40% above some of his competitors. "Ohio is not cost competitive," he complains.

If you talk to one of those southern competitors, Taber Extrusions, the competitiveness answer comes not just in lower costs but specialized skills. Privately held and with 250 employees, Taber makes large, long and wide aluminum alloy extrusions in numerous rod, angle, hollow and beam shapes. It uses multiple forming technologies, including friction stir welding, and focuses on high-value, intricate small-lot contracts. Taber's 8,600-ton press in Russellville, Ark. (shown), can, for instance, extrude a 100-ft.-long wing stringer that is so large that special routing is needed to rail ship it.

Its answer to low-cost China is high-value American expertise. "We specialize in hard-to-make things," says sales manager Steve Althardt.

A Silver Supplier Excellence award winner from Boeing, Taber also serves Gulfstream, Cessna and Lockheed Martin's aircraft programs. It has felt the downturn in general aviation but balances its aviation portfolio with defense and naval contracts—the MRAP mine-resistant vehicle, M-113 Bradley and Littoral combat ship among them. And Taber has a niche as a major supplier of compound aluminum bow risers for archers.

Naturally, the company is watching the evolution of composite structures in aircraft. "It doesn't make us happy that aluminum will decrease in the aircraft segment," he says. "But there's a lot of aluminum that will be used in airplanes for years to come."

With Joseph C. Anselmo and Graham Warwick in Cleveland.

BY RUPA HARIA
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COMMENTARY

London's Lament

Dearth of strategy threatens U.K. aviation


BAA

The U.K. suffers from the heaviest taxes on flying in the world, its airport infrastructure is decaying, and its planning process to revitalize air transport is appallingly difficult. As a result, the country's leading airport, Heathrow, continues to head toward secondary hub status in Europe. Yet, the coalition government is failing to properly address strained capacity at Heathrow Airport and beyond. The question on many minds is: What will come first, a new government or a proper aviation policy?

Shortly after taking power in May 2010, the coalition canceled plans for a third runway at Heathrow, despite the outgoing Labour government rubber-stamping the project. The coalition also made clear that Gatwick Airport and Stansted Airport won't get new runways. Instead of airport growth, the government wants to focus on promoting sustainable aviation through low-carbon alternatives.

It has set up a South East Airports Taskforce charged with improving the passenger experience at airports; a first planning document for a sustainable U.K. aviation framework is due to be published this month. The sustainable aviation framework will likely address noise, which is measured near Heathrow by solar-powered monitors (see photo). A consultation on this document would occur in about a year, with plans to adopt the final framework in 2013.

Many in industry regard the process as a time-wasting exercise. "We will have no clearer strategy by the time the coalition exits Parliament, even if they last the full term" that is set to expire in 2015, one airport CEO tells me.

An aviation alternative touted by the coalition is high-speed rail between London and Birmingham that amazingly manages not to stop at Heathrow. It may slightly ease traffic demand for short-haul trips, but will do little for medium and long-haul travel. International Air Transport Association Director General Giovanni Bisignani recently pointed out that the high-speed rail solution was not working fast enough: "If building 2,000 meters of runway takes decades, building or upgrading 650 kilometers of rail will take several lifetimes."

By contrast, London Mayor Boris Johnson has proposed building a new airport in the Thames Estuary, an idea fraught with financial and logistical challenges and unlikely to materialize. "Airspace is a major consideration to be factored in when assessing the merits of an estuary airport, or any other new airport for that matter," says U.K. Civil Aviation Authority Chief Executive Andrew Haines, who adds that over the years, "the U.K.'s airspace system has become complex and increasingly difficult to manage." Establishing another airport would require a huge amount of work on the part of air navigation service provider NATS to completely redesign London's air corridors.

"It's not a failure of imagination not to envisage a new airport," says Stephen Hardwick of Altcon, an adviser to Global Infrastructure Partners when it successfully bid for Gatwick. "It's economically, socially and politically unthinkable. And that's even without asking the millions of birds in the Thames Estuary how they plan to avoid jet engines."

Moreover, the coalition's opposition to new runways at London airports effectively means no action for at least a decade. Under the Planning Act 2008, any nationally significant infrastructure project must have a National Policy Statement (NPS). It is critical to any planning decision, such as any airport project to increase capacity by at least 10 million passengers each year.

Lacking an NPS, there is "significant uncertainty attached to any proposals for increases in airport capacity, and realistically the required investment will not come forward," says Duncan Field, a partner at legal firm SJ Berwin. The coalition's decision to prioritize sustainable aviation over an NPS "suggests that actually we will not see any significant increases in airport capacity well beyond the current Parliament and perhaps for at least another 10-15 years." Field says. "Even if a new government is elected in four years' time with a determination to produce an NPS to provide a framework to allow for significant increases in airport capacity, in all likelihood it would take the new government most of the next term—four years or so—to undertake adequate forecasts, assessments and consultation." Even once a project to pursue is defined, getting that approved will add at least three more years, he notes.

Industry lobbying has so far had no effect on the government. Meanwhile, Amsterdam, Paris and Madrid continue to take the lead in Europe, leaving the U.K. trailing behind as a secondary hub. Addressing London's airport capacity has never been so urgent.

Airports should be working with the opposing Labour Party on developing a post-2015 policy, says Hardwick, adding that "if the coalition really does [wreck] the economy and throw a million more people out of work, and they lose the next election, what is Labour's plan for aviation?"

BY FRANK MORRING, JR.

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COMMENTARY

Commercial Crew

SpaceX refining concepts for Dragon capsule

Space Exploration Technologies Inc. (SpaceX) hopes to reach the International Space Station on a trial cargo run before the end of the year. Now its engineers and astronauts are working on concepts to convert the Dragon cargo capsule into a crew carrier. With at most two flights left for the space shuttle fleet, NASA is eager for the commercial-crew work to go forward, and the company is likely to be a winner in the second round of the commercial crew development (CCDev-2) competition that will be announced by the end of this month. NASA expects to have $250 million in CCDev-2 funds to help private companies defray the cost of building a commercial crew transport infrastructure. SpaceX has proposed using some of the money to develop the liquid-fuel pusher-type launch abort system (LAS) it will need to human-rate the Dragon.

Ken Bowersox, an experienced NASA astronaut with 5½ months of ISS crew time under his belt, joined the company in 2009 as vice president for astronaut safety and mission assurance. He says SpaceX plans to develop its own hypergolic LAS propulsion hardware using the expertise it gained developing the Merlin engines that power its Falcon 1 and 9 launchers. SpaceX opted for the pusher because it saves weight over a pull-off tower and the shield needed to protect the capsule from the tower's plume during an abort. Only 60% of the Dragon's nominal 2,700-lb. fuel load would be required for an abort, raising the possibility of a propulsive landing after parachuting to dry land in the manner of Russia's Soyuz vehicle. On a nominal flight, of course, all of the fuel could be used for maneuvering in orbit. While the LAS is the "pacing item" in the company's CCDev-2 proposal, it is also beginning to work out the crew accommodation that would be required for the ISS missions.

SpaceX wants to carry a crew of seven in its human-rated Dragon, and is working on the best seat arrangements to give all of them easy access to the hatch at the top of the capsule. Normally it will fly an automated route to the space station like its unmanned cargo version, but it will carry two specialists in Dragon operations to take over in an emergency. Like the Soyuz, Dragon's passengers and crew probably will wear ascent and entry suits to protect them in the event of depressurization. Suppliers are "still in the trade space," Bowersox says. Garrett Reisman, another NASA astronaut with ISS crew time, has just joined SpaceX, and the company is working closely with the crew office at Johnson Space Center. Bowersox says his former colleagues have a "strong preference" for what is known as the "rental car" approach in which a spacecraft would be leased to NASA for its astronauts to operate. Alternatively, the "space taxi" approach would have company specialists take NASA or international partner astronauts to the station, and then bring the departing crew home on the older vehicle that delivered them.

SOYUZ SEATS

Administrator Charles Bolden took the occasion of a $753 million purchase of 12 Soyuz seats for NASA astronauts last week to press Congress for funds to complete the commercial crew development effort. NASA and the Russian Space Agency on March 14 signed a two-year agreement extending the purchase of Soyuz spacecraft for the transportation of U.S., European, Japanese and Canadian astronauts to the ISS through June 2016. The agreement includes transportation for 12 astronauts, at a per passenger cost of $62.75 million, up from the $55.8 million it will pay per seat for six trips in 2013-14, and up from the $51-million cost of a Soyuz seat today. The latest agreement includes two launches in 2014 and 2015 as well as the return of one six-month mission in mid-2016. In addition to crew training and use of the Soyuz spacecraft as station lifeboats, the accord includes cargo services of 110 lb. per seat on ascent and 37 lb. on descent. "The president's 2012 budget request boosts funding for our partnership with the commercial space industry and prioritizes our efforts to ensure that American astronauts and the cargo they need are transported by American companies rather than continuing to outsource this work to foreign governments," Bolden says. Meanwhile, the scheduled March 30 launch of three U.S. and Russian Expedition 27 crewmembers to the station will be delayed by an electrical issue with the Kvant-V communications system on their Soyuz spacecraft.

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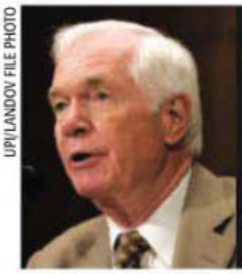
COMMENTARY

Internecine Appropriations

Gridlock agitates lawmakers, agencies alike

A couple of sometimes-maverick Senate Republicans are trying to move defense spending to the front of the appropriations line, but they are finding resistance near and far. Senators Susan Collins (R-Maine) and John McCain (R-Ariz.), both of whom have a history of bucking their congressional caucus at times, have been echoing the Pentagon's calls for passage of fresh fiscal 2011 legislative language so that the Defense Dept. can get on with better managing everything from the wars to paying its electricity bills (*AW&ST* Feb. 21, p. 28).



UPI/LANDOV FILE PHOTO

'That's above my pay grade'

SEN. THAD COCHRAN

Last week, the senators won an important ally in Senate Minority Leader Mitch McConnell (R-Ky.). In speeches on the Senate floor, McConnell and McCain, the ranking Republican on the Armed Services Committee, said they would not support another short-term spending bill unless defense were funded for the rest of the fiscal year. "I don't intend myself to support another continuing resolution that does not contain the full-year defense appropriation bill," McConnell declared. His statement lends top-level support within the Republican party to a plan that McCain has hammered out to fund what he sees as essential defense spending for the fiscal year ending Sept. 30. But it also is a legislative affront of sorts to appropriators who usually get to be the masters of the congressional spending universe, and who have already proposed spending plans themselves. Asked about the chances of McCain's proposal passing, Sen. Thad Cochran (R-Miss.), the ranking Republican on the Appropriations Committee, was noncommittal. "That's above my pay grade," he said. And Sen. Richard Durbin (D-Ill.), the minority whip, seemed cool to the idea of separating the Pentagon's accounts from the rest of federal appropriations. (The push to pass annual defense appropriations has traditionally been one opportunity to protect other priorities by tacking them on to the same bill.) Meanwhile, Adm. Gary Roughead, chief of naval operations, told reporters that the ongoing budget fight has the potential to affect 2013 budgeting since the Pentagon is now working on that request. "I'll be sitting down for the first full view of '13 this afternoon," the CNO said March 16. "And so that has the potential to be affected as well."

FEELING GROUNDED

The ongoing temporary extensions of the FAA's budget and authorization are taking a toll on the agency, officials say. The FAA is halting most new certification activities until Congress passes a fiscal 2011 budget, now not expected until at least early April, if at all. Flight Standards Director John Allen says most travel and hiring also are on hold. "We're waiting to find out what kind of budget we'll have before we turn that spigot back on," he says. Allen adds that the agency has long been under pressure to operate more like a business, but asks, "How can you operate like a business when you only have three-month budget years and a lot of friends on Capitol Hill telling you what you can and cannot do?" While progress is being made on comprehensive, long-term FAA reauthorization, the latest short-term fiscal 2010 appropriations extension only runs until April 8, while the latest authorization extension expires at the end of March. The House Transportation and Infrastructure Committee on March 16 approved another extension of the FAA's authorization through the end of May, the 18th such short-term extension. Even if a budget is passed in April, Allen notes that the FAA is bracing for cuts. "We're just being very, very careful."

CAUGHT IN THE WEBB

With NASA's James Webb Space Telescope in limbo amid reports of a possible $1.5 billion cost overrun, Ed Weiler, head of NASA's science directorate, is reminding budget-conscious lawmakers that the Hubble Space Telescope was similarly troubled during its development before triumphing as arguably NASA's greatest scientific achievement. "Where we are on James Webb now reminds me of where we were on Hubble in the mid-eighties," says Weiler. Hubble was finally orbited seven years late after exceeding its budget by 300%. "We stuck with it, despite a lot of people who wanted to see it canceled," Weiler tells the Senate Commerce Committee. For about the same constant-year dollar cost, the infrared Webb telescope will be 50-100 times more sensitive than Hubble, he says. NASA put the brakes on Webb in its fiscal 2012 budget request in February, which allocates only $375 million to continue fabrication and testing while deferring a decision on a launch date until the next fiscal year. Launch was slated for September 2014, but an independent review promoted by Sen. Barbara Mikulski (D-Md.) estimated that NASA would miss that target by more than a year.

BROKEN CHA

Japan's earthquake is a reminder that spreading production can mean accumulating risk

BRADLEY PERRETT/BEIJING, MADHU UNNIKRISHNAN/WASHINGTON and LEITHEN FRANCIS/SINGAPORE

Soma is a Japanese coastal city less than 100 km (60 mi.) south of Sendai, about 200 km from the epicenter of the massive earthquake that devastated much of the northern part of the country on March 11.

The town's two IHI Corp. plants make parts for space equipment, aero-engines and other gas turbines. But Suma Aero-engine Works Nos. 1 and 2 are idle—and their sudden silence raises a key issue. For a product such as an aircraft or engine, composed of many thousands of indispensable parts, the greater the geographic dispersion of manufacturing, the greater the chance of a natural disaster somewhere disrupting production.

IHI says it has no reports of casualties among its employees. But it also does not know when the factories will be able to resume production—underscoring the uncertainty across the industry more than a week after the calamity.

Fuji Heavy Industries says some of its suppliers suffered serious damage, while Mitsubishi and Kawasaki Heavy industries both say it is too early to know the condition of their supplier bases. For the moment, those latter three companies—suppliers to Boeing, Airbus, Embraer and others, and based well away from the earthquake—are all operating normally. Each is working with its suppliers to determine the impact, but none is saying when it will be sure how suppliers have suffered nor what measures might be taken to work around any interruption to the flow of parts.

"It is hard to know because the supply chain is very complicated," says a Mitsubishi spokesman.

As to IHI's two aero-engine plants in Soma, "no current outlook for their restoration can be provided," says IHI. "While placing our strongest priority on the safety of our employees, we will be examining the damage in detail." IHI is a member of the IAE commercial-engine consortium.

"The catastrophe that has befallen Japan has raised questions about economic globalization and just-in-time manufacturing," says Lexington Institute analyst Loren Thompson. "Our idea about the way manufacturers are supplied rests upon a foundation of optimistic assumptions that can be washed away with one temblor [earthquake]."

IN

KYODO/LANDOV

Eighteen Japanese F-2 fighters were damaged by the tsunami that engulfed Matsushima air base in northeast Japan.

A Boeing spokesman in Tokyo says that so far there has been no delay in the deliveries of subassemblies to Boeing from Japan, but he adds some companies that work for Boeing's Japanese suppliers have been affected by the earthquake and tsunami.

Boeing says it has enough inventory to cope with any short-term disruptions its Japanese suppliers may face. But if they experience production delays that last longer than several weeks, then Boeing will have problems, the company says.

Airbus says it is unsure of the effect on production and is monitoring the situation.

Dirk De Waart, a director of management consultancy PRTM, points to the 4% fall in Boeing's share price on the news of the earthquake, erasing $2 billion in its market capitalization.

Noting that 35% of the 787 and 20% of the 777 are from Japan, De Waart says Boeing reduced financial risk at the cost of uncertainty in its supply chain. "Japan consistently ranks as one of the riskiest countries in the world to do business from a location perspective. The country has a history of earthquakes and natural disasters," he adds.

"This latest disaster underscores the realization that just-in-time increases risk to a point where companies are becoming vulnerable." Top management "is starting to understand that this kind of disaster is worth buffering inventories for." De Waart says aerospace companies in the future may look to do second-sourcing deals to safeguard against uncertainty. "Fas-

FX Fighter Contest Set For Further Delay

LEITHEN FRANCIS/SINGAPORE

Japan is unlikely to issue a request for proposals (RFP) in March for FX fighters because the defense ministry and other authorities are too busy dealing with the nuclear crisis and other repercussions from the March 11 earthquake and tsunami, say industry executives.

The country does have a firm plan to order 50 fighters to replace its fleet of aging McDonnell Douglas F-4s. Prior to the earthquake, industry executives said the defense ministry was working to issue the RFP in March. Shigeru Iwasaki, the Japan Air Self-Defense Force's (JASDF) chief of air staff, told Aviation Week on March 3 that if no RFP is issued this month, it could cause problems because there might be too little time to consider the proposals and make the recommendation for the procurement to be in Japan's 2012 budget.

One industry executive says the air force and ministry are still working to issue the RFP, but ultimately it is up to Defense Minister Toshimi Kitazawa to make the announcement and issue the document. "But the minister is very busy with the relief effort," says the executive.

Japanese authorities earlier disclosed that there are six aircraft types on the list for consideration: the Boeing F/A-18 and F-15, Dassault Rafale, Eurofighter Typhoon, and Lockheed Martin F-22 and F-35. The U.S. government, however, has made it clear that the F-22 is unavailable for sale overseas.

In a separate development, the defense ministry is investigating whether it can repair 18 Mitsubishi F-2 fighters that were damaged by the tsunami. The JASDF's Matsushima air base in Miyagi Prefecture, near the epicenter of Japan's 9.0 magnitude earthquake, was inundated with seawater that impacted 18 F-2s and a number of other aircraft. The service ordered 98 F-2s of which four were still to be delivered as of early March.

The damaged F-2s were all two-seaters and formed a trainer squadron, says a source familiar with the situation. Some were parked on the flight line; others were inside hangars. Local news reports say the tsunami that ravaged northeast Japan had waves as high as 33 ft.

"[The defense ministry] doesn't know yet if the aircraft can be repaired, but they will be difficult to repair because the cockpit and engines were soaked," says the source. "The priority right now is the relief effort," he adds.

teners, etc., can be dual-sourced. And it's vital to ensure that both suppliers are using a variety of sub-suppliers."

The leader of Bain & Co.'s global aerospace and defense practice, Mike Goldberg, says: "It's pretty unrealistic to double-source large aircraft structures." But, he adds, "in the component and sub-assembly level, companies should look at distributing work more" widely. "The trend in supply-chain management has been toward single-source supply for the low cost. This disaster will cause companies to revisit the tradeoff between lowest cost and availability. It may make sense to double-source components to avoid a global supply chain putting all their eggs in one basket."

BRADLEY PERETT/AW&ST

Mitsubishi Heavy Industries builds Boeing 787 outer wings in a Nagoya plant far from the earthquake. But the company does not know how much its suppliers have been affected.

While the earthquake, tsunami and threatened nuclear disaster at the Fukushima No. 1 power station also resulted in power shortages, Fuji, Kawasaki and Mitsubishi, far to the south, were unaffected. Fuji says it incurred minor damage. With the other two heavies, as they are nicknamed, it resumed operations three days after the catastrophe.

But the whole Japanese archipelago is seismically active, which leaves open the danger that one day an earthquake could hit Japan's aerospace heartland in and around Nagoya. The risk should not be overstated, however. Japanese factories, even those making equipment of extraordinary precision, are designed to cope with earthquakes of powerful magnitudes.

Boeing's Seattle facilities coped well with a magnitude 6.7 earthquake in 2001, while its South Carolina plant is built to ride out hurricanes. On the other hand, that is a reminder that production is exposed to a seismic fault line in the U.S., fault lines in Japan and South Carolina's weather.

Among the infrastructure damaged on March 11, Sendai Airport was flooded by the tsunami and covered in mud. The field was needed for relief flights, however, and 1,500 meters (4,900 ft.) of a runway had been cleared by March 17. Until all the mud is removed, the Japanese Civil Aviation Bureau will not know whether the rest of the runway was badly damaged by the earthquake, says an official of the bureau's safety and security division.

Japanese aerospace company Jamco has an aircraft maintenance, repair and overhaul firm at Sendai Airport and it also was damaged by the tsunami.

The magnitude 9.0 earthquake had its epicenter 130 km off the coast of northeast Japan's Oshika Peninsula near Sendai city. More than 15,000 people are believed to have died.

With Robert Wall in London.

Going Global

AMY BUTLER/ORLANDO, FLA., and WASHINGTON

Two of the U.S. Air Force's new Global Hawk Block 30 aircraft are conducting imagery intelligence missions over Japan following the massive earthquake that struck off the island chain's northeast coast on March 11.

This marks the Northrop Grumman Global Hawk's fourth combatant region of operations abroad—the Pacific, Central Command (supporting Iraq and Afghanistan), European Command and Southern Command (over Mexico and South America). Talks are now under way to potentially fly new Block 30 versions from NAS Sigonella in Italy to monitor activities in Libya, Bahrain and other areas of unrest in Africa and the Middle East, according to program officials.

The two unmanned aerial systems (UAS) are flying out of Andersen AFB in Guam and providing imagery along with U-2 aircraft from Osan Air Base in South Korea. The second UAS arrived there in early January, says Gen. Gary North, who oversees U.S. Air Forces in the Pacific.

The Global Hawks over Japan are the Block 30I configuration, carrying the Enhanced Integrated Sensor Suite (EISS) capable of collecting images of wide swaths of land. The imagery will be digitally relayed for processing. The U-2 is employing the mainstay Optical Bar Camera, which also can provide high-resolution wide-area views of the terrain. This camera, however, uses wet film, which must be sent back to Beale AFB, Calif., for development and processing prior to exploitation.

While both aircraft are surveying areas wrecked by the earthquake and tsunami, they can also be helpful with the growing crisis at the Fukushima Daiichi nuclear power station on Japan's northeast coast.

Global Hawk's EISS can provide infrared imagery of the plant, which is helping workers find the hottest areas of the nuclear reactors, some of which are thought to have either begun melting down or are on the cusp of such a disaster.

Efforts are now focused on cooling the reactors' fuel rods; at issue is knowing where water is needed most. Even though the Global Hawk can remain a significant distance from any radiation that might be contaminating the atmosphere, one program expert notes that the Air Force has decontamination procedures that could be implemented once the aircraft lands.

Meanwhile, six Global Hawk versions are operating out of Al Dhafra Air Base in the United Arab Emirates; the high-altitude UAS arrived there nearly a decade ago to support allied operations following the 9/11 terrorist attacks in the U.S. They comprise three Air Force Block 10 aircraft, a single Navy Block 10 outfitted with maritime surveillance software and two Block 20 UAS outfitted with the Battlefield Airborne Communications Node relay system.

As activities ramp up abroad, Air Force officials are finishing a report on the initial operational test and evaluation phase for the Block 20/30 aircraft. The program has suffered delays and come under fire during the past year for cost growth.

However, Air Force acquisition chief David Van Buren says the situation is turning around. "I was unhappy. I was unhappy with our own government program office," he declared recently. "I'm happy to say we have reversed the course with Northrop [Grumman] and its suppliers" on cost. Together with the company, he has identified $39 million in savings for the program.

Changing the Game

Canadian robotics may stretch commercial satellite lifetimes

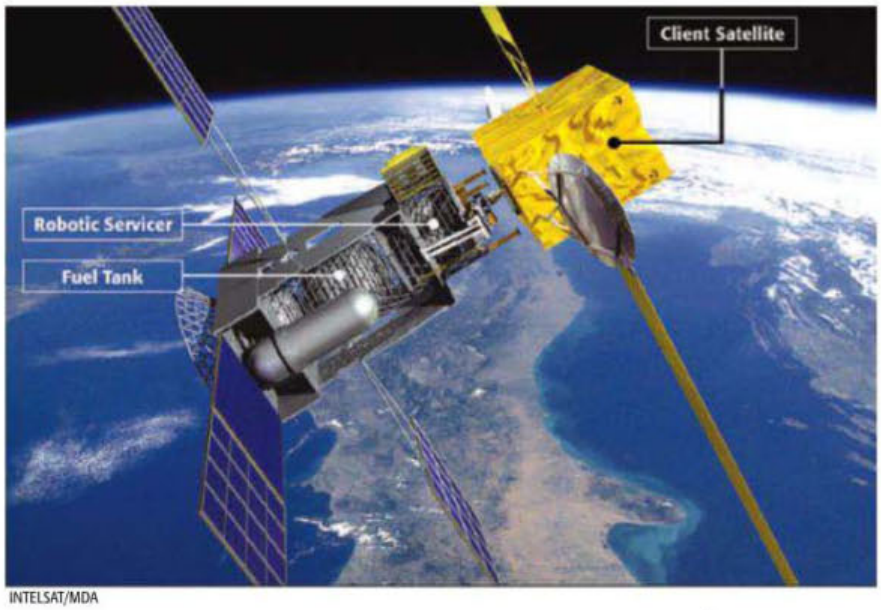
ViviSat, a joint venture of ATK and U.S. Space, is developing this "space tug" approach to satellite servicing.

VIVISAT

FRANK MORRING, JR./WASHINGTON

Satellite operators may no longer have to throw away perfectly good geostationary communications satellites if a $280 million deal between Intelsat and Canada's MacDonald, Dettwiler and Associates (MDA) works out.

The arrangement—crafted by the world's largest commercial satellite operator and the company that developed the sophisticated robots on the International Space Station—is designed to add in-orbit refueling and simple repairs to the way commercial satellite operators manage their fleets.



INTELSAT/MDA

Announced at the Satellite 2011 conference here last week, the agreement could add years of life to valuable spacecraft that would otherwise be decommissioned for lack of fuel.

Many technical and financial questions must be answered before robotic satellite servicing becomes the norm, but the initial venture already has a commercial competitor that is pushing an alternative its managers say would be simpler and less expensive than the MDA approach.

In-orbit servicing has long been studied by governments and commercial interests as a way to extend satellite-service life; but until Intelsat entered its deal with MDA, the concept was not considered sufficiently mature to be worth serious investment. The most significant recent push came from Europe, where an industrial team led by Dutch Space worked with the European Space Agency on a concept called the ConeXpress Orbital Life Extension Vehicle. That effort has lagged for lack of support from the insurance industry, a prime potential customer (*AW&ST* Feb. 19, 2007, p. 60).

The Canadian company can legitimately trace its satellite-servicing heritage to the STS-49 space shuttle mission in May 1992, when astronaut Pierre Thuot rode the robotic arm on the first flight of Endeavour to help two other spacewalkers manhandle the stranded Intelsat-VI (F-3) satellite into the payload bay for repairs. Applying its long experience in space robotics, which includes the Pentagon's Orbital Express servicing demonstration, MDA is developing a robotic servicer that will be able to grapple 75% of the commercial communications satellites in geostationary (GEO) orbit and either refuel them or use its robotic arm to make simple repairs.

In Intelsat, MDA has found an anchor customer with deep pockets for its robotic satellite refueling and repair service.

The spacecraft will use lidar ranging—another Canadian space technology niche—to approach the target satellite from below, flying the final few meters autonomously at a closing speed of "centimeters per minute," according to Steve Oldham, president of MDA's new Space Infrastructure Services unit.

After locating the satellite's apogee kick motor nozzle with video and target-recognition software, the "servicer" inserts a probe into the nozzle to grapple the target and draw itself up to its docking ring. Removing the appropriate tool from what amounts to a tool belt, the arm will open the target's fill-and-drain valve, insert a hose and pump in the appropriate hypergolic fuel.

"We refuel in exactly the same way as an operator on the ground fuels a satellite for the first time," says Oldham.

The servicer also will be able to perform some repairs, possibly including releasing snagged solar arrays. MDA will control its servicing spacecraft from Intelsat headquarters in Washington, installing its own workstations there and using the satellite operator's communications networks to send commands.

Thierry Guillemin, Intelsat's chief technical officer, says the initial test will be conducted with an Intelsat spacecraft at or near the end of its service life. If that works, the company hopes to use the technique to extend the life of satellites that still are carrying customers and are in good shape otherwise.

"It's a whole realm of possibilities that opens in terms of how you can use that in managing your fleet, from the standpoint of controlling the life of the satellites that are in orbit [and] mitigating risk," Guillemin says, noting that the servicer will allow an operator to accommodate launch failures and other anomalies with greater flexibility than is possible now.

MDA plans to buy a Proton-class spacecraft with recent flight heritage, probably from Russia's Information Satellite Systems (formerly NPO PM). The robot will be built at MDA facilities in Canada and attached to the bus, which will be modified to carry as much fuel as its launch vehicle can lift—estimated to be 2,000 kg (4,400 lb.).

Once that fuel is gone, Oldham says, the servicer itself will be refueled by tankers lofted separately for the purpose. To avoid creating orbital debris in a mishap, the servicer will take the target satellite to an orbit several hundred kilometers higher than its operational altitude for refueling. Typically the servicer will drop from fuel-saving free drift in a higher orbit to remain on station at a target spacecraft in GEO for a few weeks.

Oldham says the company will spend "several hundred million" dollars developing the spacecraft, only part of which will be recouped by the Intelsat payments, which will mostly be disbursed based on servicing achieved.

Oldham says MDA will fund the development with $50 million a year from its cash flow; financing will come from a variety of institutions and some support from Canadian government departments. Canada's contribution to the ISS includes its large robotic arm and the special-purpose dexterous manipulator (Dextre) that is scheduled to simulate the job on a mockup that MDA now proposes to do for real (*AW&ST* March 7/14, p. 26).

Intelsat has high hopes for the service, which will start with the test mission 3.5 years after fabrication begins. The operator's initial deal is for half of the payload, leaving MDA to sell the other half to other customers. In a "cartoon" version of the equation offered by Intelsat, a communications satellite is worth $100 million in annual revenue at the beginning of its time in orbit, when it is delivering peak power. That declines to 50-60% of peak at the end of its service life, while a servicing visit for refueling will cost $30-50 million, depending on the fuel load delivered.

Launch Diversity

Satellite operators seek ways to hold down the cost to orbit

FRANK MORRING, JR./WASHINGTON

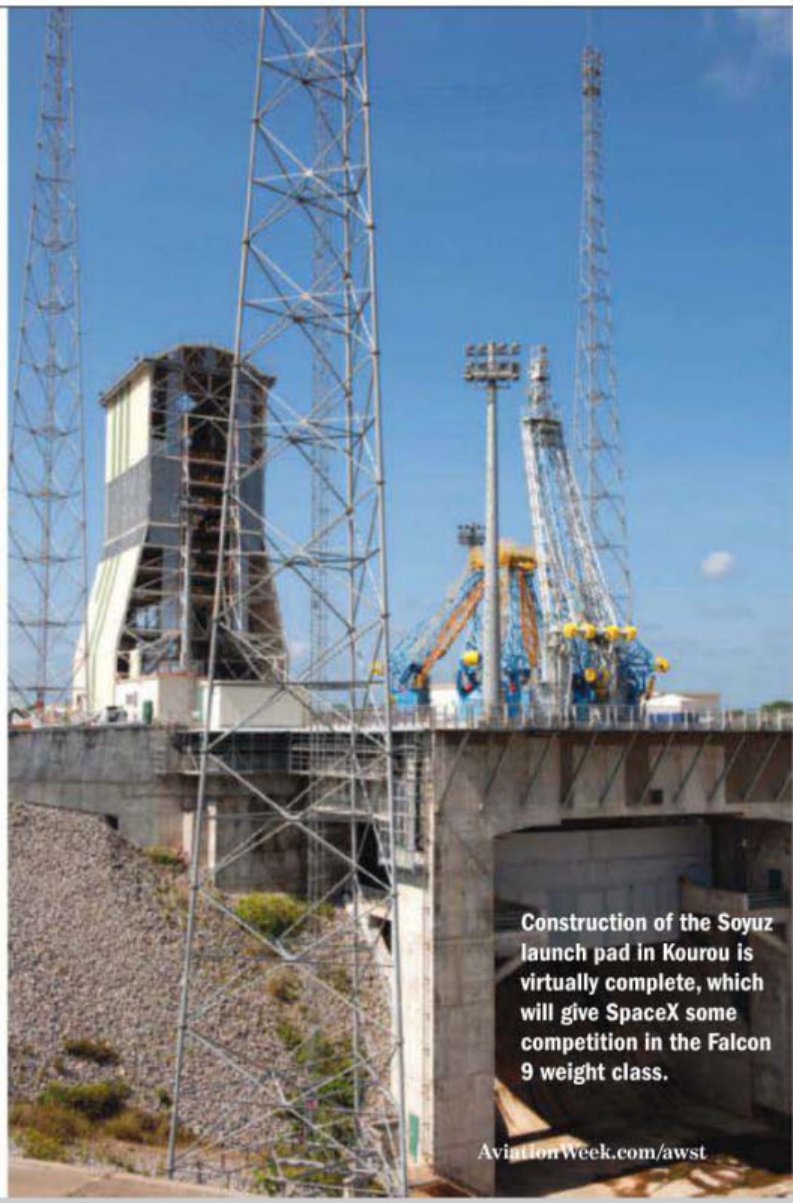
The decision by SES to launch a medium-size geostationary communications satellite on a Space Exploration Technologies Inc. (SpaceX) Falcon 9 rocket marks another effort by satellite operators to add to their bottom lines by taking a tight-fisted approach to the prices they pay for launch services.

Luxembourg-based SES has also entered a "framework understanding" with Sea Launch as the latter emerges from Chapter 11 bankruptcy protection that could see the ocean-going Sea Launch Odyssey again lofting SES spacecraft from the equatorial Pacific Ocean someday.

"We have always considered the launch vehicle system provided by Sea Launch to be an important participant in the commercial arena of heavy-lift launch providers," says SES CEO Romain Bausch. "Given our desire for a vibrant and competitive launch service market, we are pleased to see a new Sea Launch emerging and re-engaging."

Meeting reporters at the Satellite 2011 conference here last week Bausch repeated earlier calls for "diversity" in the satellite-launch market to help hold down the cost of service. In addition to assigning SpaceX what could be the startup's first mission to geostationary transfer orbit, Bausch also suggested that satellite electric propulsion—previously used for station-keeping in orbit—could be added to the launch-cost equation.

"You don't need to have these large launch vehicles to launch mid-size satellites, but you can do it more efficiently



Construction of the Soyuz launch pad in Kourou is virtually complete, which will give SpaceX some competition in the Falcon 9 weight class.

"Extending the life makes sense, of course, if the spacecraft is generally healthy," Guillemin says. "Every year we are decommissioning several satellites that we would love to keep in service. That's a waste of assets, and if you can refuel these satellites it's a plus."

In addition to commercial customers, the company expects to sell to the space insurance industry, which already has seen the robotic hardware at MDA facilities in Canada, according to Oldham, and to government customers.

One potential government customer for the company that hopes to compete with MDA—ViviSat—is the U.S. Air Force. The service has been trying to raise the orbit of its first Advanced Extremely High Frequency (AEHF-1) satellite using its electric Hall Current Thrusters because the $2 billion military communications satellite's apogee kick motor didn't work (*AW&ST* Nov. 22, 2010, p. 36).

ViviSat, a new 50-50 joint venture of U.S. Space and ATK, is marketing a satellite-refueling spacecraft that connects to a target spacecraft using the same probe-in-the-kick-motor approach as MDA, but does not transfer its fuel. Instead, the vehicle becomes a new fuel tank, using its own thrusters to supply attitude control for the target. Company officials say they had good response in meetings at the Satellite 2011 conference, although they concede their concept is not as far along as MDA.

Instead of the robotic sophistication of the Canadian approach, ViviSat is selling simplicity and a lower cost. Its engineers believe they can dock to 90% of the 450 or so geostationary satellites in orbit.

"Taking the more simple approach allows us to meet the risk tolerance of the industry," says Bryan McGuirk, a former SES executive who is chief operating officer at ViviSat. "It's lower risk, and that's been very well accepted in our meetings so far."

In addition to extending the life of an out-of-fuel satellite, the company could also rescue fueled spacecraft like AEHF-1 by docking with it in its low orbit, using its own motor and fuel to place it in the right orbit, and then moving to another target.

"Every year there are unfortunate situations where things don't make orbit," says McGuirk.

Not surprisingly, the satellite-manufacturing industry is not eager for outside companies like MDA and ViviSat to sell services that would cut into their replacement markets. At a Satellite 2011 manufacturers' panel, top spacecraft builders discounted the servicing idea as too high-risk and financially uncertain.

"I think the technology to do certain kinds of in-orbit servicing is either at hand or not very far in the future," says David W. Thompson, CEO of Orbital Sciences Corp., who joked that his company might want to weld shut the fill-and-drain valves on the small GEO satellites it builds. "[But] I don't think, given the way our industry works today, that it's something you're going to see as a purely private undertaking."

ARIANESPACE

by using smaller launch vehicles and combining the capabilities of these launch vehicles with electric propulsion," Bausch says, explaining that low-thrust ion propulsion systems could gradually raise a spacecraft to its orbit above the equator.

That approach would take more time, but in large fleets like the 44-satellite SES operation there is enough existing capacity to plan for it and hold down launch costs. With Intelsat putting down serious money to extend the life of its satellites already on orbit by refueling them there (see p. 23), the market for launching commercial geostationary birds may be shrinking below the 22 or so a year expected for the next few years.

At the same time, competition is stiffening. In addition to Sea Launch's return to the fray, SpaceX is eager to join in with the Falcon 9 it has developed to deliver cargo and eventually crew to the International Space Station (see p. 18).

"Falcon 9 ideally complements our roster of Ariane 5 and Proton boosters, as well as our framework launch understanding with Sea Launch," Bausch says, adding that SES engineers conducted "extensive due diligence" before deciding to put the SES-8 spacecraft on the new rocket.

Under construction at Orbital Sciences Corp., SES-8 is scheduled to launch in the first quarter of 2013 to the orbital slot at 95 deg. East Long., where it will be co-located with the NSS-6 satellite to support growing demand for direct-to-home broadcast TV delivery in South Asia and Southeast Asia, as well as customers in the Middle East, Afghanistan, Australia, Papua New Guinea and Korea.

As part of its deal with SpaceX, SES is requiring that the launch company demonstrate a new fairing that will fit its satellite, and to fly at least once with uprated Merlin engines that will meet its requirements.

Gwynne Shotwell, president of the Hawthorne, Calif.-based launch provider, says the modified engines will generate 125,000-135,000 lb. thrust, up from 115,000 lb. for the original. Changes in the design that also eliminate the need for off-site plating services contributed to the boost in engine performance, she says. The in-house approach is one way SpaceX is working to hold down its costs and pass savings along to customers, Shotwell adds, noting that the company has started spinning its own tank domes in-house this month.

Bausch says the SES-8 satellite will be too big to launch on a Russian Soyuz rocket flying from the Baikonur Cosmodrome in Kazakhstan, where the 51.6 deg. N. Lat. reduces launcher efficiency. But the Falcon 9 will get some competition from that quarter for geostationary transfer orbit (GTO) launches later this year, when the Franco-Russian Starsem partnership begins flying the Soyuz from Europe's Guiana Space Center.

Soyuz can use the geographic advantage of the northern coast of South America, at 4 deg. N. Lat., to lift 2.8 metric tons to GTO instead of 1.7 tons at Baikonur. In 2011 the European center near Kourou, French Guiana, will see its first Soyuz launch and the first launch of the smaller Vega vehicle, according to Jean-Yves Le Gall, chairman and CEO of Arianespace.

Vega, which can put satellites as large as 2 metric tons into polar and low Earth orbits, is to be used for scientific missions. Arianespace will continue to use its Ariane 5 to joust with International Launch Services' Protons for orders to launch large commercial communications satellites to GEO, but Le Gall says he isn't worried about competition from SpaceX yet.

"We already have behind us four satellites which are now in our order book which were previously manifested with SpaceX," he says.

Still, the market for launching large spacecraft is growing more competitive as Sea Launch gets back in business. Kjell Karlsen, president of Sea Launch, says it will take until 2013 for his company to return to full speed of five launches per year, with two this year and three in 2012. Success getting through bankruptcy is more evidence the operators are looking for diversity in the ways they get their spacecraft to orbit, he says.

Altered Landscape

European companies continue push for U.S. work despite string of contract losses

AMY BUTLER/WASHINGTON and ROBERT WALL/LONDON

A string of procurement choices by the Pentagon—including an American KC-X platform, a stunted buy of Italian airlifters and a defunct Italian Marine One airframe—exemplify how difficult it can be for foreign designs to earn the right to fly in U.S. livery.

Foreign contractors may be quietly chagrined, but still appear resolved not to walk away from the potential of selling goods to the largest single buyer of military hardware on the globe. The Pentagon's fitful buying practices and procurement missteps have, however, taken their toll on what appeared a few years ago to be an imminent push by European contractors onto U.S. soil after EADS won the Army Light Utility Helicopter, the EH-101 was chosen to transport the president, and the C-27J tactical transport was selected.

But, the landscape has drastically changed. Several opportunities were lost—or some say derailed: the C-27J has been truncated, the EH-101 contract annulled and the EADS win in the KC-X refueler overturned. Some Europeans see a pattern, arguing the U.S. has resorted to protectionism.

For foreign executives, the huge U.S. market remains attractive. But they face a new reality challenging their goals amid flattening Pentagon budgets and against the political backdrop of high unemployment numbers in America.

"There is no policy line connecting these dots," Ashton Carter, Pentagon procurement chief, tells Aviation Week. "We have had to make tough decisions to cancel a lot of poorly performing programs. And, there have been just as many or more that had an American company as its prime contractor as had a non-heritage company as its prime." David Berteau, director of the Defense-Industrial Initiatives Group for the Center for Strategic and International Studies, agrees. "You'd be hard-pressed to say that there is a conspiracy theory," he says. "The results [of these decisions] may look like a pattern, but the process that you use to get to these results isn't a pattern at all."

The U.S. procurement process has fallen under greater public scrutiny in recent years, diminishing the chance that politics can influence source selections. "You can't really hide those kinds of shenanigans in the kind of environment we operate in," he says. Air Force Chief of Staff Gen. Norton Schwartz notes that any bias toward or against a particular company cannot weave its way into a "pristine" process.

The Pentagon's latest decision to end its refueler relationship with EADS and select, instead, a rival KC-135 replacement from Boeing (the 767-based KC-46A) is the largest such failed attempt by a contractor pushing a European design for the U.S. military. The KC-X contract is valued at more than $30 billion, according to EADS, which proposed an A330-based design. Also at stake was a strategic goal by EADS to establish a final assembly facility for A330s and potentially other commercial airliners, in Boeing's back yard, on U.S. soil, if it won KC-X.

Schwartz rejects the suggestion that EADS was simply a foil that forced Boeing to sharpen its pencil and lower its price. "This is about the best deal, pure an simple," he says of Boeing's win. He acknowledges that the final selection of the 767-based tanker grew out of an environment where "we maybe didn't have all of the cost discipline that we should have had. That is going to become an increasingly distant memory."

"The basis on which the tanker decision was made was spelled out in the [request for proposals] last year," Carter says. "We followed the rules and the decision process described in that RFP, which was released and written before we knew who the bidders would be."

EADS CEO Louis Gallois is putting a brave face on the turn of events after the recompete that some say favored Boeing from the outset. The bidding has led to a positive relationship with the Pentagon and Congress, he notes, adding that the company was treated fairly.

EADS North America Chairman of the Board Ralph Crosby notes the company accepted that the most recent KC-X RFP did not allow for evaluating the attributes of its larger tanker offering. "We accepted those rules. And by accepting the rules to opt to compete, we did so with the full knowledge of understanding that it was not optimum from our standpoint," Crosby says. "We understood exactly what the parameters were [and]—from a process standpoint—the Defense Department did precisely what they said they were going to do" by selecting the KC-46A.

EADS is now faced with the challenge of trying to meet growth targets in the U.S. without the tanker contract and a U.S. final assembly facility that would have benefited its commercial business. EADS is looking to reach €10 billion ($14 billion) in revenue from the U.S. market by 2020. Doing so with a tanker win was not considered easy. With the loss, it is an even greater challenge, especially as the company has opted to forego bidding on the future presidential helicopter.

Negotiations are still not final on the terms of the KC-45 contract termination from 2008, including the financial settlement over the first A330 partially bought by the Air Force for its tanker test program.

EADS

EADS is now focused on other U.S. work, such as the Army's Armed Aerial Scout program, and potential acquisitions that have proved difficult to execute.

A similar—though less extreme—obstacle was encountered by Alenia North America, the U.S. arm of Italy's Finmeccanica, which won a competition in 2007 with prime contractor L-3 Communications to sell C-27Js to the Pentagon. The deal was quickly truncated from 78 to 24 after program control shifted from a very supportive Army to the Air Force, which favors buys of more Lockheed Martin C-130Js. Company officials projected sales as high as 145 of the small airlifters, providing the justification for building a stateside final assembly facility at Cecil Field in Jacksonville, Fla. With the truncated order, however, Alenia's plans for a U.S. industrial presence have waned.

The C-27J and KC-X examples raise a question of whether foreign companies should rely on large numbers of Pentagon sales as the basis for establishing stateside assembly plants, though it is unlikely that commercial business alone will justify the cost to move stateside.

Italian executives overseeing a bid with Lockheed Martin to sell EH-101s modified for the Marine One mission were also peeved by requirements disputes between the White House and Navy. These spats led to contract cancellation in 2009. A new competition for that mission has yet to get under way. Talks with the Pentagon on the Marine One termination settlement are still ongoing.

Finally, Air Force Gen. Mark Welsh, who oversees U.S. Air Forces in Europe, acknowledges that the Pentagon's recent decision to walk away from the project with Germany and Italy for a common Medium Extended Air Defense System (Meads) will "frustrate" European allies. "It is not something they will be excited about," he tells Aviation Week. Washington has decided not to buy the system, leaving Italy and Germany to fund procurement if they can find the money. The partners would do so, however, knowing that the interoperability desired by jointly procuring with the U.S. is compromised.

MBDA CEO Antoine Bouvier acknowledges he was surprised by the turn of events. However, he says the decision does not undermine his desire to grow his market share in the U.S.

Taken in their totality, these decisions paint a harsh view of the landscape faced by European companies eager to sell to the Pentagon and willing to invest in U.S. infrastructure. Though some executives privately question whether politics—such as adverse perceptions of buying a foreign platform, formidable lobbying efforts by traditional U.S. contractors on Capitol Hill or flat-out protectionism—are at play, not everyone shares that view. Others acknowledge that fitful Pentagon management is equally perilous to top U.S. companies.

During a speech last month for investors, Carter noted that Pentagon officials "are committed to continue opening our markets" while also being attentive to security concerns. "Globalization of our market is not an option—it is a reality. Our utilization of . , , 'non-heritage' firms is essential for nearly all of the systems upon which we rely," he said.

European firms will have future opportunities to test what the lay of the land really is. In addition to the Armed Aerial Scout program, the U.S. Air Force is likely to compete the Common Vertical Lift Support Program (CVLSP) helicopter for the executive lift and nuclear convoy support mission and a new high-performance jet trainer will include international designs.

Though CVLSP was going in the direction of a sole-source to U.S.-based Sikorsky for a modified UH-60 only one month ago, Air Force officials said last week they are now inclined to compete the work. Several offshore designs, including an AgustaWestland AW139 and models from EADS, are expected to compete.

A forthcoming competition for a T-38 replacement will likely exclusively include designs from foreign bidders—the Aermacchi M-346, BAE Hawk and Lockheed Martin/Korea Aerospace Industries T-50. Though Boeing is eyeing a clean-sheet design, the Pentagon will be hard pressed in a tough budget environment to justify a costly development program with available off-the-shelf designs.

Despite the changing landscape of the Pentagon's recent decisions, a single U.S. win for a European firm outweighs several other export or domestic successes. The bottom line is that regardless of how slim the chances for foreign supplier may appear to be or may actually be, not bidding is not an option.

Cost Fears

Allies predict F-35 price increases and worry that no one can estimate a realistic total

DAVID A. FULGHUM and GRAHAM WARWICK/WASHINGTON, ROBERT WALL/LONDON and ALON BEN-DAVID/TEL AVIV

Customers for Lockheed-Martin's stealthy F-35 Joint Strike Fighter—among them Canada, Israel, Britain and Australia—are shifting their mood from anxiety to paranoia over increasingly unpredictable costs.

Foreign analysts now expect JSF prices to significantly exceed even the latest Pentagon estimate, putting government officials in fiscal and political jeopardy as they try to craft a rational purchase plan for the fifth-generation warplane.

Adding new concern was congressional testimony by Lt. Gen. Mark Shackleford, military deputy to the assistant secretary of the Air Force for acquisitons, who says that "we currently expect up to a two-year delay" in fielding the first operational unit, which shifts the date to 2018. The delay is being triggered by the most recent program restructuring.

A new report by Canada's Office of the Parliamentary Budget Officer estimates that total program costs for the country's 65 aircraft will be U.S. $29 billion which means a total program (through-life) unit price tag of about $450 million per aircraft in Fiscal 2009 dollars.

For Israel, a long, list of unique requirements from the Israeli air force (IAF) has almost disappeared for the first 19 JSFs. Options for installing Israeli weaponry produced a staggering price tag, while plans to fit the F-35 with Israeli electronic warfare systems were rejected for both technological and political reasons.

Britain is concerned about the cost of F-35 upgrades because of problems dur-

ing earlier collaborations with the U.S. In its Lockheed Martin C-130J program the U.K. was forced to closely integrate upgrade plans with the U.S., rather than allowing indigenous modifications at a lower price as it did in the earlier C-130K buy. British army officers told Aviation Week that the computerized air-drop system was flawed, making cargo recovery in Afghanistan more difficult and dangerous. With the F-35, the situation is expected to be even more extreme, says a British government official.

Australia has also been the victim of U.S. miscalculations in an earlier cutting-edge project. Its Boeing/Northrop Grumman Wedgetail surveillance aircraft is more than four years behind schedule as Canberra considers the F-35. The airborne early warning and control aircraft's software cost and schedule problems mirror those of the F-35.

Canada's report—"An Estimate of the Fiscal Impact of Canada's Proposed Acquisition of the F-35 Lightning II Joint Strike Fighter"—came out March 10. The report predicts that average unit production cost for its F-35s will be $148 million with an additional $15 million for the engine, which brings the total to $163 million per aircraft. Cost estimates given to Congress last week say the fourth low-rate initial production batch, with engines, will cost $127 million per aircraft for the F-35A, $141 million for the F-35B and $158 million for the F-35C.

Lockheed Martin is reviewing details of Canada's F-35 cost estimates. Company officials contend their estimates are based on proprietary F-35 program data and predict that each Canadian aircraft will cost $70 to 75 million when deliveries begin in 2016.

"It is not immediately obvious, given the available evidence, how the cost can be reduced to estimates predicted by Lockheed Martin over 10 years ago," the Canadian report says. "Overall, F-35 development is now five years behind the schedule set at the outset of the program, and total [development] overruns are projected to exceed $21 billion, or 60% above the original goal. Unless there is compelling evidence to the contrary, it is difficult to see prices reducing to their original estimated level," it concludes.

"It's hard to do those sorts of calculations with confidence, so there's a degree of uncertainty—which I think the report notes appropriately," says Andrew Davies, program director at the Australian Strategic Policy Institute and a member of the independent peer-review panel for the Canadian report. "But I think the estimates here are about as good as educated outsiders can get them using public source data."

The British cite an inflexible upgrade program for the C-130J as a collaboration problem with the U.S. they would like to avoid with the F-35.

ROYAL AIR FORCE

The Canadian study also lists a number of additional opportunities for cost escalation that could inflate Ottawa's F-35 bill. Research, development, test and evaluation costs grew 40% between 2001 and 2009 while production cost increased 54%. Elimination of the F-35B that could drive up unit cost for Canada due to a smaller total buy, as could reductions in sales to the U.S. and other militaries. The integration of nation-specific weapons not cleared by Lockheed Martin and the Defense Department may lead to additional costs for Canada. The unique cost of operating and supporting a fifth-generation strike fighter is still a significant, unknown quantity. Changed circumstances at the time of mid-life upgrades and overhauls would make F-35s more expensive and dependent on availability of Lockheed Martin's workforce and facilities.

Canada's analysis goes on to contend that elimination of the alternative engine program would leave it with no competitive leverage to lower engine costs. Some U.S. lawmakers agree.

"For those who might ask the question regarding F-35 program cost, at what point does this program become unaffordable, I would respond that if you believe our nation needs a fifth-generation stealth fighter, you have no choice," says Rep. Roscoe Bartlett (R.-Md.), chairman of the House Armed Services subcommittee on tactial air and land forces. "Having no choice but to continue to pay for F-35 development and procurement cost increases is exactly why many of us do not believe it is wise to create the same monopoly situation [for the engine] by giving a decades-long, $110 billion, sole-source contract [to Pratt & Whitney]."

Short-term savings from abandoning the F136 engine will total $2-3 billion, Bartlett contends, while the manufacturer, General Electric, says these will be $1 billion. But savings from re-competing engine buys over 40 years would save more, Bartlett says.

U.S. analysts offer their own cautionary notes. "The program continues to lag [budget and schedule] predictions," says Michael Sullivan, director of acquisition and sourcing for the U.S. Government Accountability Office. "It is not out of the woods yet."

Software is another area of imperfect cost estimates. The early software development packages are projected to be two years late for each block, the result of underestimating the time and resources required, and the need for new code continues to grow. As software is rebuilt and added, "costs have grown by 40 percent," Sullivan says.

Others point to earlier disappointments with buying into advanced U.S. technology. A senior Royal Australian Air Force officer with insight into the Boeing/Northrop Grumman Wedgetail aircraft, summed up the dilemma of foreign purchasers: "It's great kit and just what we needed, but it would have been so helpful and caused us so much less pain [with the government] if we had been told up front how big that radar was going to be [3.5 tons], how long it actually was going to take [five years over

As with its first F-16s, Israel is absorbing the news that its initial 19 F-35s will be bare-bones models. A lengthy list of unique requirements has been shelved.

U.S. AIR FORCE

schedule] and how much it was actually going to cost [more than $4 billion]."

Israel's defense establishment is divided on the question of whether to go ahead with procurement of F-35s, despite expected delays, or to postpone the program until costs and schedules are clear. Jerusalem is expected to be the first international customer for the F-35A with deliveries to begin in 2015. But recent discussions with the F-35 program and Lockheed Martin officials made it clear that there will be delays in delivery, with Israeli estimates varying from two months to two years.

The IAF's first squadron of F-35s will be almost identical to the international JSF, except for an indigenous C4I (command, control, computers, communications and intelligence) system. "The first aircraft will have the bare necessities required to go into combat," a senior IAF official told Aviation Week. "We will gradually expand their capabilities."

This is a sharp turn from the IAF's initial vision of an F-35I, equipped with Rafael's Python 5 and Spice missiles. "When we received the first F-16Is, they were almost bare as well," says the official. Those limitations have not cooled the IAF's enthusiasm for the new aircraft. The deployment of Russian-made SA-17 (Grizzly) and SA-22 (Greyhound) short-range air defense missiles by Syria is considered a genuine challenge for the IAF.

The cost to Israel will be $145 million each for 19 A-model aircraft. But there is talk of using near-term F-35 funding for other projects. "Despite the F-35's advantages, it will not be the panacea for Israel's problems and most of its tasks can be performed with similar effectiveness through existing planes with one upgrade or another," claims a February report by the Institute for National Security Studies.

However, the IAF traditionally has the upper hand over other services and with the current volatility in the Middle East it is expected to request an increase in the number of its fighting platforms. But other services, as well as the defense ministry of defense, are less eager, saying that delaying the payments for F-35s in a year or two could provide the missing funds for missile defense programs and the new armored fighting vehicle for the army.

Lockheed Martin has warned that postponing the acquisition could result in greater delays and jeopardize a controversial offset package for Israeli industry. The defense ministry, Lockheed Martin and Israeli industries are denying news reports of a Lockheed Martin pledge for $4 billion in offsets, but Israeli and U.S. officials have confirmed the amount with Aviation Week.

The Canadian JSF audit also drew Britain's attention. U.K. officials say its cost assumptions seem credible. As with Canada, they note that it has been difficult to properly assess underlying program costs. JSF concerns come as the British government is trying to adopt more realistic budget planning, with Defense Secretary Liam Fox vowing that only fully funded programs will proceed.

Competitive Edge

New helicopters will keep AgustaWestland and Eurocopter ahead in commercial market

GRAHAM WARWICK and ANDY NATIVI/ORLANDO, FLA.

AGUSTAWESTLAND CONCEPT

Europe is stepping up its challenge to the U.S. rotorcraft industry, with Eurocopter nearing the launch of its X4 medium twin and AgustaWestland opening the order book for its AW169 intermediate twin and closing in on taking control of the BA609 civil tiltrotor program from Bell Helicopter.

Already dominant in the civil market, both European manufacturers are pushing hard to win U.S. government business with military derivatives of their commercial products. The companies are touting a technological edge over their U.S. rivals they argue will only increase with their new products.

Replete with military work, U.S. manufacturers are being more cautious about the commercial market. Sikorsky is developing the X2 high-speed helicopter as an armed scout but does not yet see a civil application. Having sidelined the BA609 tiltrotor, Bell is studying a new medium twin, for which it has not set a timeline.

Eurocopter will launch development of the X4, a replacement for its AS365/EC155 Dauphin medium-twin family, early in the second quarter, says Lutz Bertling, president and CEO. Entry into service is planned for 2016. Still under wraps, the X4 will offer a "significant increase in payload, performance and safety, and a much higher level of assisting the pilot," he says.

Key to Eurocopter's plans is government support, in the form of French stimulus funding, for research to develop technologies that are at a low maturity level. Government support has played a considerable role in the growth of the European helicopter industry, but new regulations require launch aid for civil rotorcraft to be repayable. New procedures control the spin-off of government-funded military technology to commercial products, and AgustaWestland in January agreed to repay state development aid for the AW139 and BA609.

"After a long discussion, we have a good agreement with [the European Commission] that we hope will be enforced on others," says AgustaWestland CEO Guiseppe Orsi. "Any aid given has to be reimbursable and there is a certain procedure to be used to spin off technology from military to civil." State loans to launch the Eurocopter X4 will be repayable and comply with Brussels regulations, Bertling says, but the research support needed to mature technologies will be a government subsidy and be for more than just the X4.

While less than hoped for, the state aid offered is sufficient to launch the X4, Bertling says. The level of research funding available will determine which technologies make it into the helicopter. "The more we get, the more we will invest," he says. The first version of the X4 will not have all the new technologies, "but we will still get technologies we never thought we would see in a helicopter."

Eurocopter is continuing work on the X3 high-speed hybrid helicopter, with flights to resume in the second quarter aiming for a 220-kt. airspeed. Sikorsky has reached 250 kt. with its X2 Technology coaxial-rotor demonstrator, but company president Jeff Pino says, "the commercial potential is not readily apparent yet." He cites the cost of speed, from the increased fuel consumption of the more powerful engines.

First delivery of AgustaWestland's 4.5-ton, 8-10-passenger AW169 is planned for the end of 2014.

"Just being faster cannot be the objective," says Bertling. While it has yet to launch a product based on the X3, Eurocopter is aiming to increase "payload times range per flight hour" by 50% for only a 25% increase in the cost per flight hour. This would increase productivity on long missions, he says.

AgustaWestland "still believes the tiltrotor is the most credible solution for the future," says Orsi. "The tiltrotor's advantage is not only its higher speed, but the fact it can operate like an airplane, flying higher and being

Russia Funds New High-Speed Helo

MAXIM PYADUSHKIN/MOSCOW

The Russian government this year will kick in financing for a new high-speed helicopter program to be developed by national rotorcraft maker Russian Helicopters.

An official from the ministry of industry and trade says the budget will reach 400 million rubles ($14 million) for the conceptual design phase. The government hopes the new model will help the Russian manufacturer gain 15% of the global rotorcraft market by 2020.

The high-speed helo program was launched in 2007, and Russian Helicopters had been working on two design concepts—the Kamov

pressurized." The long-running BA609 program remains essentially stalled, but negotiations with Bell to take it over are continuing. "I think they will close soon," he says. "We have spoken to most of the suppliers and they are ready to restart the program with us."

Bell CEO John Garrison confirms active negotiations are under way, but he maintains that completing development of the BA609 "will require a partnership." The main issue is the money required to get the aircraft to certification and production, which is well above €500 million ($700 million), including funds

EUROCOPTER

The EC145T2 features Eurocopter's signature fenestron shrouded tailrotor, mounted on a composite tailboom

to refresh technology and cure obsolescence after 15 years of development.

While AgustaWestland is keen to continue investing, Bell is not. "We want full control of the aircraft, and Bell has agreed," says Orsi. "Transferring the program to us is more difficult than we thought, but we hope it will be solved in the next few months." The likely outcome will see AgustaWestland becoming the sole BA609 "owner," with Bell continuing as a major supplier, but not real partner, and possibly keeping the intellectual property on some critical technologies.

AgustaWestland's current revenue growth is built largely on the AW139 medium twin, orders for which rose 42% in 2010 after a slump in 2009. The company hopes to repeat the success with the smaller "light intermediate" AW169, which will fly in 2012 and enter service at the end of 2014. Eurocopter, meanwhile, pans to start deliveries of the EC175, its competitor to the AW139, in 2012, initially to the oil and gas market. Sikorsky also will begin delivering its answer to the AW139, the S-76D, in 2012.

These new helicopters are expected to enter a rebounding market. The civil sector, which has declined sharply from its 2008 peak, is expected to begin a slow recovery in 2012, depending on the impact on the global economy of unrest in North Africa and the Middle East and the earthquake and tsunami in Japan.

"There will be a new growth cycle in the civil market from 2012, led by the oil and gas and parapublic markets," says AgustaWestland's Orsi. The steep downturn in orders in 2009 will continue to be felt in lower deliveries through 2011, and orders are not yet back to pre-crisis levels, says Eurocopter's Bertling. "We saw activity at the end of 2010 and beginning of 2011, and expect the U.S. market to recover this year, but slowly," says Marc Paganini, president and CEO of American Eurocopter. "We think it will come back to 2006-08 levels."

Eurocopter introduced a slew of improved commercial products at the Heli-Expo show here early this month, unveiling the uprated EC145T2 light twin and announcing upgrades to several other models under the "e-generation" label. Most are built around Turbomeca's new Arriel 2+ turboshaft, which has compressor, turbine and control improvements to increase power and reduce fuel consumption and operating cost.

First flown in secret in June last year, the EC145T2 introduces Eurocopter's hallmark fenestron shrouded tailrotor for increased efficiency, lower noise and improved safety. The T2 has more powerful Arriel 2E engines and an uprated gearbox, giving a 25% increase in performance over the basic EC145. The helicopter has a composite tailboom and new cockpit with three large-format displays and a four-axis autopilot.

Under the e-generation banner, deliveries of the single-turbine AS350B3e will begin in August. The helicopter has an Arriel 2D providing 12% more power and the ability to maintain full 850-shp takeoff power for 30 min. The EC135P2e/T2e light twins will be certified by mid-year and provide an 88-lb. increase in maximum takeoff weight (MTOW), allowing for an extra passenger, Bertling says.

The AS365N3e medium twin will be delivered beginning early in 2014 with improved hot-and-high performance, 15% more power from Arriel 2N engines and a 441-lb. higher MTOW combining to give an increase in payload of up to 794 lb. The larger AS322L1e Super Puma will introduce the glass cockpit and autopilot from the heavier EC225 and will be certified in the first quarter of 2012.

Looking ahead, Bertling says Eurocopter plans to introduce a diesel-powered version of its slow-selling EC120 single-turbine light helicopter, "but not in 2012-13" because of other priorities. "The EC120 will get a second life with diesel power, and become dramatically cheaper," he says. Eurocopter also is "working actively" on hybrid diesel-electric power for light helicopters, but is revealing little.

Ka-92 with coaxial rotor and expected weight of 9-12 tons as well as the 5-ton Mil Mi-X1 concept with conventional helicopter layout. But an official in the Russian aircraft industry tells Aviation Week that the project now moving forward will likely be a new design, incorporating technologies from both Mil and Kamov concepts.

Some of the technology being developed under this effort, such as the new main rotor blade, will likely also be used to upgrade existing rotorcraft, such as the Mi-171 transport helicopter.

According to the ministry of industry and trade, Russian Helicopters delivered 214 rotorcraft in 2010, compared to 183 handed over the year prior; military customers took 51% of those deliveries. The company's revenues exceeded $2 billion.

Far From Dull

Dassault sets sights on refining SMS and defining MALE UAV

BAE SYSTEMS

Dassault has signed on to a BAE Systems proposal to jointly pursue a Franco-British medium-altitude long-endurance (MALE) unmanned aircraft program notionally based on a derivative of the Mantis demonstrator.

ROBERT WALL/SAINT-CLOUD, FRANCE

Dassault faces another difficult year, with uncertainty over how quickly its core business aircraft market will recover and the knowledge that revenue will drop because of fewer deliveries.

Although there has been a slowdown in cancellations and a slight uptick in order activity, Chairman/CEO Charles Edelstenne says the current macroeconomic environment makes it hard to predict when the business aviation market will rebound. Turmoil in the Middle East and North Africa also could slow defense exports.

Business jet manufacturers, in general, report an improvement in the market, with Gulfstream's fourth-quarter 2010 net orders reaching the highest level since the downturn. But the recovery is weighed toward the top end of the market. Gulfstream is seeing some mid-cabin activity but Cessna, with its smaller jets, is still waiting for orders to return.

Dassault suffered a net loss of nine Falcon business jets orders last year. Deliveries reached a high of 95 aircraft, driving net sales to €4.2 billion ($5.8 billion), but will drop to roughly 70 this year—below 2009 levels.

Despite these problems, Edelstenne remains bullish for the long term. Russia is a strong market, he notes, and China is of growing importance. The company is entering this period with more than €3 billion in hand, having increased the available cash by €1 billion in 2010.

At the engineering level, much of the year will be focused on refining the systems design of the SMS, Dassault's next business aircraft, which is scheduled to hit the market in 2016. High- and low-speed wind-tunnel tests have been completed, and major partners have been chosen although not identified. Edelstenne says 300 engineers are working on the detailed design across the supplier network. That team, based at Dassault's Saint-Cloud headquarters outside Paris, will remain in place until mid-2012, when the engineers will return to their various companies to begin working on the so-called virtual design plateau to finalize the aircraft.

On the defense side, the company also is poised for a major engineering push as part of its recently signed agreement with BAE Systems to pursue a Franco-British medium-altitude unmanned aircraft program. BAE will be responsible for defining the aircraft and engine selection—with turbofans and turboprops still under consideration—while the French company will focus on systems integration and testing, says Eric Trappier, executive vice president/international at Dassault Aviation.

The concept will be an evolution of the Mantis flying demonstrator developed by BAE Systems. Many details, though, remain to be defined, including the number of air vehicles per system.

The notional €1 billion program will be split equally between both sides. But other companies are eyeing the effort. EADS has indicated it may pursue the project, and a General Atomics official says there is hope the governments will decide on joint procurement, not joint development, which could open the door to one of its Predator versions.

The timeline for the program has not been set. The U.K. initially was targeting a 2016 in-service date, which Trappier says is attainable given adequate funding. But a Royal Air Force official says 2018 now seems more likely, with an industry official noting that 2020 also is being suggested, partly owing to budget constraints in Paris and London.

Sensor selections have yet to be made, and Trappier suggests that supplying the radar could be one avenue for Thales to enter the program. France and the U.K. have not spelled out the program requirements, although the system is expected to be capable of being armed.

Trappier says the relationship with BAE Systems could grow to encompass a potential Franco-British cooperation on unmanned combat aircraft. The two companies have been pursuing separate paths, with BAE working on the Taranis demonstrator and Dassault leading the European Neuron project.

Dassault, meanwhile, continues to pursue several export campaigns for its Rafale fighter; India, Brazil and the United Arab Emirates are currently most active.

Money on the Long Term

Technology and finance are playing a big role in the single-aisle fight

MICHAEL MECHAM/SCOTTSDALE, ARIZ.

As major manufacturers fight for their definition of what future 100-200-seat, single-aisle aircraft will look like, they at least have the advantage of talking to an industry that has access to low-interest loans and financiers impressed with the discipline airlines showed in bouncing back from the global recession.

But the competitive landscape is fluid. More airplane owners are not tied to an airline brand, so manufacturers have to build aircraft with that in mind. They have in widebodies, but Airbus and Boeing's single-aisle designs date back to a day when leasing was less important.

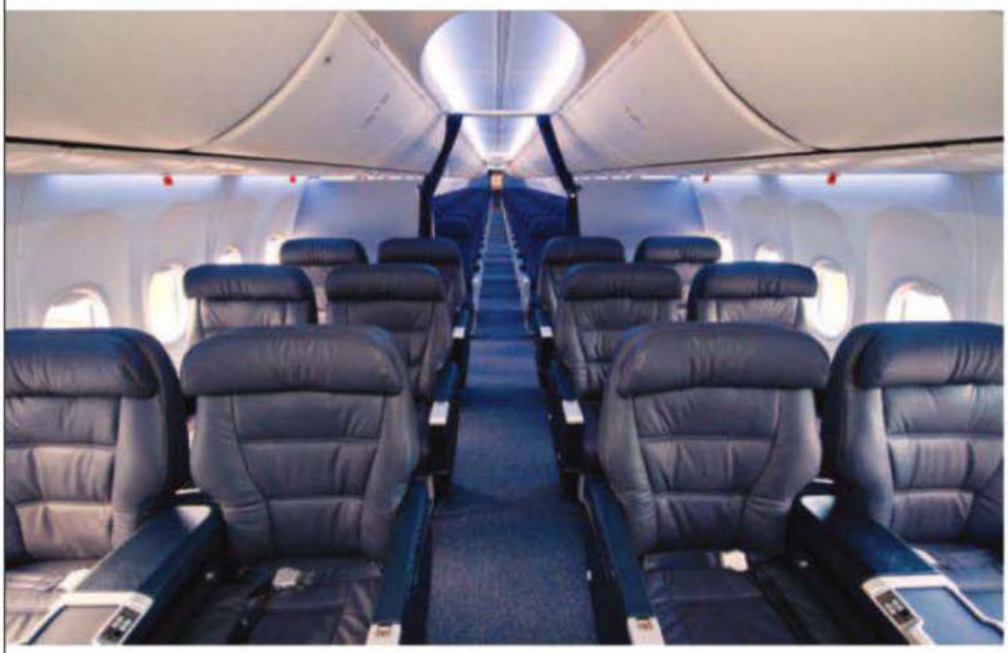
As healthy as airlines are—the International Air Transport Association estimates $16 billion in 2010 net profits globally—they face constant shocks over which they have little control. Oil prices and political, economic and natural calamities top the list, with Japan's earthquake and tsunami providing a poignant example of the latter.

Five years ago, China did not even have a market for leased cars; today it is pouring funds into aviation, says Steven Townsend, deputy managing director and chief commercial officer for Bank of China-owned BOC Aviation, now Asia's biggest lender and a fast-rising powerhouse globally.

Two key parameters for the mix of legacy and upstart carriers that operate single-aisle jets are purchases to accommodate growth and replace old aircraft. About half of each will need financing, says Steven Udvar-Hazy, the executive who helped start aircraft operating leases.

"In just the next five years, 5,000 aircraft are to be built, 40% of them on operating leases," he says. In that mix, just seven or eight leasing companies will do the "heavy lifting," he says.

GE Capital Aviation Services President/CEO Norman Liu agrees that the market is tightening. "It's becoming a game of scale, over time," he says.



BOEING

"Micro steps" Boeing has taken to refresh the 737NG family, such as the new SkyInterior with redesigned luggage bins, will help it bridge the time needed to develop a successor airplane.

"It's going to be a tremendous opportunity and great challenge in terms of financing and operations in [the leasing] market," Udvar-Hazy, chairman/CEO of Air Lease Corp., said here last week at the annual International Society of Transport Aircraft Traders (Istat).

It's not just the old rules of financing that are changing; so are the rules of who might be manufacturing this century's single-aisles. Canada's Bombardier is challenging the Airbus-Boeing duopoly for 110-130 seats; China's Comac is learning the game with the 150-seat C919; and Irkut wants to revive Russia's airplane heritage with even larger single-aisles.

But for now, the focus is on how the duopoly will respond. Airbus has written the first part of the competitive equation by insisting that airframe technologies will not be mature enough to support an all-new single-aisle family until at least the mid-2020s. Instead, it is pursuing an incremental approach of product improvement, seizing on powerplant advances from Pratt & Whitney and CFM International to offer a New Engine Option for its A320 family for a service entry in 2016. Sales of at least 4,000 NEOs are projected, Marketing Vice President Andy Shankland told Istat. If that happens, Airbus's greatest success story will reach about 12,000 orders.

Boeing has yet to move. It is worried, says Boeing Commercial Airplanes President/CEO James Albaugh, about a poor business case for a Boeing 737 re-engining effort. Although "officially" still studying the re-engining versus new airplane issue, Albaugh's skepticism prompted twice as many of the Istat crowd responding to an instant electronic poll to conclude that Boeing will build a new airplane as to conclude it will re-engine.

"Those of us who know Boeing, their DNA, see them as more likely to go for a new airplane" says Udvar-Hazy, who was Boeing and Airbus's largest customer when he was CEO at International Lease Finance Corp.

More generally, Albaugh says Boeing is searching for a formula that brings a worthy successor to the industry's longest-serving and best-selling aircraft line

while not getting carried away with its design. "Southwest Airlines has taught us over the years: do not add to the complexity of what [we] do," he says.

Albaugh readily acknowledges that the Boeing 787 program, which is now three years late and swimming in billions of dollars in R&D over-spend, was bathed with complexity. Boeing has already said it will co-produce the 737NG and its successor to assuage memories of the pain it caused airlines when it abruptly cut off 737 Classics with the shift to the NG. But his comment that NGs could be produced for another 20 years was startling.

Liu says he can appreciate what Boeing is struggling with. "It has to build for the low-cost carriers, the network guys and those in emerging markets that just want everything bigger," he says.

If it proceeds with a successor while Airbus follows the more conservative re-engining route, Boeing will be displaying a high degree of confidence that it can master a lot of new technologies in airframe design, materials and manufacturing for single-aisles that have been troublesome in the 787, its premier widebody effort. But Boeing's strategy will carry some advantages. It can allow Airbus's NEO and other single-aisle competitors introducing Pratt & Whitney's PW1000G turbofan or CFM International's Leap-X technology to work through some of their inevitable challenges. It also will have time to respond to Rolls-Royce's desire that its RBR282 design be in the running.

Although long-range twin-aisles typically require more technology for flight and passenger services than single-aisles, Albaugh says the option possibilities for a 737 successor are a worry. For instance, besides airframe changes, will airlines accept the complexity of fly-by-light flight controls to save weight? "We could get to an eye-watering number," he says. "We have to limit technologies. I don't want this airplane to be the son of 787."

Boeing has shown a willingness to take on airframe risk that Airbus shies away from. The 787's single-piece composite fuselage assemblies are more technically risky than the composite panels Airbus selected for the A350. But, aside from manufacturing boldness, there are other issues at play in the apparent divergence in the pace at which two airframe makers are progressing. "It's not a question of who's right or wrong; it's a question of resources," says Liu.

The Capacity Trap

As airlines worldwide tally up aircraft orders, they risk repeating past mistakes

JENS FLOTTAU/FRANKFURT and ROBERT WALL/LONDON

AIRBUS CONCEPT

ILFC has ordered 100 Airbus A320NEOs, returning to the aircraft market after an absence of more than three years.

While carriers around the world are still enjoying strong growth rates and higher fares backed by global GDP growth, several factors may lead the industry into an overcapacity situation as soon as next year.

These factors include uncertainty over the price of fuel, GDP development in key markets, markedly increasing delivery stream for new aircraft backed by a stronger than expected early order cycle and, not the least, the ambitious expansion in various pivotal markets planned for this summer.

The International Air Transport Association (IATA) says in its most recent *Airlines Financial Monitor* that "capacity on both passenger and freight markets is now ahead of traffic volumes." Therefore, excess capacity is "starting to present a potential threat to profitability." The airline group believes that one key to the short-medium trend will be where fuel prices go and whether they will "slow economic growth and therefore transport demand."

For the short term, analysts are still bullish. "I don't think capacity will be a major issue at least in the first three quarters of 2011," says Bankhaus Metzler air transport analyst Juergen Pieper.

"But the big question is whether airlines will be able to rely on similarly benign macroeconomic conditions next year." The 5-6% industry growth emerging as a likely scenario for 2012, "has to be seen much more critically," Pieper believes.

Uwe Weinreich, a Unicredit airline analyst, believes that carriers will have to revise their aggressive capacity expansion in two of the most important long-haul markets, transatlantic and Europe-Asia routes, as soon as August.

Some revisions are happening now, although they were caused by high fuel prices rather than lower demand. Delta Air Lines, American Airlines and United Continental have all said they will grow capacity more slowly than

Udvar-Hazy points to the money tree. "The A400 and A350 XWB, both running ahead of budgets, will tap [Airbus parent] EADS for the next 4-5 years, so Airbus won't have the money to launch a new airplane," he says. "Airbus did the most intelligent thing it could: Take advantage of the engine technology, where the R&D is being expended by Pratt and CFM.

"Boeing is totally different," he says. Compared to the A320, Boeing's best-selling 737-800 has more seats and slightly lower unit costs. With that advantage, it has bought time with "micro steps" for the NG family—a new cabin interior and a bump-up in the efficiency of the CFM56-7B engine. By the end of the decade, says Udvar-Hazy, "the 787 will be flying and they can move on to a new airplane."

Liu, who heads the industry's largest leasing group, agrees. "Boeing learned a hell of a lot over the last three years" with the 787. He is betting it can hit the end-of-decade service entry mark.

The plurality of Istat members who think Boeing will develop a new airplane were responding to a question about an aircraft family seating 150-250 passengers, not the current levels of 100-200.

The top end of that seating raises questions about efficient passenger loading. Udvar-Hazy suggests that Boeing build the industry's first twin-aisle specifically designed for regional operations.

New airplanes aimed at serving higher passenger counts are a trend Airbus and Boeing agree on. Traffic growth and higher yield prices have made 125-seat airplanes appear too small to many carriers for economically efficient operations, explains appraiser Fred Klein, president of Aviation Specialists Group.

But while the majority of airlines move away from smaller single-aisles, there is room at the bottom for an airframe specifically sized to seat 110-130 passengers, says Bombardier President Gary Scott.

Scott has no ambitions for his CSeries to breach the 150-seat mark, as the Chinese and Russians do. But give him 130 seats, and Bombardier will be happy. "There's just a lousy $600 billion [market] below 150 seats," he quips, citing Boeing's own 20-year traffic forecast.

But Bombardier has not received a new CSeries order in a year and holds just 90 that are firm. Townsend says it's a matter of the Canadians finding "the right price point."

originally anticipated. United may retire older, less fuel-efficient aircraft. The flip side of that decision is that carriers apparently no longer believe they can raise fares to the levels they would need and still fill seats. That trend remains limited to the U.S. at this stage. If skeptics are right, it could become an industry-wide issue next year.

While high fuel prices and economic uncertainty have troubled the industry for some time, an increasing delivery stream and major new aircraft orders could make the problem worse in the medium term, as airlines could be repeating past mistakes of over-ordering in the upturn and ending up with too much new—expensive—capacity when markets turn bad.

IATA estimates that airlines will take an average of 120 additional aircraft each month this year, up from around 100 in 2010. That figure includes large regional jets, too. While IATA believes older aircraft coming out of storage will mostly be scrapped because they tend to be less fuel-efficient, it points out that "new deliveries represent a potential overhang in capacity that could add to the current squeeze on profit margins."

According to data from the Center for Asia Pacific Aviation, of the 10 airlines that will receive the most aircraft this year, six are in the region with the weakest travel outlook, Europe: Ryanair, Turkish Airlines, Alitalia, EasyJet, Air France and Lufthansa. Only three are Asian (Air China, China Southern Airlines and All Nippon Airways) and one Latin America (LAN Airlines). But the six European carriers and their regional partners combined will take more than 200 aircraft this year. By comparison, Emirates will receive 12 more in 2011.

Airlines are still adding to their backlogs, too, particularly in Europe and Asia, in spite of the fact that the backlog is equivalent to almost 40% of the in-service fleet, near the historic peak.

Lufthansa last week became the latest major carrier to add to its aircraft purchases, ordering 25 Airbus A320NEOs (New Engine Option), five A321NEOs and five Boeing 777Fs. For Airbus, the order is a welcome sign of support. Lufthansa is the first European airline to go for the NEO. Its first NEO will be delivered in 2016, though the carrier has not yet decided with which of its units the aircraft will be placed. The order adds to an earlier International Lease Finance Corp. (ILFC) commitment for 100 A320NEOs (plus 33 Boeing 737-800s). TAM Brazil became the Latin American launch customer for the NEO last month, ordering 22 A320NEOs.

In addition to fuel prices, the current wave of orders is driven by concern that production slots may not be available

But there is also renewed activity in the widebody market. Already this month, Boeing recorded widebody orders and memoranda of understanding from Cathay Pacific, Air China (for the Boeing 747-8), Hong Kong Airlines (Boeing 787s, 777s), Lufthansa and Aeroflot. Turkish Airlines, Cathay Pacific and Iberia added Airbus long-haul jets to their portfolios.

Some of the fleet decisions are being driven by the run-up in fuel prices. Iberia, for instance, agreed to buy eight A330-300s (with options for eight more) to replace A340s, noting that the new aircraft will be 15% more fuel efficient.

But Iberia is also cognizant of the potential overcapacity problem, industry officials indicate, which is one reason the airline is retaining flexibility as to how many A330s it is acquiring now and what portion of its A340 fleet it will phase out.

An Airbus official says that in addition to fuel prices, the current wave of orders is driven by concern that production slots may not be available if airlines wait too long to place orders. Even though Airbus and Boeing have ramped up narrowbody and widebody output, near-term delivery positions are scarce.

During the last run-up in fuel prices, airlines struggled to find delivery positions for new aircraft, which is spurring activity this early in the recovery cycle, another industry official points out. Simply coming out of several years of crisis also is contributing. For instance, ILFC has few delivery slots left with Airbus and Boeing and is looking to rebuild its order book now that its immediate survival is no longer in doubt.

ATC Upgrade

FAA approaches milestones in ERAM and Stars programs

ADRIAN SCHOFIELD/AMSTERDAM

The FAA is about to take major steps in two long-running projects that will update its core air traffic control systems and form an essential base for the NextGen modernization program.

The agency is set to begin replacing the main operating system at the largest terminal control facilities under a new agreement with Raytheon, with work under way at the first of these sites. Meanwhile, the FAA is preparing to give the final go-ahead for nationwide deployment of the new en route system that has been developed by Lockheed Martin.

While the En Route Automation Modernization (ERAM) program has endured timetable slips, the system has been operating continuously at the Salt Lake City center for a couple of months, FAA Chief Operating Officer Henry Krakowski tells Aviation Week at the ATC Global Conference. It has also been in full-time operation at Seattle, which is the second initial site. ERAM is the base system that will be used to control traffic at all of FAA's en route centers.

The FAA hopes to declare the system "in service" by the end of March if the first two sites continue to run smoothly, Krakowski says. This will open the way for it to be introduced to at other centers, probably starting with Minneapolis.

Krakowski acknowledges the ERAM program is 6-12 months behind schedule. However, he says this had "minimal or no effect" on the NextGen timetable.

Under the Raytheon deal, the company will install its Standard Terminal Automation Replacement System (Stars) at 11 major terminal radar approach control (Tracon) facilities by 2015. An initial goal calls for five systems to be operational by the end of 2013, says Raytheon Director for Domestic Automation Michael Espinola.

Dallas/Fort Worth will be the first of the 11 to receive Stars, and the New York, Chicago, Atlanta and Northern and Southern California facilities are among this group.

This is the latest chapter in the turbulent history of the FAA's effort to replace the automation systems at its Tracons. The original plan in 1996 was to deploy Stars at all Tracons, with the largest facilities at the end of the list. But the FAA subsequently decided to limit the deployment, and to date Stars has only been installed at about 50 mainly small and medium-sized FAA facilities.

The FAA wanted to reassess its options for the remaining sites—including potentially going with a different system. After looking at other alternatives, late last year the agency decided to return to the original plan and introduce Stars at the 11 large Tracons. This resulted in a $177 million contract extension beingsigned with Raytheon in December.

Raytheon executives say the FAA was encouraged by last year's successful implementation of automatic dependent surveillance-broadcast (ADS-B) at the Philadelphia Tracon, which uses a Stars system. The agency wants to have Stars in place at the larger facilities before they receive ADS-B.

Site surveys have begun at Dallas/Fort Worth, says Espinola. The system is scheduled to be declared operational there by October 2012. The second site is expected to follow in February 2013, and the next three at one-month intervals.

After this deployment, there will be about 100 smaller Tracons that do not have Stars. The FAA is still determining how it will proceed with these locations.

FAA controllers operate the Standard Terminal Automation Replacement System (Stars) at Boston's approach control.

RAYTHEON

Delay Dilemma

Europe scrambles to address summer air traffic congestion fears

ADRIAN SCHOFIELD/AMSTERDAM

European airlines and air traffic control agencies are bracing for what could be a grim summer of flight delays, just one more headache for an industry still recovering from an unprecedented series of ATC crises in 2010.

As growth increases in many European markets, indicators point to a very challenging peak travel season—even without the forces of nature and labor strife that caused massive ATC disruption last year. Air navigation service providers (ANSPs) are working on operational improvements to try to prevent bottlenecks, but there is general agreement that larger political changes are needed in the long term.

"If we take the [factors] we know about, it looks like a bad summer for delay in Europe," says Eurocontrol Director General David McMillan at the ATC Global Conference this month. Rather than "sitting and waiting for this," airlines and ANSPs have been discussing what actions can be taken. "Operationally, there is a lot we can do to make [the system] run more smoothly," says McMillan.

One such move would be to enable resources to be shifted to ANSPs that are stretched by peak traffic surges. If opening up another airspace sector would help, controllers could be loaned from one ANSP to another. Also, system upgrade timetables will be examined and coordinated to make sure they do not cause problems, and more alternative flows and contingency plans will be prepared in case of external disruptions.

While ANSPs are reacting well with tactical changes like these, this does not reduce the need for longer-term reforms, says Jeff Poole, the International Air Transport Association's director of industry charges, fuel and taxation. IATA has long called for more urgency in the Single European Sky (SES) process, and has stressed the need for a network approach and centralized oversight.

However, these concerns require political change that is beyond the authority of the ANSPs. A list of the political actions needed was drafted at a recent high-level conference on SES organized by the European Commission, which has committed to addressing them.

There has already been movement on one of these issues. European member states have finally voted to approve Eurocontrol as the network manager in the SES process. A formal notification of this is expected soon.

The network manager role does not mean Eurocontrol will dictate orders to ANSPs, McMillan stresses. Rather, it will assess actions needed to improve the overall European network, and recommend changes to states and ANSPs. Eurocontrol is already doing this in many respects, but it will now have "a little more authority" to advocate for a network approach, says McMillan.

Poole says last year's ATC disruptions present a "compelling case for moving forward" with political and operational changes. These disruptions included the volcanic eruption in Iceland that prompted recurring airspace closures, industrial action by employees of some ANSPs, and unusually heavy snowstorms that caused operational havoc.

There were 175,000 flight cancelations in the European system in 2010, up from just 32,000 in 2009. Of the total in 2010, 100,000 cancelations were caused by volcanic ash crisis alone.

Last year was an "annus horribilis" for ATC in Europe, says Graham Lake, director general of the Civil Air Navigation Services Organization (Canso). It was a "year we cannot afford to repeat," he warns.

Aviation stakeholders are worried that this summer could see increased flight delays at European airports.

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54th Annual

Laureate Awards

The 2011 Laureate winners at the awards gala in Washington are joined by Aviation Week President Greg Hamilton (first row, third from right) and *Aviation Week & Space Technology* Editor-in-Chief Anthony L. Velocci, Jr. (first row, far right).

Four hundred luminaries from all corners of the global aerospace and defense industry converged on Washington for Aviation Week's 54th annual Laureate Awards. The standing-room-only dinner, held March 8 at the ornate Andrew W. Mellon Auditorium, continued a long-standing tradition of honoring the industry's technology pioneers, top managers and leaders of tomorrow.

More than 40 individuals comprising the finalists for the awards were recognized by editors from *Aviation Week & Space Technology* (*AW&ST*) and its sister publications, *Defense Technology International*, *Business & Commercial Aviation* and *Overhaul & Maintenance*. Winners were then announced for eight categories: Defense/Government, Space, MRO, Commercial Air Transport, Workforce, Aeronautics/Propulsion, Business/General Aviation and IT/Electronics. Also presented were two honors whose recipients had been previously announced: the Aviation Week Heroism Award and the Philip J. Klass Lifetime Achievement Award, named in honor of *AW&ST*'s legendary Cold War-era avionics editor.

Following tradition, the event kicked off with special awards presented to four of Tomorrow's Leaders—one student each from the U.S. Naval Academy, Coast Guard Academy, Air Force Academy and Military Academy. Next, the Klass award was bestowed upon two of the industry's game changers: unmanned air vehicle (UAV) pioneers Tom Cassidy, the retired president of the aircraft systems group at General Atomics Aeronautical Systems; and serial entrepreneur Abraham Karem. Executive Editor James R. Asker credited Cassidy for his pivotal role in helping making UAVs mainstream, while noting that Karem founded the first of several UAV companies literally in his garage 28 years ago.

The event was capped by *AW&ST* Editor-in-Chief Anthony L. Velocci, Jr., honoring Capt. Daniel Aufdenblatten and mountain guide Richard Lehner for performing a record-breaking high-altitude long-line aerial rescue of three Spanish climbers on Nepal's Mount Annapurna. Velocci's presentation was accompanied by a video of the dramatic rescue.

Nominations for the awards are solicited each year from inside the industry and from editors across Aviation Week's family of print and online publications and were announced in January (*AW&ST*, Jan. 10, p. 48). Winners were selected by an editorial team led by Velocci and Asker. This year's awards ceremony was co-sponsored by BAE Systems, Boeing, Lockheed Martin, Northrop Grumman, Dassault Systemes and ITT Corp.

ALL LAUREATES PHOTOS BY CHRIS ZIMMER

Thomas J. Cassidy, Jr., and Abraham Karem, UAV Pioneers

PHILIP J. KLASS LIFETIME ACHIEVEMENT AWARD

Unmanned aircraft played a prominent role in many of the nominations for Laureates throughout the evening, so it was fitting that both recipients of the Philip J. Klass Lifetime Achievement Award were pioneers of the unmanned air vehicle (UAV) industry. Thomas J. Cassidy, Jr., and Abraham Karem were each credited for work that helped move UAVs from occasional roles on the sidelines to becoming essential assets in a variety of military operations. In presenting the awards, Aviation Week Executive Editor James R. Asker said the two men were "pivotal in bringing about the UAV revolution."

Karem, an Israeli engineer who immigrated to the U.S., founded his first company, Leading Systems, in 1983, literally in his garage in California. In that era, UAVs crashed frequently and had little endurance once aloft. To Karem, those problems were opportunities. And because of that—and the fact that he might be able to build entire aircraft in his garage, he wryly admits—Karem says he decided to work on UAVs.

Abraham Karem (right) and Thomas J. Cassidy, Jr., (center) received the Philip J. Klass Lifetime Achievement Award from Aviation Week Executive Editor James R. Asker.

The company developed the Amber family of UAVs, one of which set a 38-hr. endurance record in 1988. The little company went bankrupt and was acquired in 1990 by General Atomics Aeronautical Systems. With CIA funding, Leading Systems had developed an operational UAV called the Gnat 750, which General Atomics evolved into the Predator.

Karem started another company, Frontier Systems, which teamed with Loral Space and Communications on the Tier II Plus UAV. Next, Karem's company undertook a project to develop a helicopter UAV for the U.S. Defense Advanced Research Projects Agency (Darpa). That led to the A160 Hummingbird, with a unique Optimal-Speed Rotor. In 2004, Frontier Systems was acquired by Boeing, which continues to work on the Hummingbird.

Karem is at work at yet another startup. His Karem Aircraft is working on applications of the Optimal-Speed Rotor for tiltrotor aircraft.

If Karem would fit the bill at a Hollywood casting call for an engineer's engineer, Cassidy is a archetype of an entirely different sort—the ever-confident fighter pilot who rises to a commanding presence as an admiral of the U.S. Navy. Indeed, in addition to his estimable achievements in the military and the aerospace industry, Cassidy has the rare claim to fame of having played himself in a blockbuster movie, *Top Gun*.

But it was after serving in the Navy that Cassidy had his biggest impact. Cassidy became president of the aircraft systems group at General Atomics Aeronautical Systems in San Diego. While he held that role, he became only the second person to be featured on the cover of *Aviation Week & Space Technology* (*AW&ST* May 30, 2005). He recently retired from the post but remains active.

Along with General Atomics CEO Neal Blue, in the 1990s, Cassidy believed unmanned aircraft systems could become a game-changing military technology. Convinced that the Predator had great potential but unable to persuade military services to fund it in a full-blown program, General Atomics kept the program alive with its own money.

Cassidy's faith in the Predator proved prescient. Everything changed after the terrorist attacks of Sept. 11, 2001. Only a few years later, the U.S. Air Force chief of staff told a congressional hearing he was pushing General Atomics for "every Predator they can possibly build."

Armed with Hellfire missiles, the remotely piloted vehicle demonstrated a stunning ability to hunt down and take out Al Qaeda and Taliban leaders in Afghanistan and elsewhere. The Predator was evolved into a family of UAVs including the Reaper and Sky Warrior.

"More than any other company, General Atomics made UAVs mainstream," Asker said at the award dinner. "Tom deserves a huge amount of the credit for making UAVs affordable, adaptable and reliable."

As one measure of just how far unmanned aircraft systems have come—a datum that might even surprise an old fighter jock like Cassidy himself—the Air Force now trains more pilots of UAVs than of manned aircraft.

Capt. Daniel Aufdenblatten and Mountain Guide Richard Lehner

HEROISM AWARD

Since 1970, more than 40 climbers have perished trying to scale 26,000-ft. Mount Annapurna, an enormous Himalayan massif in central Nepal and the 10th highest mountain in the world. Last spring, three Spaniards narrowly escaped joining those grim statistics, thanks to the heroics of a mountain guide with nerves of steel and a pilot who was determined to push high-altitude flight to its limit.

The experienced climbers were within just 4,000 ft. of the summit when terrible weather conditions halted their progress. There they remained for 36 hr., exposed to brutal cold and gale-force winds. Unless they were found and rescued fast, they faced certain death.

Their sole lifeline turned out to be a mobile telephone that still was operable despite the harsh environment. They placed a call to Fishtail Air, a charter helicopter company based at nearby Kathmandu. Within minutes, an early-morning rescue flight was airborne. It was a cooperative effort involving Fishtail and Switzerland's Air Zermatt, which has many years of experience rescuing climbers in the Alps.

At the controls of a Eurocopter AS350 rotorcraft was Capt. Daniel Aufdenblatten, an Air Zermatt pilot. Also on board were Swiss Mountain Guide Richard Lehner and a physician.

The helicopter had been transported to Nepal just two months earlier. In order to reach the stranded climbers, the aircraft was stripped of all but the most essential hardware. Even its doors and all the seats behind the pilot were removed to reduce weight to a minimum.

AIR ZERMATT

Mountain Guide Richard Lehner dangles from beneath a Eurocopter AS350 (above) flown by Air Zermatt pilot Capt. Daniel Aufdenblatten. Lehner (right) and Aufdenblatten (left) received the Heroism Award from *AW&ST* Editor-in-Chief Anthony L. Velocci, Jr.

At around 7 a.m., under an azure blue sky and brilliant sunshine, Aufdenblatten and Lehner located the men and proceeded to attempt a rescue using the "long-line" method. The technique, which allows injured climbers to be plucked from even the most treacherous slopes and ledges, involves a rescuer being harnessed to a cable and flown—dangling meters below the helicopter—to the scene of an accident. There, victims can be harnessed to the cable, hoisted and evacuated without the helicopter having to hover for too long a period at altitude, where the thin air makes flying difficult and dangerous.

For this rescue, Lehner was suspended at the end of the cable. When he reached the climbers, they were snow blind, suffering from extreme exposure and unable to walk. Aufdenblatten and Lehner airlifted them one by one to the safety of a base camp situated at an altitude of just under 13,000 ft. A fourth man in the climbing party, stranded higher up, could not be located and perished.

Aufdenblatten's and Lehner's feat turned out to be the world's highest-altitude long-line rescue, for which they received the 2011 Aviation Week Heroism Award.

X-51A Waverider Hypersonic Vehicle Team
AFRL/Pratt & Whitney Rocketdyne/Boeing Phantom Works

AERONAUTICS and PROPULSION

A 143-sec. flight over the Pacific in May 2010 will be remembered as the moment the supersonic-combustion ramjet proved itself capable of powering a practical aerospace vehicle, crowning decades of research and winning the X-51A Waverider hypersonic vehicle team the Aviation Week 2011 Laureate for Achievement in Aeronautics and Propulsion.

The X-51A program is funded by the U.S. Air Force and the Defense Advanced Research Projects Agency and managed by the Air Force Research Laboratory's Propulsion Directorate with NASA participation. The program's goal is to demonstrate that a hydrocarbon-fueled scramjet engine is ready for transition to practical applications.

The path that led to the 2010 flight began with the 1993 cancellation of the X-30 National AeroSpace Plane. After more than a decade of laboratory research and wind-tunnel tests of increasingly capable scramjet engines, the X-51A flight marked the first time researchers had successfully flown a highly integrated, thermally balanced and fully controlled air-breathing hypersonic vehicle.

X-51A program managers Charles Brink (left), Air Force Research Laboratory Propulsion Directorate; Joseph Vogel (second from left), Boeing Phantom Works; and George Thum (right), Pratt & Whitney Rocketdyne, with Aviation Week Senior Editor-Technology Graham Warwick.

On May 26, 2010, the Boeing-designed X-51A was released over the Pacific Test Range from under the wing of a U.S Air Force B-52H at Mach 0.8 and an altitude of 49,500 ft. Some 4 sec. after drop, a modified Atacms solid rocket motor ignited, powering the stack to 60,000 ft. where the booster was jettisoned and the Pratt & Whitney Rocketdyne SJY61-2 scramjet engine was ignited.

For 143 sec. the X-51A slowly accelerated and maintained stable, controlled flight while onboard sensors telemetered data to U.S. Navy test range aircraft, and to ground stations at NAS Point Mugu, Edwards AFB and Vandenberg AFB all in California. A leaking engine nozzle seal slowed acceleration and curtailed the flight, the X-51A reaching Mach 4.88 instead on the planned 5.9, but the 143 sec. of scramjet-powered flight was 11 times longer than any previous air-breathing hypersonic flight.

This flight was significant since it was the first time a scramjet engine had proved it could accelerate a practically designed aerospace vehicle in a controlled flight for a substantial amount of time. To accomplish this milestone, Boeing and Pratt & Whitney Rocketdyne designed a highly integrated aircraft, with a hypersonic wave-rider configuration, practical high-temperature structure, electronic flight control system, and fully integrated closed-looped engine control to optimize scramjet performance while keeping the engine thermally balanced.

Receipt of the Laureate comes as the X-51A team prepares for its second flight, planned for late March, which aims to repeat the profile of the first flight but achieve the full 240-sec. duration under scramjet power and accelerate to a top speed close to Mach 6.

Receiving the 2011 Laureate for Achievement in Aeronautics and Propulsion are: Charles Brink, X-51A program manager, Air Force Research Lab, Propulsion Directorate; George Thum, X-51A program manager for Pratt & Whitney Rocketdyne; and Joseph Vogel, X-51A program manager for Boeing Phantom Works.

The other finalists for the 2011 Laureate were the Qinetiq Zephyr solar-powered unmanned aircraft, Sikorsky X2 Technology high-speed helicopter demonstrator and Solar Impulse prototype solar-powered around-the-world aircraft.

With a 22.5-meter wingspan, but weighing just 50 kg, Zephyr established a new endurance record, completing a 336-hr. 21-min, flight over Yuma Proving Ground, Ariz., in July 2010, reaching an altitude of 70,000 ft. and demonstrating truly persistent surveillance.

Solar Impulse prototype HB-SIA completed a through-the-night flight on July 8, 2010, marking a major milestone for the Swiss team's bid to fly around the world on solar power to demonstrate the potential of sustainable energy for aviation.

On September 15, 2010, the X2 technology demonstrator reached 250 kt., setting an unofficial speed record for helicopters. With its rigid coaxial rotors and pusher prop, it flew twice as fast as a conventional helicopter while retaining the same low-speed capability.

Auto-GCAS Team
Lockheed Martin/AFRL

INFORMATION TECHNOLOGY and ELECTRONICS

The team that developed the Automatic Ground Collision Avoidance System (Auto-GCAS) for the U.S. Air Force won the Aviation Week Laureate Award for Information Technology and Electronics.

Auto-GCAS is considered by its developers to mark the single greatest improvement to military aviation safety in the last 45 years, as well as the most important new flight control technology since fly-by-wire. The system predicts an impending ground collision and performs an automatic avoidance maneuver to protect pilots even if they have lost situational awareness or become disoriented, or are experiencing G-induced loss of consciousness (G-LOC). Over the next 25 years, Auto-GCAS could save 170-plus pilots, over 200 aircraft and more than $10 billion for the U.S. armed forces, Pentagon estimates suggest.

IT/Electronics Laureate winner Edward Griffin (center) holds the award that also was presented to Donald Swihart (right). Looking on is Bill Sweetman, editor-in-chief of Aviation Week's *Defense Technology International*.

The milestone for which the award was presented was the completion of initial flight testing on Lockheed Martin F-16 Block 40/50/52 variants, clearing the way for final tests and integration of Auto-GCAS across the entire fleet. It is due to be operational from 2014.

Auto-GCAS is also set for adoption on the Lockheed Martin F-22 and the F-35 Joint Strike Fighter and is compatible with the Navy's Boeing F/A-18E/F Super Hornet. Follow-up efforts include potential Auto-GCAS applications on non-digital military aircraft and unmanned aircraft systems, as well as development of an automatic air collision avoidance system.

Auto-GCAS differs fundamentally from earlier "predictive" GCAS (PGCAS), which issues a warning signal if the aircraft violates pre-set limits for rate of approach to the ground. Auto-GCAS developers note that the limitation with these systems is that they have to warn pilots in time for them to react. That inevitably leads to nuisance warnings if the pilot is aware of the aircraft's flight path, and causes pilots to sometimes disregard GCAS messages.

Predictive GCAS is also not effective if the pilot is disoriented or incapacitated by G-LOC, and is limited in its ability to protect against hazardous maneuvers initiated at high altitude. The result was that, although PGCAS was introduced on the F-16 force starting in 2000, there were still 16 controlled-flight-into-terrain losses in 2000-09, 15 of them involving aircraft with PGCAS installed.

Auto-GCAS is designed to perform an energetic recovery maneuver in a short interval, after the point where an alert pilot would normally maneuver, and before the aircraft's position is non-recoverable. Consequently, flight testing was challenging because unnecessary maneuvers could be dangerous in themselves. Flight tests ranged from vertical supersonic dives in afterburner, to lower-speed approaches to extreme mountainous terrain, with low-level flying down to 100 ft.

Demonstrating the integrity of the program also involved validating the Pentagon's Digital Terrain Elevation Data on which the system is based. In some cases, existing DTED information proved insufficiently accurate for testing, and was augmented with detailed data gathered by a space shuttle mission carried out in 2000.

The award was presented to Lockheed Martin program manager Edward Griffin, and Donald Swihart of the U.S. Air Force Research Laboratory. Other key players include the Pentagon's Defense Safety Oversight Council, represented by safety analyst Mark "Tex" Wilkins and NASA Dryden Flight Research Center engineer Mark Skoog.

Runners-up for the award were Paul Robinson, founder of AeroTech Research, for the company's new TAPS real-time turbulence reporting system, John Albrecht of the Defense Advanced Research Projects Agency's Microsystems Technology Office and William Deal of Northrop Grumman, leaders of a joint team in the development of terahertz electronics.

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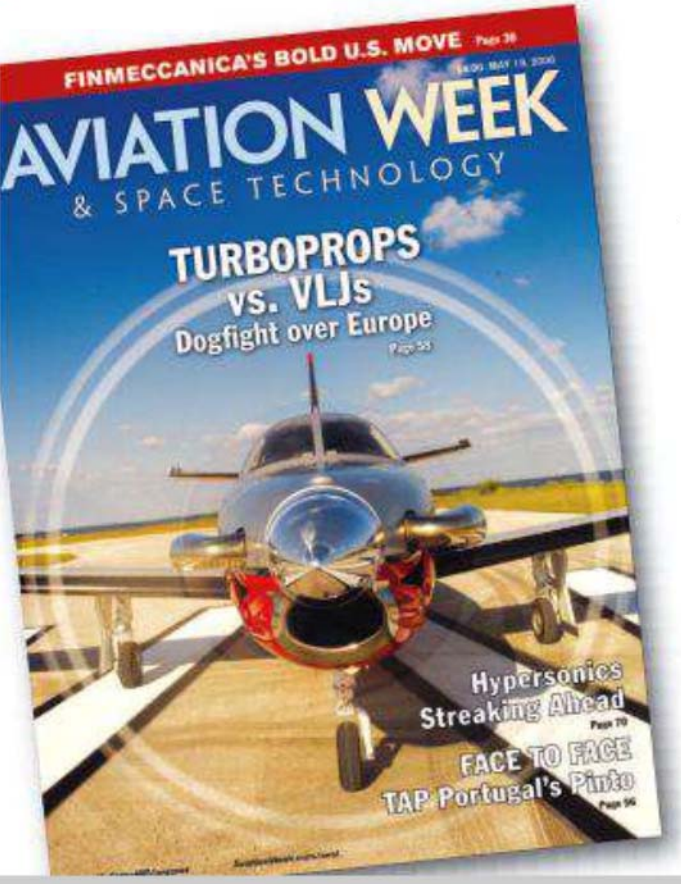

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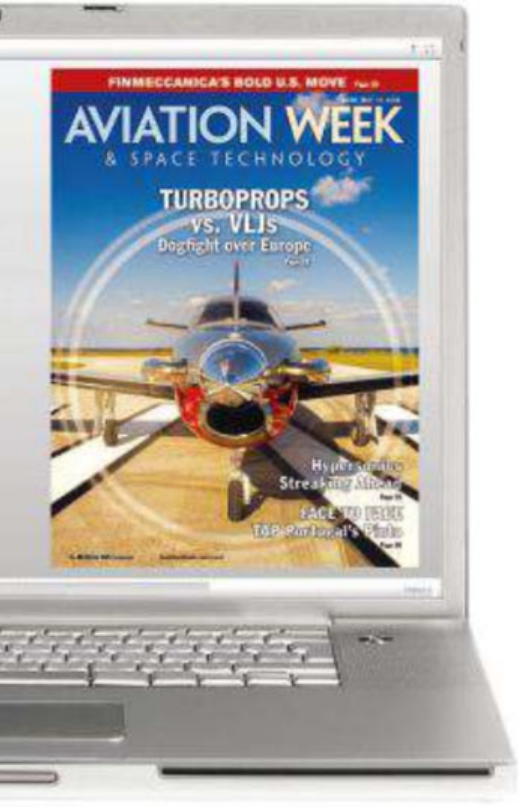

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AVIATION WEEK
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Jim French, Flybe CEO

COMMERCIAL AIR TRANSPORT

In the face of stiff competition from large network carriers and high-growth, low-cost airlines, Flybe, the U.K.-based regional airline has managed to carve out a strong business niche for itself. Jim French, the airline's chief executive, and this year's Aviation Week Commercial Air Transport Laureate winner, has also put the airline on a strong growth footing.

Flybe has not just managed to be profitable. It also has steadily grown market share to become the largest regional carrier in Europe and the largest domestic airline in the U.K.

French has been instrumental in Flybe's commercial success and, undeterred by the flight disruptions from volcanic ash last year and despite adverse economic conditions, managed to pull off a successful initial public offering raising more than £60 million ($96.4 million) to finance the further evolution of the airline. The shares surged more than 15% as they commenced trading.

FLYBE

Aviation Week International Editor Robert Wall holds the Commercial Air Transport Laureate award that was presented in absentia to Flybe CEO Jim French, for building his company into a major low-cost carrier in Europe.

The IPO is needed to finance French's ambitious growth plans, including expansion through acquisitions to establish bases in continental Europe. The money raised will also be used to pay for a major aircraft order Flybe placed last year with Embraer for up to 140 E-Jets, comprising 35 firm orders, with options and purchase rights for a further 105.

French has overseen a major transformation to standardize on a two-type fleet—E-Jets and Bombardier Q400 turboprops—as it phased out legacy aircraft inherited through its acquisition of the British Airways Connect operation.

Flybe's CEO also put in place broad code-sharing agreements with Air France, covering 85 routes at the outset, and with Finnair, to expand Flybe's strategic reach.

Runner-ups in the Commercial Air Transport category were:

Tim Clark, president of Emirates Airlines. Clark has been overseeing the rapid growth of the Middle Eastern carrier, taking advantage of its strategic position and young fleet to become one of the biggest headaches for European and North American network carriers. In 2010, Emirates placed the largest Airbus A380 order to date, for 32 aircraft, bringing its order book for the mega-transport to a staggering 90 units. Clark also has turned Emirates into one of the most important reference customers for Airbus and Boeing as they consider the evolution of their widebody designs.

Robert A. Morin, vice president of the transportation division for the U.S. Export-Import Bank. He and his firm stepped up to plug major financing holes that emerged as banks retrenched during the financial crisis that began in late 2007. Without the increased effort by Exim, as well as the European export credit agencies, Boeing and Airbus would have seen deliveries drop much further than they did. In effect, the actions of these financial institutions saved thousands of jobs.

Klaus Heinemann, CEO of AerCap, managed to navigate his leasing business through the difficult economic conditions of the last few years. In the process, he kept sight of the long-term vision to strengthen the independent aircraft leasing company and managed to orchestrate an all-share transaction to merge with Genesis Leasing in an $1.8 billion transaction. The deal has turned AerCap into a company with more than 350 aircraft in its asset base. Its fleet and aircraft on order have a book value of $10 billion. Heinemann will retire in May.

Michael Kostelnik, forceful leader of homeland UAS

DEFENSE and GOVERNMENT

Hours after the then-only U.S. Customs and Border Protection Predator B unmanned aerial system (UAS) crashed on April 25, 2006, the chief of CBP's Air and Marine Div. found himself cornered in a congressional hallway with two Aviation Week reporters.

By coincidence, the official, Michael Kostelnik, was on Capitol Hill to update lawmakers on the nascent UAS program and he had already agreed to meet the reporters to do the same. Despite the accident in the Arizona desert, he kept both appointments, and what he said was remarkable for both his candor and his confidence.

"It's pretty much destroyed, it's not going to be repa-

USAF Maj. Gen. (ret.) Michael Kostelnik (left), now with U.S. Customs and Border Protection, received the Defense and Government Laureate from Aviation Week Deputy Managing Editor Michael Bruno.

rable," Kostelnik said. He acknowledged that the domestic crash of a UAS—and in particular one where aircraft control had been inexplicably lost—could be an insurmountable public relations nightmare, but he was adamant it was just a learning experience (*AW&ST* May 1, 2006, p. 35). "It's unfortunate for us we lost a $7 million aircraft, but we'll buy another one and move on."

Fast forward to 2011, and CBP now counts five land-focused Predator Bs and, since last year, two maritime variants called Guardians that were developed in a unique interagency effort with the U.S. Coast Guard. For helping to usher in domestic adoption of UAS, and particularly in meeting post-9/11 homeland security and defense needs, Kostelnik received the 2011 Defense and Government Laureate.

The Guardian fleet—distinguished from other Predators by a large belly-mounted Raytheon APS-134 SeaVue surveillance radar and prominent wingtip-mounted UHF/VHF radio antennas—will patrol the Great Lakes and the Gulf of Mexico.

Meanwhile, three General Atomics Predator Bs already are assigned to the Mexican border area, operating from the Army's Fort Huachuca in Arizona. Two more are assigned to the Canadian border region based at Grand Forks AFB, N.D.

At the same time, CBP and the Coast Guard—both in the Department of Homeland Security—work under a UAS Joint Program Office to identify and address common maritime UAS requirements, including sensors, command and control, data processing, logistics, training and basing.

Kostelnik is no stranger to pioneering flight operations. From 2002-05, he was deputy associate administrator for the International Space Station and space shuttle at NASA. And before joining the space agency, Kostelnik spent more than 32 years on active Air Force duty, from flying the F-4 and F-15 to commanding the Air Armament Center at Eglin AFB, Fla. He retired at the start of 2002 as a major general and then joined the federal government's senior executive service.

Kostelnik's Laureate competitors likewise are no strangers to pioneering operations. USAF Col. Cordell DeLaPena and Northrop Grumman's Claude Hashem were cited for the Battlefield Airborne Communications Node (BACN) program. In less than six weeks, they delivered the "bacon" system to theater. This high-altitude, airborne payload connects disparate voice and data networks, improving situational awareness and coordination between ground and air forces.

The Airborne Laser team, led by Air Force Brig. Gen. Robert McMurry, Boeing's Mitchell Ray, Lockheed Martin's Stephen Headrick and Northrop Grumman's; Andrew Grove helped accomplish the first shoot-down of a missile in February 2010 using a chemical oxygen iodine laser. Although the program has been shelved as an operational system owing to several concerns, the Pentagon continues to look for development spinoffs and expertise from the project.

And in Israel, Iron Dome reportedly is soon to become operational. A relatively fast development program started in 2007, Iron Dome uses the Tamir interceptor and is designed to intercept unguided rockets and protect urban areas and military facilities from indiscriminate rocket attack. The team was led by Yossi Drucker and Uzi Zuckerman at Rafael's Air Defense Directorate.

Multinational Group That Pioneered Commercial Space Radar

SPACE

The group of companies from Europe and North America that commercialized space-based radar is the 2011 space laureate winner.

The new business was built on the groundbreaking work of Germany's Joerg Herrmann, the former managing director of Infoterra GmbH who oversaw development, construction and launch of the twin one-meter-resolution commercial X-band imaging satellites TerraSAR-X and Tandem-X.

Those radar spacecraft, along with Italy's CosmoSkyMed constellation and the Radarsat 1 and 2 birds fielded by Canada's MacDonald Dettwiler and Associates (MDA), are helping to make satellite radar imagery an essential element of geospatial information packages used in government, defense and business applications.

Named jointly in the award were Herrmann's successor as Infoterra managing director, Vark Helfritz; John Hornsby, president of MDA's Geospatial Services; and Marcello Maranesi, CEO of Italy's e-GEOS.

The 2011 Space Laureate went to, from right, Vark Helfritz, Infoterra managing director; Roger Mitchell, representing MDA Geospatial Services President John Hornsby; and Riccardo Sarti, representing Marcello Maranesi, CEO of Italy's e-GEOS. Aviation Week Senior Space Editor Frank Morring, Jr., left, presented the award for the companies' commercialization of space radar services.

An early indication of the potential value the commercialized radarsat imagery carries came when the Pentagon's National Geospatial-Intelligence Agency (NGA) awarded contracts to the U.S. representatives of the three companies, after the U.S. military failed in several attempts to procure a fleet of radar satellites separate from those highly classified systems operated by the intelligence community.

A lack of cohesion in requirements and advocacy for the expensive system hobbled the U.S. Air Force effort, and NGA turned to the private sector, which also has the advantage over classified systems of being able to distribute its products to allies. The NGA contracts are worth a minimum of $10,000 and up to $85 million over five years.

When a service is needed, NGA conducts a competition among the three vendors, which can take up to a week or two, depending upon the complexity of the requirement. Products from all three providers have been purchased by NGA since the contracts were signed.

The launch in June 2010 of Tandem-X to work in combination with TerraSAR-X, which was orbited in 2007, brought to market global high-resolution, stereo, radar, digital elevation models and other products that had not previously been available commercially.

After the BP oil spill in the Gulf of Mexico last April, Canada's Radarsat 1 and 2 helped emergency-response managers see where the oil was at any given time, providing an overview that helped officials mitigate the disaster.

With the launch of CosmoSkyMed 4 in November 2010, the constellation reached full operating capacity of 1,800 all-weather images a day. In addition to NGA, the governments of Japan, Turkey and Germany have expressed interest in its services.

Also nominated for the 2011 space laureate were Junichiro Kawaguchi, project manager at the Japan Aerospace Exploration Agency, who led the team that developed and operated the Hayabusa asteroid sample return mission; and Frank McKenna and Vladimir Nesterov, president of International Launch Services and general director of the Khrunichev Space Center, respectively.

Kawaguchi's team improvised brilliantly to keep their spacecraft's electronic propulsion system working through repeated anomalies to bring Hayabusa home with particles of the asteroid Itokawa in its sample canisters. As a result, scientists around the world are beginning the first hands-on analysis of material from an asteroid.

McKenna and Nesterov upgraded the Proton launch vehicle supply chain and its quality-assurance system, heading a U.S.-Russian industrial team that sharply improved the booster's reliability and lowered costs. As a result, commercial activity grew to seven or eight launches per year from four or five, with a sustained payload backlog.

Richard Stephens, Boeing Senior Vice President for Human Resources and Administration

WORKFORCE

If you're into watching *Fringe*, *Big Bang Theory* or any other science/engineering/math-oriented television show, you may want to join in applauding this year's Workforce Laureate winner, Richard Stephens. In Stephens' world, engineers, scientists, mathematicians and technologists are rock stars, and he has made a mission of bringing recognition and status to the people who drive his company and the aerospace and defense industry.

Stephens, senior vice president for human resources and administration at Boeing, has worked in the national arena for the better part of two decades to improve education both inside and outside of the classroom and to ensure that today's young people see the innovators and inventors in the media that pervades their lives for what he estimates to be more than 7 hr. per day. He believes that young people need to see faces like their own in these professions if the industry is going to compete for the best and brightest people.

Boeing's Richard Stephens received the Workforce Laureate from Aviation Week Special Projects Editor Carole Rickard Hedden.

While science, technology, engineering and math are at the heart of Stephens' work, he has taken on the broader objective of learning, using a systems engineering approach. It is not fluff or touchy/feely—he is using rigor, discipline and processes similar to those used to support exploration and invention.

For Boeing, Stephens has led efforts to reduce the number of university relationships to a manageable cadre that meet quality standards, using an approach similar to Boeing's supplier qualification process. The result is improved success in attracting graduates who are likely to develop, grow and lead at Boeing, while also driving down cost-per-hire.

Stephens' Boeing team also has put in place strategic planning for people that aligns directly to financial and technological strategic planning and is considered during the same reviews. In 2009, as the recession put a stranglehold on the economy and Boeing's customers, Stephens took on the task of revamping the corporation's education policies. While it was an unpopular move, the new policies maintained alignment of employees to business competency needs and allowed Boeing to preserve its intern and cooperative education programs.

Prior to leading human resources and administration at Boeing, Stephens ran the corporation's homeland security and services business, the space shuttle and tactical combat systems business, and internal services.

Beyond the bounds of Boeing, Stephens has spoken with organizations ranging from film producers to high school science teachers about the importance of well-rounded students who master tactile and mental acuity in a sequence that produces a learning individual versus a single-skilled worker.

Stephens has served on the Department of Homeland Security Advisory Council, the Secretary of Education's Commission on the Future of Higher Education, and on the National Science Resource Center Advisory Board. He also serves on the President's Board of Advisors on Tribal Colleges and Universities and was the tribal chairman for the Pala Band of Mission Indians in 1988-89.

He chairs the Career and Workforce Development Steering Committee for the American Institute of Aeronautics and Astronautics, leads the Workforce Steering Committee for the Aerospace Industries Association (AIA), is a member of the Business Higher Education Forum and founding member of the Business Industry STEM (Science Technology Engineering & Math) Education Coalition.

In his AIA role, Stephens has joined with NASA and Aviation Week to direct a study that examines the factors used by college students and young professionals as they make career decisions. The goal of the research is to help the industry understand these factors and align expectations with reality and adjust where needed.

A second nominee for the Workforce Laureate, Wanda Austin, chairs the Young Professionals and University Student Survey Advisory Board. She is CEO of The Aerospace Corp. The third nominee, Paul Graziani, has served on the Aviation Week Workforce Study Advisory Board and implements a broad range of high school and college student internships at Analytical Graphics Inc., where he is CEO.

Outstanding students from U.S. service academies

TOMORROW'S LEADERS

The needle of a compass tells you where you are, provides context and can guide you along a journey, combining a look to the stars with a look at the next step in front of you.

And according to the U.S. service academy graduates honored at the 2011 Aviation Week Laureates ceremony, serving their country and following in the footsteps of the other Laureates honored this year are two destinations along that journey.

Cadet First Class Gregory John Eslinger of the U.S. Air Force Academy spoke on behalf of the four 2011 honorees, first applauding the scientists and engineers surrounding him, and second pledging the students' commitment to trying to live up to the achievements of the other honorees.

Celebrating the aerospace leaders of tomorrow are, from left, Aviation Week President Greg Hamilton; honorees U.S. Naval Academy Midshipman Nicholas Connor Dunn and U.S. Air Force Academy Cadet 1st Class Gregory John Eslinger; Vice President Michelle Lamberton of Tomorrow's Leaders Sponsor BAE Systems; honorees Coast Guard Academy 1st Class Cadet Jordan Kellam and U.S. Military Academy Cadet Matthew Craig Belanger; and McGraw-Hill Information and Media President Glenn Goldberg.

His salute set the stage for the strong message cast by this year's Laureates ceremony—attracting the best and brightest young people to aerospace is some of the most important work faced by the industry's leaders.

Eslinger's message and that of Michelle Lamberton, vice president for internal audit at BAE Systems who presented the awards, resonated with an overarching goal of sharing the mission of an industry inspired by innovation, invention and exploration and dedicated to bringing young people into the fold of experts who have come before them.

Honored along with Eslinger were Cadet Matthew Craig Belanger of the U.S. Military Academy; Midshipman First Class Nicholas Connor Dunn, U.S. Naval Academy; and First Class Cadet Jordan Kellam, U.S. Coast Guard Academy. Eslinger plans to go into engineering upon graduation while Belanger, Dunn and Kellam have their compasses pointed toward flight school.

Lamberton said the students have set a current record for doing the right thing, but that doing "right" takes on a different meaning in a society more transparent and global than ever before. The award, she says, should serve as recognition but also as a challenge—that the industry's leaders should follow these students for the coming decades to see how accurate a guide the lensatic compass they received as their award guides them in the future.

Belanger, a native of Hooksett, N.H., will become his family's first college graduate in June. He is majoring in mechanical engineering with a specialization in aerodynamics. His first assignment will be at Fort Rucker, Ala., for flight school. He hopes to fly either the AH-64 Apache or the UH-60 Black Hawk.

Dunn is on the Superintendent's List at Navy and will graduate seventh in his class this year. He is a Trident Scholar, participating in research in directed energy control systems and was a presenter at the 13th Annual Directed Energy Symposium. The aerospace engineering/astro major has been a brigade academics officer, squad leader and company training sergeant. After graduation, the Pacific Palisades, Calif., native will report to NAS Pensacola, Fla., for pilot flight training.

Eslinger grew up in the shadow of Cape Canaveral, Fla., the spark for his major in astronautical engineering at USAFA. He ranks among the top 2% of his class and has gained experience working with the academy's FalconSAT small satellite program. Eslinger currently is the chief data analyst for FalconSAT-5 and presented the primary payload for FalconSAT-6, which is under development. Upon graduation he will be a developmental engineer in the U.S. Air Force.

Kellam grew up in Monument, Colo., and is studying civil engineering at the Coast Guard Academy. He recently received the Moles Student of the Year Award for excellence in his major. His senior design project is a new pier system for Coast Guard Station Cortez. He has helped plan the academy's annual Ethics Forum and spent last summer at Coast Guard Air Station Sitka, Alaska, working in the aviation community. Kellam's compass is pointed at flying the Coast Guard's HH-60 Jayhawk helicopter, and he begins that effort with training at NAS Pensacola after graduation.

Tim Sassenrath and the Apache PBL program team

MAINTENANCE, REPAIR and OVERHAUL

The metrics used to determine the success of performance-based logistics (PBL) programs can be complex, often measuring such things as availability, cost avoidance and component fill rates. But to U.S. and coalition ground forces in Iraq and Afghanistan, the equation, particularly when it comes to the U.S. Army's Apache attack helicopter, is easier to explain. As expressed by an Army officer, "When Apaches fly, soldiers don't die."

In 2010, the Apache D Unique Airframe Component PBL, which covers the U.S. Army's AH-64D Apache Longbow Attack helicopter fleet, achieved 95% material availability in deployed locations, and 91.4% for all locations, easily exceeding the U.S. Army's requirement of 85% availability.

Tim Sassenrath (left), director of Boeing's Apache Worldwide Support, received the MRO Laureate on behalf of the Apache Performance-Based Logistics program from Aviation Week Deputy Managing Editor Frank Jackman.

PBL objectives generally include shifting cost and risk away from the government to industry participants, as well optimizing total system availability while minimizing cost, and reducing both logistics footprint and burden on the maintainer. Key performance parameters include material availability, material reliability and total ownership cost.

The Apache PBL program managed by Boeing is part of the life-cycle sustainment strategy to support the more than 600 AH-64D Apaches in the Army's fleet. The PBL program exceeded the Army's material requirement despite a sustained operations tempo surge that pushed flight hours to levels 20% greater than expected. Also, because of a focus on continuous improvement, the components covered by the Apache PBL now exceed reliability design specifications by over 60%, resulting in reductions in cost logistics footprint and burden on aircraft maintenance personnel.

Another aspect of the Apache PBL program is an award-winning obsolescence and diminishing manufacturing sources program intended to help avoid costs, mitigate risk and better support the aircraft. By monitoring and resolving component obsolescence issues, the industry/government partnership has avoided $10 million in costs and was expected to close over 400 obsolescence cases in 2010. The team received the 2009 Defense Department Diminishing Manufacturing Sources and Materiel Shortages Team Achievement Award.

Finally, the Apache PBL program also entails transitioning work to government depots, which is intended to enhance the military's organic capability and to create second sources of supply. As of late 2010, two components had been transitioned and a joint government/Boeing Integrated Product Team was working to determine the feasibility of transitioning approximately 40 additional components.

The three runners-up in the MRO category all were involved in U.S. military programs. Col. Douglas C. Cato, commander of the U.S. Air Force's 76th Aircraft Maintenance Group at the Oklahoma City Air Logistics Center at Tinker AFB, was nominated for process initiatives that significantly reduced the time and cost of maintaining and servicing C-/KC-135s that flow through the facility for programmed depot maintenance. Cato's team was able to reduce flow days by nearly 12%, saving about $1.1 million per aircraft.

Capt. Andrew Hartigan, Naval Undergraduate Flight Training Systems Program Office (PMA-273) program manager at NAS Patuxent River, Md., and his team were nominated for saving Navair more than $100 million while bolstering safety in training. Hartigan sponsored one of the Defense Department's first formal business case analysis (BCA) efforts. The BCA included a full simulation of the Navy's training maintenance, repair and overhaul activities. The result was improvement management and a better understanding among stakeholders about how their actions may affect costs, readiness and aircraft service life.

David Mann, director of the U.S. Air Force's 572nd Aircraft Maintenance Sqdn., which is part of the 309th Maintenance Wing at Hill AFB, Utah, was nominated for improving C-130 Hercules throughput by 33% in fiscal 2010 without adding personnel. Mann's squadron overhauled its approach to execution management to focus on work synchronization. Over time, the unit went from finishing an average of 2.5 aircraft per month to 3.5 per month. In fiscal 2010, the squadron returned 44 C-130s to service compared with 33 the previous year.

Corporate Angel Network's Randall Greene

BUSINESS and GENERAL AVIATION

It's a simple idea: If your business jet has an empty seat, give it to someone who needs it—specifically, a cancer patient traveling to and from a treatment center. The gesture costs the aircraft operator nothing, but can save the patient thousands of dollars and considerable stress during a time of extreme personal hardship. That simple generosity took form in 1981 as the Corporate Angel Network—CAN.

The pilot of the first flight was Leonard Greene, a CAN co-founder and the brilliant creator and head of Safe Flight Instrument Corp. Greene's commitment to CAN was complete: He flew not only the first patient—a 19-year-old boy traveling home for Christmas in Detroit from treatment in New York—but also the 100th, 1,000th and 10,000th patients as well. He provided CAN with funding and office space in Safe Flight's headquarters in White Plains, N.Y., before it moved into its own building at nearby Westchester County Airport.

Randall "Randy" Greene (left) received the Business and General Aviation Laureate from *Business & Commercial Aviation* Editor-in-Chief William Garvey.

When Greene's son, Randy, took charge of Safe Flight in 2001, the company's close association with CAN could have loosened, and the charity left to fend for itself. But he chose quite a different path, becoming chairman of CAN's board and reinvigorating the operation with new leadership and even more support. He has given generously of his time, heart and treasure, and enlisted the support of some of business aviation's best, including the heads of Hawker Beechcraft, Gulfstream Aerospace, Cessna Aircraft and Dassault Falcon Jet, to ensure CAN has sufficient lift, funds and facilities to continue helping those in need.

In 2002, the year Randy Greene became chairman, CAN arranged travel for its 15,000th cancer patient. Last year, a NetJets owner donated flight time to a 16-month-old boy receiving treatment at New York's Memorial Sloan Kettering Cancer Center, along with his mother; he was CAN's 35,000th passenger-patient. In 2010, an unprecedented 3,021 cancer patients received free transport through CAN and its more than 500 volunteer companies.

Upon learning of the record, Dr. Brian Kushner, a renowned oncologist specializing in neuroblastoma at Sloan Kettering, sent CAN a congratulatory note, stating: "I see so many patients (all children) at the treatment center who are benefiting hugely from this service. Thank you!"

The other worthy nominees were Brian Delauter, Marianne Stevenson and Robin Eissler.

While its charge is to protect the public, the Transportation Security Administration (TSA) is viewed by many in the industry it monitors as an impediment since it slows rapid movement. When TSA encountered business aviation—which is all about immediacy, flexibility and privacy—the results were terrible: surprise screenings, gateway airports, armed security officers, temporary flight restrictions and the infamous large-aircraft security program. Every move seemed to generate industry anger and distrust. Then TSA assigned Brian Delauter to put things right as its head of general aviation. A tall order, but Delauter's experience as a flight instructor and airline and business aviation pilot gave him practical insight into the industry's frustrations. In his role, Delauter has demonstrated a refreshing willingness to listen and then champion business aviation's positions within the TSA. His is a lonely and relentless fight, but whose outcome is a keen importance to the business and general aviation communities.

When Haiti crumbled under a devastating earthquake early last year, Marianne Stevenson and Robin Eissler knew just what to do. Their all-volunteer relief organization—Corporate Aviation Responding in Emergencies—earned its wings after Hurricane Katrina in 2005, coordinating business aircraft to deliver life-saving personnel and supplies to the Gulf Coast. The same coalition sprang into action for Haiti, coordinating missions for more than 700 flights, transporting 3,800 medical and emergency service personnel, and delivering 1.4 million lb. of critical supplies. The group—now called the AEROBridge—continues to work in disaster response, including continuing support of relief efforts in Haiti.

BACK TO JUP

Solar-powered probe set to skim cloud tops to learn what's below

FRANK MORRING, JR./WASHINGTON

NASA is preparing to launch another spacecraft to Jupiter that will try to uncover some of the mysteries the planet kept hidden the last time a human-built robot ventured into its cold, radioactive and relatively dark neighborhood.

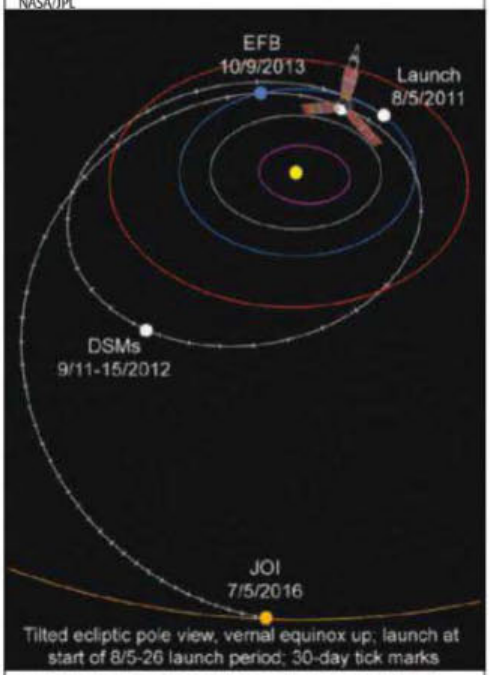
Named Juno, after the Roman god Jupiter's wife, the unique spacecraft will set a record by running on solar power rather than the nuclear radioisotope thermoelectric generators (RTG) previously used to operate spacecraft that far from the Sun. It will pick up where the Galileo mission left off in September 2003, when that probe was sent crashing into the gas giant's clouds at the end of its service life to prevent accidental contamination of one of Jupiter's moons.

Juno is essentially a flying windmill rotating around a titanium box. Most of the spacecraft's 66-ft. diameter is taken up with huge arrays designed to capture as much solar energy as possible in the dim sunlight at Jupiter. And to shield delicate hardware from the high-energy radiation at the massive planet, most of the instrument electronics is crammed into a box with titanium walls as much as half an inch thick, tucked right in the middle of the spacecraft for maximum protection.

In orbit at Jupiter, Juno will turn at 2 rpm as its nine instruments collect data on the gas giant's structure and composition. Unlike Galileo, which orbited at the planet's equator where it could also visit the Jovian moons, Juno will take up an orbit over Jupiter's poles to avoid the worst of the radiation belts.

"We have this elliptical orbit which dives down between the innermost radiation belt and the cloud tops at about 4,000 km [2,500 mi.]," says Jan Chodas, Juno project manager at the Jet Propulsion Laboratory (JPL). "Our prime data-taking pass is about 6 hr. around perijove, close to the planet, and then we swing back out in this 11-day orbit and relay the data back and set up for the next orbit. So it's that knowledge of where the radiation belts are, and the precise navigation to pinpoint the spacecraft on that trajectory, that is mission-enabling."

NASA/JPL



The Juno mission will use the same Atlas V variant that sent New Horizons to Pluto, with a single Earth flyby to reach Jupiter.

The space around Jupiter is so hot that mission designers expect Juno to survive there for only 30 orbits—less than a year. Planning to handle the radiation started early, Chodas says, and included developing the cubic-meter titanium box known on the project as "the vault."

Aside from the solar arrays, the spacecraft is "short and squatty," says Tim Gasparrini, Juno program manager at Lockheed Martin in Denver. The body measures 3.5 meters (11.5 ft.) tall and 3.5 meters in diameter. Right in the middle is the titanium vault. Measuring 0.8 X 0.8 X 0.6 meters, it weighs 150 kg. (330 lb.) and is "not your typical aerospace construction," he says.

The mass of the titanium walls provides a radiation shelter where all of the spacecraft avionics are housed. "All the sensors are outside," Gasparrini says. "But as much of the critical avionics [as possible] is sandwiched in the vault. [Exterior equipment] is as hard as it could reasonably be within cost constraints. It's expected that after 30 orbits you've pretty much taken your radiation beating, and you're not going to survive much longer."

The approach, like the decision to use solar power, was taken to curtail the cost of the mission, which was developed under the cost-capped New Frontiers program. One of the biggest challenges was making all of the pieces fit inside the vault.

"It's like a jigsaw puzzle," says Chodas. "You've got a cube, and you've got things mounted on a central panel and on all the panels that fold up to make the cube. That layout is 'easy to do,' but the cabling that runs from box to box and in and out of the vault is a work of art. The first time I saw the flight cable I said, 'Wow, you guys are going to stuff all that in there?'"

When it reaches Jupiter in July 2016 and begins taking science data, Juno will set the record for distance from the Sun for a spacecraft operating on solar power. The Stardust comet sample return mission used solar power at 2 astronomical units (AU), twice the distance of the Earth from the Sun. But Juno will operate at 5 AU. To obtain the power the mission needs at that distance, the probe's solar arrays are very large—two wings of four solar panels

ITER

each, and one with three, plus the boom that holds Juno's magnetometer.

The "ultra triple junction" gallium arsenide solar cells, built for Juno by Boeing's Spectrolab Inc. subsidiary, will be able to convert more than 28% of the solar energy hitting them into electricity at the beginning of the mission. They have thicker cover glass than Earth-orbiting arrays for extra radiation protection, and still will darken over time under the radiation effects, reducing their efficiency at the planet. Even so, they should generate plenty of power for the job they have to do.

"At Earth the solar arrays generate around 18 kw," says Gasparrini. "At Jupiter they generate roughly 400 watts. So in general, if you can have enough energy to light a 100-watt bulb at Earth, you'll only have enough energy to light a nightlight at Jupiter."

Of the 400 watts the huge arrays will generate at Jupiter, half will go to the heaters and other thermal subsystems that keep the electronics warm. That is another factor in operating so far from the Sun. At Mars, for example, only a third of a probe's power is needed for warmth. But even the 200-250 watts remaining for Juno's science package will be enough to take data, record it and send it back to Earth through the high-gain antenna.

"For talking purposes, half of it goes to thermal subsystems; half of it goes to everything else," Gasparrini says of Juno's power distribution. "Certainly we don't have as much power as some of the other missions that we do, but it isn't four or five times different. It's in the family."

Juno's solar arrays actually consume less spacecraft mass than an RTG, but the question was moot for the mission designers because there wasn't an RTG available to them. The last one in the U.S. inventory is being used on the Mars Science Laboratory to be launched this fall, and developing a new set of RTGs for Juno "would have broken the bank," Gasparrini says. Like the precise navigation and the titanium vault, the solar arrays were mission-enabling, he says.

LOCKHEED MARTIN

Flight-ready Juno spacecraft underwent acoustic testing at Lockheed Martin in Denver. The large solar arrays folded against the side of the spacecraft will provide roughly 400 watts at Jupiter.

As with any spacecraft, mass is crucial, and Juno is no exception because of all of the maneuvering involved in getting to Jupiter and collecting data. The spacecraft itself is baselined at 1,500 kg, with a 2,000-kg fuel load. Gasparrini says it will actually come in with about 100 kg more fuel than planned as final hardware weights are booked against the 3,625 kg allowed the spacecraft on its Atlas V 551 launch vehicle.

The Atlas variant is the same vehicle that lofted the New Horizons mission on Jan. 19, 2006, toward a Pluto flyby in July 2015. That launch set a record for the fastest escape from Earth's gravity that stands today, and New Horizons reached Jupiter in only 13 months (*AW&ST* Jan. 9, 2006, p. 46). Juno is heavier and will proceed at a more stately pace to its orbital insertion in 2016.

The launch window for Jupiter will open on Aug. 11, with flight opportunities through Aug. 31. The Atlas V will propel the spacecraft toward Jupiter, Gasparrini says, and its Centaur upper stage will send it in the right direction. After that it will be a relatively straight shot to Jupiter, requiring only one Earth flyby—in September 2013—before moving on to its polar orbit at Jupiter on July 5, 2016, or a little later.

The arrays will start to deploy 70 min. after launch, unfolding at their spring-loaded hinge lines at roughly 30-min. increments while the spacecraft spins at 0.5 rpm. The launch vehicle will spin Juno up, and it will continue to spin at different rates throughout the mission.

During cruise to Jupiter, the normal spin rate will be 1 rpm, increasing to 5 rpm at orbit insertion. It will spin at

2 rpm while collecting science data. "You basically can stabilize yourself for free, with no power, by the fact that you're spin stabilized," Gasparrini says. "That was a consideration for the design of the payloads; they all had to be designed to do their science while we were spinning."

Missions funded under NASA's New Frontiers program are led by the principal investigator who suggested it. Scott Bolton of Southwest Research Institute in San Antonio, Texas, proposed Juno, and he says the idea arose when he was using the radar on the Cassini Saturn probe to study Jupiter's radiation belts.

The "glow" in radio wavelengths from Jupiter's relatively warm atmosphere was noise that obscured his listen-only observations, which in effect made the Cassini radar into a long-range microwave radiometer.

In discussions with colleagues pursuing the question—left over from the Galileo mission—of how much water is in Jupiter, Bolton realized that it might be possible to make microwave measurements of the atmospheric glow from a polar orbit below the radiation belts, which otherwise obscure precise temperature measurements.

"If I get this measurement in the atmosphere at a whole bunch of different frequencies, I can compare them with my model of how warm Jupiter is, and the only thing that's the variable is how much water's in there," Bolton says.

There were other questions that could be answered with a polar-orbiting probe flying under the radiation belts, including those involving Jupiter's magnetosphere and gravity fields. That led to the Juno proposal, which was the second New Frontiers project selected by NASA.

The science payload that emerged carries nine instruments and 25 sensors. At its core is the microwave radiometer (MWR) that grew out of Bolton's work with the Cassini radar. The MWR will be able to sound much deeper into the planet's atmosphere than the physical probe that Galileo dropped, using six wavelengths to measure composition over a range of altitudes.

Other instruments in the suite are:

- Jovian Auroral Distributions Experiment (JADE), which will study the plasma structure of the planet's aurora, measuring particle distributions in the polar magnetosphere.
- Jupiter Energetic-particle Detector Instrument (JEDI), for measuring hydrogen, helium, oxygen, sulfur and other ions in the polar magnetosphere.
- Ultraviolet Spectrograph (UVS), an imaging spectrograph that works while the spacecraft is spinning by recording data on ultraviolet photos detected during each rotation.
- Jovian Infrared Auroral Mapper (Jiram), which will study the linkages between the auroras and the planet's magnetosphere.
- Plasma Wave Instrument (Waves), which will measure radio and plasma spectra in the aurora.
- Fluxgate Magnetometer (FGM), two sensors that will measure the strength and direction of the planet's magnetic field.
- Advanced Stellar Compass (ASC), a star tracker designed to give extremely accurate data on the magnetometers' pointing.
- Gravity Science (GS), which will use Doppler effects on the spacecraft's communications with Earth to study the planet's mass properties.

(For more on the science Juno will deliver, see p. 54.)

In addition, the spacecraft will carry a three-color camera called JunoCam to deliver imagery for public engagement and outreach, as well as for scientific context.

Unlike the Mars Science Lab and the James Webb Space Telescope—both suffering cost overruns—Juno is one of the first major space science missions to go through a NASA process called the Joint Confidence Level (JCL), which uses outside reviews to estimate cost at a 70% level of certainty. In budget hearings before Congress this year, Administrator Charles Bolden has boasted that Juno and the lunar Gravity Recovery and Interior Laboratory (Grail) missions have benefitted from the process.

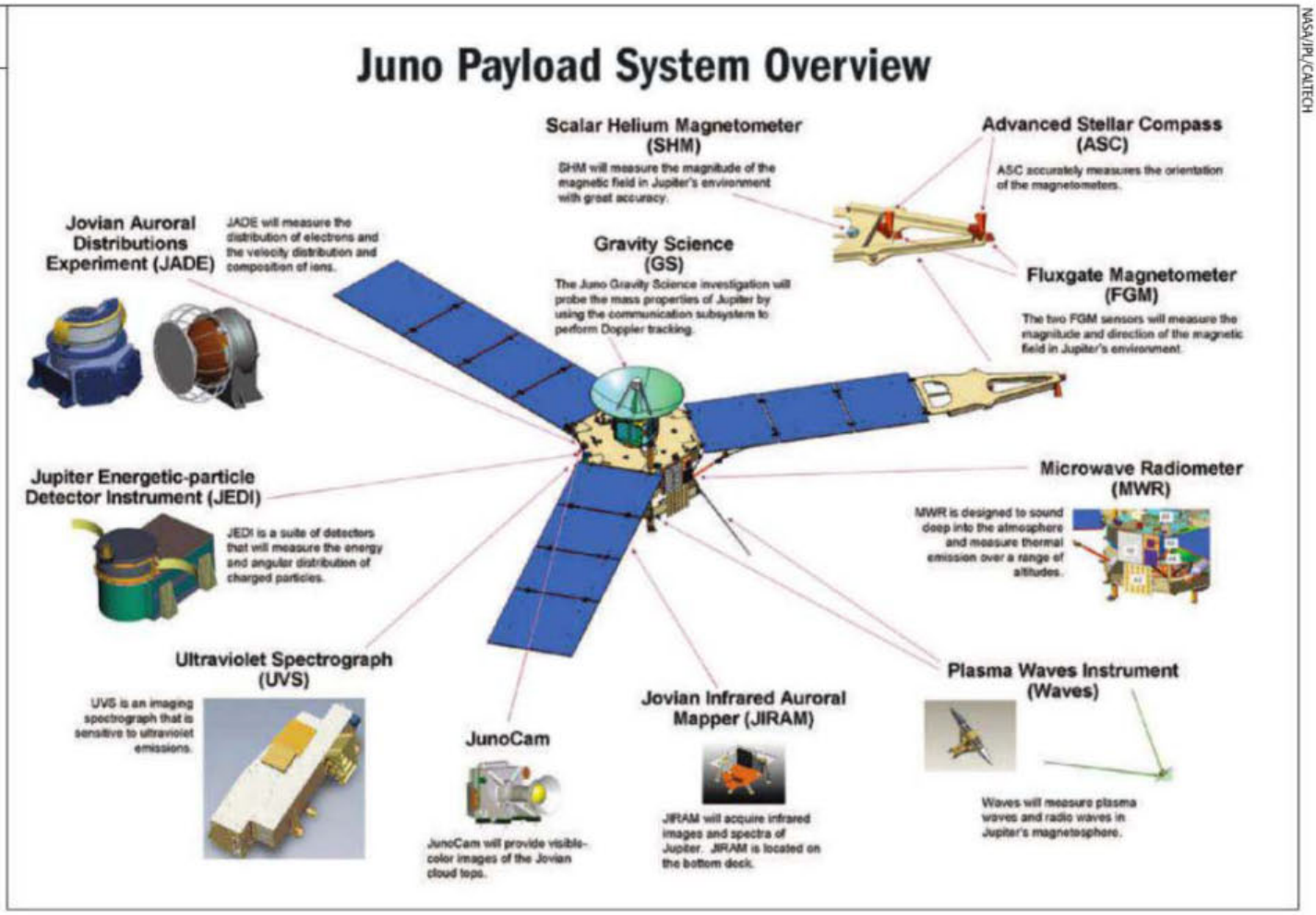
"We have independent assessments on our cost and schedule," he told the House Appropriations subcommittee that sets NASA spending. "Grail and Juno are coming in on cost and on schedule because they were subjected to the JCL process, where we had independent assessments as to what our real cost is going to be."

In general, New Frontiers missions like Juno are said to be capped at $700 million. But the accounting for Juno is a little more complex because of early changes in the budget profile for the project.

According to Jim Adams, deputy direc-

LOCKHEED MARTIN

Technicians install the 330-lb. titanium "vault" that will protect Juno electronics from Jupiter's harsh radiation environment. Even with protection, the spacecraft is expected to survive for only a year.



NASA/JPL/CALTECH

tor of planetary science in the Science Mission Directorate at NASA headquarters, the original cap on the second New Frontiers mission—which became Juno—was $650 million, including the launch, as measured in fiscal 2003 dollars.

When Juno was selected two years later, the cap quoted was $842 million in then-year dollars, including the launch. The difference was attributed to inflation and changes in NASA accounting schemes, and could be traced back credibly to the $650 million figure, Adams says.

That figure called for a launch date in 2009; but NASA managers almost immediately stretched out the program twice to meet other agency needs—first to a launch in 2010 and then to the current planetary window in August. With the first change, the cost estimate went up to $931 million to account for the additional time, inflation and rising launch costs. The second stretchout took it to a $1.07 billion estimate.

After that the project was subjected to a JCL review to gain the 70% confidence level required under the process. That boosted the estimated total cost to $1.107 billion, where it stands today. Of that amount, an internal figure called the "principal investigator cost cap" is $1.09 billion, which leaves the project "a little bit of headroom" for rising costs during the operations phase coming up.

Those most likely would arise if Juno encounters an unexpected technical problem during cruise to Jupiter or while it is gathering science; but from a technical standpoint, it has indeed remained on track once the schedule was set for good at NASA headquarters. As of March 9, the program had 21 days of schedule margin remaining before the launch window opens, and the spacecraft had finished thermal vacuum testing at Lockheed Martin's Denver facility.

Chodas, the JPL project manager who runs the program for Principal Investigator Bolton, and Gasparrini, who developed the flight system at Lockheed Martin, both attribute their success in keeping on track to several engineering factors.

Those factors hinge in large part on the experience their respective engineering organizations have gained in previous planetary science missions. That may have implications for future deep-space exploration if NASA's current budget problems force the agency to curtail large missions in the years ahead.

"The people who are in the jobs, across the board, have the right set of experiences, and the right collaboration," Chodas says. "People move around on different jobs and so they'll say, 'Oh, watch out for this, or have you thought about that,' because they did that job on a previous development."

That collaboration was particularly useful on Juno because it relied heavily on heritage hardware and software from previous missions—another factor its top managers say contributed to Juno's relatively smooth development. The spacecraft avionics suite was derived from equipment originally developed for the Mars Reconnaissance Orbiter and other spacecraft.

Beyond that, the two delays early in the program gave its developers more time to prepare for the difficult environment Juno will encounter, and think through potential pitfalls carefully.

"The environmental challenges that we knew we would face were tackled early on in the design, so it wasn't like getting halfway through building and testing it and suddenly realizing, 'Oh, you mean we have to be magnetically clear; we didn't use the right materials, we didn't use the right techniques?' A lot of foresight and planning was put in. We had a lot of the typical issues that crop up when you build hardware and software, but not that sort of thing."

Parting the Veil

Jupiter's clouds believed to hide evidence on the ways planets form

FRANK MORRING, JR./WASHINGTON

NASA/ESA/E. KARKOSCHKA (UNIVERSITY OF ARIZONA)

NASA's Juno mission will probe Jupiter's atmosphere in search of clues to how the largest planet in the Solar System, and the Solar System itself, were formed from a primordial cloud of gas.

Jupiter is probably the oldest planet, but it keeps its secrets veiled beneath the clouds and massive storms we can see from Earth. By sending Juno beneath the planet's radiation belts in a polar orbit that takes it just 3,000 mi. above the cloud tops, scientists hope to unravel some of those mysteries with sounding measurements that should reveal the planet's composition and structure.

"The primary questions that we're after have to do with the origin of Jupiter, the origin of the Solar System and how planets were made, and how and why the planets are a little bit different than the Sun, and particularly the history of the volatiles that eventually led to Earth and life itself," says Southwest Research Institute scientist Scott Bolton, the Juno principal investigator. "In particular what we're after is how much water or oxygen is inside of Jupiter."

The nuclear-powered Galileo mission dropped a probe into Jupiter's atmosphere in July 1995 that returned data for almost an hour. But while the probe obtained good measurements for nitrogen and sulfur, it stopped working—crushed by the mounting pressure 150 km below the cloud tops—before it could return a valid figure for water. Finding that figure will be one of the primary objectives of Juno.

"We don't really know where the water came from on our Earth," Bolton says. "We have these oceans and people say, 'Well, maybe they came from comets.' Some of the people like to think that it came from the heavy bombardment period. . . . Maybe Jupiter was bombarded, too, and that's where its water came from. Maybe that's where the heavy elements came from. We don't really know. Those basic measurements are fundamental to tell us the history of Jupiter, to place where it formed, how long it took to form and the process that made it. It kind of gives us the traceability of these volatiles at that stage of the Solar System."

Basically, Juno will use its microwave radiometer to measure the absorption of radio waves by different components of Jupiter's atmosphere, including water and ammonia. The atmosphere "glows" in radio wavelengths, and the frequency tells scientists what is blocking the radio waves or letting them through.

"If I go down deeper with a longer wavelength, then the atmosphere can become more transparent to me at the longer wavelength, and I'll see the glow from deeper down," Bolton says. "The reason the atmosphere is transparent or opaque is because water and ammonia are doing the absorbing in the atmosphere at these particular wavelengths. . . . At the top of the atmosphere and the very high frequencies, I'm measuring ammonia. Deeper down I'm measuring water because that's what's doing most of the attenuation. So it's sort of a trick. That's our microwave experiment, and that's largely the basis of Juno."

Scientists hope to answer questions about the origins of the Solar System by probing beneath the clouds of Jupiter, seen in this Hubble telescope view with the moon Ganymede.

A probe in polar orbit close to the planet also was attractive to scientists trying to figure out the planet's internal structure by making very precise measurements of its gravity, using the Doppler shift in spacecraft communications back to Earth. Based on that data, researchers may be able to determine if there is a core of heavy elements at the center of Jupiter, something they don't know today.

NASA was already considering a polar-orbiting mission to Jupiter just to measure the planet's full magnetic field, so Juno filled the bill for that. And the polar orbit gave researchers a chance to use the aurora there to study the polar magnetosphere "as a freebie," he says.

"All these groups formed together under me to create Juno," says Bolton.

Once the data start flowing in 2016, Juno will be able to answer questions that go beyond the particulars of its target planet. Scientists believe the Solar System was formed when a cloud of hydrogen and a little helium coalesced into the Sun, with the leftovers going on to form Jupiter. But Jupiter has other elements, and accurately measuring them—starting with water—has long been a goal of space scientists.

"Something must have happened after the Sun was formed to allow Jupiter and the rest of the planets to be formed with a little bit different mix," Bolton says, explaining that the cooling of the primordial planetary disk allowed different materials to separate out at different rates, beginning with the water ice. The goal of Juno is to fill in the blanks.

"We go to Jupiter to do this because it's big," he says. "It has most of the material other than the Sun. If I take everything else in the Solar System I don't get Jupiter."

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How Feds Can Aid GenAv Exports

BY JACK J. PELTON

Jack J. Pelton is chairman, president and CEO of Cessna Aircraft Co. The following is excerpted from recent testimony before the House subcommittee on commerce, manufacturing and trade.

Cessna fully supports current efforts to reform and streamline the overall export licensing and policy framework. As an aircraft manufacturer, we have found that we have a generally positive export environment for our physical products: aircraft, spares and ground support equipment. However, ITAR (International Traffic in Arms Regulations) in many cases is a problem for our utility and special mission aircraft sales. These aircraft do not contain sensitive military systems, are functionally equivalent to commercial aircraft and do not provide a significant military or intelligence impact, yet many of the existing controls and policies have slowed our globalization and sales efforts.

Due to the high safety standards we follow in the U.S., manufacturers cannot sell aircraft or major aircraft parts unless they are certified as airworthy by the FAA. This means the financial health and competitiveness of U.S. manufacturers in the global market depends in large part on the ability of FAA to do its job.

Unfortunately, we are concerned that the FAA will be unable to meet certification requests by manufacturers. Unless the FAA is provided adequate resources, and implements new processes and procedures to streamline the certification process, we believe it will not be able to keep up with service demands by manufacturers. This will severely diminish the competitiveness of U.S. industry and its ability to bring new products to the global market and create new jobs in the economy.

> "The availability of credit continues to be a constraint on exports."

There is a mechanism already in place, however, that can help manage the resource demands on the FAA. For aircraft certification, it established Organization Designation Authorization (ODA) in 2006. This allows the FAA to delegate routine certification tasks such as the review and approval of thousands of individual drawings and tests. Most aircraft manufacturers have invested in the development of an ODA system approved by the FAA, but unfortunately the certification process efficiencies have yet to be realized. The lack of procedural standardization across the FAA and inconsistent interpretation of regulations also negatively affect the efficiency of the certification process. This leads to an increased workload for both the FAA and industry since the requirements change from one project to the next, and even depend on the FAA employee or office with whom a manufacturer is working.

Last October, the Government Accountability Office released a report citing the FAA's inconsistent interpretation of regulations as a long-standing problem and a leading challenge for the aviation industry. The FAA acknowledges but generally has not addressed the issue.

Moreover, the U.S. industry continues to see increased validation requirements from foreign national aviation authorities to obtain certifications redundant to the FAA's in order to be able to sell and export products into their countries. The U.S. has established bilateral agreements with our primary trading partners to streamline the validation and acceptance of FAA-certified products and equipment. However, the effectiveness of the agreements varies from country to country. Some follow the intent of the bilateral, while others do not. Those that do not tend to require more in-depth information and more extensive investigations, which often mean repeating similar procedures for each country.

Europe, for example, has comprehensive regulations and certification processes similar to the FAA's that often result in a much higher level of involvement by the European Aviation Safety Agency and redundant activities for both design and operational approvals. Our ability to improve this situation has been hampered by a delay in implementation of a new safety bilateral agreement between the U.S. and Europe. We now expect this to happen on May 1. This should allow the FAA to be more proactive in ensuring the intended benefits of validation and reducing the burden on the authorities and industry.

The availability of credit continues to constrain exports. Cessna has worked to create a $500 million facility backed by the U.S. Export-Import Bank of the United States. This agency has assisted Cessna with exports during the past couple of years when liquidity in the market was very tight. We applaud Exim Bank for working with us to deliver creative solutions that support exports.

General aviation is an important contributor to the U.S. economy, supporting more than 1.2 million jobs, providing $150 billion in economic activity and, in 2010, generating nearly $5 billion in exports. We are one of the few manufacturing industries that still provides a significant trade surplus for the U.S. These exports accounted for 62% of the billings generated by GA manufacturers, significantly up from the 50% attributed to exports in 2009.

Cessna, like others, is coping with the realities of a weak economy. The three major manufacturers in Wichita have all experienced major declines in sales. In 2010, Bombardier Learjet was down 39%, Hawker Beechcraft 22% and Cessna 28%.

We believe the market is stabilizing, as we see an increase in orders in some segments. The tax bill that passed at the end of 2010 will extend the R&D tax credit and allow 100% expensing for capital investments like aircraft, avionics, engines and cabin equipment. If government and industry work together on the issues discussed today, we will help ensure our country stays ahead of the pack economically and technologically.

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