

**Northrop's T-X
Trainer Surprise**

**HEALTH CHECK
India's Airlines**

**General Atomics'
UAV Laser Weapon**

\$14.95 FEBRUARY 16 - MARCH 1, 2015

AVIATIONWEEK

& SPACE TECHNOLOGY

**WHY
THE PILOT SHORTAGE
IS REAL**



**RICH MEDIA
EXCLUSIVE**

DEFENSE UPDATES

Australia ■ China ■ India



AviationWeek.com/awst

Powered by **Penton**



The Partner You Can Count On™

A Global Leader in Aerospace and Defense

Reliable and Affordable Space, Defense and Aviation Systems

With the merger of Orbital and ATK's Aerospace and Defense Groups, we have created an exciting new company that our customers can count on for reliability, innovation and affordability. We develop and manufacture a wide range of products, from space and strategic launch vehicles and their rocket propulsion systems; to tactical missile systems, precision-guided weapons and ammunition; to satellites, space components and aerospace structures. Through robust investments in advanced technology and sustained commitment to execution excellence, we are dedicated to providing the aerospace and defense systems our customers rely on for their most critical missions.



*To learn more about Orbital ATK visit our
website at OrbitalATK.com*

\$14.95 FEBRUARY 16 - MARCH 1, 2015

AVIATIONWEEK

& SPACE TECHNOLOGY

Middle East Arms Markets

PAGE DTI 8

Northrop Grumman's T-X Trainer Surprise

PAGE 56



**RICH MEDIA
EXCLUSIVE**

New Sub-Hunting Tricks

PAGE DTI 21



**RICH MEDIA
EXCLUSIVE**

UPDATES

**Australia ■ China ■
India ■ Iran**



The Partner You Can Count On™

A Global Leader in Aerospace and Defense

Reliable and Affordable Space, Defense and Aviation Systems

With the merger of Orbital and ATK's Aerospace and Defense Groups, we have created an exciting new company that our customers can count on for reliability, innovation and affordability. We develop and manufacture a wide range of products, from space and strategic launch vehicles and their rocket propulsion systems; to tactical missile systems, precision-guided weapons and ammunition; to satellites, space components and aerospace structures. Through robust investments in advanced technology and sustained commitment to execution excellence, we are dedicated to providing the aerospace and defense systems our customers rely on for their most critical missions.



*To learn more about Orbital ATK visit our
website at OrbitalATK.com*

Editor-In-Chief Joseph C. Anselmo
Executive Editor James R. Asker
Managing Editors Jen DiMascio, Jens Flottau, Graham Warwick
Assistant Managing Editor Michael Stearns
Associate Managing Editor Andrea Hollowell
Art Director Lisa Caputo
Director, Editorial and Online Production Michael O. Lavitt
Director, Digital Content Strategy Rupa Haria

DEFENSE, SPACE AND SECURITY

Editors Jen DiMascio (Managing Editor), Jefferson Morris (Associate Managing Editor), Michael Bruno, Amy Butler, Michael Fabey, Sean Meade, Frank Morning, Jr., Bill Sweetman (Chief Editor, Defense Technology Edition)

CIVIL AVIATION/MAINTENANCE, REPAIR AND OVERHAUL

Editors Jens Flottau (Managing Editor), Madhu Unnikrishnan (Associate Managing Editor), Sean Broderick, Cathy Buycy, John Croft, William Garvey, Fred George, Rupa Haria, Molly McMillin, Guy Norris, Bradley Perrett, Jessica Salerno, Adrian Schofield, Brian Sumers, Lee Ann Shay (Chief Editor, MRO Edition)

Chief Aircraft Evaluation Editor Fred George

For individual e-mail addresses, telephone numbers and more, go to www.AviationWeek.com/editors

EDITORIAL OFFICES

1166 Ave of Americas, New York, N.Y. 10036
 Phone: +1 (212) 204-4200

BUREAUS

AUCKLAND

53 Stainercross St., Green Bay, Auckland 0604, New Zealand
 Phone: +64 (27) 578-7544
Bureau Chief Adrian Schofield

BEIJING

D-1601, A6 Jiangou Menwai Ave., Chaoyang, Beijing 100022, China
 Phone: +86 (186) 0002-4422
Bureau Chief Bradley Perrett

BRUSSELS

Rue de LAqueduc 134, 1050 Brussels, Belgium
 Phone: +32 (2) 648-7774
Bureau Chief Cathy Buycy

CHICAGO

330 N. Wabash Ave., Suite 2300, Chicago, Ill.
 Phone: +1 (312) 840-8445
Bureau Chief Lee Ann Shay

COLUMBIA, S.C.

1120 Baffin Road, Columbia, S.C. 29212
 Phone: +1 (803) 727-0809

Managing Editor, AviationWeek.com Sean Meade

FRANKFURT

Am Muehlberg 39, 61348 Bad Homburg, Germany
 Phone: +49 (69) 2999-2718 Fax: +49 (6172) 671-9791
Bureau Chief Jens Flottau

LONDON

50 Broadway London SW1H0RG, England
 Phone: +44 (207) 152-4521
Bureau Chief Tony Osborne

LOS ANGELES

10 Whitewood Way, Irvine, Calif. 92612
 Phone: +1 (949) 387-7253
Bureau Chief Guy Norris

MOSCOW

Box 127, Moscow, 119048, Russia
 Phone: +7 (495) 626-5356; Fax: +7 (495) 933-0297
Contributing Editor Maxim Pyasushkin

NEW DELHI

Flat #223, Samachar Apartments,
 Mayur Vihar—Phase-1 (ext.), New Delhi 110091, India
 Phone: +91 (98) 1154-7145
Contributing Editor Jay Menon

PARIS

40 rue Courcelles, 75008 Paris, France
 Phone: +33 (06) 72-27-05-49
Bureau Chief Amy Svitak
Contributing Editor Pierre Sparaco
pierre.sparaco@orange.fr

SAN FRANCISCO

271 Coleridge St.,
 San Francisco, Calif. 94110
 Phone: +1 (415) 314-9056
Bureau Chief Madhu Unnikrishnan

WASHINGTON

1911 Fort Myer Drive, Suite 600
 Arlington, Va. 22209
 Phone: +1 (703) 997-0333

Bureau Chief James R. Asker
Administrator of Bureaus Kyla Clark

WICHITA

1500 N. Willow Lane,
 Wichita, Kansas 67208
 Phone: +1 (316) 993-3929
Bureau Chief Molly McMillin

Art Department Scott Marshall, Colin Throm

Copy Editors Patricia Parmalee, Andy Savoie,
 Richard Leysdon, Diana Bell

Production Editors Elizabeth Campochiaro, Bridget Horan,
 Ellen Pugatch

Contributing Photographer Joseph Pries

PENTON

David Kieselstein
Chief Executive Officer

Warren N. Bimblek

Senior Vice President, Strategy and Business Development

Nicola Allais

Chief Financial Officer/Executive Vice President

Gregory Hamilton
President, Aviation Week

OEM partners include UTAS, Safran, GE Aviation, Honeywell, Curtiss-Wright and many more.



**Production, Spares and MRO for
Business, Commercial and Military Aircraft**

EXTENDED LIFE SOLUTIONS

Under license or acquisition, Ontic supports your customers by providing OEM-pedigreed product for as long as there is a need. Value for the OEM. Value for the customer.

ONTIC
 A BBA Aviation company

Avionics, Electronics, Power, Engines, APUs,
 Hydraulics, Fuel Measurement Systems,
 Electro-Mechanical, Heat Transfer,
 Landing Gear, and much more.



(+1) 818 678 6555 ontic.com

New for 2015!

SpeedNews Aerospace Additive Manufacturing Briefings



April 7, 2015

Terranea Resort • Palos Verdes (Los Angeles) • CA

In conjunction with SpeedNews Aerospace Manufacturing Conference

Please visit www.SpeedNews.com for more information

SpeedNews

11500 W. Olympic Blvd., Suite 574 • Los Angeles, CA 90064, USA

Tel: +1-424-465-6501 • Fax: +1-424-465-6506 • conferences@speednews.com

SpeedNews is part of the Penton Aviation Week Network

AVIATION WEEK

& SPACE TECHNOLOGY



Digital Extras Tap this icon in articles in the digital edition of AW&ST for exclusive features. If you have not signed up to receive your digital subscription, go to ow.ly/AkXJo

- 8 Feedback
- 10 Who's Where
- 12-13 First Take
- 14 Up Front
- 16 Going Concerns
- 18 Inside Business Aviation
- 19 Airline Intel
- 20 Reality Check
- 22 Leading Edge
- 24 Commander's Intent
- 26 In Orbit
- 28 Washington Outlook
- 71 Classified
- 72 Contact Us
- 73 Aerospace Calendar

DEFENSE

- 30 General Atomics** completes lab tests of 'third-gen laser system,' saying it sets new standards in efficiency
- 31 Northrop Grumman** halts Uclass work as Pentagon yet again delays competition for carrier-based UAV
- 32 U.S. Navy reduces** planned F-35C orders by a third, starts new investment in standoff weapons
- 34 Lockheed Martin** leverages Israeli know-how to develop a roll-on, roll-off AEW capability for helicopters
- 35 Harris's acquisition** of Exelis could create one of the West's largest aviation and A&D providers
- 56 Northrop Grumman-led** team now opts for a clean-sheet design for USAF T-38 replacement program



50

Enjoying solid funding, the Chinese aerospace sector is looking into just about every fabrication technology that it can, including laser-forming for manufacturing parts in fighters such as the Shenyang J-31.

- 58 Small problems** that blighted early NH90s are still causing concerns as operators struggle to procure spares

SPACE

- 36 Space shuttle** experience on reusability, survivability guiding next-gen commercial spaceflight vehicles
- 60 European aviation** authorities are skeptical that the space sector can meet safety standards

COMMERCIAL AVIATION

- 37 ICAO takes small** steps first as it navigates path to global tracking and conflict zone alerts
- 38 China Airlines** gears up for North American business growth, especially transfer traffic from mainland

- 38 Middle East** commercial aviation MRO market is growing at faster rate than the global average

- 40 Legacy airlines** in Europe and the U.S. have seen the growth of Gulf carriers with increasing dismay

- 42 New upgrade** package may be key to streamlining Boeing's production transition to advanced 777X family

- 43 Joint widebody** airliner project between Russia and China is one step closer to coming to fruition

INDIAN AIRLINES

- 45 Air India faces** myriad challenges as it tries to regroup, including the creation of more domestic airlines
- 46 India's aviation** sector is a financial minefield, but that has not deterred foreign investors



ON THE COVERS

This week, Aviation Week publishes two print editions. On the cover far left, pilots of an American Airlines Boeing 757 fly over Providence, Rhode Island, in this photo by Kent Wien for the airline's training department. A special report delves into causes and consequences of a looming pilot shortage in the U.S. (see page 62). Also in both editions are reports on Northrop Grumman's T-X trainer (page 56), Indian airlines (page 45), General Atomics' laser (page 30) and Asia-Pacific defense (page 50). On the cover of the Defense Technology International edition, a Royal Jordanian Air Force H-60 Black Hawk prepares to deliver fast-roping troops during a multinational exercise at King Abdullah II Special Operations Training Center, with an MD 530F scout in the background. U.S. Army photo by Spc. Samantha Parks. That edition includes an additional section of articles on defense. Aviation Week publishes a digital edition every week. Read it at AviationWeek.com/awst and on our app.

ADS-B IS COMING. WE COULDN'T WAIT.



Equip Today and Take Advantage of NextGen Now.

NXTTM
800/600
ADS-B XPDR



L-3 offers a diverse line of products and services for airlines. Our transponders were the first certified and available for airliners to meet the global mandates for ADS-B, with installations already complete on hundreds of aircraft. Our new NXT-800TM and NXT-600TM transponders are DO-260B- and DO-181E-compliant to meet ADS-B Out mandates and are optimized for flight in the NextGen/SESAR air traffic environments. When coupled with L-3's SafeRoute[®] ADS-B In solutions, they help reduce flight times and fuel consumption, while increasing airspace capacity. We also have Iridium SATCOM to meet upcoming directives in China and other regions, as well as TCAS, TAWS, standby systems, voice and data recorders, displays and aftermarket services.

Update your fleet with L-3 Aviation Products. L-3com.com/AviationProducts.

Aviation Products

  L-3com.com



**Download
& Login
Instructions**

Start reading today by following the steps below.

DOWNLOAD. Go to the Apple App Store, search for "Aviation Week" and download the *Aviation Week & Space Technology* app to your iPad or iPhone.

OPEN. Once the app is downloaded, open it on your device.

LOGIN. Tap on any locked article to get the login screen OR on the menu icon in the upper right corner of the app screen (image with three parallel lines) and tap "Login." Log in using the email address associated with your subscription.

Forgot Password? Tap the "forgot password" link on the login screen and follow the reset instructions emailed to you (this password may not be the same as for your Zinio digital edition).

Already Downloaded? Make sure you have the upgraded version of the app, which fixes some bugs and adds a tutorial for users. Go to the Apple App store and click on "updates" to download. You can also improve performance by going into Settings, clicking on Safari and selecting "clear history and website data."

Android User? An Android version of the app has been developed and will be available shortly.

Desktop/Laptop Access: Go to AviationWeek.com/awst, click on "read the digital edition" under the cover image.

Problems? If you don't have a registered email or password, or are having problems with the download or login, contact our customer care team for assistance:

Toll-free (North America)
800-525-5003

Outside North America
(+1) 847-763-9147

Email: awstcustserv@halldata.com
Web: AviationWeek.com/awstcustomers

31

48 India's beleaguered aviation sector has started to see signs that could foretell a turnaround in fortunes

ASIA-PACIFIC DEFENSE

50 Chinese report outlines efforts that Avic entities are putting into advanced manufacturing technology

50 Australia gives up major state support for aerospace manufacturing and demand for offsets

53 India opens way for global aerospace and defense giants to inject know-how and funds into local ops

54 Heated talks between Paris and New Delhi surround Dassault's responsibility for Indian-built Rafales

TECHNOLOGY

59 U.S. Army warns further budget cuts could threaten development of advanced rotorcraft

PILOT SUPPLY

62 Impending retirements forcing pilot supply chain to unify in a search for solutions to keep cockpit seats filled

64 Supply and demand in Asia translates to premium pay and opportunities for expatriate pilots

66 Pilot academies in Australia play leading role in helping to fill cockpits at Southeast Asian, Chinese airlines

68 Airline industry looks at streamlining the process of certifying pilots to ease expected shortage

70 USAF tackles looming pilot retention problem as airlines grow aggressive on hiring

EDITORIAL

74 Looming airline pilot shortage could adversely affect the U.S., due to the importance of commercial aviation

26



E-JETS
E2
THE SECOND
GENERATION

Prepare for departures from the norm.

With our E-Jets E2 program well under way, it is time for a look inside, where well-conceived design for a new generation allows passengers to enjoy their own personal territory. This "space within a space" is achieved through clear delineation, advanced ergonomic engineering, and meticulous attention to detail throughout the sumptuous cabin. All to ensure each seat – and every crew station – is a great destination in itself. Leaving normal expectations far behind.



LOVE WHAT YOU FLY



Commercial Aviation

Aviation Week & Space Technology welcomes the opinions of its readers on issues raised in the magazine. Address letters to the Executive Editor, Aviation Week & Space Technology, 1911 Fort Myer Drive, Suite 600, Arlington, Va. 22209. Fax to (202) 383-2346 or send via e-mail to: awstletters@aviationweek.com. Letters should be shorter than 200 words, and you must give a genuine identification, address and daytime telephone number. We will not print anonymous letters, but names will be withheld. We reserve the right to edit letters.

LAST WORD ON PERSON OF THE YEAR

Why is it the notorious are the ones who are lifted to such an elevated status as person of the year (AW&ST Jan. 15-Feb. 1, cover and p. 36).

Vladimir Putin is merely the leader of a country that manufactures anti-aircraft missiles and supplies them to a military force that it recruited, trained, supports and controls. Yet he denies any part of this force.

As to his purported impact in three categories: Military, Commercial Aviation and Space. For the military realm, you state that world leaders are told to increase defense spending by 20% for their own safety. Well spending on anti-terrorism *should* be that much.

And a heightened risk to commercial aviation? Banning flights through certain countries' airspace is not new. Failure to follow proper protocol will lead to adverse situations in many quarters of the world.

In the space sector, any effort as long term as the International Space Station will be in a constant state of turmoil. Members will move in and out due to the fluid nature of such a program.

I do not see that your selection truly had a grandiose effect on aviation.

Roy Steele

GEORGETOWN, TEXAS

HUMAN FACTORS ARE KEY

The recent string of airline accidents has a common thread that points to a human factors issue in the interface of pilot and machine.

Human factors play a very important role in aircraft design and in the FAA certification process as cockpits become more automated. However, adequate training and testing in dealing with the interface is lacking.

It is commendable that the FAA has recognized this problem and is in partnership with training and testing stakeholders as well as industry volunteers to develop the Airman Certification System—set to be introduced by year-end—which updates training and testing of pilots and their ability to interface with the aircraft systems and automation in all phases of flight under normal and emergency conditions.

Robert J. Stewart

SAVANNAH, GEORGIA

THINKING BEYOND 'BLACK BOX'

I agree with the premise in "Learning the Right Lessons" (AW&ST Jan. 15-Feb. 1, p. 15) that easier-to-locate

recorders may speed investigation but would not make air travel safer.

I reiterate the proposal I originally submitted to Feedback years ago (AW&ST July 6, 2009, p. 8): Real-time transmission of flight and voice data, rapidly screened by computers for deviations and discrepancies, can alert ground pilots in the loop, who can then call the cockpit crew and encourage corrective actions.

This could proactively avert mishaps, save lives and aircraft and improve flight safety.

Frank Yang, Flight Surgeon

RALEIGH, NORTH CAROLINA

ANOTHER PROUD INSTITUTION

"Celebrating France's Aviation Heritage" (AW&ST Feb. 2-15, p. 18) states that the Aeroscopie museum in Toulouse is trying to emulate Seattle's "Boeing-sponsored museum." Please

note that the Seattle Museum of Flight is *not* a Boeing museum. We are an independent non-profit enterprise. In fact we have more Lockheed Martin than Boeing aircraft in our collection. And I would like to take this opportunity to say that if, by chance, Lockheed has a stealth aircraft they could donate, the museum and aerospace aficionados worldwide would be grateful.

*Rees Shuman, Docent
Seattle Museum of Flight*

SEATTLE, WASHINGTON

ROTE RESEARCHER RESPONDS

"Rule Out Rote" (AW&ST Feb. 2-15, p. 60) states that during a simulator training event in which an unexpected stall was introduced "the correct response in all cases is to immediately push the power levers forward for full power." This statement is stunning in its aerodynamic ignorance.

Stall recovery has nothing to do with power and everything to do with angle of attack (AOA). Decades ago the U.S. Air Force had its student pilots put the T-38 into a full aft stick stall and then try to recover using power alone. Full afterburner had no effect.

We have at least one confirmed case—the catastrophic accident of Air France Flight 447—in which a fully functional aircraft was stalled and then crashed into the sea with full power and full aft stick controls.

The proper first response in any stall is to immediately reduce the AOA. This allows aerodynamic control to be regained. Power (up to maximum) may then be added to minimize the altitude lost.

If industry continues to propose that power is the proper corrective action for a stall—and AW&ST promulgates it—flyable airplanes will continue to crash.

Guy Wroble

DENVER, COLORADO

NASA Ames Research Center's Stephen Casner responds: *The data were collected before the FAA's release of Advisory Circular AC 120-109, when there was still much ongoing debate about the prevailing "power your way out of it" approach to stall recovery during simulation events. For this reason, the research team was uninterested in pilots' stall recovery; the sole focus was on pilots' stall recognition.*

The thrust response data led us to wonder why pilots would do something different when they were asked to recognize the stall themselves, rather than having the simulator operator announce the event. During 40% of the stall events, pilots turned to the research pilot in the right seat and asked about the nature of what was going on (stickshaker, buffeting, deteriorating airspeed, pitch-down attitude).

Although the industry has moved toward implementing the stall-recovery technique the reader references, it should be noted that pilots still continue to practice one very familiar stall routine, and in doing so may be failing to prepare themselves to recognize the many ways in which stalls might appear.



AN ICON JUST GOT LARGER



THE NEW NAVITIMER 46 mm



Thierry Casale



Bridget Coulon



H.M. Crofford



Jon Hester



Rodrigo Pesoa



Dirk Schmitt



Ron Case

To submit information for the Who's Where column, send Word or attached text files (no PDFs) and photos to: stearns@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.

Patrick Piedrafita has been appointed head of the A350 program at Airbus. He has been head of the A330-family program and succeeds **Didier Evrard**, who is now executive vice president-programs. Following Piedrafita is **Eric Zanin**, who has been head of procurement operations. **Klaus Roewe**, who has been head of the A320neo program, is now head of the A320-family program and succeeds **Daniel Baubil**, who is now senior adviser to Evrard. **Charles Champion** has been named director-general of Airbus operations and will continue as executive vice president-engineering.

Thierry Casale (see photo) has become senior vice president of the programs directorate of Toulouse-based ATR. He was senior vice president-operations.

Brad Sims has been appointed chancellor of Embry-Riddle Aeronautical University-Worldwide. He was chief academic officer at ERAU and had been dean of the College of Technology at Indiana State University. Sims succeeds **John R. Watret**, who is now senior vice president/chief operating officer. **Richard Heist** has been named senior vice president-academic affairs/provost. He was chief academic officer for the Daytona Beach (Florida) Campus.

Bridget Coulon (see photo) has become vice president-human resources for the corporate office and Enterprise Shared Services organization of the Northrop Grumman Corp., Falls Church, Virginia. She was human resources business leader for the engineering, manufacturing and logistics section of the company's Electronic Systems Sector in Baltimore. **Heather M. Crofford** (see photo) has been named the organization's vice president/CFO, effective March 9. She has been director of business management for the Cyber division within Northrop Grumman's Information Systems Sector. Crofford succeeds **Donald E. McHugh, Jr.**, who has been appointed vice president/business operations director/controller of National Security Technologies, a joint venture in which Northrop Grumman is a partner.

Francois Bastin has been appointed CFM programs director/executive vice president of CFM International at France-based Snecma. He succeeds **Cedric Goubet**, who has been appointed

ed executive vice president-commercial engines. Goubet succeeds **Francois Planaud**, who has become executive vice president-services.

Jon Hester (see photo) has been promoted to vice president-visual systems from general manager for New York-based FlightSafety International.

Jurgen Schwarz has become senior vice president-engineering of Germany-based Continental Motors Group.

Rodrigo Pesoa (see photo) has been promoted to senior director of sales for Latin America from sales director of South America for Dassault Falcon Jet.

William McLemore has been appointed vice president/chief information officer at Houston-based Landmark Aviation. He was CIO for the Apex Clearing Co.

Dirk Schmitt (see photo) has become Frankfurt-based CEO for cargo services for Germany and Austria for Swissport International. He held senior management positions at Luxair Cargo.

Vasu Raja has been promoted to vice president from managing director of international revenue management at American Airlines.

Ron Case (see photo) has become CEO of Cadence Aerospace, Newport Beach, California. He succeeds **Larry Resnick**, who will continue as chairman. Case was CEO of Synchronous Aerospace.

USAF Lt. Gen. (ret.) **Charles R. Davis** has become executive vice president of the New York-based Seabury Aerospace & Defense Consulting Div.

HONORS AND ELECTIONS

Dirk Breynaert, co-founder/chief technology officer of Newtec, is one of four technology pioneers who will be inducted into the Satellite Hall of Fame of the New York-based Society of Satellite Professionals International. He will be cited for his work as CEO when he pushed for Newtec to develop and introduce innovations in DVB and also "played a

leadership role in the standards development process" that led to DVB-S, DVB-S2, DVB-RCS and DVB-S2X. As a result, more than three billion people have access to the latest content. He later became CTO and has worked to penetrate the throughput barriers that have limited the satellite industry.

Another inductee will be **Mark Dankberg**, co-founder/CEO/chairman of ViaSat. He will be honored for creating an organization that pioneered a series of technologies with major impact on the evolution of defense, mobile and Internet communications. The third inductee will be **David Thompson**, co-founder/chairman/CEO of the Orbital Sciences Corp., which developed the Orbcomm low-Earth-orbit communications and remote-sensing fleet, small-class GEO communications and Earth-observation satellites, scientific satellites for NASA and cargo resupply vehicles for the International Space Station. The fourth inductee will be **Xuyen T. Vuong**, vice president/chief scientist of Artel, which is the largest bandwidth provider to the Defense and Homeland Security departments.

Former NASA Deputy Administrator **Lori Garver** has been named the winner of the National Space Society's 2015 Space Pioneer Award in the non-legislative Government Service category. This award is scheduled to be presented at the society's 2015 International

Space Development Conference in May. She will be cited for "supporting launch privatization and new technology development that will allow more effective human space operations both in low Earth orbit and beyond." ☼

“

“The Dreamliner is a perfect fit for THAI in terms of its range, size and fuel efficiency.”

“The 787 also serves our goal of being an environmentally responsible airline.”

“Passengers will certainly enjoy the quiet and spacious cabin of this aircraft.”

”

Mr. Charamporn Jotikasthira
President
Thai Airways International



THE DREAMLINER EFFECT.
THAI SUCCESS.

First Take



NORTHROP GRUMMAN

DEFENSE

Northrop Grumman has scrapped plans to offer BAE Systems' Hawk for the \$1 billion U.S. Air Force T-38 replacement program, opting instead for a clean-sheet trainer. Subsidiary Scaled Composites is to fly a prototype by year-end. A competition is expected to begin in fiscal 2016, and Boeing also plans a clean-sheet design (page 58).



EMBRAER

Embraer launched a two-year test program with the Feb. 3 first flight of the KC-390 tanker/transport from Gaviao Peixoto, Brazil. Powered by two International Aero Engines V2500-E5 turbofans, the fly-by-wire airlifter flew for 1 hr. 25 min. The Brazilian air force has ordered 28 KC-390s for delivery beginning by early 2017.

France confirms government-to-government agreement with Egypt on an arms package to include 24 Dassault Rafale fighters. Deliveries could begin in 2018, says France's procurement chief. Still in search of an export

contract, France is continuing negotiations with Qatar, but discussions with India over a 126-aircraft deal are bogged down on how Rafales will be produced there (page 54).

Israel Aerospace Industries (IAI) has launched a maritime patrol aircraft based on Bombardier's Global 5000 business jet. India and Asia are target markets. IAI will modify the aircraft, installing its ELI-3360 mission system, adding hardpoints and certifying the new configuration. The aircraft



ISRAEL AEROSPACE INDUSTRIES

can be equipped with a magnetic anomaly detector, sonobuoys, torpedoes and missiles.

Defense electronics suppliers Harris and Exelis delighted analysts by unveiling a planned \$4.75 billion merger on Feb. 6. A day later Alliant Techsystems completed the \$5 billion merger of its aerospace and defense business with Orbital Sciences. The deals lead analysts to predict further portfolio shaping as the supplier base in both the defense and commercial sectors consolidates (page 35).

Saudi Arabia is the first export customer for Europe's MBDA Meteor ramjet-powered beyond visual range air-to-air missile, signing a contract worth more than \$1 billion to arm its Eurofighter Typhoons. MBDA has previously sold Brimstone air-to-ground and Storm Shadow cruise missiles to the Saudis.

COMMERCIAL AVIATION

Bombardier has a new CEO and financing plan. Former United Technologies aerospace executive Alain

Bellemare is succeeding Pierre Beaudoin, who becomes executive chairman following Laurent Beaudoin, who is retiring. The company plans to raise \$600 million in equity and \$1.5 billion in debt to help fund development of the CSeries and Global 7000/8000. Bombardier will also explore "participation in industry consolidation" with certain businesses.

Ten of 49 pilots of Taiwan's TransAsia Airways failed an oral test on handling the twin-turboprop ATR 72 after an engine failure and were suspended from flying, along with another 19 who had not yet attempted the test. The test came a week after a TransAsia ATR 72 crashed on takeoff from Taipei's Shansong Airport, when one engine auto-feathered and the crew shut down the other one. Suspended pilots are expected to be retrained and retested in a month.

To keep it selling until the 777X enters service in 2020, Boeing is to upgrade the 777-300ER to reduce fuel burn by 2% from 2016 onward. General Electric, exclusive engine supplier with the GE90-115B, expects to begin testing improvements by year-end, targeting about a 0.5% specific fuel consumption reduction. The rest is expected to come from aerodynamic improvements (page 42).

Alleging that unfair government subsidies to Gulf carriers Emirates, Etihad Airways and Qatar Airways have tilted the playing field, American, Delta and United airlines have petitioned the U.S. government to limit open skies deals with Qatar and the United Arab Emirates. Seven European airline CEOs have also complained to the European Commission about the "absence of a level playing field."

Spurred by the disappearance of Malaysia Airlines Flight 370 and shootdown of Flight MH17, International Civil Aviation Organization (ICAO) members have agreed to implement comprehensive global tracking and conflict zone warnings over time, and take interim steps almost immediately. ICAO will launch "without delay" a "simple centralized web-based repository" of threat information, and airlines will be strongly encouraged to voluntarily begin tracking their aircraft (page 37).

A free “Alert” aircraft tracking service will be offered in 2017 by start-up satellite surveillance provider Aireon and the Irish Aviation Authority. While the primary use of space-based automatic dependent surveillance-broadcast is designed to reduce separation for subscribing airlines over the North Atlantic, Ireland will provide tracking data as a public service for rescue coordination centers and other vetted users.



BUSINESS AVIATION

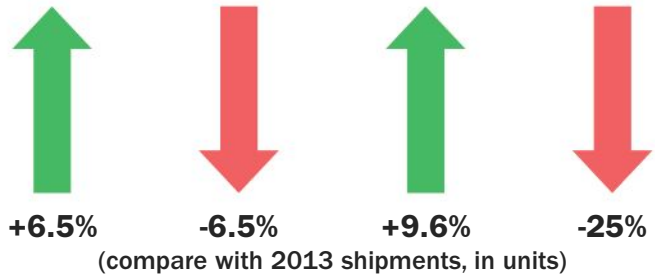
Dassault’s largest, longest-range business jet, the Falcon 8X, made its first flight from Bordeaux-Mérignac, France, on Feb. 6. A stretch of the Falcon 7X, powered by three uprated Pratt & Whitney Canada PW307Ds, the 8X has a range of 6,450 nm. A three-aircraft, 550-flight-hour test program is planned, leading to certification in mid-2016.

Agusta Westland is flying the first British-assembled AW189 commercial helicopter, the second of 11 for the Bristow Group’s U.K. Department of Transport search-and-rescue contract. The SAR version was certified in December, and the Italian-assembled first aircraft is being used for training in the U.K.

New Zealand startup Composite Helicopters International has filed to certificate a new light single-turbine family: the entry-level, five-seat KC630 with a Rolls-Royce RR300 for certification in late 2017; and the high-power, six-seat KC650 with a Honeywell LTS101, and a proposed medium-power KC640 with Rolls M250-C20B, to follow in 2018.

Airship developer Hybrid Air Vehicles has received a second “multimillion dollar” funding tranche from the U.K. government, to help return its prototype to flight and develop a production Airlander hybrid airship. The “significant grant” from the Regional Growth Fund will unlock private-equity investment and customer funding for demonstrations,

2014 General Aviation Shipments



Business Jets 722 Turboprops 603 Pistons 1,129 Helicopters 971

Source: General Aviation Manufacturers Association

HAV says. The prototype is planned to fly in the second quarter.

SPACE

Europe was first to send a lifting-body spaceplane into space when its wingless Intermediate Experimental Vehicle (IXV) splashed down in the Pacific west of the Galapagos on Feb. 11



EUROPEAN SPACE AGENCY

after a flawless reentry that could open the door to reusable space vehicles. The unmanned IXV was launched eastward by Vega from Kourou, French Guiana, on a 100-min. suborbital flight.

SpaceX scrubbed an attempt to recover the first stage of its Falcon 9 when high seas prevented the unmanned landing barge from keeping its position, but successfully launched the Deep Space Climate Observatory spacecraft on Feb. 11. The company says the first stage soft-landed in the Atlantic within 10 meters (33 ft.) of target and “nicely vertical.” SpaceX will now beef up the seaworthiness of its “drone ship.”

52 YEARS AGO IN AW&ST

The Boeing 727 passenger jet made its first flight on Feb. 9, 1963, powered by three Pratt & Whitney JT8D turbofans. The first commercial Boeing program to use a dedicated aircraft for flight testing, the 727 was the first jetliner fitted with an auxiliary power unit. Six years later the Boeing 747 made its maiden flight, also on Feb. 9.



SPECIAL REPORT: Army Program Tests Bell UH-1B at High Speeds

Read our original coverage of these and other momentous events at AviationWeek.com/100.



By Kevin Michaels

Kevin Michaels is a vice president with ICF International's Aerospace & MRO consulting practice in Ann Arbor, Michigan.

COMMENTARY

Rethinking Bombardier

Why the aircraft builder needs a radical overhaul

Where there is smoke, there is usually fire. Bombardier's shelving of the Learjet 85 midsize business jet last month is symptomatic of two much larger issues that new CEO Alain Bellemare must confront in the near future: one is financial, the other is strategic.

The financial issue is liquidity. Bombardier has roughly \$2.5 billion in cash and cash equivalents on hand, and it has an estimated \$100 million-per-month burn rate to support development of the oft-delayed CSeries narrowbody airliner (see photo), the high-end Global 7000/8000 business jets and until recently the Learjet 85. The CSeries looks to be at least a year away from entry into service (EIS), and Bombardier must cover a \$750 million bond payment due next year. Given the \$1.5-2 billion in working capital that it needs to run the business and meet debt covenants, it looks like Bombardier risks running out of cash in 2016.

Now Bombardier's strategic issue: In contrast to its Commercial Aircraft business, Business Aircraft has a great product portfolio—particularly in large cabin aircraft—but it is being starved of development funds as Bombardier circles the wagons around the CSeries. Case-in-point is Bombardier's late response to Gulfstream's G650, which entered service at the end of 2012.

A fast response was needed, but lacking development funds, Bombardier's competing Global 7000/8000 will not enter service until 2016-17. This has left Gulfstream with a generous four or five years alone in business aviation's most profitable segment. Not surprisingly, Bombardier ceded its No. 1 market position to Gulfstream last year. And last month, Bombardier halted the Learjet 85, citing "weak market demand" at a time when interest in smaller business jets is poised for growth. Business Aircraft's problem—lack of development funds—is growing worse.



BOMBARDIER

Its credibility is also suffering, which may have contributed to poor 0.6 book-to-bill ratio in 2014 when rival Gulfstream experienced robust unit sales.

What should Bombardier do? The company appears to have two major options short of a government bailout: issue high-yield debt or fundamentally restructure.

Issuing debt would rattle financial markets, but would allow Bombardier to bring the CSeries to market and possibly fund the \$1 billion-plus Global 7000/8000 development program. Not surprisingly, Bombardier just indicated it will seek up to \$1.5 billion in long-term debt. This will buy time but not address the financial implications of running a CSeries production line at suboptimal rates. My firm, ICF International, forecasts the CSeries to be a niche aircraft with 40-60 deliveries per year, when 100 or more is the likely breakeven threshold. Additionally, Boeing and Airbus are using marginal pricing to sell their "last off the line" 737s and A320s before they are reengineered later in this decade.

Then there is the issue of scale. Last year, Bombardier delivered less than \$2 billion worth of airliners; Boeing and Airbus combined for more than \$100 billion. Bombardier portrays the CSeries EIS as the end of its challenges;

in reality, it could be just the beginning. How in the long run can the company remain in the same league as these giants while simultaneously competing in business aircraft? This means Commercial Aircraft likely will bleed cash for the foreseeable future and continue to drag down other parts of the business.

This leaves fundamental restructuring as the best long-term option for the survival of Bombardier. I believe it could survive and thrive by pursuing a three-point restructuring.

First, sell the aerostructures business. Aerostructures is not a core competency and does not provide a competitive advantage in Bombardier's core aircraft business. Shedding this business would sharpen management's focus and provide much-needed capital.

Second and most controversial: Sell or pursue a joint venture for the money-losing Commercial Aircraft business. As discussed in my June 23, 2014, column (page 13), China's Comac appears to be the best option. To be successful, Comac needs Western certification expertise, a global customer support function, and systems engineering and supply chain capabilities. Bombardier can provide all four. Bombardier needs capital and customers; Comac can supply both. I call this the "Combardier" scenario. Combardier could then market the CSeries in China and the Comac C919 to customers outside of China. On paper, the two are a hand-in-glove fit. The real world is far messier, and politics could block such a tie-up. If Combardier is not in the cards, then Bombardier must find another partner quickly.

The third element of restructuring is to double-down on the profitable, \$6 billion-plus Business Aircraft unit. Freed of the distractions and financial drain of the CSeries, Bombardier could accelerate development of the Global 7000/8000 and restart the Learjet 85. With a broad product portfolio and strong brand, Bombardier would have a real shot at regaining its No. 1 position.

Fundamental restructuring is never easy, but Bombardier's current course is potentially unsustainable. The new Bombardier would be a focused, highly profitable Canadian business aircraft leader. And Combardier might just have the scale and resources to break the Boeing-Airbus duopoly. ☐

Profitability **first**



COST-EFFICIENCY

The ATR-600 series aircraft is the most competitive and cost-efficient product airplane in the regional market.

REMARKETABILITY

With more than 180 operators in over 90 countries worldwide, ATR aircraft offer operators, investors and financiers stable lease rates, good value for money and strong residual values over time.

INNOVATION

Rely on the best high-flying investment!

PROPELLING THE NEXT CONNECTION



atrbroadcast



atracraft



atracraft.com



atracraft



ATR





By Michael Bruno

Senior Business Editor
Michael Bruno blogs at:
AviationWeek.com/ares
michael.bruno@aviationweek.com

COMMENTARY

Plus or Minus

Why a post-Chenevert UTC is emblematic of a reshaped aerospace industry

When the news broke late last November, few could believe it at first. Louis Chenevert, architect of the aerospace and defense sector's largest merger and acquisition (M&A), the \$18.4 billion purchase of actuation systems and landing gear provider Goodrich, was suddenly out as chairman/CEO of United Technologies Corp.

News reports told of an anxious board of directors concerned that he was too complacent and not focused enough on securing the multi-industrial giant's growth. How much of that drove his departure may never be known beyond Chenevert, the board and the new senior management at United Technologies (UTC). But one thing is known: Despite the jarring transition, Wall Street approves.

That is because Chenevert's replacement by Gregory Hayes could lead to more so-called bolt-on acquisitions and divestitures of current business lines, bringing even better positioning for growth and stock prices, too. "He's more likely than his predecessor to pursue financial initiatives like more aggressive [share] buyback, portfolio shaping (but not sale of Sikorsky), and M&A," Cowen and Co. analysts say.

If so, count United Technologies among the latest to jump on the portfolio-shaping bandwagon. On Feb. 6, Harris and Excelis excited analysts and stock traders alike by unveiling their planned \$4.75 billion combination (see page 35). It came the day before Orbital Sciences closed on its similarly sized match-up with the A&D portion of Alliant Techsystems.

"The management change at United Technologies is intriguing because



Former UTC CEO Louis Chenevert

of what this might imply regarding a fresh look at its defense portfolio," says analyst Byron Callan of Capital Alpha Partners. "Other defense firms could also elect to further focus on core businesses and review their portfolios." He says M&A volume for deals worth \$100 million or more picked up pace in 2014, and he expects the trend to continue.

The reasons are self-evident. As government spending bottoms and even looks up, and airliner manufacturers move to boost production even more to meet historic backlogs, companies are moving beyond post-recession survival mode and eyeing long-term growth prospects. In turn, most observers believe 2015 could be a banner year for M&A in aggregate numbers of deals and total spending, and at all levels except between the few remaining defense prime contractors and OEMs.

"Sentiment on the sector will start to focus on growth, and we continue to expect more consolidation in the defense industry at all levels," Canaccord Genuity analysts say.

"We've seen 60-plus defense-related deals announced in 2014, which we think is well up on the year before," say RBC Capital Markets analysts. "As the defense sector becomes more

comfortable in the improving outlook, we expect M&A in the sector to gather momentum. Structural growth areas like cybersecurity, C4ISR, electronics and UAVs are likely to be sought after."

Likewise, in the commercial aviation subsector, M&A is expected to be "very robust" over the next 12-24 months, with 92% of respondents to a GE Capital survey late last October seeing an uptick. They cite opportunities to gain savings via streamlining business operations, increased availability of low-interest rates to finance acquisitions and relatively low purchase prices.

"Record-high backlogs for commercial aircraft give buyers an unprecedented level of visibility," says Yair Reiner, aerospace and government services analyst with GE Antares Capital, a provider of M&A financing to private equity-backed middle-market companies. "Plane makers want suppliers to become both stronger and leaner, which encourages and rewards consolidation. And defense spending, a significant thorn for the industry in recent years, is showing signs of stabilizing."

Orbital ATK and Harris Corp. are good examples of seemingly natural pairs becoming the next big mid-tier players. But while the Pentagon does not want its primes to consolidate wholly—and OEMs such as Airbus Group, Boeing and Embraer are unlikely to do so due to established market positions—many industry watchers see them shaking out, too.

For instance, Europe's Airbus recently announced a major divestiture plan, as has Italy's Finmeccanica, including possibly selling off U.S.-based DRS Technologies. Northrop Grumman has hired Brett Lambert, a former defense industrial policymaker who mapped industry for the Pentagon during the recession, as a vice president in corporate strategy.

Myriad analysts say awards of major contracts such as the U.S. Air Force Long-Range Strike Bomber this year could help primes decide whether to stick with aircraft manufacturing. Imagine Northrop shaving off its aerospace division—as it did shipbuilding—including a sale to Boeing or another OEM. In the end, some surmise, it could simply be a question of what price to sell at—win or lose the bomber. ☞

AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

OUR VISION, REFLECTED



CLOSE TO HOME

Beyond groundbreaking color, PPG delivers service at jet-speed through a global network like no other.

To expedite product delivery and bring technical resources closer to our aviation customers, PPG offers global capability from 16 regional Application Support Centers (ASCs) around the world. Besides providing direct access to our market-leading coatings, sealants, and transparencies, ASCs offer rapid-response services such as color matching and blending, window systems assembly, chemical management, and value-added packaging for PPG coatings, sealants, and materials supplied by customers. What else does proximity enable? For one, the arrival of pre-mixed frozen sealants and customized sealant solutions that reduce process time and waste—technicians thaw only what's needed.

Visit ppginnovation.com/closetohome to learn how innovation at PPG is helping our aviation customers.



Scan to learn more.



PPG Industries

Bringing innovation to the surface.™

The PPG Logo is a registered trademark and *Bringing innovation to the surface* is a trademark of PPG Industries Ohio, Inc.
© 2015 PPG Industries, Inc. All rights reserved.



By William Garvey

Business & Commercial Aviation Editor-in-Chief

William Garvey blogs at:

AviationWeek.com

william.garvey@aviationweek.com

COMMENTARY

Bienvenue, Y'all

Whistling 'Dixie' with an accent

A small Southern town 100 mi. from anywhere, Columbus, Mississippi's matters of historical note include a graveyard full of Confederate and Union soldiers felled at the Battle of Shiloh, the boyhood home of playwright Tennessee Williams, and a company, now bankrupt, that once turned out more toilet seats than any other in the world.

So it came as a surprise to many in the aerospace community when in 2003, Eurocopter—now Airbus Helicopters—chose Columbus as a site for light final assembly work involving its AS350 AStar helicopter. But the Europeans had grander aspirations.

Three years later, the company won a U.S. Army contract to build the UH-72 Lakota, a militarized version of the twin-engine EC145; the Mississippi facility (center photo) will produce some 300. Last year, the plant began full assembly of the AStar (right photo), the first of which is to be delivered right about now. The facility could eventually produce 60 annually. To date, the Mississippi unit—which employs 230, almost half of them military veterans—has delivered more than 800 aircraft.

When it began building what has grown to a 331,000-sq.-ft. factory, the company had the Golden Triangle Regional Airport (GTR) pretty much to itself. But not anymore. Today the airport is home to both Stark Aerospace, a division of Israel Aerospace Industries, and Aurora Flight Sciences; both are unmanned air vehicle manufacturers. “When we started, no one else was here,” says Samuel Adcock, vice president and general manager of the Airbus Helicopter facility. “We blazed a trail that others have followed.”

He is referring to new industries at the airport and its environs, representing 5,000 new jobs. Similar moves are being made by other international business aviation manufacturers as well, and the Southeastern United States seems to be their favored landing place.

Honda Aircraft has built a sprawl-



AIRBUS HELICOPTERS PHOTOS

ing, sparkling new campus comprising headquarters, manufacturing, research, training and service facilities at the Piedmont Triad International Airport in Greensboro, North Carolina. Meanwhile, Honda Aero, the joint venture of Honda and GE, is building engines at a brand new facility in nearby Burlington.

Some 480 nm south, at Florida's Melbourne International Airport, Embraer has created its own campus for assembly of its Phenom jets. Last year it also opened a research center there, and currently is undergoing a \$76 million expansion of its assembly and delivery facility to accommodate its Legacy executive jets as well.

Meanwhile, Dassault Falcon Jet is investing \$60 million to add another 250,000 sq. ft. of space at its Little Rock, Arkansas, completions center—already the largest facility operated by the French manufacturer—to handle the new 5X and 8X models.

And not to be overlooked, Michelin is manufacturing tires for business and commercial aircraft at its facility in Greenville, South Carolina.

So does this embrace of “the South,” long home to Gulfstream, Bell Helicopters, Piper, and Continental Motors, among other original equipment manufacturers (OEM), constitute a

true and growing trend among their international counterparts? “Absolutely!” says one business aviation veteran executive. “It’s noticeable.”

According to Adcock, the attractions are many. The weather is much milder and more accommodating for flying, barbecuing and golf; living, land and power costs are lower, as are taxes if compared with other regions; there's a good pool of skilled labor; and local and state governments are eager—read, generous with tax breaks—to attract high-value manufacturing jobs.

Richard Aboulafia, vice president and aviation analyst with the Teal Group, says yet another factor stimulating foreign companies to manufacture or assemble in the U.S. is concern over fluctuations in currency.

“The Southeast is especially appealing to non-U.S. companies,” says Robert Stangarone, a consultant with broad experience in business aviation manufacturing. Coming to the South, he says, allows them “to be closer to their customers in their largest market, the U.S., while having the flexibility to start with a greenfield operation and build the business from the ground up with a clean sheet, using



the latest technology, manufacturing, environmental and logistics concepts.”

Another draw is the Southeast's universal embrace of “right to work” laws, which hold that no worker can be compelled to join a union, or pay union dues. As a result, unions are not well represented in the region, obviating an often-contentious relationship—and one “that's killing Wichita,” according to one veteran of the battles there.

So will the new Southern palate of fried chicken and foie gras, sushi and shoofly pie continue to expand?

“There are two things necessary to constitute a trend: data and a logical explanation,” Aboulafia notes. “And it seems to me we have both.” ☞



By Jens Flottau

Managing Editor for Civil Aviation
Jens Flottau blogs at:
AviationWeek.com/thingswithwings
Jens.flottau@aviationweek.com

COMMENTARY

Accept Reality

European and U.S. airlines seek protection against Gulf carriers, but should consider more clever responses

If there was any need to show how serious a threat the Gulf carriers have become to the club of legacy airlines, then the Big Six airline groups in the U.S. and Europe could not have come up with

more impressive action: In December, Air France-KLM and Lufthansa Group wrote a letter to the European Commission (EC) asking it to ensure fair competition. While they did not exactly specify what they wanted, it was clear they want traffic rights withdrawn from Emirates, Etihad Airways and Qatar Airways. Then, in late January, British Airways-parent International Airlines Group (IAG) welcomed Qatar Airways as its new largest shareholder. And almost at the same time, the CEOs of American, Delta and United asked the Obama administration to give up on open skies and limit air service from their new competitors.

What five of the largest airlines in the world are demanding is a return to pure protectionism. They want their governments to protect them from new market entrants that are beginning to dominate one part of the long-haul market—traffic to, from and between Southeast Asia, the Middle East, Europe, Africa and Australia. Gulf carriers are also growing their presence in North America, based upon long-established open skies deals for which the U.S. side has been pushing.

The demands by United, American, Delta, Lufthansa and Air France-KLM are in pursuit of their interests only and have nothing to do with the principles of free competition. They stand in a long and poor tradition of similar cases over decades: British Airways' fight against the rise of Virgin Atlantic, the much-delayed approvals for Virgin America, and the U.S. industry-labor alliance against Norwegian Air International are just a few examples that show how little trade principles are valued when the consequences are painful.

Some of the arguments used could almost be called cynical. The U.S. carriers want capacity between Gulf states and the U.S. to be reduced to local demand. Yet it should be up to any company to determine whether it wants to pursue connecting traffic. It was KLM, part of the Air France-KLM group, that adapted the FedEx

Chapter 11 bankruptcy protection in the U.S. is an incredibly powerful tool for airlines (and other companies) to reduce structural costs. It is a tool not available to carriers outside the U.S. European carriers still benefit from significant "restructuring aid" by their governments. Carriers such as Air India only survive on bailouts. Competition can be distorted almost anywhere almost all the time, but as long as it is not painful or even in one's own interest, nobody complains. And isn't the kind of protection American, United and Delta are asking for, a subsidy in the guise of economic policy?

Reversing open skies is clearly not the answer, and one can only hope that governments stand firm. It is time for the incumbents to accept reality and concede that parts of the market now offer a superior product at competitive prices. IAG came to the conclusion



JOEPRIESAVIATION.NET

hub-and-spoke principle for passenger traffic, and is to this day an airline that is way bigger than justified by the local market in the Netherlands. KLM has been "stealing" traffic from others, so why shouldn't Emirates, Etihad and Qatar be entitled to do the same? Lufthansa or Delta, too, operate huge hubs that not only connect their home markets with foreign countries but also happily connect China with Africa or Europe with Latin America.

And then there is this issue of "fair competition" that European and U.S. majors argue should link traffic rights to the absence of subsidies. While it is true that access to enormous financial support from the state—to which Emirates insists it has no access—can distort competition, other factors can do the same harm.

years ago that it is better to cooperate than to compete. The recent Qatar investment into the holding company that controls British Airways, Iberia and Vueling is only a consequence of the strategy IAG CEO Willie Walsh has pursued for many years. He does not need the money from Qatar, but he benefits from the strategic link that aligns IAG's interests with Qatar's. It is high time for others to consider similar steps. While Emirates has clearly demonstrated it is not keen to cooperate, Etihad would be very open, even though the strategic value of investing in European (and, potentially, U.S. airlines) is not that clear from the point of view of Gulf carriers. The potential targets should not be bothered as long as it helps them deal with one of their biggest challenges. ☺



By Pierre Sparaco

*Former Paris Bureau Chief
Pierre Sparaco has covered
aviation and aerospace
since the 1960s.*

COMMENTARY

Air France Endangered, Again

The future is looking bleak
for France's national airline

It seems Air France, a once-proud flag carrier with an impressive history, may never see the light at the end of the tunnel. In the next few days it is expected to unveil another severe cost-cutting plan, the third in a row, and more job cuts. Ground staff and flight attendants will be involved but not cockpit crews.

The carrier, despite Herculean efforts, is unable to regain profitability because its traffic growth remains below the European average. Domestic traffic is lagging, while low-cost carriers, chiefly EasyJet and Ryanair, are posting robust results, mainly by attracting more high-yield business passengers.

The Franco-Dutch Air France-KLM group is rapidly losing ground. It is now the smallest of the European majors, behind Lufthansa and the International Airlines Group (IAG) comprising British Airways and Iberia. This year, IAG will acquire control of Aerlingus—a major coup. Over the past several years, Ryanair desperately tried, but failed, to buy the Ireland-based Aerlingus. Now that airline will help IAG to strengthen its market share in the European market, thanks to an efficient hybrid economic model

that is close to the low-cost principle.

Is Air France doing too little, too slowly? Experts and airline analysts maintain divergent views, although it is obvious that company executives earlier in this century largely underestimated the threat from low-cost carriers. Jean-Cyril Spinetta, then-Air France-KLM chairman/CEO, now fiercely disputes the accusation. But the recently deceased Robert Esperou (a noted aviation authority) was convinced the French carrier was paying the high price for underestimating the clout of low-cost competitors.

Today, the future largely depends on Transavia's French unit, the group's newly reactivated low-cost subsidiary. Initially, Transavia was a charter airline serving leisure destinations from the Netherlands and France. In the last few years, it gradually evolved into a scheduled carrier operating an

all-Boeing fleet of 21 737-800s, with eight more soon to come. Based at Paris Orly International Airport, Transavia is expected to carry about 4.6 million passengers this year. Clearly, it is no longer a minor player. However, despite the claims of Air France-KLM executives, the relaunched carrier is far from having the size and power to launch a counterattack against low-cost giants. According to company executives, by 2020 Transavia will operate 80 aircraft, although it is not expected to achieve profitability until 2017.

But Air France-KLM leadership has additional reasons to worry. The group's strategy depends on its long-haul route system, and yet the key factor facing them now is the rapid proliferation of more lower-cost competitors on the horizon.

European legacy carriers are lobbying against Norwegian Air International, which is seeking transatlantic traffic rights. And other newcomers such as Air Canada's low-cost affiliate Rouge, which serves a number of European destinations, have entered the game. AirAsia X also could become a competitive threat.

But the most ominous rumors are coming from Amstelveen, near Amsterdam, home of KLM Royal Dutch Airlines's corporate headquarters. Although its top executives are maintaining a stoic face in public, their deep disappointment about the Air France-KLM merger is becoming increasingly apparent. The group's Dutch arm was always profitable. Its French branch, however, has consistently posted heavy losses, and this has led to resentment.

As soon as the merger agreement was unveiled, eyebrows were raised about the parties' cultural dissonance; keep in mind the Netherlands' "northern" and France's "southern" temperaments. Although company governance was combined and unified, both parties had to relinquish their working language in favor of English, the sole workable solution. Do cross-border mergers really work? Suddenly, the question is taking on new urgency. ☛

Transavia's long-term plan is to expand its fleet to 80 Boeing 737-800s in the next six years.



TRANSAVIA

Aviation Week's Fleet and MRO Forecasts



Unbiased Data for Accurate Strategic Planning

Aviation Week's 2015 Fleet & MRO Forecasts contain the 10-year outlook for tens of thousands of aircraft so you can improve your strategic planning and capitalize on the business opportunities ahead to generate revenue.

Available for aircraft in the Commercial, Military, Business Aviation and Helicopter markets, rely on the 2015 Fleet & MRO Forecasts to:

- Examine utilization rates of specific aircraft or engine types to predict future maintenance requirements
- Generate targeted regional MRO forecasts and see which regions and countries will be expanding...and which are contracting
- See how various market sectors will spend the bulk of their MRO dollars
- See the delivery and retirement trends across all the world's regions

Find out More Today!

Call 1.866.857.0148 or +1.847.763.9147 or go to
marketing.aviationweek.com/2015Forecasts



COMMENTARY

The Right Track

A century after creation of NACA, the National Advisory Committee for Aeronautics, can NASA hope to match its storied legacy?

Any discussion of NASA's aeronautics research cannot avoid confronting the defining fact: its level of funding. The \$571 million sought for aeronautics in 2016 is barely 3% of NASA's total \$18.5 billion budget request, and minuscule next to the \$72 billion in 2014 sales by the U.S. civil aircraft industry it is supposed to support.

Congress gave NASA another \$100 million for aeronautics in 2015, for a total of \$651 million, but it is just for one year and hardly moves the percentage needle. NASA's aeronautics funding is what it is, it seems, so the challenge for its aviation research leadership has been to make the most of what the administration and lawmakers are prepared to provide.

That has involved defining a new strategic vision with six research thrusts addressing future challenges to civil aviation and aligning programs with those thrusts, from low-carbon propulsion to assured autonomy. With the 2015 budget released in January and the 2016 request "we will start doing the work in earnest," says Jaiwon Shin, associate administrator for aeronautics.

Foreseeing growing global demand for mobility, challenges for energy efficiency and environmental sustainability, along with the impact of technologies from other industries, the strategy breaks no new ground, but marks a departure for NASA. "We can no longer do research and hope someone will do something with it," says Shin. "We must be relevant and have a clear goal that we work to grow the U.S. economy."

By articulating a strategic vision and establishing the research thrusts, Shin's team intends that NASA over time will more narrowly focus its aeronautics research and move away from spreading its limited funding too thinly over too



broad a portfolio—a "peanut butter" approach much criticized by industry.

"We have a clear set of goals to streamline against. That's why we have the strategy. It's not revolutionary, but it says these are the goals we want to focus on and we start from there," he says. "Next we put the processes in place to begin streamlining. And that is hard, because we have a lot of activity associated with our workforce."

Unlike the U.S. Defense Advanced Research Projects Agency, which works through industry and academia and can simply cancel programs, NASA cannot easily exit areas of research and lay off government researchers. Instead it must refocus them on the new goals. "We have to be patient and have a long view," says Shin.

To that end, NASA aeronautics has established three mission programs "designed to select and focus the research so we can deliver." These are the restructured Aviation Operations and Safety, Advanced Air Vehicles and Integrated Aviation Systems programs, focused on "bread-and-butter"

research developing air traffic management tools and aircraft technologies for the near- to mid-term.

"But if we have only these mission programs, we would be so brittle. Over the next five years we would produce some amazing stuff, then the light bulbs would go out," says Shin. Therefore, key to the strategy is the new Transformative Aeronautics Concepts (TAC) program, which he describes as "our engine for innovation" and a way to "breed an agile, flexible culture" within NASA aeronautics.

This is a tall order for TAC, set up to rekindle NASA's X-plane culture by funding 18-24-month feasibility demonstrations of advanced concepts that could progress to further development within the mission programs. The first demos will involve low-cost towed X-planes, autonomous electric vertical-lift and distributed electric propulsion.

One reason for Shin's optimism is the pending, as-planned completion of the Environmentally Responsible Aviation (ERA) project—the first six-year program he can remember that finished without changes in scope forced by gyrations in funding. "We have stayed the course. Funding was stable, and it got to do what it was set up to do. ERA will deliver a lot of compelling technology to industry."

Collaboration and being tightly connected to the customers for its technology are central to the strategy. "ERA did a lot of cost sharing with industry. If we had to change scope, they would not want to be part of it," Shin says. "ERA is a good precedent, allowing industry to see NASA as a reliable partner."

While an extra \$20 million or \$100 million is painfully small next to what NASA spends on space, Shin views it as an endorsement of the aeronautics strategy. "We're back on the right track. We have the rationale, program content, commitment and workforce. Now we have to make tangible, compelling progress."

He hopes that ultimately 2015-16 will be viewed as the dawn of a new era in aviation, where autonomy, electric propulsion and the Internet of Things will combine with traditional aviation technologies. "This is the 100th anniversary of NACA. I believe we are opening up another 100 years." 🚀



Stay true

Whichever way you cut it, the many facets of the TRUEngine™ program add more sparkle to your CFM56 investment. World-class support, unmatched product knowledge, and the peace of mind knowing your engine has been maintained to CFM's precise standards. But the real gem is retaining as much as **50% higher** residual value*. Brilliant.

Go to cfmaeroengines.com/services

CFM International is a 50/50 joint company between Snecma (Safran) and GE.

*Based on CFM, GE and independent third-party research.

Unmatched Experience | World-Class Support | Exceptional Value

CFM56



Read Sweetman's posts on our blog Ares, updated daily:
AviationWeek.com/ares
bill.sweetman@aviationweek.com

COMMENTARY

Breaking the Bank

The Pentagon is on course for fiscal disaster

The fiscal 2016 U.S. defense budget's details matter less than they should, being part of a plan to drive a wedge between the Republican Party's defense hawks and tax tightwads. But the bigger picture is one of chaos and waste in the 2020s, beyond the Future Years Defense Program (FYDP).

A five-year plan is useless when programs take 20-25 years from the first big investments to meeting the original operational requirement. A FYDP full of new starts means trouble in the out-years, as the \$100 million hatchlings turn into multibillion-dollar chicks.

If the Pentagon was a family, the parents would be buying new cars every other year and eating out three times a week while blithely planning to put all five kids through Harvard. This is sometimes called the "bow wave," but that's a euphemism for fiscal misfeasance.

A dollar-by-dollar analysis is difficult, but the picture is clear. The Pentagon is starting some very large new acquisitions, many current programs plan on spending at high rates throughout the 2020s, and there are few large projects due to be completed.

Nuclear deterrence justifies many of the new starts. While politicians talk about minimum deterrence, the nuclear hawks have made other plans. A 2008 contract for a Common Missile Compartment committed the U.S. Navy to a ballistic missile submarine based on the existing multi-warhead Trident missile.

In 2011, there was a public debate about whether the Long-Range Strike Bomber (LRSB) would be wired for nuclear weapons. Today, the B61-12 bomb is in full development and the nuclear role is central to public advocacy for the bomber. Development is expected to cost nearly \$4 billion per year in 2020, and the \$550 million cost target is just for procurement in 2010 dollars and is only a goal until there is a Milestone B review.

The 2016 budget starts programs for



WIKIPEDIA

a new intercontinental ballistic missile and a replacement nuclear cruise missile. Together with the B61-12, these will cost money outside the Pentagon budget as the U.S. revamps its rusty bomb factories—more than \$100 billion by 2024, according to the Congressional Budget Office.

This is not minimum deterrence; it is a force that can be uploaded with more warheads, a feature that is intended to deter any other player from restarting the Cold War race.

The 2016 budget gives a look at what current programs will cost in the 2020s. The biggest by far is \$14 billion per year for the F-35, through 2030 and beyond. The KC-46 tanker runs through the late 2020s and the Air Force seems determined to make the T-X trainer supersonic, agile and expensive. The Ford-class carriers continue to cost more than the Nimitz, and the Navy plans to procure two surface combatants in parallel.

But wait, there's more. Every

think-tank wonk and industry planner inside the Beltway and beyond has a different version of the Third Offset strategy—the emerging plan to gain a robust technological advantage over threats of the 2020s and beyond. But all can agree that nobody knows how much the Third Offset technologies and systems will cost because nobody knows what they are.

The budget also will be crimped as personnel costs continue to outpace inflation, until the government adopts reforms to compensation. The January report of the Military Compensation and Retirement Modernization Commission produced some sensible recommendations, which will be blocked by well-funded groups representing those who do best from the current situation.

None of this is new. In 2001, the Bush administration arrived with a similarly wishful policy, including stealthy helicopters, cruisers and fighters, and a plan to spend 20% of the procurement budget on leap-ahead technologies. The collapse of those plans can be only partly blamed on the wars that started in 2001-03, because much of that cost was offset by a fatter Pentagon top line. Even absent 9/11, the plans were unfeasible. No lessons were learned.

The Navy has been the first service to see where the trend is going today, announcing publicly that it cannot afford to build the Ohio replacement submarine. In the 2020s, if the Pentagon wants to fully fund its new projects, it will have to spend much less than it now plans on other things—whether land forces, tactical fighters or a 300-ship Navy—and not just prune them but cut them root and branch, including personnel, bases and shipyards.

The resistance to every such cut will make the Battle of Stalingrad look like a cakewalk. Instead, when the mis-planned acquisitions start to max out the Pentagon's Visa card, the response will be to stretch and delay, at enormous cost, and to kill things as a last resort after billions have already been flushed away.

Considered as a highly regressive workfare and welfare system with a secondary warfighting capability, the Pentagon is on a path to do very well indeed. But that's not the idea, is it? ☹

31ST SPACE SYMPOSIUM



SPACE FOUNDATION

April 13 - 16, 2015

The Broadmoor Hotel, Colorado Springs, Colorado USA

**REGISTER TODAY
STILL TIME to SAVE!**
on Standard Industry Registration
Ends March 20, 2015!

2010 Rate for
Active Duty
Military and
Government
including meals

JOIN THE CONVERSATION! GLOBAL PERSPECTIVES – INFLUENTIAL PARTICIPANTS!

Critical Dialogue on Today's Issues from Industry Executives, Decision Makers and Thought Leaders

FEATURED SPEAKERS



Jean-Jacques Dordain
Director General
The European Space
Agency (ESA)



Gen. John E. Hyten, USAF
Commander
Air Force Space Command



**The Honorable
Deborah Lee James**
Secretary of the Air Force



Jean-Yves Le Gall
President
Centre National d'Études
Spatiales (CNES)



David Parker, Ph.D.
Chief Executive Officer
United Kingdom Space Agency



Johann-Dietrich Wörner
Chairman of the Executive Board
German Aerospace Center (DLR)

ENGAGE

Compelling speakers, panels,
topics and special programs

CONNECT

Profitable networking opportunities

REGISTER TODAY!

www.SpaceSymposium.org/av3

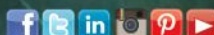
+1.800.691.4000



Secure Online Registration

Official Media Partner

Stay Connected:



COMMENTARY

Training Day

Teaching regular folks to fly in space

There are at least seven human spacecraft under development in the U.S., as the government hands off civil access to low Earth orbit to the private sector. The diversity of the vehicle designs—capsules for Blue Origin, Boeing, Lockheed Martin

and SpaceX; suborbital spaceplanes for Virgin Galactic and XCor Aerospace, and an orbital lifting body for Sierra Nevada—is matched by that of the passengers lining up to fly on them. No longer will the government select space travelers solely for intelligence and physical fitness. Most astronauts will select themselves, largely on the basis of their ability to buy a ticket.

Dr. Jim Vanderploeg, a former NASA flight surgeon who has worked with Virgin Galactic on what it will take to screen passengers before they fly on SpaceShipTwo, says the customer list shows the spaceflight cohort has expanded beyond prime-of-life astronauts to the “18-to-high-80s” age group, with “the entire gamut” of health and fitness. Using centrifuge screening of about 100 individuals, including 77 early SpaceShipTwo customers, he concludes that “most people with well-controlled medical conditions are suited to take a flight like this,” provided they are trained.

During the space shuttle era, NASA astronauts typically trained about a year for a two-week spaceflight, according to Michael Lopez-Alegria, a former International Space Station (ISS) commander who moderated a panel discussion on commercial spaceflight training at the annual FAA Commercial Space Transportation Conference Feb. 4-5. Initially ISS crews trained for four years for missions lasting a few months.

“The other end of that spectrum might be the passenger briefing you get on an airplane about putting your mask on first and then helping those next to you,” he says, noting that train-

ing for “spaceflight participants” will seek a middle ground.

The pilots who actually fly the new space vehicles are likely to be skilled, military-trained test pilots—including those with shuttle experience—and will be familiar with the training they receive. Boeing’s CST-100 commercial ISS crew vehicle will be fully automated, but the pilots must be ready to take over manual control at any point in a flight, says Chris Ferguson, the commander of the final shuttle mission and deputy program manager for operations on the Boeing commercial crew vehicle. Boeing has subcontracted for the same Johnson Space Center organization that manages NASA human missions, and will install its training simulators in the same JSC buildings—Nos. 5 and 9—that housed shuttle training hardware.

“To our flagship customer, the environment will look very similar to them,” he says.

The first private commercial spaceflight customers of the new era are likely to ride SpaceShipTwo and the XCor Lynx, neither of which has been to space yet. XCor, which will carry a single passenger alongside a company pilot in its two-seat suborbital spaceplane, will outsource most passenger training to one of the private companies offering it (*AW&ST* Oct. 3, 2011, p. 54). Exceptions include operation of the pressure suit the passenger will wear, and emergency-egress procedures, says Rick Searfoss, XCor director of flight test operations and chief test pilot.

“We really want people to experience at least the G-profile, and that’s . . .

platform agnostic,” says Searfoss, an ex-shuttle commander. “You can go off in a centrifuge and do that, or you can go out and do some wild and crazy flying.”

Panelists noted that potential space tourists tend to be very “into it,” and eager to prepare for what they see as the experience of a lifetime. Beth Moses, who brings skills honed at NASA Johnson to her job as chief astronaut trainer at Virgin Galactic, says “it is amazing what people want” when she asks them what they need from their training.

“There are folks that are interested in somersaults; there are folks that are interested in a Zen moment; there are folks that really want to stay oriented and be able to spot their house from space, point toward Mecca from space; there are folks that are in groups and want to make sure they get the perfect family portrait with their faces and the reflection of the window and a certain part of the Earth behind them with exactly the right lighting,” she says. “There are folks that want to make sure that, instantly from space, they can tweet.”

That “magic” moment will come when the passengers unbuckle from their seats and float freely in the cabin (see illustration), taking advantage of the shirtsleeves environment that Moses is helping shape in her dual role as program manager for the SpaceShipTwo cabin being built to replace the one lost along with pilot Mike Alsbury in an atmospheric flight test last year (*AW&ST* Nov. 14, 2014, p. 28).

But to get there, Virgin Galactic’s customers will experience a long flyout in the WhiteKnightTwo carrier aircraft that air-launches the spacecraft at 50,000 ft., and the G-loads of rocket-propelled boost to space, atmospheric reentry and the jolt that comes when the wings are feathered and unfeathered on its unique reentry profile.

That training will take place in the company’s facilities at Spaceport America in New Mexico, where the passengers will spend three days learning what to expect during the flight and rehearsing what they want to do in space and the life-critical actions they must perform. Most critical, says Moses, will be returning to their seats and strapping in when ordered to do so for the bumpy return to Earth. ☼

By Frank Moring, Jr.

Senior Editor Frank Moring, Jr., blogs at: AviationWeek.com/onspace
moring@aviationweek.com

VIRGIN GALACTIC



22-26 FEBRUARY 2015
ADNEC, ABU DHABI, UNITED ARAB EMIRATES

Under the patronage of His Highness Sheikh Khalifa Bin Zayed Al Nahyan,
UAE President & Supreme Commander of the UAE Armed Forces.

إيدكس
2015



DEFENCE TECHNOLOGY FOR THE FUTURE

2015

THE INTERNATIONAL DEFENCE EXHIBITION AND CONFERENCE

The world's leading joint defence exhibition returns to Abu Dhabi in February 2015, attracting more than 1,200 exhibitors and 80,000 local, regional and international trade visitors and officials from the governments, industry and armed forces.

VISITOR REGISTRATION IS NOW OPEN!

Don't miss this opportunity to meet with the top local and international manufacturers and suppliers of the latest equipment, technology, systems and crafts.

To register at IDEX 2015, visit www.idexuae.ae

To book an exhibition stand or outside space, email info@idexuae.ae

Strategic Partner:



Co-located With:



Co-located With:



Organised By:



In Association With:





COMMENTARY

In Congress's Hands

From the F-35 to the FAA and more, fiscal 2016 debates are heating up

The Pentagon's \$585 billion request for fiscal 2016 may far outpace spending by other countries, but if current budget caps force a reduction, lawmakers are looking for ways to help balance the books. Five high-profile defense analysts from Washington think tanks offered suggestions to the House Armed Services

Committee Feb. 11. Some echoed the Pentagon's recommendations to cut bases, personnel and compensation. But many of those ideas have been rejected by Congress year after year, and in that light, Rep. Adam Smith (Wash.), the top Democrat on the committee, asked the analysts to identify a major weapon system. "Something has to go," he said. "What would you say should go?"

According to American University Prof. Nora Bensahel, the "obvious answer" is the F-35 Joint Strike Fighter. "That is the defense program that is eating the entire defense budget alive," she said, quickly adding that she is not advocating canceling the years of investment and sunk costs. Rather, she said, the Air Force doesn't need the 1,763 F-35s it has planned in its program of record. Despite that recommendation, Congress has been a year-over-year supporter of the F-35, directing the Pentagon to buy an additional four of the fighters this year.

With that in mind, lawmakers are hardly likely to curtail production of the costliest defense program in history. Rather, they are gearing up for another tussle over base closures, personnel spending and, when it comes to hardware, the A-10 Thunderbolt II. The most recent round played out in the media. Citing recently declassified data, *USA Today* has reported that A-10s are the aircraft most likely to cause civilian casualties and friendly fire incidents. But the Project on Government Oversight points out that might be because the A-10 has been flying far more missions than other aircraft, arguing that



'Something has to go.'

—REP. ADAM SMITH

CQ ROLL CALL/NEWSCOM FILE PHOTO

A-10s actually have the second-lowest rate of civilian casualties. ☒

SPACEFLIGHT DIVIDE

NASA has won White House approval for a \$519 million budget increase in fiscal 2016, but if Congress goes along, it will assume control of a new Earth-observation portfolio. Under the \$18.53 billion budget request now pending before lawmakers, the U.S. space agency will take over missions previously handled by the National Oceanic and Atmospheric Administration, leaving weather-forecasting as that agency's sole focus in space. NASA is seeking \$8.5 billion for human spaceflight, including for work on commercial crew capsules that Boeing and SpaceX are developing to shuttle crew to and from the International Space Station. It would also include ongoing development of the heavy-lift Space Launch System (SLS), and preparations for the second unmanned flight test of the

Orion crew capsule for exploration beyond low Earth orbit. The SLS figure is a cut of \$367 million, to \$1.3 billion, from what Congress enacted for the current fiscal year.

The agency and Congress have been at odds over human access to space. The administration is pushing the two commercial crew vehicles, and Congress has shifted funds from the commercial vehicles to SLS. The request for commercial spaceflight in fiscal 2016 is \$1.2 billion, up from \$805 million in fiscal 2015. Rep. John Culberson (R-Texas), the new chairman of the House Appropriations subcommittee that funds NASA, has taken a strong personal interest in mounting a robotic mission to Europa, one of the moons of Jupiter, which may harbor more water beneath its frozen surface than exists on Earth.

The \$30 million the agency wants for mission formulation work in fiscal 2016 doubles the amount requested last year, according to NASA budget documents, and would come on top of \$100 million Congress ultimately enacted for fiscal 2015 with Culberson's support. ☒

ON DECK

FAA's \$15.83 billion budget request for fiscal 2016 seeks to patch holes created by chronic underinvestment and government spending limits. The request "allows for maintenance of the existing infrastructure as well as forward movement on NextGen, Unmanned Aircraft Systems (UAS) and commercial space transportation," according to the agency. Proposed NextGen funding totals \$956 million, spread across several facilities and equipment programs.

The total represents about a 12% increase over what Congress provided for fiscal 2015. That is not likely to be a contentious issue on Capitol Hill. Rather, all eyes this year will be on two primary issues: the FAA reauthorization bill to replace one expiring at the end of this fiscal year and the ongoing fight over the Export-Import Bank, whose authority ends in June.

Business aviation will be watching those and a number of other issues including streamlining the certification process for manufacturers and repair stations, tax and trade issues, and standards for business aircraft interiors. ☒



BALTICS
EASTERN EUROPE
RUSSIA

May 5-6, 2015 • Budapest, Hungary



MRO BEER delivers the most comprehensive conference & showcase on aircraft maintenance in the region.

- Case studies
- Better business processes
- On-site experts
- Access to innovative products
- New revenue, partnership and growth opportunities

Featuring MRO showcase of regional and global supplier and service providers.

Register early and save: www.aviationweek.com/mrobeer
or call: +1.646.392-7883 or in U.S./Canada, +1 800.722.6344x2



Produced By



Sponsor



Media Sponsors



Be a part of the community, network with your peers, and achieve results!

Follow us on:



Supporting Partners



Official Publication



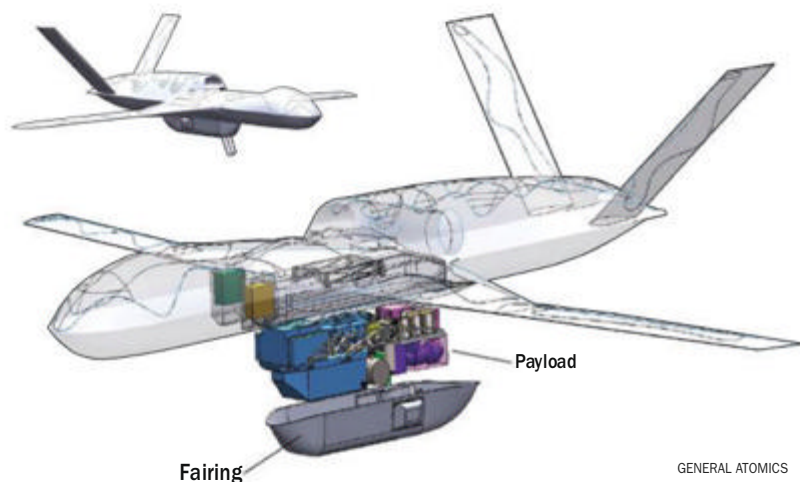
Powered by **Penton**

Big Zapper

General Atomics claims laser breakthrough

Bill Sweetman **Washington**

General Atomics (GA) has completed laboratory tests of what it calls its “third-generation laser system,” saying that the weapon sets new standards in efficiency, beam quality and system weight. According to an industry source, the company says the new laser will deliver 150 kw of energy, with three times higher beam quality than the Laser Weapon System (LaWS) now being tested by the U.S. Navy on the amphibious warfare ship Ponce, and will be able to fire 10 shots between 3-min.-long recharges.



This concept section of a laser pallet installed in an Avenger shows laser modules, power storage and cooling. A turbine generator could be incorporated.

Moreover, the laser is being designed as part of a 3,000-lb. self-contained package that can be installed in the weapon/payload bay of the company's Avenger turbofan-powered unmanned air vehicle. The same industry source suggests that GA's technology is mature enough to fly on an Avenger within 18 months, given adequate funding.

According to analyst Mark Gunzinger of the Center for Strategic and Budgetary Assessments (CSBA), a 150-kw laser “with decent beam quality” would be a step above previous electrically powered laser weapons, which have demonstrated the ability to engage targets such as mortar rounds and small unmanned air vehicles. The new weapon could be “effective against air-to-air missiles, and against cruise missiles using a crossing shot,” he surmises.

The new system—not yet formally named—has evolved from government-funded programs and is being developed with a mix of government and company money, according to Mike Perry, GA's vice-president for laser and electro-optic systems. These programs include the High-Energy Liquid Laser Area Defense System (Hellads), still underway with the support of the Defense Advanced Research Projects Agency, and the Army-sponsored Robust Electric Laser Initiative (Reli). GA's Reli work was completed in 2013.

The latest Hellads demonstrator, a 150-kw weapon, is ready for delivery to Darpa, Perry says. It is due to be tested at White Sands (New Mexico) Missile Range, and by the end of the current fiscal year—the last in which

work is funded—it should be moved to a mountaintop site to emulate airborne missions, including targeting of ground vehicles and aircraft self-defense.

The “third-generation” laser is more refined than Hellads, Perry says, although it uses technologies that have been integrated into the latest Hellads demonstrator. While not confirming specific figures, Perry says the beam quality—a measure of how tightly the beam is focused—is “the highest ever achieved on an electrically pumped laser” and that its power output is comparable to the 150-kW Hellads. However, the Hellads name is not being used for the new system, which employs a different lasing medium. Perry declines to say whether or not it is a liquid medium.

He says the system's space, weight and power requirements are sized to the Avenger. GA has noted that the UAV has a 3,500-lb. payload and 20 kw of power available. This was not the initial target of the program, Perry says, but the UAV and laser programs were evolving in parallel. “The Avenger was a challenge, but if we could size it for the Avenger all other platforms would be easier.”

The engineering that remains to be done before the system can fly is “not in the laser,” Perry says, but in the platform integration and design of a beam director and a target acquisition system. GA, he believes, is “substantially ahead” of competitors using fiber lasers, partly because of experience gained in the Hellads program. Another industry source points out that an airborne laser is “a system of systems” including power conditioning and storage, cooling and optics as well as laser modules, and that these may be areas where GA has moved ahead of its rivals, in part because of in-house expertise with high-energy storage systems.

The timescale for future developments will depend on budgets, Perry says. The next step would be to ground-test a complete system, followed by integration into an aircraft. “We see the Avenger as the next step, but others see other platforms coming first. It will be determined by the customer.” The special-operations community, for example, has proposed several different approaches to develop for a pallet-mounted laser that could be installed on a C-130.

The U.S. Missile Defense Agency,

meanwhile, is pushing UAV-borne lasers for target discrimination as an interim step toward the much higher-power levels needed for interception. The MDA is requesting \$285.8 million in fiscal 2016-20 for "weapons technology," according to budget documents, and the aim is to "build the foundation for the next-generation UAV-borne laser system, capable of tracking and eventually destroying the enemy at a much lower cost than the existing missile defense system." Of that, about \$45 million is expected in fiscal 2016.

MDA Director Vice Adm. James Syring was tight-lipped about the work during a Feb. 2 briefing. "At the power levels we're talking about today, forward discrimination and tracking in the near term" are possible missions, he said. "Due to the classification level, I'd just like to leave it at that for today."

A December 2014 report by the Congressional Research Service summarizes estimates of the effectiveness of different laser power levels against different target classes, as published by a number of sources over the past 10 years. Most agree that guided missiles start to become vulnerable as power exceeds 100 kw if the beam quality remains high. One important issue is that the power of the laser is only one element of its "target fluence," which according to Gunzinger's 2012 report for the CSBA is defined as the amount of energy that a laser device can concentrate on a desired spot on a target over a specific distance. Fluence is affected by beam quality, jitter and atmospheric absorption and scattering.

The effectiveness of a laser weapon will also depend on the hardness of the target and the kill mechanism. For instance, a missile aimed at an aircraft could be defeated at close range and short time-to-impact if its radome (already under thermal and aerodynamic stress) is destroyed, as postulated in a number of research papers. That damage would both destroy the missile's seeker and destabilize it aerodynamically, and a relatively small miss distance is needed to prevent damage to the aircraft. Defending a ship against an anti-ship cruise missile may mean more power and range to ensure that missile fragments and fuel do not hit the ship. Says the CSBA's Gunzinger: The earlier Hellads is believed to use liquid-cooled slab laser modules. ☛

—With Amy Butler in Washington.

Northrop and Lockheed rethink Uclass in light of more Pentagon waffling

Amy Butler Washington

As federal spending for defense has decreased, the Pentagon has made an effort to rely on industry's development dollars to keep major procurements on track, which has opened the door to more dialog on requirements early in a program's life. However, in at least one high-profile case, the budget ax is having a chilling effect on this initiative.

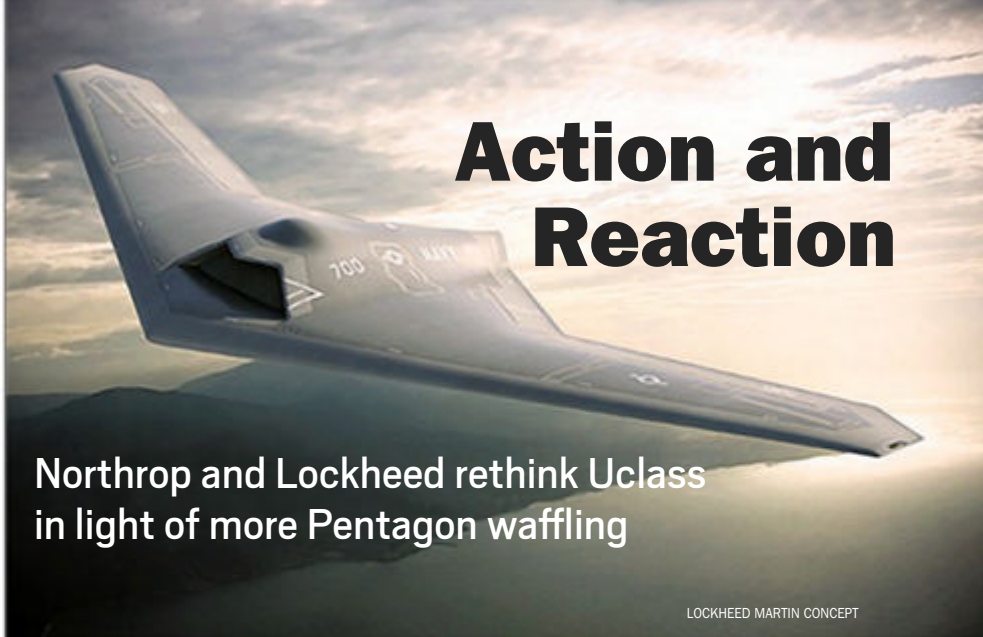
Northrop Grumman and Lockheed Martin have scaled back work on developing their own company-funded designs for the U.S. Navy's Unmanned Carrier Launched Airborne Surveillance and Strike (Uclass) aircraft.

This is because the Navy's program to produce an unmanned aircraft for near-term use on aircraft carriers has been punted again. In its fiscal 2016 budget request—released Feb. 2 to Congress—the Navy slips its plans to release a long-awaited request for proposals for the air vehicle to fiscal 2016. The service seeks \$135 million, down from \$403 million requested last year.

The program was originally slated to begin in 2014, with the first aircraft fielded in 2020. Since then the Pentagon has waffled, first on requirements for the aircraft (debating levels of survivability versus payload), and then on the timing of a competition. Now the very program seems to be in question. Deputy Defense Secretary Robert Work says the decision to proceed with Uclass is part of a larger review of intelligence, surveillance and reconnaissance programs across the entire Defense Department.

Uclass could have been stunted due to advances by the Air Force and CIA in developing its stealthy, unmanned

Action and Reaction



LOCKHEED MARTIN CONCEPT

Lockheed Martin is slowing its work on Uclass in light of another program delay from the U.S. Navy.

RQ-180 reconnaissance system, which is thought to be entering operations this year. Details have not been released by the Pentagon, but the Air Force acknowledged its existence in December 2013 in response to an Aviation Week query. The RQ-180 is being developed as a stealthy, penetrating intelligence collector that would assume the role once held by the SR-71 in being able to surveil well-defended targets around the globe.

Rep. Randy Forbes (R-Va.), a member of the House Armed Services Committee, said during a Feb. 3 Defense Writers Group that the discussion about Uclass was mired in classified restrictions. "I wish I could be more specific with you on the Uclass," he said. "I am pretty comfortable at this particular point in time, although most of the conversations are on a classified level. But I'm pretty comfortable with the direction. . . . I'm not trying to be vague. I just don't want to go to jail."

Based on the fiscal 2016 budget request, Uclass vehicles are now expected no earlier than 2022. Work on the aircraft carrier portion, control systems and connectivity segments will continue, says Rear Adm. William Lescher, deputy assistant Navy secretary for budget.

Ultimately, the program—estimated in June 2013 to cost \$3.7 billion—could field as many as 24 Uclass vehicles on four aircraft carriers. Although the numbers are not high, the program is significant, as this is the first major project for the Navy to field unmanned intelligence and strike assets—with

some level of survivability—on the aircraft carrier alongside F/A-18E/Fs and, eventually, the F-35C.

Northrop Grumman—once considered a frontrunner for Uclass based on its contributions to the X-47B, a stealthy, unmanned predecessor demonstration project—has halted its Uclass work. “Because we were funded for only \$15 million two years ago, we must have stable requirements to design any real airplane and would have to carry a genuine program design review effort against shifting requirements at a much higher level of effort on internal money . . . [so] we have stopped our current efforts,” said one

industry official of Northrop’s work.

A company spokesman declined to provide details about the decision.

Lockheed Martin also is scaling back its work, says company spokeswoman Heather Kelso. “We are adjusting our pace, especially with the requirements and acquisition program in flux.”

Boeing declined to comment on its company-funded Uclass status. It has been stung before, having designed the X-45C for an antecedent requirement for the USAF that was partly government-funded but eventually dropped.

General Atomics did not respond to requests for comment.

However, some industry officials are

citing the waffling on Uclass as an example of how poor guidance from the Pentagon can waste precious company R&D funds. They fear the effort will be overcome by events; threats and air defense systems continue to advance as the delay drags on. Or the system could be eclipsed by the F/A-XX, the Navy’s moniker for a next-generation F/A-18E/F replacement.

Originally, Navy officials eyed Uclass as a small-scale follow-on to the Unmanned Combat Air System Demonstrator, the Northrop Grumman-led X-47B project, which, in July 2013, achieved the first carrier landing of a stealthy, tailless unmanned aircraft.

Course Change

Navy diverts money from fighters to missiles

Bill Sweetman Washington

The U.S. Navy has reduced its planned buys of the Lockheed Martin F-35C Joint Strike Fighter by almost one-third over the fiscal 2016-20 Future Years Defense Program (FYDP), while committing almost \$800 million to new standoff weapon developments and canceling the only missile program that was primarily dedicated to the F-35C. All the new developments are part of the fiscal 2016 presidential budget proposal and constitute the first move by a U.S. service to slow down its JSF procurements.

Last year’s budget buys four F-35Cs, including two added late in 2014 by the lame-duck Congress. The Navy now plans to buy another four aircraft each in fiscal years 2016 and 2017. The rate ramps up slowly in the final three years of the FYDP, peaking at 12 aircraft in fiscal 2020 and buying 38 F-35Cs in the plan period. The FYDP includes 83 F-35Bs for the Marine Corps, unchanged from earlier years.

Under 2015 plans the Navy would have bought 54 F-35Cs in the fiscal 2016-20 span, with F-35C production reaching 20 per year in 2020. The JSF Program Office states that “the Navy’s commitment to the program remains strong” and that it expects the Navy’s cutbacks to be offset by international JSF procurements.”

The Navy says the reduction is budget-driven. Each of the 12 F-35Cs that the Navy plans to buy in fiscal 2020 has a gross weapon system unit cost of \$144 million (44% more than the Air Force’s F-35A) and a flyaway cost of \$115 million. The weapon system unit cost of the F-35B averages \$147 million at its full 20 per year production rate. In total, the Navy expects to spend \$4.7 billion for 32 F-35s in 2020. In 2013, the service spent \$3.7 billion for 49 new fighters, comprising 37 F/A-18E/Fs and 12 EA-18Gs.

The 2016 budget cancels the Raytheon AIM-9X Block III, an increased-range version of the air-to-air missile with a more powerful motor. In April 2014, AIM-9X program manager Capt. John Martins said that the Block III was primarily intended for the F-35C because it would permit the fighter to carry six beyond-visual-range missiles: four AIM-120s internally and two Block IIIs on outer-wing pylons. The Block III would have entered service by 2024. One element of the canceled project, a new warhead meeting insensitive munition standards, will continue into the AIM-9X program.

Two new initiatives cover standoff weapons launched outside the range of surface-to-air threats. The new-start Advanced Anti-Radiation Guided Missile—Extended Range

(Aargm-ER)—receives \$267 million in development funding across the 2016-20 FYDP and will mate the existing guidance system and warhead of the AGM-88E Aargm with a new motor. Two motor options were studied: dual-pulse for a 20-50% range improvement, or solid integrated rocket-ramjet for doubled range. Budget documents indicate that the Navy has chosen the rocket.

A new “precision strike weapons development program” funding line, budgeted at \$510 million in the FYDP, primarily supports the new Next Generation Strike Capability effort, which combines two previous programs: Offensive Anti-Surface Warfare Increment II, a follow-on to Lockheed Martin’s Long-Range Anti-Ship Missile (Lrasm) that would be capable of air and sea launch, and Next Generation Land Attack Weapon, a replacement for the Raytheon Tomahawk. NGSC could be either a common weapon or a family of weapons, but the goal is to use technologies “across multiple mission areas” to reduce cost. Near-term strike capability is to be provided by Lrasm and modernized Tomahawks—compensating for the wind-down of new Tomahawk production.

The Navy’s budget priorities reflect the views of Chief of Naval Operations Adm. Jonathan Greenert. In June 2012, shortly after he was appointed as CNO, Greenert published an article in the Naval Institute’s *Proceedings* magazine that downplayed the importance of advanced platforms, including stealth aircraft, in favor of “payloads” including standoff weap-

Having proved with X-47B that an unmanned aircraft can operate safely on and around the carrier deck, the next step was to procure Uclass and field aircraft for decks in small numbers to begin mixing manned and unmanned operations from aircraft carriers.

Industry officials do not disclose total amounts spent on Uclass concepts, due to competitive sensitivity.

The next aircraft program likely to rely heavily on corporate investment is the Air Force's pending project to buy a T-38 replacement aircraft for a next-generation trainer for fighter pilots operating F-22s and F-35s. Multiple companies are funding prototype designs

or demonstrators. USAF originally suggested it wanted to take advantage of as much off-the-shelf technology as possible to curb prices and development time. This prompted probable bids from Northrop Grumman/BAE Systems offering the Hawk; Lockheed Martin/Korea Aerospace Industries, the T-50; and General Dynamics/Alenia Aermacchi, the M-346. All of the proposed models would have relied on modifications to existing designs. Then Boeing entered the fray, saying it will create a clean-sheet design. Now Textron is examining a possible T-X application based on elements of its Scorpion prototype.

But the Air Force has shifted gears. USAF Secretary Deborah Lee James said last month that T-X will be a pathfinder program for her initiative to open a more frank cost-and-requirements dialogue with industry. Her goal is to better inform the Air Force on the price of its requirements needs; eventually, she hopes the service can make requirements trades to arrive at the most capable system for the right price.

Ultimately, however, the shape of this discussion could prompt some competitors to drop out or change course due to the scarcity of corporate development dollars. ☼

Fiscal 2016 Presidential Defense Budget Request (\$ millions); F-35 Program Breakdown: Fiscal 2015-20

(\$ millions)	Fiscal Year														
	2015				2016		2017		2018		2019		2020		2015-20
	Quantity	Request	Quantity	Enacted	Quantity	Request	Quantity	Budgeted	Quantity	Budgeted	Quantity	Budgeted	Quantity	Budgeted	Total
F-35 Joint Strike Fighter - Total Program	34	7,965	38	8,084	57	10,532	66	11,700	88	12,686	90	12,578	92	12,295	67,875
F-35A Joint Strike Fighter (USAF)		4,644	28	4,619	44	6,425	48	7,247	60	7,908	60	7,680	60	7,185	41,065
Procurement	26	3,553	28	3,691	44	5,260	48	5,356	60	611	60	6,024	60	5,527	26,468
Advance Procurement		292		292		460		529		522		498		506	2,807
F-35 Modifications		188		29				310		294		260		260	1,153
JSF / F-35 - EMD- SDD (R&D)		563		568		589		323		115		5.3		5.4	1,606
F-35 Squadrons-OSD (R&D)		44		40		115		269		339		372		390	1,526
F-35 EMD - ACD&P (R&D)		5.0													
F-35 Joint Strike Fighter (Navy and Marines)	8	3,300	10	3,444	13	4,038	18	4,452	28	4,779	30	4,897	32	5,110	26,721
F-35C - JSF CV															
Procurement	2	611	4	849	4	898	4	848	8	1,218	10	1,496	12	1,606	6,914
Advance Procurement		29		29		49		92		112		126		204	612
F-35 CV Modifications		21		21		69									89
F-35 C - EMD - SSD (R&D)		516		502		505		443		45		0.57		0.62	1,497
Navy Follow-On Development - SDD (R&D)				11		48		104		134		146		149	591
F-35B - JSF Stovl															
Procurement	6	1,200	6	1,184	9	1,483	14	2,050	20	2,713	20	2,796	20	2,810	13,037
Advance Procurement		144		144		203		226		137		140		142	992
F-35 Stovl Modifications		286		216		256		171		175		17		18	852
F-35 B - EMD - SSD (R&D)		513		499		538		399		87		8.0		8.5	1,540
Marine Corps Follow-On Development SDD (R&D)				10		59		120		157		169		172	687

Stovl = Short Takeoff and Vertical Landing

EMD = Engineering and Manufacturing Development

ACD&P = Advanced Component Development & Prototypes

SDD = System Development and Demonstration

OSD = Operational Systems Development

Source: Aviation Week Intelligence Network analysis. All figures represent total obligation authority and are drawn from the OUSD(C) P1 and R1 documents. Totals have been rounded. Funding contained in the amalgamated Spares and Repair Parts lines is not included.

ons. Speaking to a Navy technology conference in Washington on Feb. 4, Greenert reemphasized these points, saying that any future fighter will likely "not be so super-fast because you can't outrun missiles, and not so super-stealthy because you can't be invisible. Stealth may be overrated," he said. "If you move fast through the

air . . . that puts out heat and you are going to be detected."

Also, demonstrations carried out by the Navy and Boeing in 2013 and 2014 have been aimed at using the EA-18G Growler's ALQ-218(V)2 electronic surveillance measures system to detect and track moving or relocatable emitting targets at long range,

with enough accuracy to launch a weapon at them. Both Aargm-ER and Lrasm already use advanced radio-frequency (RF) guidance and would be compatible with that approach, and Raytheon has demonstrated an RF-based passive seeker, with a millimeter-wave active terminal mode, as a Tomahawk upgrade. ☼

Powerful Packaging

Podded AESAs could open new markets for low-cost air and surface surveillance

Tony Osborne **Havant, England**

Lockheed Martin has leveraged Israeli know-how to develop a roll-on, roll-off airborne early warning (AEW) capability for helicopters.

The Ship and Aviation Systems (SAS) Mission System that has been under development in the U.K. for the last five years is competing with a system from Thales to meet the requirements of Crowsnest, a British Royal Navy program worth up to £400 million (\$600 million) to provide an organic AEW capability on the new Queen Elizabeth-class aircraft carriers toward the end of the decade.

Lockheed Martin believes the SAS mission system could have significant export potential, too, as more nations increase the protection for their potentially vulnerable surface vessels that do not have access to organic or land-based airborne radar coverage.

The system was born of the need to fit an AEW capability onto the Royal Navy's existing AgustaWestland AW101 Merlin Mk. 2 helicopters that would enable them to switch while at sea to the AEW mission from their current antisubmarine-warfare (ASW) mission.

The system devised by Lockheed Martin for Crowsnest consists of four Israel Aerospace Industries (IAI) Elta ELM-2052 active, electronically scanned array (AESA) radars, two fitted into each pod. The pods are mounted on either side of the helicopter on the Merlin's two weapon pylons. Also inside the pod is an identification, friend or foe interrogator. Avionics racks to support the two-man mission console would be added in the cabin.

Lockheed Martin says a Merlin can be converted to the AEW mission from the ASW mission in less than 3 hr.

"We are building straight off the Merlin Mk. 2 mission system that's already installed," says Younas Mustafa, airborne military solutions director at Lockheed Martin U.K. "The mission system itself detects what sensors are onboard. Once you actually connect up the pods, it knows you are in a particular configuration. . . . It is very much a plug-and-play solution."

Introducing the AEW capability adds 30 kg (66 lb.) of additional "parasitic" weight in the form of extra wiring. Flight tests have shown that once the radars are put onto the pylons, they have no impact on aircraft handling, aerodynamics and performance. The helicopter weighs less with the entire system than it would if it were carrying a pair of torpedoes on an ASW mission.

The Merlin is also able to provide all the electrical power for the four radars.

A key element in the system's development has been integration work to ensure that the four radars could be



The AESA radars fit inside the two pods, pictured here in an early prototype configuration on a Royal Navy Merlin Mk. 2 ASW helicopter.

grouped to provide 360-deg. coverage. Much of this work was done in Israel, where IAI Elta demonstrated the combining of radar information from several arrays on its Boeing 737 radar testbed.

The system also correlates feeds from an automatic identification system for shipping and the Orange Reaper electronic support measures system with the radar data to reduce display clutter and improve situational awareness. Lockheed Martin engineers used and built upon the correlation software engine used in the Sikorsky MH-60R Seahawk ASW helicopter and added algorithms to deal with air threats.

Thales, meanwhile, plans to outfit

the Merlin with upgraded versions of the incumbent mechanically scanned Searchwater 2000 radar system from the Westland Sea King Mk. 7 helicopter. Thales argues that its option is the lower-cost alternative, as the U.K. Defense Ministry already owns the system.

Thales has not responded to repeated requests for details on trials of its system. Lockheed Martin's Mustafa says his company's SAS mission system is "future-proof," has less impact on the Merlin aircraft and is "plugging new sensors into an existing solution."

The Lockheed Martin system allows for overland and overwater surveillance, and can generate images using synthetic aperture (SAR) and inverse synthetic aperture radar modes. The radars feature a non-cooperative-target-recognition functionality, although company officials declined to discuss the results of tests of that capability.

During trials, operators found they

could use the AESA technology to generate a radar picture and disseminate it to other assets by Link 16 in 2 min., 30 sec., compared to as long as 40 min. on the Sea King Mk. 7 or the E-2C Hawkeye. The trials also tested all the radar modes, and Lockheed Martin officials say the images produced

by the SAR are as good as those from the U.K. Royal Air Force's Raytheon Sentinel radar-reconnaissance aircraft.

If the Lockheed Martin system is selected, Vector Aerospace will build the radar pods, and the U.K. will have control over the source code for the radars, enabling it to add more capabilities later, if desired. Lockheed Martin says the system is not restricted by U.S. International Traffic in Arms Regulations and can be applied to other helicopters and fixed-wing platforms. The company has conducted design studies to fit AESA pods to the Airbus Helicopters EC725, Mil Mi-17 and Sikorsky SH-60 Seahawk. Mustafa says there would be a significant market for the system in the overland-surveillance mission.

Lockheed Martin delivered its proposal to the U.K. Defense Ministry at the end of January, and a down-select decision is expected by April 2015. ☐

Over and Out

Harris's \$4.75 billion acquisition of Exelis finishes the former ITT spinoff's journey

Michael Bruno **Washington**

If it closes as expected, the \$4.75 billion acquisition of Exelis by Harris could instantly create one of the largest aerospace, aviation and defense providers in the West outside of the "primes."

Ultimately, the Feb. 6 deal may also come to be revered as a masterstroke in business deal-making, due to the timing of still-low interest rates and defense budget stability, as well as corporate compatibility and international growth potential. When Exelis becomes a subsidiary of Harris, the combination equates to a technology, communications and services giant across a wider field of local and national government customers worldwide, plus some commercial clients.

Still, for employees, bondholders and others, it could get worse before it gets better. For starters, Melbourne, Florida-based Harris expects to save \$130-150 million in streamlining cuts, including workforce reductions and possibly moving its headquarters.

Harris's corporate credit rating also takes a hit, as the deal is funded mostly with debt, according to Standard & Poor's Ratings Services and Moody's Investors Service. And Exelis carries almost \$2 billion in underfunded pension liabilities, which could compete for Harris's future cash flow allocations.

But executives on both sides see all of it as manageable, and if so, the deal could be one for A&D history books. At more than \$8 billion in combined annual revenue, the new Harris would rank behind the six traditional U.S. defense primes and only L-3 Communications in the middle tier, according to a comparison of regulatory filings. The deal also caps a four-year journey for McLean, Virginia-based Exelis, which was born of a spinoff from ITT, and last

year spun off a major portion of its own business, now called Vectrus.

"This transaction provides immediate value to Exelis shareholders as well as long-term upside potential from the equity ownership stake in Harris," Exelis CEO and President David Melcher says.

"This is a highly strategic and compelling combination that generates significant value for our customers," echoes Harris Chairman and CEO Bill Brown.

Analysts see the logic. "Once integrated, the combination of Harris



DENVER INTERNATIONAL AIRPORT

Exelis's airport operations systems—used by Denver International Airport and others—are among many complementary offerings the companies will share as part of Harris.

and Exelis provides the new company stronger positions in military communications, space payloads and sensors and information systems, particularly for air traffic control," says Byron Callan of Capital Alpha Partners. The combined entity could develop new electronic warfare products as well.

"Given the defense electronics nature of both companies (and duplicate overhead) we expect this deal will have plenty of synergistic attributes," says Steven Cahall of RBC Capital Markets. Those include combining radio frequency and electro-optical solutions

for intelligence and reconnaissance, Exelis's in-orbit sensors with Harris's ground-based space network, FAA Next Generation air traffic management work, and tactical radios, all areas in which both companies are well established.

An information technology and services company, Exelis moved in 2014 to focus on the U.S. Air Force, FAA and NASA while turning away from the U.S. Army and the years of land-warfare-oriented business that drove its growth starting under ITT (*AW&ST*, Oct. 6, 2014, p. 35). Exelis has been involved on every GPS satellite going back to when it was part of ITT, although it suffered a bruised reputation two years ago from a delay in delivering GPS III. At the same time, Melcher has pressed to build up international business, in part by trying to find overseas opportunities and match them with prime partners it knew well.

Harris, a communications and IT company serving government and commercial markets in more than 125 countries, also has moved away from ground-focused radio work that was lucrative during the wars in Iraq and Afghanistan. In particular, Brown has emphasized research and development spending that exponentially exceeds the industry average (*AW&ST*, June 11, 2014, p. 48).

Together, the merged companies will have roughly 23,000 employees, including about 9,000 engineers and scientists. Annual pre-tax earnings are estimated at \$1.8 billion. About 10,000 employees, including 3,000 engineers and scientists, and \$3.25 billion in revenue will come from Exelis.

For Harris, Exelis will "balance" the revenue stream by boosting Air Force, Marine Corps and Navy work, as well as international sales. As for pension liabilities, executives note that new U.S. laws have lowered and spread funding requirements, pushing them forward so that rising interest rates in the future could make them smaller and require less overall cash.

The deal is expected to close in June but first requires Exelis shareholder approval, as well as the customary regulatory approvals. But analysts see all of that coming.

Says RBC's Cahall, "With the Defense Department budget backdrop improving, this is exactly the sort of deal we have thought logical in defense mergers and acquisitions." ☛

Costly Lessons

Shuttle experience on reusability, survivability guides commercial crew

Frank Morring, Jr. **Washington**

Most of the companies building next-generation commercial spaceflight vehicles to carry humans to space are drawing on the rich and sometimes sensitive database generated by NASA's 30-year history flying the space shuttle, with the expectation it will help them save money and lives as they build reusable spacecraft for a marketplace in low Earth orbit and beyond.

All of the engineering teams developing human-spaceflight vehicles except the one at Blue Origin have discussed forensic evidence on crew survivability garnered from the Columbia accident investigation, according to one of the



NASA

physician/astronauts who studied exactly what killed the orbiter's seven crewmembers.

Lessons from that 2003 accident, the loss of Challenger in 1986, and from flying and reflighting the space shuttle through all 135 of its missions can help those developing new reusable spacecraft avoid some of the mistakes of their predecessors when they designed the orbital spaceplane in the 1970s, says an experienced shuttle mission director and program manager who is helping apply them to the new vehicles.

"Pay me now or pay me later," says Wayne Hale, now director of human spaceflight at Special Aerospace Services, a Boulder, Colorado, engineering consultancy. "You can skimp on the tests up front. You can skimp on what it needs to be to make that first flight certification, to make a design that will get you off the ground the first time, at a lower cost, maybe, and then pay for it over the life of your vehicle. If you want to use it twice, you can maybe get away with it. If you want to use it 10 times, you can wind up costing yourself a lot more."

There is no way the Columbia crew could have survived the breakup of their orbiter after it lost its left wing to a crack in the thermal protection system caused by falling foam debris

on ascent two weeks earlier. But careful forensic analysis after the catastrophe revealed "survival gaps" in cabin and crew-equipment designs that could give space travelers a better chance in future accidents if they are fixed, according to Dr. Michael Barratt, a flight surgeon/astronaut in the NASA Human Research Program Office.

"This is really the only source of high-altitude hypersonic breakup information we have with regard to human response to it," Barratt says. "It's incredibly valuable, and it's obviously information that came to us as a very high price, and something we are obligated to process."

The data show all but one of the crewmembers died of blunt-force trauma. Their shoulder harnesses did not lock as the failing shuttle spun slowly in the thin upper atmosphere, and they suffered head injuries inside the non-conformal helmets, suggesting redesigns of both the crew safety constraints and helmets.

None of the crewmembers was able to close a helmet visor. The cabin decompression killed one of them outright, and the rest lost consciousness, which led to a requirement that crews on the remaining shuttle flights practice sealing their suits, Barratt told the annual FAA Commercial Space Transportation Conference here Feb. 5.

The forensic results of the Columbia accident investigation are contained in a NASA publication—"Loss of Signal: Aeromedical Lessons Learned from the STS-107 Columbia Space Shuttle Mishap"—released last year. That material has

Space shuttle main engines were designed to be reused, but they had to be pulled after each flight for inspection.

formed the basis for ongoing discussions between the agency and the teams developing new human spacecraft. Blue Origin has yet to engage in the process because "we just haven't had the opportunity," Barratt says.

In a separate presentation to the FAA conference, Hale described a number of unanticipated engineering difficulties in reflight preparations for the shuttle, which was originally intended as a low-maintenance "space truck" able to operate with rapid turnaround times. Cabin windows, for example, regularly returned to Earth pitted by small micrometeoroid and orbital debris (MMOD) strikes. Shuttle-processing engineers eventually concluded it was easier to replace the 2-in.-thick windows, which also played a thermal protection role, after each flight than to find and polish out the tiny MMOD craters.

Similarly, reusing the space shuttle main engines involved a lot more work than expected, because they needed internal borescope inspections after each use.

"You couldn't get access while the engines are installed on the orbiter, so we came to a requirement to pull the engines off every flight, which is not a small job," says Hale. "You have to take off a bunch of stuff to get to the engines, and once you've got the engines open . . . we had a lot of engineering creep, and a lot of things that were good things to do, we did. Because, why not?"

The result, he says, was more than 5,000 man-hours per flight spent in the aft compartment where the main engines operated, only about one quarter of which involved the inspections and other mandatory tests.

"Early in your design process, you need to understand your vehicle environments very well," Hale adds, suggesting "the story's not completely told" on whether shuttle lessons will be usefully applied to the new vehicles. ☛

Stepwise Safety

ICAO takes small steps first as it navigates path to global tracking

John Croft **Montreal**

Spurred in large part by two disasters in 2014—the disappearance of Malaysia Airlines Flight 370 in March and the shootdown of the carrier's Flight 17 (MH17) in July—the member-states of the International Civil Aviation Organization (ICAO) have agreed with few exceptions to implement a comprehensive suite of global tracking and conflict-zone warnings over time but to take interim steps almost immediately.

In response to the MH17 shootdown, the conference of 118 states and 34 observer organizations meeting for a High-Level Safety Conference in Montreal during the first week of February decided to launch “without delay” a “simple centralized web-based repository” of threat and safety information to help air navigation service providers and airlines assess destination and overflight risks in conflict zones. Eurocontrol developed an early prototype of the system, but ICAO will operate the first implementation.

The Dutch safety board has not released its final report on the MH17 crash, only confirming in a preliminary report an external explosion, widely believed to have been caused by a long-range surface-to-air missile (SAM) fired by Russian separatists, that

Delegations from 118 countries gathered in Montreal the first week of February to debate aviation safety issues.

destroyed the Boeing 777-200ER in cruise at 33,000 ft. over eastern Ukraine. The downing took place in an active military conflict zone, but high-altitude air routes over it remained open.

In the aftermath, ICAO formed the Task Force on Risks to Aviation in Conflict Zones (TF-RCZ) to study concepts for sharing risk data and create guidance for developing risk assessments that states can use to decide when to issue warnings or close airspace. Estimated to cost as much as \$2.5 million per year to operate, the web portal will be operated by ICAO and draw upon input from all member-states. Only certain users will be able to add data, and ICAO says it will not be responsible for information from anonymous sources.

Threat-assessment best practices came from ICAO's Aviation Security Panel Working Group on Threat and Risk (WGTR) and input from 21 member-states. Risk factors to consider appear to mimic the MH17 scenario:

- Local presence of SAMs.
- An area of armed conflict.
- Military or unmanned aircraft being used in a combat role.
- Aircraft being used to transport ground troops or military equipment.
- “Poorly trained or inexperienced personnel” operating the SAMs.
- A lack of “effective” air traffic management caused by the state responsible for that airspace not having full control of its own territory.
- Routing that passes over or close to assets of “high strategic importance.”

Despite the impact of the MH17 disaster, the WGTR considers the potential for intentional and unintentional long-range

SAM attacks to be of low risk, despite 70 states having the weapons and others wanting them.

“The WGTR would assess the current risk from intentional attack as low, primarily due to the fact that where intent may exist, there is currently no evidence of capability in terms of hardware and trained personnel,” says the group. While past events suggest a higher risk from unintentional attacks, in particular confusing a military target with a civilian aircraft, the group says such events are also rare and of low risk.

Russia expressed concern that legal assessments should be made regarding provisions that would penalize a state for not providing information, suggesting the concept should be approved at the next ICAO Assembly in 2016. The ICAO Secretariat disagreed, however, saying the “overwhelming majority agreed that these issues could be addressed as they arise during the implementation process.”

Nearly one year after the disappearance of MH370, with no end in sight to the search for the aircraft, the ICAO members agreed to finalize plans for a Global Aeronautical Distress and Safety System (Gadss) while “strongly encouraging” airlines to voluntarily begin flight-tracking their aircraft with updates every 15 min. when in oceanic or remote regions. With 15-min. updates, typically provided through Automatic Dependent Surveillance-Contract (ADS-C) transmissions via ACARS over



JOHN CROFT/AW&ST

satellite links, the time to activate search-and-rescue services will be reduced to 44 min. from 89 min. today, according to ICAO.

A fully functional Gadss, likely available on new aircraft beyond 2021, is expected to include:

- Normal tracking updates every 15 min. sent to an airline's operational control center.
- An autonomous distress-tracking mode that transmits position, time and identification updates at 1-min. intervals, activated automatically or by the crew or ground when certain attitude or system health issues occur.
- An improved method for recovering flight data and cockpit voice recorders.

ICAO is proposing that the distress-tracking mode be standard on new aircraft built after 2021 and that automatic deployable flight recorders (AFDR) be installed on new aircraft from 2019. As an alternative to ADFRs, airlines could use a different form of data recovery, possibly data-streaming before a crash, as an option on all aircraft from 2016.

To improve its guidance to airlines, by August ICAO plans to complete a multinational test of operator flight monitoring, air traffic services, search-and-rescue and civil and military cooperation. ☺

Very Chinese

China Airlines gears up for North American business growth

Bradley Perrett **Taipei, Taiwan**

Probably more than anything, Taiwan's China Airlines wants access to transfer traffic from mainland China. While rivals such as Korean Air can pick up passengers from China and transfer them to onward flights, especially to North America, Beijing is withholding that right from



CHINA AIRLINES

Taiwanese carriers, even though it views them as Chinese.

Transfer traffic is one of the economic carrots that China dangles in front of Taiwan as a reward offered for the island nation moving politically closer to the mainland. No one outside of the Chinese government knows when the aviation policy will change, but China Airlines is getting ready.

The Skyteam alliance member is concentrating on southern and eastern China as it builds up the services across the Taiwan Strait that have been allowed since 2008, says Chairman H.H. Sun. When and if the transfer rights are granted, the China Airlines brand should be well-established in the cities that it can best serve. Since the island is off the southeast coast of the mainland and routes to North America from East Asia head northeasterly, Taiwanese carriers are poorly placed for carrying passengers from northern China.

Obtaining the transfer rights is taking longer than expected, says Sun. Taiwan's opposition party, wary of closer relations with the mainland, won local elections in November. That followed student protests earlier in 2014 that stalled a trade deal with the mainland. Beijing cannot have been pleased.

China Airlines' fleet plan shows it cannot afford to bet heavily on the transfer rights becoming available at any particular time. The 10 Boeing 777-300ERs and 14 Airbus A350-900s that the carrier has ordered are enough to replace 13 Boeing 747-400s and six Airbus 340-300s and add capacity for normal growth. Four of those 777s are in service.

A challenge will be the density of Skyteam members in the region. China Eastern Airlines, China Southern Airlines and Korean Air are also members and therefore compete for pas-

China Airlines is fitting its 777-300ERs with features, including this bar, that suit traditional Chinese tastes.

Fueling Growth

Widebodies drive most of Middle East MRO expansion

Lee Ann Shay **Dubai**

The Middle East commercial aviation maintenance, repair and overhaul (MRO) market is growing at a faster rate than the global average, and the majority of those expenditures are being driven by widebody aircraft. Globally, widebodies account for 18% of the in-service fleet, but in the Middle East that percentage surges to 50%, according to Aviation Week fleet data.

During the next decade, expect Middle East operators to accept 1,900 new aircraft—with the Boeing 777-8 and -9 the highest percentage types—12%, the fleet data show.

Besides widebody dominance in the region, the fleet will have a low replacement factor. The global average aircraft replacement factor is forecast to be 44%, according to Brian Kough, Aviation Week director of forecasts and analysis, but the Middle East fleet retirement rate is expected to be only 21% over the next decade. This rate has an impact on MRO expenses. Airlines in the Middle East will spend \$4.6 billion on MRO in 2015, according to Aviation Week forecasts. Engine expenses account for

41%, followed by components at 22%.

ICF International also predicts the Middle East MRO market at \$4.6 billion this year but pegs it to grow 6.7% per annum to \$8.8 billion in 10 years, compared to \$8.7 billion in Aviation Week's data. ICF Principal Richard Brown says 76% of that \$4.6 billion will be spending for widebody aircraft, with narrowbodies representing 19%.

Four carriers—Emirates (29%), Qatar Airways (15%), Etihad Airways (15%) and Saudi Arabian Airlines (8%)—account for two-thirds, or about \$3 billion, of Middle East MRO expenses, says Brown. Those airlines all have in-house maintenance capabilities, which helps explain why 76% of heavy airframe MRO is performed within the region. Of that, 81% is conducted in-house, "which means the opportunity for third-party suppliers targeting Middle East airframe and modifications is relatively small," says Brown.

The pool of independents shrank last year when Abu Dhabi Aircraft Technologies (ADAT) became Etihad Airways Engineering after the airline purchased ADAT's airframe and component assets in May from Mubadala. Mubadala retained ADAT's engine capabilities and is aligning them with its plans to produce engine parts in Al Ain for General Electric and Rolls-Royce. Expect Etihad to continue offering third-party MRO services from its facilities in Abu Dhabi.

Emirates, the largest airline in the region, with 233 widebodies—and the most expansive engineering group besides—offers some third-party maintenance services through Emirates Engineering. It completes most MRO in-house and

AVIATION WEEK & SPACE TECHNOLOGY

Defense Technology

International



Choose Your Weapons

A Renamed and Rearmed Littoral Combat Ship

Page DTI 19

U.S. NAVY/MASS COMMS. SPEC. 2ND CLASS ARMANDO GONZALES

The Sea Just Got Safer



Introducing the new SeaTalon Maritime Patrol Aircraft

Based on the proven Global 5000 missionized biz-jet platform, the SeaTalon features:

- Maritime surveillance & reconnaissance
- Long range and endurance
- Anti-surface warfare
- Anti-submarine warfare
- Airborne NCO command post
- EW suite
- Search & Rescue



www.iai.co.il
market@elta.co.il

SEE US AT
AERO INDIA 2015
Israel Pavilion
Hall A, Booth A1.1



Contents

FRONT LINE

- DTI4 Holistic Protection**
U.S. Army wants occupant-centric armored vehicle designs
- DTI4 Video Outreach to Robots**
Researchers say robots learn tasks from YouTube videos
- DTI6 Proof Positive**
DNA marking assures integrity of microcircuits
- DTI7 Game Theory**
U.S. Navy video game hones missile-defense techniques

DEFENSE ANALYSIS

- DTI8 Prime the Pump**
Low oil prices have no effect on Middle East procurement
- DTI12 Titans of Business**
Gulf states are fertile ground for local defense industries
- DTI15 Double Whammy**
German OEMs face cutbacks at home and export restrictions
- DTI16 The Devil in the Details**
Iran's nuclear program proceeds despite sanctions



DTI4

- DTI17 Meeting Needs**
Israel is developing major defense deals with India
- DTI19 If It Floats, It Fights**
U.S. Navy is expanding the lethality of its surface forces
- DTI20 Change in Tack**
China and Russia plan to build bigger destroyers
- DTI21 Element of Surprise**
Technology is remaking submarine warfare
- FIRST PERSON**
- DTI22 Winslow Wheeler**
Pentagon expert on the many problems of procurement

The next issue of the Defense Technology Edition will be dated March 30-April 12.

SpeedNews Aerospace Additive Manufacturing Briefings

April 7, 2015

New for 2015!

Terranea Resort
Palos Verdes (Los Angeles) • CA

In conjunction with SpeedNews Aerospace Manufacturing Conference



Please visit www.SpeedNews.com for more information

SpeedNews 3rd Annual Aerospace Manufacturing Conference

April 8-9, 2015

Terranea Resort
Palos Verdes (Los Angeles) • CA



SpeedNews
11500 W. Olympic Blvd., Suite 574 • Los Angeles, CA 90064, USA
Tel: +1-424-465-6501 • Fax: +1-424-465-6506 • conferences@speednews.com

SpeedNews is part of the Aviation Week Network, a Penton Business

Safety Zone

U.S. Army applies holistic engineering to armored vehicle design

Advances have been made in designing vehicles to withstand blasts from improvised explosive devices (IEDs) and mines, mostly through use of heavy armor and blast-deflecting underbodies (think MRAP). But now the U.S. Army is focusing on system engineering of armored vehicles that incorporates multiple techniques to resist the blast of a roadside bomb and provide maximum protection to occupants.

The goal of the Occupant Centric Platform (OCP) program undertaken by Tardec, the Army's Tank Automotive Research, Development and Engineering Center in Warren, Michigan, is no occupant injuries from IEDs and mines—even in a resulting crash or rollover. Tardec seeks to achieve this with a vehicle that incorporates protective and ergonomic design features.

The initial test vehicle, called Camel (Concept for Advanced Military Explosion-mitigating Land demonstrator), is a 60,000-lb., eight-wheel design that transports 11—two crewmembers and nine soldiers. Camel has at least a dozen design features that are geared as much toward soldier comfort and protection as operational performance.

The interior is sized for 90% of the 2015 soldier population, as determined by the Army's Natick (Massachusetts) Soldier Research, Development and Engineering Center. Angled, energy-absorbing seats are designed to reduce spinal injuries in a blast. There are designated stowage spaces for soldiers' weapons and equipment, all of which are restrained by belts and straps, and cameras transmit 360-deg. video images from outside onto multiple interior screens. The interior can be reconfigured to create space for injured troops in stretchers.

The vehicle has a low center of gravity and wide track to reduce the potential for rollover. A U-shaped underbody with a deflector shield channels shock waves from a blast away from the hull and interior. Stainless steel tension rods support the floor, which will absorb energy from a blast, thus mitigating its effect on soldiers' feet and ankles. The floor is also decoupled from the hull as an added safety measure, and the vehicle's independent suspension has 14 in. of travel.

There are no gas or brake pedals in the driver's area—hand controls are used instead. Eliminating pedals removes a point of entry for blast pressure, protects a driver's feet and legs and allows for the installation of a seamless underbelly.

In performance, the powertrain has a 100-kw integrated starter-generator that automatically shuts off the engine to save fuel when the vehicle stops, and restarts immediately when the driver activates the accelerator. A 24-speed automatic transmission developed by SAPA Transmission Inc. of Fort Lauderdale, Florida, is used. (SAPA received a



The Camel armored vehicle interior is designed for occupant comfort and safety.

U.S. ARMY

\$7.8 million contract from the Army in 2010 for a four-year development program aimed at producing an electrically controlled, fuel-efficient powertrain that runs on a wide range of fuels and fuel mixtures.) Advanced lithium-ion 6T batteries provide twice as much power density as a conventional lead-acid battery.

The Camel version is undergoing tests, including live fire, that are designed to qualify its safety, comfort and blast resistance. ☼

—Pat Toensmeier

Autodidacts

Robots are learning tasks by watching 'how-to' videos

Maintenance and repair and logistics could in the not-too-distant future be among tasks completed by cognitive robots, which would learn them by watching instructional videos and teach this information to other robots.

This is some of the thinking inspired by recent developments from a robotic-sensing program established by the U.S. Defense Advanced Research Projects Agency (Darpa). The program, called Mathematics of Sensing, Exploitation and Execution (MSEE), is funding research at the University of Maryland that allows robots to process "how-to" visual data on cooking from YouTube and other Internet videos. After viewing a video, the robots are able to learn, rapidly and with a high degree of accuracy, which utensil or other kitchen objects to pick up and manipulate to accomplish food-preparation tasks.

MSEE began by focusing on sensing. Robots would perceive and understand what is happening in a visual scene, says Reza Ghanadan, a program manager at Darpa, in a statement. "We've now taken the next step to execution, where a robot processes visual cues through a manipulation action-grammar module and translates them into actions."

The ability to do this from a video is especially challenging, the Maryland researchers note in a paper they presented last month at a meeting of the Association for the Advancement of Artificial Intelligence. This is due to the absence of 3-D data for the robot to process and multiple variations in appearance and occlusions of the hand, as well as differences in how objects are grasped and manipulated.

"The grasp type is an essential component in the charac-

DSEI

15 - 18 September 2015

The World Leading
Defence & Security Event

ExCeL, London www.DSEI.co.uk

AIR + LAND + NAVAL + SECURITY + MEDICAL + UNMANNED

Engage with the whole defence & security sector at DSEI 2015

VISITOR
REGISTRATION
**NOW
OPEN**

- 1,500 companies representing the whole supply chain, from Primes to SMEs
- 6 dedicated areas featuring state-of-the-art solutions
- Largest display of the latest defence & security technology
- Networking opportunities with 32,000 representatives from government, military, industry and academia from all over the world
- High-level seminars delivering the latest insight into the defence & security markets from an international perspective

Register NOW on:

www.DSEI.co.uk/2015

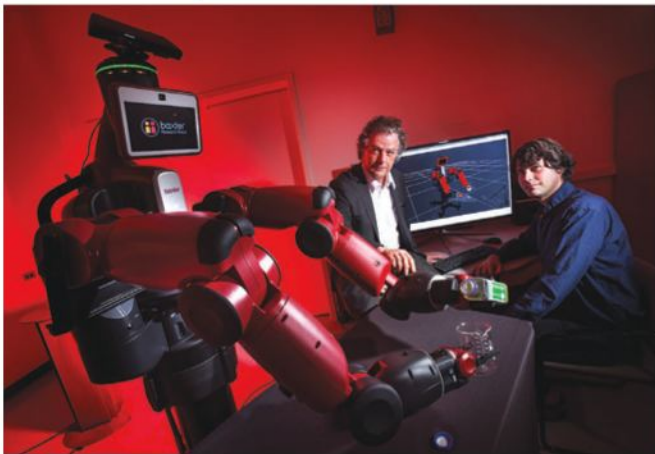
SUPPORTED BY



ORGANISED BY



IMAGES COURTESY OF: Supacat, Peter Harlsson SAAB, Richard Seymour and THALES



Yiannis Aloilmanos (left) and other researchers at the University of Maryland teach robots to learn by watching Internet videos.

recognition modules for grasping and recognizing objects.

Previous efforts to teach robots to accomplish various tasks used sensors that interpreted surroundings as always being new rather than apply previously acquired knowledge to them. Ghanadan says the current methodology “allows robots to continuously build on previous learning . . . which could have a huge impact on teaching and training.” The learning-based approach means robots no longer need programming code to learn tasks and can, in fact, acquire knowledge faster, at less cost, and share it among other robots.

“This learning-based approach is a significant step toward developing technologies that could have benefits in areas such as military repair and logistics,” Ghanadan says. ☛

—Pat Toensmeier

terization of manipulation actions,” the researchers write. Among the techniques to enable robots to learn tasks from videos is the use of convolutional neural network-based

Proof Positive

DNA marking technique confirms integrity of microcircuits

Counterfeit microcircuits are a major concern in weapons procurement. The chips, which control targeting accuracy and other critical parameters, can wreak havoc if they do not perform to specifications. They can also be a means of sabotaging weapon systems if covertly supplied by a hostile government through seemingly legitimate companies.

The U.S. Defense Logistics Agency (DLA) recently started an anti-counterfeiting initiative at its Land and Maritime Electronics Product Test Center in Columbus, Ohio. According to a DLA statement, the procedure, called DNA marking, will validate the authenticity of microcircuits sourced from industry and, in the process, increase their reliability through the supply chain.

The test center began applying DNA markings to FSC (Federal Supply Class) 5962 electronic microcircuits in December. DLA expects to mark at least 85,000 microcircuits annually with the technique, which uses special equipment to insert an undisclosed identifier derived from botanical DNA on the surface of a microcircuit to validate its authenticity.

The DNA molecule in use is reportedly robust and will survive the life of the microcircuit. DLA says it cannot be replicated, reengineered or digitally copied. Personnel use hand-held scanners to detect the identifier, and special forensic tests will reveal data

about the microcircuit’s supplier along with manufacturing details such as part and lot numbers, when the microcircuit entered DLA’s supply chain.

This information was often lost when technicians removed a microcircuit from its packing for installation.

The DNA marking program dates to fiscal 2012 when DLA issued a Request for Information on the technology and its application. Despite the anti-counterfeiting benefits it provides, many suppliers did not initially want to add a DNA marking step even though DLA offered to reimburse them for the cost. However, as counterfeiters of microcircuits—and other defense supplies—have become more sophisticated in recent years, the adoption of such a program was a matter of when, not if.

DLA is using a DNA material for the process called Sig-Nature, which was developed by Applied DNA Sciences of Stony Brook, New York. DLA conducted an 18-month R&D project with leading defense contractors to test the integrity of the material and the marking process. The marking reportedly resisted all attempts to defeat it on a variety of surfaces—ceramic, glass, gold, plastics and some metals. Initial tests successfully marked 14,000 parts at a U.S. original component manufacturer’s facility, and more than 350,000 parts at a major offshore fabrication site. ☛

—Pat Toensmeier

A U.S. Marine Corps M1A1 Abrams tank fires a 120-mm. round. The DLA seeks to assure the integrity of microcircuits in this and other weapons with a special DNA marking technique.



U.S. MARINE CORPS

Life-or-Death Gaming

Video game trains sailors in anti-missile defense tactics

Dismounted soldiers and marines have long used video game simulations to practice or refine combat skills. The U.S. Navy is going the same route, employing a video game called *Strike Group Defender: The Missile Matrix*, to train sailors in how to effectively confront and neutralize anti-ship missiles.

Thirty units of the collaborative video game have been released to the fleet to train and evaluate specialists in surface electronic warfare (EW).

The game was developed by the Office of Naval Research (ONR) and by the Massachusetts Institute of Technology's Lincoln Laboratory, along with Metateq Inc. of Alexandria, Virginia, which designs, develops and produces immersive media for training among other products, and software specialist PipeWorks Studio of Eugene, Oregon.

According to a Lincoln Laboratory statement, the objective of the game is to immerse players in a simulated threat environment that exposes them to defense tactics against cruise missiles. "Although players can choose to intercept the missiles or to deploy decoys to divert the missiles from their targets," the statement explains, "the game is designed to promote the effective use of decoys."

Players, in fact, win rewards when their use of decoys diverts enemy missiles from ships.

With the electromagnetic spectrum now accepted by the Navy as a true battle domain, service leaders such as Chief of Naval Operations Jonathan Greenert want to "[improve] the ability of forces to detect and defeat adversary radars and anti-ship missiles," ONR reports. *Strike Group Defender* is one aspect of this training, and is being upgraded on an ongoing basis by ONR and the Naval Postgraduate School, based on data from sailors who train with the game and the logs they keep.

The game dates to 2013 when an initial version called *Red Team/Blue Team* simulation was demonstrated at

the Air and Missile Defense Technology Workshop at Lincoln Laboratory. As conceived, Red Team adversaries would seek to develop missile attack strategies to destroy Blue Team ships. The Blue Team in turn worked out counterstrategies focused on decoys.

The manager of PMR-51, which oversees ONR's integrated air and missile defense science and technology and transition work, grasped the value of the game as a training tool for EW officers, strike group planners and tactical action officers, notably in coordinating a hard-kill (firepower) or soft-kill (decoys) response to enemy missiles and understanding the



A Rolling Air Missile is fired from the USS Theodore Roosevelt. The Navy is using a video game to help teach surface warfare personnel how to counter anti-ship missile threats with firepower or decoys.

advantages and tradeoffs of each.

The software displays different threat scenarios for players, all in high-quality visuals. In some scenarios players have 20 sec. or less to respond to incoming missiles. Team play reportedly improves collaboration skills, and the exposure to different threat environments gives novices a rapid introduction to threat assessment, tactics and decision-making.

Strike Group Defender is so well designed that it won an award as the best serious game entered by a government organization from a panel of international judges at the Interservice/Industry Training, Simulation and Education Conference last December. 🗳

—Pat Toensmeier

SpeedNews
Conferences since 1987

SpeedNews Conferences offer ways to meet with distinguished experts in the aerospace industry, and learn about current trends, new products and forecasts, as well as network with your customers and peers.

Don't miss these upcoming events!

**SPEEDNEWS 5TH ANNUAL
AEROSPACE RAW MATERIALS &
MANUFACTURERS SUPPLY CHAIN CONFERENCE**
March 2, 2015
Beverly Wilshire, Beverly Hills, CA

**SPEEDNEWS 29TH ANNUAL COMMERCIAL
AVIATION INDUSTRY SUPPLIERS CONFERENCE**
March 2-4, 2015
Beverly Wilshire, Beverly Hills, CA

**NEW! SPEEDNEWS AEROSPACE ADDITIVE
MANUFACTURING BRIEFINGS**
April 7, 2015
Terranea Resort, Palos Verdes, CA

**SPEEDNEWS 3RD ANNUAL AEROSPACE
MANUFACTURING CONFERENCE**
April 8-9, 2015
Terranea Resort, Palos Verdes, CA

**SPEEDNEWS 3RD ANNUAL EUROPEAN
AEROSPACE RAW MATERIALS & MANUFACTURERS
SUPPLY CHAIN CONFERENCE**
September 14, 2015
Hôtel Palladia, Toulouse, France

**SPEEDNEWS 16TH ANNUAL AVIATION INDUSTRY
SUPPLIERS CONFERENCE IN TOULOUSE**
September 14-16, 2015
Hôtel Palladia, Toulouse, France

**SPEEDNEWS 20TH ANNUAL BUSINESS & GENERAL
AVIATION INDUSTRY SUPPLIERS CONFERENCE**
October 5-7, 2015
Jonathan Club, Los Angeles, CA

**AEROSPACE DEFENSE
SUPPLY CHAIN
PROGRAMS AND REQUIREMENTS**

NEW! AEROSPACEDEFENSECHAIN CONFERENCE
November 3-5, 2015
Omni Scottsdale Resort & Spa at Montelucia,
Scottsdale, AZ

**For information about attending,
sponsoring and speaking,
please contact:
conferences@speednews.com
Tel: +1-424-465-6501
www.speednews.com**

All Systems Go



GORDON ZAMMIT

Plunging oil revenues are not slowing Middle East defense spending

Pat Toensmeier **New York, Francis Tusa** **London**
and **Christina Mackenzie** **Paris**

The precipitous decline of oil prices over the past seven months is affecting key sectors of the global economy, with markets seeing big winners (consumers, manufacturers, oil importers) and big losers (oil producers and exporters).

Since June 2014, the benchmark price of Brent crude has fallen 57%, to \$49 per barrel on Jan. 23, from \$115, the lowest level in almost six years. With no declines in production planned by OPEC, some forecasters predict prices reaching \$39 per barrel by July before rising to around \$65 toward the end of the year.

Among regions hit hardest by the free fall of oil prices is the Middle East, where many countries rely heavily on oil revenue for programs ranging from infrastructure to defense procurement. Whatever cutbacks might result from lower oil revenues, however, indications are that Middle Eastern defense budgets will not take a hit, at least not immediately.

This is the consensus of experts who cite several reasons for this outlook.

- The biggest purchasers of military equipment in the Middle East, the United Arab Emirates (UAE) and Saudi Arabia, are well into major procurement programs for air, land and sea that make little sense to cancel or curtail.

- The UAE and Saudi Arabia have amassed sizable foreign exchange reserves that allow them to maintain high levels of defense spending despite plunging oil prices. Saudi Arabia is be-

lieved to have \$750 billion of reserves.

- The rise of the Islamic State, ongoing threats from Al Qaeda in the Arabian Peninsula, concerns about Iran's regional and nuclear ambitions, and instability in Syria, Iraq and Yemen create a combustible environment that requires a high level of military deterrence. Also a factor, at least for the short term, is the death on Jan. 23 of Saudi King Abdullah, and the potential this may create for challenges to the kingdom.

- This is a good time to continue or accelerate some procurement programs. The decline in value of the euro, to \$1.15 as of Feb. 3 from \$1.37 in December 2013, makes military equipment sourced from European countries much less expensive.

"Military procurement and capabilities are high priorities for Middle East countries," says Pieter Weze-man, senior researcher for the arms and military expenditure program at the Stockholm International Peace Research Institute (Sipri). This is reflected in the high level of spending as a percentage of GDP in countries such as Saudi Arabia (9.3% in 2013) and the UAE (4.7% in 2012). "With almost all countries in the region facing armed conflict, the pressure to main-

With \$750 billion in cash reserves, Saudi Arabia can maintain defense spending despite low oil prices. Ongoing programs include acquisition of Eurofighter Typhoons.

tain spending is enormous," he adds.

From 2009-13, the most recent year for which Sipri has data, the UAE was the world's fourth-largest arms importer, and accounting for 22% of deliveries to the Middle East. Saudi Arabia, the fifth-largest importer, received 20% of regional shipments during that period. Major orders for aerial weapons alone included 154 new or upgraded F-15SA fighters from Boeing and 72 Typhoons from Eurofighter. Since 2009, Saudi Arabia, the UAE and Bahrain received or ordered large numbers of guided bombs, surface-to-surface missiles and cruise missiles from Western contractors, mostly in the U.S. and U.K.

Total defense expenditures in the region grew 64% in 2004-13, Sipri reports, from \$91.5 billion to \$150 billion. The commitment to defense spending despite falling oil revenues is notable when the break-even price for major buyers is considered. According to one source, in 2012 that figure ranged from \$55 per barrel for Qatar to \$85 for the UAE and around \$87 for Saudi Arabia.

Saudi Arabia has maintained a current account surplus of more than 20% in most of the past 10 years, which, as noted, built up its cash reserves. (The country was stung by low oil prices in the late 1990s.) Deciding in 2008-09 to undertake a massive defense procurement program worth \$25-40 billion, oil prices ultimately had less to do with matters than it might seem. Brent oil peaked at \$130 per barrel in mid-2008 then fell to \$39 in December of that

NEW TOOLS FOR NEW RULES



Visit us at

AERO INDIA 2015

Israel Pavilion, Hall A, Booth A2.5

Because nothing escapes our attention

Total protection against all threat types

- **All-in-Small** is a next generation suite combined into one LRU designed for airborne EW protection. It includes an EW Suite Controller, Digital Radar Warning receiver, Laser Warning Receiver, IR Missile Warning System and Chaff and Flare Dispensing Controller. The Suite includes provisions for Emitter Location and Net Centric capabilities and integrates with ECM Jammer and DIRCM.
- **PAWS/PAWS-2** is a family of combat proven and cost effective Missile Warning Systems (MWS) for all airborne platforms, which uses life-saving IR technology for improved protection and mission effectiveness.
- **IR-CENTRIC®** is a comprehensive and combat-proven unique solution. IR-CENTRIC is available as an add-on to the PAWS family of IR-MWS and introduces new capabilities that will be demanded by the missions of tomorrow.

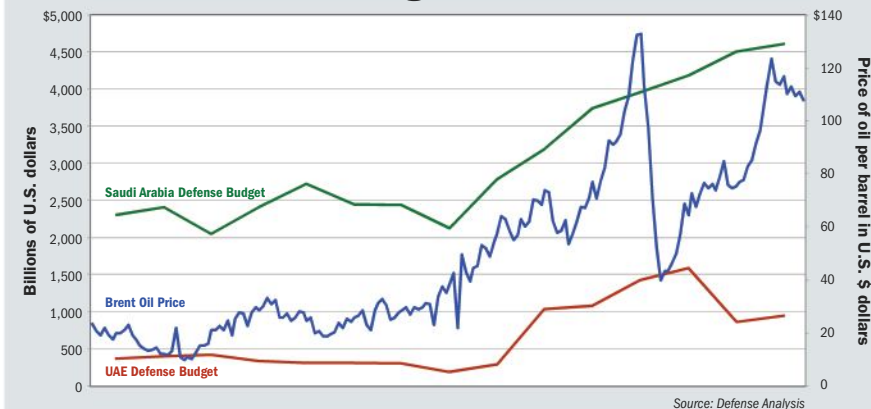


Elbit Systems
EW and SIGINT - Elisra

N E X T I S N O W ®

www.elbitsystems.com

Oil and Budgets Do Not Mix



Defense spending by Saudi Arabia and the UAE does not track the Brent oil benchmark price. In this analysis of oil prices and defense budgets from 1997-2011, spending by both countries rises even when oil revenues fall.

of Iran acquiring nuclear weapons.

What might also influence what the Gulf states do in the near term is the massive backlog in orders for the UAE, Saudi Arabia and Qatar. Historically, the Saudis have taken deliveries at a rate of \$6 billion annually, and the UAE at \$2 billion. That means these countries have a delivery backlog of potentially nine years and seven years, respectively.

Low oil prices are likely to have an effect on some procurement spending, but because of the cash reserves of many Gulf states it will not be extensive. If prices remain low or depressed for some time, though, they could have an impact in 3-4 years, when the current "procurement indigestion" of the Gulf states ends, and they begin to consider buying more equipment. At that stage, depleted treasuries are likely

year, but the deals, mostly with the U.S., progressed over the next three years. This shows that the price of oil is only one factor the kingdom considers in procurement.

More relevant is that after the 2008 price collapse, it was not just Saudi Arabia that continued buying: The UAE and Qatar also extended themselves for deals worth \$15 billion and \$25 billion, respectively, when oil prices

were low or recovering slowly. Even as oil prices retreated from the December 2008 trough, defense orders continued to rise. Qatar and the UAE built up major cash reserves over the past decade, and it is likely that these were behind the 2008-12 spending spree.

In fact, almost all of the Persian Gulf states increased defense spending dramatically during this period, which likely reflected growing fears

RGW 90 Family

Recoilless Grenade Weapon 90 mm

HEAT/ HESH • Anti Structure • Area Denial

DND

Dynamit Nobel Defence



Designed for mission

www.dn-defence.com
info@dn-defence.com

to temper procurement ambitions.

Meanwhile, the drop in value of the euro to the U.S. dollar is of significance to French defense contractors, especially those whose products are now much more affordable for countries with lower oil revenues. Until 2013, the Rafale and F/A-18 E/F fighters had the same figure on their price tags except that one was in euros and the other dollars, which made the euro price 20-30% more expensive. As one industry specialist says: "If the dollar and euro were on parity then these two aircraft would cost the same."

This year's Middle East defense budgets will not change, as they were set before the oil slump. But Patrick van den Ende, a research fellow at the Paris-based FRS strategic research foundation, says the drop will not much affect the medium term either. "Defense budgets have risen 56% across the region over the past decade, totaling \$150 billion for the Middle East and \$162 billion if one includes North Africa," he notes. Defense budgets in North Africa rose 10% in 2014; Algeria accounted for 90% of this increase.

"These oil- and gas-producing coun-

What might influence what Gulf states do in the near term is the massive backlog of orders for UAE, Saudi Arabia and Qatar

tries benefited from high oil prices for years to finance the modernization of their military infrastructures, equipment and forces," van den Ende says, "and they still have important financial reserves to pay for what they ordered."

Nicolas Mazzucchi, a geo-economist and director of Polemos Consulting of Paris, agrees that "for the moment there is not likely to be a change in the way they spend their money," although he believes an "enormous hole" will be made in the budgets of countries such as Saudi Arabia and Kuwait whose incomes depend on oil. But he believes these countries are banking on the fact that shale gas extraction will soon be unprofitable, and former clients such as the U.S., which had almost stopped importing oil from the Middle East, will return.

In addition, a number of Middle

Eastern countries have embarked on partnerships with other nations to support their nascent defense industries and are unlikely to break these agreements.

Less easy to measure but possibly even more important to keeping defense budgets high is the place occupied by the military in the region. In the Gulf states, the small and elite minority native population (12% native Qataris, 13% native Emiratis) considers the military as one of the acceptable professions for themselves, while governments in Egypt and Algeria are more prone to buy equipment to keep senior officers busy and engaged with the armed forces, and not with running the country.

Egypt, in fact, could benefit from low oil prices. Should the country, an oil importer, increase revenue as a result of low prices, it would have more money for procurement. Egypt is interested in a range of equipment, from fighter aircraft and combat helicopters to tanks and naval vessels. ☛

Make your mission a success. Border control with the Dornier 228.



Please visit us at

- AERO INDIA 2015, 18-22 February, Bengaluru, Chalet 23
- IDEX 2015, 22-26 February, Abu Dhabi, UAE, booth 08-A15

View video



RUAG Aerospace Services GmbH | RUAG Aviation
P.O. Box 1253 | Special Airfield Oberpfaffenhofen | 82231 Wessling | Germany
Phone +49 8153 30-2162 | info.de.aviation@ruag.com
www.dornier228.com

**Together
ahead. RUAG**

Staking Claims

Middle East is fertile ground for local defense industries

Jon Lake London

Saudi Arabia integrated French Damocles laser designator pods on its Eurofighter Typhoons, the only operator to do so.

At a time of increasing tensions in the Middle East, many of the region's nations are spending heavily to ensure their security.

As a result, the Gulf is arguably the world's most important market for defense exports. Saudi Arabia has been spending more than 8% of GDP on defense since 2004, and in 2014 it ranked fourth in defense spending, behind the U.S., China and Russia. In the United Arab Emirates (UAE) defense spending is around 5.6% of GDP, but is forecast to rise to 6.8% by the end of 2017.

Several countries aspire to greater autonomous military and industrial capabilities, and Saudi Arabia and the UAE have declared that self-sufficiency in defense production is their ultimate aim.

In the Middle East, making defense industry work more indigenous is a key goal for many reasons, which differ from country to country. In the Gulf Cooperation Council nations,

indigenization is a means of creating high-value jobs and diversifying away from oil, as well as a way of enhancing national prestige. It also reduces dependence on U.S. equipment and avoids restrictions and controls that have sometimes been imposed by Washington. In Iran, the development of indigenous industrial capabilities has been the only means by which legacy equipment could be kept operational in the face of U.S. embargoes.

The development of local defense industries in the UAE and Saudi Arabia is facilitated by sophisticated offset programs that accompanied major arms deals. These established the joint-venture enterprises that form the backbone of both countries' defense industries.

One striking example of a successful company established by offsets is the Alsalam Aircraft Co. of Saudi Arabia. Established under the auspices of the Ministry of Defense and Aviation in

1988, as part of the economic offset program that accompanied the supply of E-3A Sentry Airborne Warning and Control System (AWACS) aircraft, Alsalam has grown to be a profitable MRO business. The company has 3,500 employees, more than 55% of them Saudi nationals, and repairs, overhauls and upgrades military and civil aircraft, including those originally supplied by Boeing, but also BAE aircraft such as the Hawk and Tornado, and Sikorsky helicopters.

The company carries out VIP completions and some manufacturing and assembly—it has manufactured new canopies for the BAE Hawk, was expected to play a role in Eurofighter Typhoon final assembly (when this was still scheduled to take place in the kingdom) and is manufacturing 70 wing sets for the upgrade element of the ongoing F-15SA program.

Together with AEC (Aircraft Accessories and Components Co.), Middle East Propulsion Co., and International Systems Engineering Co., Alsalam is part of an advanced aerospace industrial complex in Saudi Arabia.

Saudi Arabia has created a number of bodies to provide an institutional framework for encouraging the growth of an indigenous defense industry. On July 2, 2013, the Saudi Council of Ministers approved a law regulating the General Organization for Military Industries.

Saudi industry has started to produce indigenous designs. The Abdallah Al Faris Co. for Heavy Industries builds the eight-wheeled Al-Fahd Armored Personnel Carrier and Armored Fighting and Reconnaissance Vehicle variants, while the Prince Sultan Advanced Technologies Research Institute and the King Abdulaziz City for Science & Technology are working on unmanned aircraft projects, the latter probably in collaboration with South Africa's Denel.

Abu Dhabi's defense industry has even more players than Saudi Arabia, many funded by government-backed Mubadala Development, a strategic investment company tasked with diversifying and transforming the nation's economy across multiple sectors including aerospace and defense. Mubadala has a majority interest in Piaggio Aerospace and SR Technics, and owns 40% of Abu Dhabi Ship Building (ADSB). The shipbuilder, created in 1996, is responsible for the UAE



SHOW THE WORLD WHAT YOU'RE MADE OF

BE PART OF THE SINGAPORE AIRSHOW 2016

If aviation defines who you are, if it is in your very DNA, then Singapore Airshow is the platform to show the world of aviation what you have to offer. The global aerospace community and key commercial, government and military delegations will gather again at the Singapore Airshow 2016. Tap directly into the world's fastest growing region!

Exhibition space is filling fast. Secure your presence now.

75% BOOKED

TO BOOK YOUR SPACE, PLEASE CONTACT:

DANNY SOONG / VIVIAN KOO / CATHRYN LEE

TEL: +65 6595 6123 / 6595 6122 / 6595 6114

EMAIL: sales@singaporeairshow.com



SCAN FOR MORE INFO

SINGAPORE AIRSHOW 2014 ACHIEVEMENTS

- ▶ 1,018 PARTICIPATING COMPANIES FROM 47 COUNTRIES & REGIONS
- ▶ 65 OF THE TOP 100 AEROSPACE COMPANIES
- ▶ 45,152 TRADE ATTENDEES FROM 125 COUNTRIES & REGIONS
- ▶ 274 DELEGATIONS FROM 76 COUNTRIES & REGIONS
- ▶ CLOSE TO 70 CEOs, PRESIDENTS AND CHAIRMEN FROM VARIOUS AIRLINES AND INDUSTRY ASSOCIATIONS
- ▶ 1,132 HIGH-LEVEL MEETINGS TOOK PLACE BETWEEN VIP DELEGATIONS AND EXHIBITORS

SINGAPORE AIRSHOW 2016

ASIA'S BIGGEST FOR AVIATION'S FINEST

CHANGI EXHIBITION CENTRE
16 - 21 FEBRUARY



Organised by:
experia
events that influence

Official Media Partner:
AVIATION WEEK

Supporting Publications:

AIN
PUBLICATIONS

ATW
AIR TRANSPORT WORLD

FG

Flightglobal
AVIATION'S LEADER

Endorsed By:
aif
ASIA INFLUENCE FORUM

Held In:
Singapore

singapore

SINGAPORE
AIRSHOW

navy's six-ship Baynunah corvette program, the largest and most ambitious shipbuilding project in the Gulf. The corvettes are of French design, but ADSB is also building 12 Ghannatha-class missile patrol boats, which have been indigenously developed, although adapted from a Swedish design.

Mubadala also entered a joint venture with Sikorsky and Lockheed Martin to create the Advanced Military Maintenance, Repair and Overhaul Center, and teamed with Abu Dhabi Airports Co. to build an aerospace cluster at Zayed Military City, also home to the

Another Tawazun subsidiary is Abu Dhabi Autonomous Systems Investments, which has produced the Al Sabr autonomous aerial vehicle for the UAE. Based on the Schiebel S-100 Camcopter, Al Sabr is the result of an Austro-Emirati joint venture.

Tawazun Precision Industries is manufacturing an aluminum rear fuselage V-frame for the Eurofighter Typhoon, as well as components for the MBDA Marte anti-ship missile and Rheinmetall's Oerlikon Skyshield air-defense system.

Unmanned aerial vehicles (UAV) of

with independent scientific and technical services and a sustainable defense industrial base. KADDB's early focus was on the conversion and upgrade of military vehicles and land systems, before moving into the manufacture of light aircraft, producing the Seabird Aviation Jordan Seeker SB7L-360 aerial surveillance platform in a joint venture between KADDB and Seabird Aviation Australia. KADDB's projects also include mini and quadrotor UAVs, unmanned ground vehicles, mortar, gun and sighting systems, and the AC-235 and AC-295 gunship programs, which are produced in a joint venture between KADDB and ATK.

In Iran, large numbers of F-5s, F-4s, F-14s, Augusta-Sikorsky Sea Kings and

The UAE had the confidence to integrate indigenous weapons on its Mirage 2000-9s, including the Black Shaheen cruise missile and Al Hakim short-range, air-to-surface standoff weapon (shown).

other types have been overhauled, refurbished and returned to service, in some cases having integrated new and indigenous weapons.

U.S. weapon systems have been successfully copied by Iran, sometimes with improved performance. Attempts to build unlicensed copies and derivatives of U.S. aircraft types have been less successful, with few of the designs built in any numbers. Recent military programs including an indigenous fighter and a claimed copy of the U.S. RQ-170 UAV have made little progress.

More significant, Iran Aircraft Manufacturing Industrial Co. is assembling a license-built version of the Antonov An-140, known as the IrAn-140 Faraz, from knockdown kits supplied by the Ukrainian company. Maritime patrol and military transport versions are expected.

Since 1992, Iran has manufactured a range of equipment, including UAVs, surface- and air-launched cruise missiles, short- and medium-range ballistic surface-to-surface missiles, anti-tank, air-to-surface and surface-to-air missiles, as well as tanks, armored personnel carriers, artillery and rocket systems, small arms and radar systems. The nation built several frigates (reverse-engineered copies of ships in service), as well as a number of smaller inshore patrol vessels and fast-attack craft. ☒



ANTONIO DI FRANCO

industrial park built by Tawazun, Abu Dhabi's state-owned defense company.

Tawazun has a number of divisions, including Burkan Munitions Systems, established in 2007 as a joint venture between Tawazun and Al Jaber Land Systems, which has since been taken under the Tawazun umbrella as Jobaria Defense Systems. Jobaria is responsible for the Multiple Cradle Launcher first displayed at IDEX in 2013. This is a modern rocket system capable of firing 240 unguided artillery rockets within 2 min., with a crew of three.

Tawazun acquired small arms and ammunition manufacturer Adcom Manufacturing in 2007, renaming it Caracal Light Ammunition, while Nimr Automotive is Tawazun's defense vehicle manufacturing subsidiary, responsible for Nimr, the UAE's first indigenous armored vehicle.

Tawazun Dynamics, a joint venture between Tawazun and South Africa-based Denel Dynamics, is responsible for the Al-Tariq family of strap-on GPS/INS bomb-guidance systems, which have been integrated in the UAE air force fleet of Mirage 2000-9 fighter-bombers.

for developing nations an opportunity for indigenization, requiring less investment, expertise and infrastructure than manned military aircraft.

Created in the late 1980s by Emirati national Ali Al Daheri, Adcom Systems produces air traffic control radar systems and advanced communication systems, and pioneered the design, development and production of unmanned systems in the UAE. Adcom produced thousands of target drones for the UAE armed forces and 12 export customers, and has turned to the development of larger and more sophisticated reconnaissance UAVs and armed unmanned combat aerial vehicles. Adcom is reportedly in final talks to supply Russia with two of its new United 40 medium-altitude long-endurance UAVs for testing and evaluation.

Jordan's approach to bulking up a home-grown defense industry has been to identify strategic international partners for specific products or programs, and get these partners to work alongside the King Abdullah II Design and Development Bureau (KADDB). This was established in 1999, with the aim of providing Jordan's armed forces



Reversal Of Fortune

Defense cutbacks are making the German market unappealing to many contractors.

Thyssen interested in the naval business. However, with few exceptions TKMS has been far more domestically focused over the past decade. Export orders for Meko-class ships have been less frequent, and even license-built ships have sold at far lower rates than in the 1980s and 1990s.

The submarine business would seem more positive. South Korea is building a class of U-214-based SSKs, after all, and

H&K

Turkey and Singapore specified the design. And there are other prospects in Asia-Pacific, possibly including Australia. But if this were enough to make TKMS an attractive business, Thyssen would retain it. Talks about divesting the naval business continue, which indicates decision-makers believe it is better to sell the division in the face of stagnant German defense spending, a tough export market and increasingly tight export restrictions.

It is this last concern that seems to be tipping the balance in favor of divestment or withdrawal for many companies. Export

Cutbacks and export restrictions send German contractors reeling

Francis Tusa London

In just six months Germany's defense industry has gone from top of the heap to deep in the dumps.

In mid-2014, Germany was supposedly among the top global defense exporters (although the data is far less clear). By late 2014, key contractors announced their faith in the German defense market was so tenuous they were pulling out or scaling back. In some cases, this means withdrawals.

Airbus CEO Tom Enders last year attacked the low level of German defense spending, sclerotic procurement systems and tightened export regulations that are killing a raft of contracts. He backed up his criticism by announcing that Airbus will sell its Professional Mobile Radio business and stake in Atlas Elektronik, and may move production of military/police helicopters to France, all signs of a lack of confidence in the German defense market. At the same time, Rheinmetall reported it was finding the climate in Germany tough, and was seeing defense exports stymied on many levels.

The signs of a mass exodus from the defense market are also apparent in Thyssen Krupp's moves to sell its naval business, Thyssen Krupp Marine Systems (TKMS). TKMS is known for the Meko corvette/frigate class, which has sold 60 ships since 1990, 25 of which were built in German yards. The TKMS submarine division sold 45-plus conventionally powered SSK submarines during the same period, making it the world leader in SSKs, the company says.

Why, many wonder, would Thyssen sell what seems to be a profitable and highly regarded business? The answer: TKMS faces the same problem as Airbus—a stagnant German defense budget. Although TKMS has benefited from lucrative domestic orders—the U-212 SSK and F-124/125 frigate and K-130 corvette programs have generated up to \$9.25 billion since 1990—these are ending. Having had a focused German naval shipbuilding program for the last 20 years, there will likely be no new warship developments for at least a decade.

If exports were lucrative, there should be enough to keep

New export restrictions limit the sale of German-made weapons and components.



MORITZ KOSINSKY



KRAUSS MAFFEI WEGMANN

regulations are being promoted by Sigmar Gabriel, vice chancellor and minister for economic affairs and energy. As leader of the left-of-center Social Democratic Party, he has a narrow view of what should be exportable when it comes to defense materiel. He has introduced tougher tests of "acceptability" for exports, which include police sales as well as defense.

German defense companies complain that the new rules

Vice Chancellor Sigmar Gabriel is promoting limits on German defense exports.

make many exports nearly impossible. Enders cited blocking the export of a "sub-sub-component" to

Uzbekistan. Rheinmetall was forced to cancel building a military training facility in Russia. Krauss Maffei Wegmann is seeing highly profitable Leopard 2 tank deals (to Saudi Arabia, the United Arab Emirates and Qatar) blocked by the same rules. They also have halted sales of French Nexter-built MRAP-type armored vehicles to a Persian Gulf state because they use German-made chassis parts. MBDA had a sale of MMP mid-range, anti-armor missiles blocked because the firing posts were assembled in Germany. This is also of concern to France since exports of common products are governed by the 1970s Schmidt-Debre Accord. Recent permit refusals by Germany contravene the agreement.

If German defense spending continues to lag and export controls rise, the business climate is likely to worsen for contractors. And that could see companies continue to downsize. ☛

Dual-Capable

Nuclear deal with Tehran will not eliminate all threats

Bill Sweetman Washington

Iran's linked development of nuclear energy and surface-to-surface missiles is motivating multiple missile-defense programs, including most of Israel's work, exports of Patriot PAC-3 and Terminal High Altitude Area Defense missiles to the Middle East, and U.S. deployment of elements of the European Phased Adaptive Approach missile defense system. The progress of Iran's projects, however, remains under debate and wrapped in secrecy.

The Obama administration has led efforts by the P5+1 group (U.S., Rus-

sia, China, France and Britain—the permanent members of the United Nations Security Council—plus Germany) to negotiate agreements that confine Iran's nuclear program to civil uses and provide assurance against covert or overt breakouts from such restrictions. Optimists see the current slump in oil prices putting pressure on Iran to pursue an agreement to lift sanctions.

Some see a nuclear agreement as sufficient to contain Iran's missile program. Medium- and intermediate-range ballistic missiles are mainly nuisance weapons because of poor accuracy and high cost, unless combined with weapons of mass destruction (WMD) payloads. They are ineffective against most military targets and, given the tracking, prediction and communications technologies available, a civil defense system can eliminate many casualties without forcing an entire city to take shelter.

Others, however, see risk in two ar-

eas. One is that Iran may see the P5+1 process as a stalling tactic, and wait for the consensus on sanctions to erode. The other is that Iran might add guidance systems to its weapons, making them lethal and effective against more targets. Sanctions were imposed because of an “unprecedented and inherently ephemeral set of circumstances,” notes Suzanne Maloney, senior fellow at the Brookings Institution. These include the inflammatory rhetoric of then-President Mahmoud Ahmadinejad and domestic repression.



PRESS TV/IR

Others, however, see risk in two ar-

In Mahoney's view, “for months, Iran's diplomacy has been focused on ensuring that Washington is seen as the spoiler if . . . prospects for a deal . . . go south.” She suggests the obstacle is simple: Iran's supreme leader, Ayatollah Ali Khamenei, is not interested in any agreement that does not leave the nation's nuclear capabilities intact.

Even if there are successes in negotiations or failures in Iran's nuclear program, there is evidence that progress in missile development continues. In a presentation last year, Israeli missile-defense pioneer Uzi Rubin argued that indicators pointing to slowdowns in missile development, which some analysts see as the result of sanctions, may be misleading. Rubin cited ongoing if unsuccessful space-launch attempts and the May 2013 unveiling of a transporter-erector-launcher (TEL) for the 2,000-km-range (1,245-mi.) Shahab-3 missile. The TEL was not a prototype:

Iran showed a production line, and modifications to the unit's design disguise it as a civilian tractor-trailer.

Other developments include Iran's announcement in February 2014 of a multiple reentry vehicle (MRV) payload for the Shahab-3. The following month, Iran's Fars news agency announced that the Shahab and the newer 800-km-range Qiam were equipped with MRVs, and showed images of 24 Qiams, apparently in a tunnel, and 44 weapons in a hangar. Also recently unveiled was Kadr F, which is capable of covering 1,950 km. Rather than a slowdown, Rubin says tests are being concealed as “part of a wider diplomatic effort to ease . . . sanctions.”

Rubin also warns of progress in adding GPS guidance to missiles. An October 2014 report by the Center for Strategic and International Studies (CSIS) quotes him as saying Iran added a guidance system to the 210-km-range, 600-kg (1,320-lb.) Zelzal-2 warhead and could do the same with longer-range missiles. “This threat can degrade the [Israeli military's] ground

In March 2014, Iran unveiled what appeared to be tunnel storage for Qiam ballistic missiles.

capabilities,” Rubin says. “It can paralyze Israel's war economy . . . and . . . inflict massive casualties.”

Rubin says nations such as Iran find missile development easier and cheaper than building or maintaining strike aircraft. In a 2013 interview, he noted that “we are in the middle of a revolution” in guided rocketry. “An iPad can guide a missile,” he said, predicting a widespread increase in the use of guided ballistic missiles in the next five years.

Others are more cautious. The CSIS report pointed to areas of uncertainty, including “limited tests under ‘white-suit’ conditions” that give a distorted impression of accuracy and lethality, the potential effectiveness of missile defense systems, and the risks and costs of retaliatory strikes. Even with guidance systems that offer better theoretical circular-error-probable numbers, “CEP applies to 50% of perfectly located and launched missiles that operate perfectly in flight to reach a perfectly located target . . . [P]ractical test and evaluation, as well as U.S. combat experience warn that the error budget of things that can degrade operational accuracy in a real world missile is far greater than the accuracy of the platform would suggest.” ☛

Supply and Demand

Israeli defense technology lands lucrative market in India

David Eshel Tel Aviv

Israel remains one of the fastest-growing defense suppliers to India, a position that is particularly impressive given the fact that it is not primarily selling main platforms, but essential systems and subsystems.

Indo-Israeli relations received a boost last year from the election of the conservative Bharatiya Janata Party, led by Narendra Modi as prime minister. Members of the new government, especially Modi, are supportive of Israel, and the election eased bottlenecks that plagued defense business between the countries for years. These included two contracts worth \$650 million. The first is for 262 Barak 1 air-defense missiles for the Indian navy. With delivery scheduled for December 2015, the 14 ships that presently lack these missiles for their air-defense systems will acquire them.

The second covers India's decision to acquire more than 8,000 Spike man-portable anti-tank missiles from Israel to replace the aging French-made Milan. India favored the Israeli missile over the U.S. Javelin, primarily due to the potential for local production and technology transfer, a major focus of decision makers.

Israel is open to India's objectives for technology transfer. Israeli Prime Minister Benjamin Netanyahu has expressed the country's willingness "to discuss transfer and development of technologies with India."

Israel and India are also enhancing cooperation on counterterrorism. The threat of jihadist terror organizations and radical movements originating in the Middle East is spreading to India, which has a large Muslim population. Part of this effort has been underway for years, equipping India's special forces and counterterror units with Israeli weapons such as the Tavor assault rifle, Negev light machine gun and B-300 rocket launcher.

Over the past two decades, Israeli companies were invited to provide and help integrate weapons, avionics and sensors for jet fighters, helicopters, armored fighting vehicles, ships and submarines. Among the systems are air-to-air missiles, helmet-mounted sights, radars, precision guided weapons and targeting pods, digital displays and avionics modules for glass cockpits, advanced electronic warfare systems and communications.

Israeli companies modernized India's artillery by upgrading Russian-made M46 130-mm howitzers with Israeli 155-mm guns. Another program likely to be renewed is the establishment of ammunition production plants that provide self-sufficiency of supply for the Indian army.

Israeli companies were involved in the integration of key elements of the indigenous Arjun Mk-II main battle tank. Two suppliers providing elements for the tank are Israel Aerospace Industries (IAI) and Elbit Systems. IAI provides the 120-mm guided Lahat missile fired from the gun, which enables the tank to engage laser-designated targets 8 km (5 mi.) away. Elbit Systems supplies some optronic systems used by the crew, including an independent commander sight and fire control elements.

Among issues discussed by India and Israel are bilateral programs concerning acquisitions by both militaries. One program is the development and fielding of a medium-range surface-to-air missile called MRSAM, an area air-defense system developed initially for naval use and positioned to replace Barak 1 missile systems in use by the Indian and Israeli navies. The initial development contract was signed by IAI and India's Defense Research and Development Organization in 2006, followed three years later by another contract for an extended-range land-based variant. Missile development was plagued with delays and technical problems, extending the work by five years. However, in late 2014 the system performed its first end-to-end intercept test on land, demonstrating all elements of the naval and land-based system. The team is scheduled to perform the first intercept test at sea this year, and deploy the full system on operational ships, some of which are already equipped with radars, launchers and battle management systems.

Other successful programs that have gained momentum in recent years are land-based air-defense systems such as Spyder, specified by India for the Quick Reaction surface-to-air missile (SAM), selected in 2009 to protect mobile army elements. The system deploys with four Python 5 and Derby air-to-air missiles from Rafael, identical to the weapons already in use with the Indian navy. Rafael also has Spyder variants suited for the Indian army's Short Range SAM if this program reopens for competition.

India could eventually get the enhanced version of the Derby missile, which has a new, compact seeker from Rafael. The smaller seeker enables the use of more propellant in the



India's Arjun Mk-II main battle tank includes weapons and sensors from Israeli companies.

ANIRVAN SHUKLA



India is a major UAV market. Israeli supplier Elbit Systems will feature the Hermes 900 at the Aero India expo in February.

India's growing appetite for UAVs, prospects are opening, attracting more Israeli producers such as Elbit Systems, as well as international providers from Europe and the U.S. At Aero India IAI will highlight two of its latest Heron variants—a larger version designed with a more spacious payload bay, and the Super Heron, equipped with a heavy-fuel engine. Elbit Systems is offering the Hermes 900,

which proved successful in competitions with the Heron both in Israel and in overseas markets.

The need for heavy-fuel engines is required to improve operations from high-altitude and remote locations, supporting the new Indian Mountain Strike Corps, to be deployed along the Himalayan border with China. As these units are required to become self-sufficient in surveillance and intelligence-gathering, deployment of unmanned platforms in support of corps and below levels is needed. Such systems could include medium-altitude long-endurance UAVs and smaller, electrically powered platforms supporting brigades and battalions with ad hoc intelligence.

To meet such requirements, manufacturers in Israel have come up with enhanced electrically powered mini-UAVs and tactical aerostats to support long missions and carry heavy payloads.

Training systems and services are another growth area for Israeli companies. One leader in the field is Elbit Systems, with a comprehensive training system for the Indian military. Elbit and Indian aerospace company Hindustan Aeronautics Ltd. (HAL) formed a joint venture specializing in training systems. The model for this has been successful with the Israel Air Force and other customers.

Elbit is supporting Indian air force training programs, including the fleet of trainer aircraft, supplying air-combat instrumentation using its Ehud autonomous air combat maneuvering instrumentation system and providing “fly-by-hour” simulation services. In the future, the company will integrate virtual avionics to enhance flight training, integrating actual training missions with ground-based simulation. ☉

same airframe, doubling the missile's range and positioning Derby in the same class as the much larger and expensive Meteor and AIM-120C7. The original Derby missile is in use by the Indian navy's Sea Harrier fighter fleet and has a radio frequency seeker developed by IAI.

India is also a prospective customer for Israel's Iron Dome counter-rocket, artillery and missile (C-RAM) system. Although New Delhi is less enthusiastic about Iron Dome's C-RAM application, the developer, Rafael, believes the military would be interested in the system's other capabilities, including air and naval defense. The new ship-based C-DOME concept is designed as an affordable replacement for Barak 1 missile systems, providing an air-defense capability that integrates with existing radar and battle management systems.

The Indian air force has been using Israeli-made laser and electro-optically guided weapons for years, and is open to diversify its guided weapons. Systems under consideration include the Spice 1000 and Spice 250 standoff precision bombs, and the STAR laser-guided weapon from Elbit Systems.

Similar to the Raytheon SDB-II, Rafael's Spice 250 will be displayed in India for the first time at Aero India 2015 (Feb. 18-22). It would enable the Indian air force to quadruple the load-out on most strike fighters. A Sukhoi Su-30MKI, for example, could carry 28 individually targeted weapons, each capable of striking a target with pinpoint accuracy at ranges beyond 100 km (62 mi.). The indigenous Tejas Light Combat Aircraft, currently limited to four guided weapons, would be able to deploy 16 Spice 250s, enabling it to strike multiple targets from standoff range.

A smaller—yet highly effective—weapon for close air support is the laser-guided rocket. Elbit Systems is among the first to pursue this opportunity in India, with the Smart Tactical Advanced Rocket (STAR), a guidance kit similar to the Elbit Systems/ ATK Guided Advanced Tactical Rocket which was developed for Hydra-type 2.75-in.-dia. (68/70-mm) weapons. STAR is now adapted for the 80-mm Russian S-8 rocket, enabling India and other countries using those rockets to operate advanced precision weapons without switching to Western standards.

India has been operating Israeli-made unmanned aerial vehicles (UAV) since the first delivery of IAI's Searcher II in 1996, and is believed to be the largest UAV operator outside the U.S. With

Rafael is looking to sell India its Spice 1000 standoff glide bomb.



RAFAEL

Lethal Weapons

U.S. Navy eyes up-armed combatants to bolster lethality of surface fleet

Michael Fabey **Washington**

After decades of focusing on defensive shields and systems to protect its surface fleet, the U.S. Navy is going on the offensive and making its ships highly lethal. The brass wants to equip as many ships as possible with firepower to give potential enemies tactical and targeting headaches.

The public unveiling of the service's "distributed lethality" concept came during the annual Surface Navy Association (SNA) National Symposium, Jan. 13-15, in Arlington, Virginia. Strategists detailed new warfare concepts that include breaking off destroyers and other small combatants from carrier strike groups to form "hunter-killer" vessel packs for diverse missions.

Rear Adm. Peter Fanta, the Navy's surface warfare director, wants ships that are ubiquitous and lethal. During World War II, Fanta says, examples of distributive lethality were everywhere. The idea was, "If it floats, it fights." The Cold War, he adds, "was distributive lethality at its best." The service fit whatever weapons it could on even the smallest ships, giving adversaries pause anytime a Navy ship entered nearby waters.

"We see the opportunity to create uncertainty in the minds of our adversaries by changing the way they view our existing and planned force," says Vice Adm. Thomas Rowden, commander of Naval Surface Forces. "As we face adversaries that are becoming more technologically advanced, it makes sense to inject uncertainty into their warfighting calculus," he notes. "Should rounds be exchanged, a distributed lethality construct allows the U.S. Navy to respond rapidly, with agility, and taking an offensive posture.

"This is a relatively simple yet powerful idea," he continues. "By applying

the principles of distributed lethality, the surface force can help sustain and extend America's competitive advantage in power projection against a growing set of sea-denial capabilities. Distributed lethality is the most effective and efficient method of capitalizing on the fleet we have today, and the one planned for the immediate future. We need to make better use



Crewmen load high-explosive incendiary tracer rounds into a 30-mm weapon system aboard the USS Fort Worth (LCS 3). The U.S. Navy wants to increase the lethality of its surface ships and broaden their offensive capabilities.

of the ships we have today, and think differently about how we equip and employ them."

Rowden adds: "More ships with more firepower acting more independently will increase the planning complexity and resourcing of our potential challengers."

He acknowledges that this is a cultural shift for the Navy. "This isn't going to happen overnight, and as Secretary [Ray] Mabus continues to grow our fleet, now is the time to consider how we will use our resources to

their best effect and bring about the increased lethality of each ship. The objective is to cause the adversary to think differently about how to attack our forces by giving them more targets to contend with. Adversaries will have to shift their own defenses to counter our offenses, thereby improving our operational advantage to exploit adversary forces."

The concept is tailor-made for the Navy's pivot to the Pacific, he says. "In the Pacific, you know how sea lanes are threatened by some nations with conflicting claims of sovereignty. Think of sea lanes as arteries that have to remain open for the free flow of commerce. The U.S. Navy is a primary enabler of maritime navigation,

preventing anything that might slow or stop free access of the world's oceans by potential future threats of peer or near-peer adversaries."

Riding the bow wave of the concept is the Littoral Combat Ship (LCS), which is being reincarnated as a frigate. Long touted as the small surface combatant of the future, LCS was derided by critics—notably outgoing Defense Secretary Chuck Hagel, who directed the Navy to find a more lethal and survivable design.

The Navy decided on modified versions of the two current LCS designs

—a steel monohull built by Lockheed Martin and an aluminum trimaran from Austal USA. The LCS-next ships will get the "FF" frigate designation, Mabus says. Back-fitted LCS vessels will also be called frigates, while future ships bought under LCS contracts that have the same modification will get the "FF" prefix as well. LCS vessels will be renamed, he says, although the Navy has not decided yet what to call them.

"These are not 'L'-class ships," Mabus said during his keynote SNA address. "When I hear 'L,' I think amphib. I spend a good bit of my time explaining what 'littoral' is. It's a frigate. We're going to call it one."

And it is a frigate, Navy officials promise, which will have enough firepower to give enemies pause, especially when teamed with destroyers and deployed throughout contested areas. ☛

Bulking Up

China and Russia work on bigger warships

Richard D. Fisher, Jr., and Bill Sweetman Washington

Bucking a trend, China and Russia are looking at more displacement and power in their next-generation surface combatants. With the exception of the U.S. Navy's 14,500-ton Zumwalt class, most planned destroyers and frigates are below 10,000 tons, but China's Type 055, under construction, and Russia's Lider (Leader) class, announced in 2014, are around 12,000 tons. Some reports suggest both ships could evolve into nuclear-powered combatants.

Bigger ships cost more to build and need more fuel, but bring advantages. In littoral and combined-arms campaigns, a larger ship has more vertical

In the absence of public briefings, this model provides the most credible preview of its potential capabilities. While it does not match the sharp cant angles and simple alignments of the U.S. Navy's stealthy Zumwalt, the Type 055 appears less cluttered and stealthier than the current-production Type 052D destroyer. The initial version will be powered by two combined gas turbine or diesel power sets.

In addition to four large active, electronically scanned arrays (AESA) in the deckhouse, the Type 055 may be the first Chinese warship with an integrated mast for additional AESAs for radar, communications and electronic warfare

marine warfare helicopter; one of the heaviest for shipboard use.

The Lider-class destroyer is at an earlier development stage. Russian media say the defense ministry approved technical specifications in the fall of 2014 and detail design should start this year at the Severnoye Design Bureau. The navy plans to acquire six ships each for the northern fleet and Pacific fleet, with the first entering service no earlier than 2023.

The Russian navy is only just preparing to commission its first large post-Cold War combatants, the Project 22350 Admiral Gorshkov frigates, and is establishing domestic production of marine gas turbines from Ukraine. Reports indicate the key feature of the Lider class will be larger weapons, including naval versions of S-400M and S-500 SAM systems. Images produced by weapon systems integrator Agat show a large, two-sided, rotating

Artist's concept of China's Type 055 warship shows stealth design and VHF radar on the aft deckhouse.



CHINESE INTERNET

launch system (VLS) tubes and can carry anti-surface warfare, land attack and anti-air-warfare weapons at the same time. Bigger ships carry bigger radar arrays, which may be more effective against stealthy targets. Warships are expected to play a role in theater ballistic missile defense, which adds another class of missile and possibly new sensors. With well over 50 megawatts of power, larger ships could be the first to carry electrically powered weapons.

China's navy could receive its first 10,000-12,000-ton-displacement Type 055 by late 2016 or 2017. Last December, Chinese military web pages showed a shipyard sign announcing: "Construction initiation ceremony for 055 destroyer No. 1." In April 2014, many pages had images of a full-size Type 055 deckhouse structure, built near a naval design institute in Wuhan. Like an earlier full-size deckhouse model of the Chinese aircraft carrier Liaoning, this will assist in development, validation and training for the destroyer's advanced electronic systems.

The aft deckhouse is expected to carry rotating AESA radar. This will replace the very-high-frequency Type 571M installed on the Type 052D destroyer, which has a Yagi array.

The Wuhan model shows that the early Type 055 will have a single 130-mm forward deck gun as on the Type 052D. Short-range weapons include a 30-mm Gatling close-in weapon system (CIWS) forward, and an HHQ-10 missile-based CIWS aft. The larger Type 055 would be a logical application for the 11-barrel, 30-mm Type 1130 CIWS with firing rate of 170 rounds/sec., which was first installed on the Liaoning and has gained notoriety among U.S. missile developers.

An undetermined number of larger weapons will be launched from the Chinese navy's new universal VLS. Speculation ranges from two banks of 64 missiles to two banks of 48 missiles. The aft hangar could accommodate two helicopters. China recently unveiled the Changhe Z-18F antisub-

AESA on the aft deckhouse and a pyramidal integrated mast rather than deckhouse-mounted arrays.

Chinese and Russian reports indicate future versions of the ships could be nuclear-powered, with some Chinese media referring to the designation Type 055B. China has yet to build a nuclear surface ship, but Russia produced four 28,000-ton Kirov-class cruisers with combined nuclear and steam propulsion: The reactors were for cruise and the steam boost was for combat.

The new ships are close in size to the U.S. Navy's California- and Virginia-class nuclear cruisers of the 1970s, which were escorts for nuclear carriers. The Navy abandoned nuclear surface combatants due to high cost. Studies in 2005-10—prompted by the Navy's interest in a massive missile-defense cruiser, the CG-X—showed that even at high oil prices, the life-cycle cost of an under-20,000-ton nuclear ship would be much higher than for a conventional type. ☐

Ocean View

New detection techniques threaten submarines

Bill Sweetman Washington

New technology and operational challenges threaten to overturn the U.S. Navy's long-standing concept of operations (Conops) for submarine warfare, according to a new study by the Center for Strategic and Budgetary Assessments (CSBA). Even the Ohio Replacement Program (ORP) ballistic missile submarines could be vulnerable to new detection techniques.

Navy submarine and antisubmarine-warfare (ASW) doctrine and technology focused for decades on making submarines quieter and able to listen passively for hostile subs, with an adjunct role for medium-frequency (above 1,000 Hz) active sonar at short range. But the CSBA report notes that expanding computer power could allow navies to exploit detection techniques that were laboratory curiosities, according to lead writer and former submariner Bryan Clark.

At the same time, potential adversaries are acquiring very quiet submarines. Technologies to reduce noise are "known and achievable," says the report, which notes that the Navy's ASW Conops was on the way to being "unexecutable" by the 1980s, as the Soviet Union undertook a crash program of quieting its fleet.

Emerging technologies include more accurate low-frequency (100-300 Hz) active sonar, which is capable of detecting targets at tens to hundreds of miles. Large submerged objects also distort natural or man-made ambient noise fields, and submarines leave radar-detectable wakes on the surface. Commercial technology—much of it driven by offshore energy exploration—provides ways of extracting weak signals from noisy marine environments. The use of "big data" memory and processing is analogous to the "track-before-detect" algorithms used by advanced radars, and the necessary processors fit on mobile platforms.

Clark also reports Chinese development of a "seafloor observatory" comprising upward-looking seabed sensors and capable of tracking movements over a wide area. This has the potential for submarine detection. Another area of rapid change is the development of

unmanned undersea vehicles (UUVs), which Clark notes is benefiting from commercially funded improvements, including lithium-ion battery and fuel cell power systems.

The Navy needs to shift emphasis from passive to active systems while using UUVs extensively in littorals where the adversary installs detection systems, the report suggests. The Navy's newest active system is imported:



The Thales Captas-4/Sonar 2087 towed array is one of the most advanced active sonars, but its operating frequency limits range.

the Thales Captas-4 variable-depth sonar for the Littoral Combat Ship. With the Multifunction Towed Array, which is part of the SQQ-89(V)15 suite being fitted to larger combatants, Captas-4 is an improvement on current systems, but has limitations, in Clark's assessment: Its range is shorter than that of submarine-launched antiship missiles, and the Navy's retrofit program is slow. Completion is "years and years away."

Low-frequency systems "don't fit into the Navy's ASW Conops," Clark

notes. A low-frequency active system is installed on the four civilian-crewed Surveillance Towed Array Sensory System ships for peacetime surveillance. Another low-frequency system is the experimental Deep Water Active Detection System installed on buoys, which is proceeding on what Clark calls a "life-support" level of funding.

The ASW strategy may have to change. Clark points out that a submarine's weakness is that it is out of the fight if forced to evade, because that creates noise. Suppressing and harassing hostile submarines may be as important as killing them, a point Clark illustrates by using as examples World War II campaigns off the U.S.

coast and in the Bay of Biscay off France: Neither killed many U-boats but both correlated to lower shipping losses.

Clark also questions whether the Navy's ASW priority should be the Boeing P-8A Poseidon. "It's difficult to rely on the P-8 as the way we do most ASW," he says. "Its biggest problem is that it can't operate against air threats, within a few hundred miles of the adversary's coast—or further out, if the adversary decides that the P-8 is a priority target."

Even the new multistatic active coherent sonar being developed for the Increment 2 configuration of the P-8A relies on the ability to detect adversary submarines at long range. The P-8A is an interceptor, tasked with pinpointing the location of a submarine detected by long-range systems.

Another issue is that the ORP is focused on quieting, which is subject to a law of diminishing returns.

The historical progression has been to start by eliminating noise sources that are strong and easy to fix, so the next step in noise reduction is dealing with weaker and more stubborn sources. However, quieting will not defeat new detection techniques based on ambient noise, active sources or non-acoustic phenomena. Protecting ORP boats, and Britain's Trident successor, may require new approaches, including active defenses and UUV decoys. ☛

 **Gallery** To see a history of antisubmarine-warfare technology, tap here in the digital edition or go to AviationWeek.com/ASWTechnology



Winslow Wheeler

Past director of the Straus Military Reform Project at the Project on Government Oversight (POGO) in Washington.

Background: Arrived in Washington in 1971 as a staffer for Sen. Jacob Javits (R-N.Y.) and worked for government until 2002, on Senate and House staffs of Republican and Democrat legislators and as an evaluator for the Government Accountability Office. He then headed the Straus Project, first at the Center for Defense Information and since 2012 at POGO.

Forty Years' War

Winslow Wheeler is a critic of Pentagon acquisition failures, and the Pentagon never fails to supply him with material. After a 40-plus-year career in Washington, he retired in January from the Straus Military Reform Project at the Project on Government Oversight. Senior International Defense Editor Bill Sweetman interviewed Wheeler for his take on needed changes in acquisition.

Defense Technology International: Does a 'military-industrial-congressional complex' dominate defense policy?

Wheeler: I never liked the model. It's something Eisenhower said on the way out the door and did nothing significant about, after being president for eight years. Even though I used it recently, I try not to overuse it. It reeks of conspiracy theory.

What causes procurement decisions to go wrong?

Dysfunctional government. It's the breakdown in the separation of powers, and it's not just the absence of oversight—it's anti-oversight. The staff of the House Armed Services Committee, Senate Armed Services Committee and defense subcommittees of the appropriations committees lust after jobs. But not with industry—second-raters take jobs with industry. First-class staffers take Pentagon jobs. Think about what that does to oversight when they advise Congress.

Do you think added oversight makes people risk-averse and slows programs down?

The industry has been trying to get rid of meddlesome oversight, in law and in practice, for decades, and has been pretty successful. I was going through historic stuff recently and was re-

minded of renegotiation boards that started in the 1930s after shipbuilding scandals. They had audits to determine profit margins, and excess profits were returned. This was the kind of thing industry was whining about in the 1970s and convinced Congress to eliminate. Wouldn't it be great if we had routine, competent audits of defense manufacturers, their overhead and profit margins? We don't have a clue what profit margins are on government contracts.

What is the role of think tanks, which are ostensibly independent, but get industry and government money and have people who rotate in and out of industry and the Pentagon?

It's sad that we don't have a requirement for think tanks to reveal funding sources. Most think tanks are reputed to have industry support. In some cases you find it in their annual reports. A lot of this is 'black money.' I've tried to understand think-tank funding, and failed because of this 'dark money.' Some think-tank reports are excellent, some horrible and most mediocre. You can learn things from them but you have to be careful, and check footnotes to see if sources actually said what they say they said.

What about revolving doors generally, rather than those in and out of think tanks?

That's a source of corruption throughout the system. It occurs in subtle ways. It's not as if a colonel who's a program manager thinks, 'I have to suck up to these guys because I want a job with them later on.' It's the beat of the jungle drum. The drum says the guy is good, part of the system and part of us. A successful program manager will be the type who says to the defense secretary and Congress, 'Here are the real problems,' and questions how they'll be solved. Not the one who says, 'Here are my problems. I've got them under control. God forbid you should take some of my budget away.' I yearn to hear the program manager who says, 'I can't go forward, we need to not spend this money.'

What changes could make a difference in procurement?

We need to get money out of the system, both in excess spending on the Pentagon budget and excess spending by manufacturers with think tanks, the revolving door and media ads. We do that first by understanding how and where that money is spent and by squeezing the money, especially government money, to force managers to make choices. Even under sequester we're spending at historically high levels.

Another problem is the nature of the people we ask to make decisions. We need to think differently about whom we ask to be defense secretary or acquisition czar. We will be on the road to recovery when we stop selecting people who are creatures of the revolving door, with nothing in their backgrounds to suggest that they ask tough questions and make decisions based on the answers they get. ☛

March 5, 2015 • The National Building Museum • Washington, DC

AVIATION WEEK *Laureate Awards*

Finalists Announced for the 58th Annual Laureate Awards!

Civil Aviation

- Airbus A350 program head Didier Evrard
- Boeing 787-9
- Federal Aviation Administration in collaboration with the National Air Traffic Controllers Association, Mitre Corp. and other aviation stakeholders
- Southwest Airlines Chairman, President and CEO Gary Kelly

Defense

- BAE Systems
- Northrop Grumman
- U.S. Army and Boeing
- U.S. Ground-Based Missile Defense team

Space

- European Space Agency
- European Union
- Indian Space Research Organization
- NanoRacks CEO Jeff Manber

Business Aviation

- Robert Bass
- Embraer
- Nextant Aerospace
- Pilatus Aircraft CEO Oscar Schwenk

Technology

- GE Aviation head of additive-manufacturing strategy Greg Morris
- Mitre Corp., working with the U.S. Air Force and others
- U.S. Naval Air Warfare Center Aircraft Division and Qinetiq
- Rockwell Collins

Innovation

- Paramount Group
- Raytheon and Saab
- Rockwell Collins
- Textron

Lifetime Achievement Awards will be presented to David Thompson, Chairman and CEO of Orbital Sciences, and John Leahy, Airbus Chief Operating Officer – Customers.

Learn more and purchase tickets to attend at www.aviationweek.com/laureates

PRODUCED BY



PREMIER SPONSORS



SPONSORS



OFFICIAL PUBLICATION



MEDIA SUPPORT





Anytime, Anyplace, Anywhere King Air 350CER



Bringing new transport capability to the warfighter.

Fixed-wing Utility Aircraft (FUA). Whether it's flying nonstop from California to Hawaii or operating from an unimproved dirt runway in Africa, the King Air® 350CER is a worldwide mission enabler that will bring new capability to the warfighter for the time-sensitive movement of key personnel, with equipment, to or within a theater of war. Beechcraft's King Air 350CER has proven itself in tough, real-world conflict environments and is in production now. Anytime. Anyplace. Anywhere.

U.S. +1.844.44.TXTAV | International +1.316.517.8270 | Beechcraft.com

©2015 Beechcraft Corporation. All rights reserved. Beechcraft and King Air are registered trademarks of the Beechcraft Corporation.

sengers who transfer to or from the flights of the dominant U.S. member, Delta Air Lines.

But China Airlines and local rival EVA Air have a curious cultural advantage. In many aspects, Taiwan is more Chinese than China—because the island has modernized without the social engineering of the Communist Party, and especially because it missed the mainland's Cultural Revolution of 1966-76.

China Airlines does not make much of this, but it shows in little touches that many mainlanders appreciate as sophistication—such as the wood-paneled look of the 777-300ER interiors, a new lounge at Taipei's Taoyuan International Airport featuring Song dynasty design elements, and even the universal Taiwanese use of old, complex Chinese writing characters. Notably, the 777s are being fitted with a decorative stand-up bar, partly for tasting varieties of tea.

The 777s have replaced 747s on the services to Los Angeles and, beginning this month, will operate to New York. China Airlines has been losing money by flying 747s to New York, says Sun. The operating cost per seat of the 777s is about 20% lower, depending on fuel prices, though new aircraft bring higher depreciation charges, he says.

China Airlines is not planning any new intercontinental destinations until taking delivery of the later widebodies, around 2018-19. At first, the priority will be to replace the inefficient older airliners, which will begin leaving the fleet this year. The carrier gives few hints about where it may add destinations, but Sun notes that Houston, now served by an extension of the Seattle service from Taipei, could be worth a direct connection.

At least four 747s will be kept, however, because the jumbos

China Airlines has ordered 10 777-300ERs to replace 747-400s on services to the U.S.

relies on OEMs for maintenance that it cannot perform.

However, with a large order book—and plans to accept 26 new aircraft this year alone—Emirates would consider setting up partnerships to expand its in-house component repair capabilities. “The supply chain readiness has not been there for component repairs and material support for next-gen aircraft,” says Abdullah Osman, vice president for engineering material management and supplier support. If Emirates pursues this option, it would primarily be to cut component repair turnaround times and logistics.

Razali Idris, vice president for maintenance and engineering for Jazeera Airways in Kuwait, says the Middle East is a hard region in which to operate due to its political volatility and punishing environment. He is confident in the airline's ability to keep passengers safe, but says that “the extreme heat, sandstorms and dust” are a big challenge. Idris would like to see more support especially for engines because they do not last as long here.

Tailored support to address the region's operating environment and logistics costs was a frequent topic during Aviation Week's MRO Middle East Conference Feb. 2-3.

In trying to address this issue, the government of Dubai is building a 145-sq.-km (56-sq.-mi.) planned community—Dubai World Center—around Al Maktoum International Airport, which became operational in October 2013. The community includes eight planned districts, including ones dedicated to logistics and aviation, that cover 45,000 sq. meters (11 acres).

allow China Airlines to achieve more than its 25% fair share of the healthy cross-strait market. The business is growing at 10-15% a year, but runway slots at the biggest cities are hard or impossible to get. Rivals, either lacking such large aircraft or unable to spare them from long-haul service, are using smaller types, usually the Airbus A330-300, as the standard solution to the problem of inadequate airspace in China. Sustained low fuel prices could allow China Airlines to keep more of the 747s, says Sun. The four youngest are 10 years old on average, and the others are 17.

An order for 50 narrowbodies that Sun hopes to place this year will support greater regional coverage of the China Airlines group, which includes Mandarin Airlines and newly established Tigerair Taiwan. Although other Tigerair franchises in Asia and Australia all operate Airbus A320s, China Airlines is considering Boeing 737s. Sun expects 25-30 of the aircraft to go into the China Airlines fleet and most of the rest to Tigerair Taiwan. Expansion of Mandarin Airlines is limited by the market of its base city, Taichung. The group has 16 737s, but at least 10 with an average age of 16 will be retired as the new narrowbodies arrive, says Sun.

Tigerair Taiwan, though 90% owned by China Airlines, will run itself, potentially competing with the parent, says Sun. ☼



Tahnoon Saif, vice president for aviation for Dubai World Center, says it is trying to attract a variety of OEM and aftermarket services businesses. “We want to become a worldwide aerospace hub to support airlines and private aircraft,” he says.

During the MRO Middle East Exhibition, Dubai World Center and Lufthansa Technik Middle East signed a letter of intent for the MRO to become an anchor tenant. This new facility will nearly double Lufthansa Technik's space and should be available by the fourth quarter of this year.

Ziad Faisal Al Hazmi, CEO of Lufthansa Technik Middle East Services, says the potential growth stems from regionalizing customer support—putting more parts, more repairs and more technical expertise here—which can lower turnaround times and costs.

Finding the right services to place in the region is important, but attracting and retaining technical talent has consistently been a challenge, too.

ICF's Brown asked the Aviation Week MRO Middle East Conference audience: “Is there enough capacity in terms of skilled labor to support this growth in the region? Can this be supported cost-effectively?”

The consultancy predicts the Middle East MRO market, which has a compound annual growth rate of 6.7% compared with the global average of 3.8%, will require 11.7 million maintenance man-hours by 2024.

Technical education programs and throughput have not kept pace with hangar mania. ☼

Backing Up

U.S. and European airlines lobby to end open skies to contain Gulf carrier growth

Madhu Unnikrishnan **San Francisco** and Jens Flottau **Frankfurt**

Legacy airlines in Europe and the U.S. have seen the growth of Gulf carriers with increasing dismay, and no efforts to contain the threat have proven successful so far. But now the major airline groups on both sides of the Atlantic are trying to strike back with intense lobbying that would spell the end of open skies.

Alleging that unfair government subsidies to the “Big Three” Persian Gulf airlines—Emirates, Etihad Airways and Qatar Airways—have tilted the playing field, Delta Air Lines CEO Richard Anderson, American Airlines CEO Doug Parker and United Airlines CEO Jeffrey Smisek have petitioned the Obama administration to limit the open-skies deal with Qatar and the United Arab Emirates (UAE).

The CEOs met with Transportation Secretary Anthony Foxx and Commerce Secretary Penny Pritzker and other administration officials Jan. 28-29 to ask the administration to consider modifying open skies. In particular, people familiar with the matter tell Aviation Week, the CEOs are expected to request that the administration begin government-to-government negotiations with Qatar and the UAE to examine alleged subsidies and overcapacity on routes between the U.S. and those countries.

The three CEOs reportedly also asked the Obama administration to jettison the deals altogether if those countries object. The CEOs are thought to be requesting capacity freezes by the Gulf carriers until U.S. airlines decide to expand in the Qatar and UAE markets, the sources say.

The initiative comes shortly after Carsten Spohr, Alexandre de Juniac, Frederic Gagey, Pieter Elbers, Harry Hohmeister, Jaan Albrecht and Bernard Gustin—CEOs of Lufthansa Group, Air France-KLM, Air France, KLM, Swiss International, Austrian and Brussels Airlines, respectively—wrote a joint letter to the European Commission criticizing “the absence of a level playing field regarding the access of certain government-supported

third-country carriers to the European aviation market.” They point out that “if the development is allowed to continue, both the economic and strategic role of European aviation will be permanently impaired.”

The European airline CEOs want a “proposal for a revised and efficient defense instrument safeguarding fair competition in the European aviation market also vis-a-vis third-country carriers.” They also are asking for strict enforcement of ownership and control regulations and are proposing an international dispute settlement mechanism for conflicts over fair competition. In essence, the European carriers are demanding the right for Europe to withhold traffic rights from Gulf carriers they believe are government-subsidized. And financial support for European subsidiaries (such as Air Berlin and Alitalia, in which Etihad holds minority stakes), should be treated according to European competition law, they argue.

The views held by the CEOs of the largest carriers are not shared by all in the industry, however. In fact, powerful players are actually in favor of supporting the Gulf airlines, diminishing the likelihood that open skies or liberal air service agreements will actually fall. Emirates, Etihad and Qatar Airways are hugely important customers for Airbus and Boeing, which have a keen interest in the airlines being able to continue their path. And non-hub airports, particularly in Europe, see the three Gulf carriers as their only opportunity to attract long-haul air service and grow passenger numbers as European legacy airlines focus on their own hubs.

The role of the Gulf carriers continues to grow in importance in international aviation, and not only because they are expanding their networks and fleets. In late January, Qatar Airways acquired a 9.99% stake in International Airlines Group (IAG), the parent of British Airways, Iberia and Vueling. The move was the first time one of the Big Three Gulf carriers invested in one of the big three European airline groups and makes Qatar Airways IAG’s

Emirates continues to increase capacity to North American destinations from its Dubai hub, posing an increasing threat to U.S. airlines.



biggest shareholder. The airline has indicated it may buy more shares.

Under Chief Executive Willie Walsh, IAG has not participated in the European lobbying campaign against Gulf carriers. The U.K. has an open-skies deal with the UAE, but France and Germany do not.

Reversing open skies would be the single most significant change in U.S. aviation policy in the past 25 years and would roll back an arrangement that has been highly beneficial to U.S. airlines.

Since its first open-skies deal with the Netherlands in 1992, the U.S. has signed more than 100 such treaties, including the landmark 2007 agreement with the 28-member European Union. And U.S. carriers have gained much from the deals, including more access to London’s Heathrow Airport.

“For the United States government to be persuaded by a non-representative vocal minority that it should change course, particularly with regard to its open-skies policy, makes absolutely no sense,” Emirates Airline President Tim Clark says.

“We have always embraced and advocated fair and open competition,” he adds. “We have never received financial subsidies or bail-outs. We did receive start-up capital of \$10 million in 1985 and a one-time infrastructure investment of \$88 million for two Boeing 727 aircraft and a training building. This investment has been more than repaid by dividend payments to the government of Dubai, which total over \$2.8 billion to date.”



DUBAI AIRPORTS

Clark is therefore “surprised by reports that the three largest U.S. carriers—each of which was a beneficiary of America’s unique Chapter 11 bankruptcy reorganization law—have presented a case against open-skies access for some airlines including Emirates, based on claims of subsidies.” He notes that his airline is “very interested to see how the figure of ‘\$40 billion of government subsidies and benefits’ was calculated.”

Clark argues that “aeropolitical protection for airlines is arguably the biggest subsidy of all. Therefore, it would be ironic, and a shame, if the U.S., who have been the forerunners of liberalization and deregulation, would now contemplate a U-turn on its successful international aviation policies for the benefit of a narrow few, based on sweeping and unfounded subsidy allegations.”

Limiting capacity would be in breach of the open-skies deals, says John Byerly, former deputy assistant secretary in the State Department. The agreements do not allow either side to limit access unilaterally, he tells *Aviation Week*. During his tenure, Byerly led negotiations on dozens of open-skies deals, including the U.S.-EU agreement. He now is an adviser to Emirates, among other airlines.

U.S. open-skies agreements, with the exception of the U.S.-EU deal, are virtually identical and have mechanisms by which the two sides can resolve disputes. The first step is for the country that has a grievance to request

consultations. If those talks do not resolve the issue, the matter can go to arbitration, Byerly says. The U.S.-EU agreement has a separate dispute-resolution mechanism, the Joint Committee, which meets periodically to oversee the implementation of the deal.

Under the terms of an open-skies deal, then, for one country to unilaterally impose capacity constraints would be a clear—and unprecedented—violation of the treaty. Abrogating the Qatar and UAE deals could have serious repercussions for the entire open-skies concept, Byerly says.

The three U.S. carriers, and organized labor, have promoted what they (and their European counterparts) call “fair skies,” which would limit foreign carriers’ access. This is akin to protectionism, Byerly says. “What is all too apparent is that these opponents of open skies want to maintain full opportunities for U.S. airlines where it is to their advantage but to close the door in markets where competitors pose a challenge,” he says. “Having grown up and prospered using open-skies rights, they now want to pull up the ladder and deny others the same opportunity.”

The three U.S. airlines defend their tactics and argue that all they want is a fair fight. “American Airlines, along with United and Delta, has begun discussions with U.S. policymakers to reevaluate existing open-skies agreements with Qatar and the United Arab Emirates and assess the impact on the U.S. airline industry of over \$40 billion in government subsidies provided to

the Gulf airlines in violation of those agreements,” American states. “A reopening of those open-skies agreements is the first step and the right step to ensure competition is preserved and enhanced and U.S. airline careers continue to prosper.”

“We welcome global competition on a level playing field and in accordance with the open-skies agreements with the United Arab Emirates and Qatar,” Delta points out. And United says that “we welcome competition with all carriers, but that competition should be on a level playing field and follow existing open-skies policy.”

But even in the airline community, the defensive approach is not common sense. The survival of carriers such as Alitalia and Air Berlin hinged on the ability of Etihad to invest. Jet Airways in India also survived because of a large capital investment by the Abu Dhabi-based airline. And in the U.S., JetBlue Airways President Robin Hayes wrote a letter to the secretaries of State, Commerce and Transportation expressing his carrier’s “unwavering support” for the open-skies policy and noting that the airline’s success in serving the Caribbean and Latin America could not have been possible without open skies.

“Similar to the domestic aviation landscape after deregulation, international services, traffic and economic activity have correspondingly grown since the United States began pursuing its open-skies policy,” Hayes states. Open-skies policy has successfully “sought to eliminate government interference in commercial decisions on routes, capacity and pricing,” he writes.

JetBlue is not in a global alliance but has struck codeshare and interline partnerships with airlines around the world, Hayes notes. Emirates is one of its partners.

Meanwhile, the three major U.S. carriers and organized labor have objected loudly to Norwegian Air International’s (NAI) application for a foreign air carrier permit, which has been pending for almost a year. They argue that the airline, domiciled in Ireland, is operating a “flag-of-convenience” business model that threatens the U.S. airline industry. NAI’s plans to use an Irish air operator certificate and source crews from there, elsewhere in the EU, the U.S. and possibly Asia violates the open-skies agreement, its opponents say. ☐

Mind the Gap

Engine and aero improvements are underway for Boeing's 777 in a run-up to 777X

Guy Norris **Los Angeles**

Boeing's new 777X flagship is due to enter service in 2020. This seems like tomorrow to the company's manufacturing side as it prepares for assembly, but for the 777 sales team looking to fill the production "skyline" during the transition it could be an eternity.

To smooth the move at the end of the decade from the current 777 family to the 777X, Boeing needs to drum up more sales to keep the Everett assembly line ticking at, or close to, the current 8.3 aircraft per month. There are currently 278 777-300ER and 777Fs in the firm backlog, representing just under three-years worth of production at the current rate. While the longer-term outlook appears to be positive—286 sales are already locked in for the 777X—the delivery trough between 2018 and the acceleration in deliveries of the new model from the 2020-22 timeframe onward is causing some concern.

But Boeing's 777 sales team is about to get a shot in the arm. To help bridge the gap to the 777X, the company plans to inject additional life into the -200LR/-300ER by developing an upgrade package that will reduce fuel burn by 2% from 2016 onward.

Boeing plans to reveal full details of the upgrade in mid-March. News of the plan first emerged in January when John

Wojick, global sales and marketing senior vice president, revealed "we are working on a fuel-burn improvement and other items for 2016 that will provide the equivalent of around 2% fuel-burn savings." He adds that, although 2014 was "a good year" with 63 new 777 sales, "we need to continue to work diligently to keep that skyline full as we transition from the 777-300ER and 777F to the 777-8X and -9X."

The coming availability of the upgrade, added to what Boeing Chairman/CEO Jim McNerney describes as the "enduring capability" of the 777, already appears to be bolstering prospects of new orders to fill out the mid-term production slots. During the recent fourth-quarter financial results call, McNerney said: "We took 63 orders in 2014, which bodes well for the 40 to 60 we need [per year] over the next few years. So I'm feeling increasingly comfortable [about] the long-term demand for the airplane. We expect demand for the 777 to remain healthy through this decade."

General Electric, which is the exclusive engine supplier to the 777-300ER/777F with the GE90-115B, expects to start initial tests of the engine-improvement element by the end of the year. "We are targeting about a 0.5% specific fuel consumption (sfc) improvement in the engine," says Bill Millhaem, general manager of the GE90 program. Focus areas include the aerodynamic "clean-up" of the fan module with elimination of steps and gaps to reduce drag, and improvements to the efficiency of the high-pressure compressor stage-1 blisk.

The most significant single change in the engine upgrade is an improvement to the active clearance control system which cools the casing of the high-pressure turbine section, helping to minimize clearances between the tips of the blades and the shroud during cruise. "We're introducing a new style manifold and increasing the 'muscle' for better clearance control," says Millhaem, who adds that the revision lever-



BOEING

Around 100 777s per year currently roll off the Everett, Washington, line. Boeing hopes the upgrade will help sustain close to this rate until the debut of the 777X.

ages active-clearance-control-system advances that were introduced with the GENx engine for the 787 and 747-8. The new manifold improves the axial coverage area of the cooling flow over the casing. In parallel with this, GE plans to reactivate a valve in the core to improve modulation of bleed air to the manifold.

Slight aerodynamic changes will also be introduced to the first-stage nozzle of the low-pressure turbine, and the “grind” of the high-pressure turbine shroud will also be optimized to improve the match between the blades and shrouds in cruise. “In aggregate, all this adds up to around 0.5% sfc. We are in the process of finalizing the design of the hardware and will be doing some testing later this year,” says Millhaem.

The upgrade is not considered a major certification effort because the engine thrust is unchanged and testing is aimed at “mostly assurance” work to confirm that none of the modifications affect durability, he adds.

The bulk of the planned 777 improvements is therefore expected to encompass aerodynamic changes, although it is not yet known what these will be. Whether some of the more novel drag-reduction features—such as the hybrid laminar-flow-control system developed for the 787-9—will be highlighted remains unclear. However, the most likely solution is expected to be a further package of aerodynamic tweaks similar in scale to upgrades introduced in the early days of the 777-200LR/-300ER program. Together with better-than-expected initial engine performance, these modifications improved the fuel burn of the 777-300ER by 3.6% compared with pre-service predictions at the start of the program in 2003. For the 777-300ER, every 1% improvement in fuel efficiency is roughly equal to 75 nm of extra range, 10 extra passengers for a load-limited flight or 2,400 lb. of cargo.

The first set of improvements, introduced in 2005, resulted from changes made to counter unexpected drag from the environmental control system’s ram air exhaust duct, and from handling changes related to the introduction of the aircraft’s raked wingtips. The duct changes included the addition of exit louvres, the modulation of which was controlled by new software in the cabin pressure system. By introducing the louvres, Boeing improved thrust recovery and reduced the drag. The wing changes were based on the addition of seven outboard 737-size vortex generators which, to Boeing’s surprise, resulted in a 0.4% improvement in fuel burn.

Following the success of these changes to the longer-range models, Boeing subsequently introduced a retrofittable per-



GENERAL ELECTRIC

Initial elements of the 777 engine upgrade will be tested later this year.

formance improvement package (PIP) based on the same modifications for the 777-200/-200ER and baseline -300 from 2008 onward. The PIP also included drooped ailerons that altered the angle at the trailing edge by 2 deg., reducing drag by creating aerodynam-

ic loading on the outboard wing and making spanwise loading more elliptical. As the aileron droop increased loading, it also caused a change in the wing twist. This reduced local flow incidence toward the wingtip, which reduced the shock strength on the outboard wing and further cut drag.

The previous 777 PIP could be incorporated by operators via service bulletins and was independent of others. Only the ram-air-system upgrade had to be conducted during a heavy maintenance check, and Boeing said fuel savings would begin to pay off within 12-18 months of modification. It is not yet known if the non-engine-related elements of the 2016 PIP will be retrofittable. ☛

Widebody Duo

Full-scale development of a Russo-Chinese widebody may begin next year

Maxim Pyadushkin **Moscow**
and **Bradley Perrett** **Beijing**

Russia’s United Aircraft Corp. (UAC) and China’s Comac have begun preliminary design of their proposed joint 250-280-seat widebody airliner, which Moscow now expects to enter service in 2025. This phase should be completed by July, says UAC President Yury Slyusar, while Industry and Trade Minister Denis Manturov suggests that full-scale development will begin next year.

“We have the money for this,” Manturov says, referring to the preliminary design. As for the next design stage, more funding will be needed, and this would fall in the 2016-18 budget cycle, according to an Interfax-AVN news agency report on the press conference.

By “next design stage,” Manturov appears to be referring to detail design. That implies that a nine-year program for

the first in the world!!

Wide field of view with flat surface

KomyMirror PAT.



Passenger Convenience



Shorten Aircraft Turns



**Saving
Non Productive Hour**



Komy Co., Ltd.

www.komy.com

full-scale development will be launched in 2016. Entry into service in 2025 would be at the end of the target period previously set as 2023-25. China and Russia each allowed eight years for development of their narrowbody airliners, the C919 and MS-21, respectively, and each now expects that it will take 10 years to bring those aircraft to fruition.

Last November Slyusar, who was then Russia's deputy industry and trade minister, said that the aircraft would make its first flight in 2021-22. Development cost is now estimated at \$13 billion before the ruble's recent fall in value, he says. That compares with a figure of \$7-8 billion he mentioned in November. The cheaper ruble should reduce the U.S.-dollar cost of the program, however; the two sides are probably budgeting in dollars because that is the currency customers and suppliers will use.

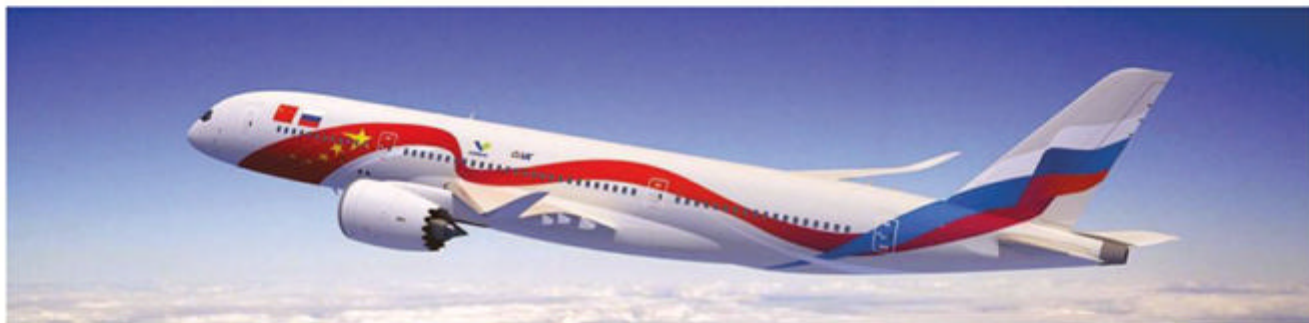
UAC and Comac, both state-owned, signed a memorandum on cooperation for the program in May 2014. A joint feasibility study was completed in autumn 2014 with positive results, says a UAC official.

early, says an industry official in the U.S. Their requirements are consistent with the large-scale use of composites that Slyusar describes.

The UAC president hopes that most of the work on the aircraft will be done in Russia. That point should be settled soon, since detailed work distribution will be defined during the current, preliminary design phase. UAC estimates that the world will need 8,000 widebody airlines through 2033, with 1,000 bought by Chinese airlines.

Comac's studies have pointed to a gap in the market for a widebody with the moderate range of 7,400 km (4,000 nm), but in November Mikhail Pogosyan, who was then president of UAC, said the joint airliner would have a range of up to 12,000 km and seat 250-300 passengers. Slyusar has refined that to 250-280 seats in the basic version, which could later be lengthened or shortened.

The intended engine for the type has not been mentioned, but a competitive widebody would almost certainly need a Western powerplant in its initial versions. Similarly, West-



UNITED AIRCRAFT CORP

Russian industry is keen to work with the Chinese since Beijing can afford to help fund the program. The joint widebody program has been met with great support from the Russian government, but a wholly Russian effort may struggle for funding. Comac is far less keen about the endeavor, say industry officials in China, because the Chinese industry would likely receive government backing for independent development of a widebody. One has been planned for several years under the name C929.

UAC is likely to develop and build the composite wing and fin for the widebody while Comac handles the fuselage, says Slyusar. Although that blueprint assigns the most difficult part of the airframe to Russia, the UAC president points out that not all of the technology is coming from his side. "China is now not only a market and investor but is also providing some expertise in technologies needed for our joint project," he says.

Still, UAC has more experience in major composite structures than the Chinese industry has, although Avic, Comac's airframe supplier, owns Austrian composites specialist FACC. UAC subsidiary Aerocomposit has developed the carbon-fiber wing for the MS-21 in cooperation with FACC and Diamond Aircraft, another Austrian company. That wing completed fatigue testing at the government aeronautical engineering institute TsAGI near Moscow last spring. Comac considered developing a composite wing for the C919, but ultimately decided against it.

The MS-21 wing has since been sent to TsAGI for static testing. Program managers for the widebody are looking at their options in acquiring tooling that needs to be ordered

The structure of the proposed Russo-Chinese widebody is likely to have a large composite content.

ern onboard systems would normally be expected.

Tensions between Russia and the West over the past year must increase the desire of Moscow, if not Beijing, to equip the aircraft as far as possible with systems from Russian and Chinese factories. The Chinese are probably far from building an industry capable of producing robust, efficient aircraft systems able to meet globally recognized certification standards, but Russian industry could develop some equipment.

Russia's United Engine Corp. (UEC) says it discussed possible joint development of a high-thrust engine for the new widebody with Avic during Airshow China at Zhuhai last November. The parties have had "serious negotiations," a UEC representative tells Aviation Week. The parameters of the joint engine should be defined in the first quarter of this year. It would be a Phase 2 powerplant for the aircraft, which would probably go into service with a Western engine.

Avic Commercial Aircraft Engines has been working on the preliminary design of a turbofan for the widebody, with the aim of entry into service between 2025 and 2030.

The Chinese have had far less experience in developing transport aircraft than the Russians, but they trail only slightly in producing aircraft with globally recognized airworthiness certification. UAC's Sukhoi Superjet 100 regional jet is the first such Russian aircraft; it entered service in 2011 and has certification endorsed by the European Aviation Safety Agency. Comac's ARJ21, a similarly sized aircraft, was declared airworthy in December after a certification program monitored by the FAA. ☉

—With Guy Norris in Los Angeles.

Extended Range

Government-owned Air India has been given eight years to return to profitability

Jens Flottau **New Delhi**

Air India's use of its aircraft—tail No. VT-ANI—best illustrates the overall state of the airline. It took delivery of that Boeing 787-8 in 2012, but the aircraft has been grounded and parted out for spares in a hangar at Mumbai's international airport for almost a year to keep other 787s flying. The Internet is rife with photos that show the aircraft without engines or radome.

That Air India is in a terrible financial state is not news. The airline has been posting losses since 2007 when the Indian government merged the two state-owned companies, Air India and Indian Airlines. This merger had a devastating impact on performance, both operationally and financially. Because of political wrangling, bureaucracy and management incompetence, Air India took years to integrate its domestic sister airline. Other projects, such as its early efforts to join the Star Alliance, fell through, and Air India became a symbol of airline mismanagement and missed opportunities.

But if one asks Rohit Nandan, things are about to change. Air India's chairman and managing director is pursuing a turnaround program aimed at restoring profitability, although he emphasizes that this will be neither quick nor easy. The Indian government has agreed to fund that turnaround until 2022, when it is expected that the airline will have returned to profitability. But the support comes with strings attached; an oversight committee is monitoring the progress, and "equity is released only on the

basis of performance," Nandan says.

The undertaking is a huge task that Nandan will be relinquishing later this year, when his term at the airline ends. He will be heading to a senior position within the aviation ministry. Meanwhile, he says the airline hopes to be cash-positive in 2018. He notes that the carrier is already in the black in terms of variable costs.

But those rays of hope notwithstanding, the airline continues to hemorrhage cash and incur huge losses. While the latest official numbers have not been publicly released, the airline is expected to have suffered a loss of well more than \$1 billion in fiscal 2014, similar to prior years' results.

When Nandan took over more than three years ago, the situation was so dire that there was serious consideration of replacing Air India entirely, instating a start-up in its stead that would not be burdened with the legacy carrier's many problems. But Nandan says too many legal and infrastructure issues made such a transfer impracticable: "It's good for academic discussions, but difficult to achieve in reality." And, Nandan points out, Air India has met or exceeded performance targets set by the oversight committee, which in turn continues to free up equity.

The fleet is a key part of the airline's

renewal plan. The carrier has already begun negotiating significant changes to its fleet plans with Boeing as it tries to sort out its future long- and short-haul requirements. Air India is "seriously looking at" converting some of its outstanding orders for 787-8s into the larger -9, says Nandan. At the same time, the airline wants to cancel the three outstanding 777-300ERs still on firm order.

While Nandan praises the performance and commercial appeal of the 787-8—the carrier has taken 18 of the 27 it has on order—he says there is a need for a larger-capacity version.

Air India has now converted all of its international Asia-Pacific and European network to 787 operations. The only exception is London-Heathrow, which it serves three times daily. But Nandan would like to make even London a 787 operation. Because the aircraft is relatively small, the airline is now considering more secondary European destinations such as Amsterdam, Munich, Barcelona and Madrid, which would not have been an option for the 777. The carrier's previous international expansion included destinations such as Birmingham, England; Milan, Moscow, Rome and Sydney.

Air India is also contemplating a change to its 777 fleet. Nandan would like to drop the remaining three orders for 777-300ERs and convert them into 737s to be flown by its subsidiary Air India Express. If Boeing agrees, the 777-300ER fleet would remain at 12 aircraft and would be used for the routes from India to North America. Air India has also sold five of the eight Boeing 777-200LRs that it had been planning to use on ultra-long-haul routes when it bought the type in 2005. The remaining three have been "minimally used" because of their relatively high fuel burn per seat.

In the short-haul segment, the

Air India wants to convert orders for the Boeing 787-8 into commitments for the larger -9.



airline hopes to introduce Airbus A320neos in 2016 and 2017 to replace aging A320s. These would be leased because the airline's board of directors has ruled against buying more. Air India currently operates 22 A319s, 26 A320s and 20 A321s. The airline would like to take more A320neos earlier, but these, too, would eventually be replaced with A320neos.

Air India Express operates 17 737-800s, and its fleet is set to grow to 36 aircraft by 2017. The airline could take more -800s as part of the planned 777-300ER settlement, but Air India would also like to introduce the 737 MAX 8 sooner rather than later.

The average age of the Air India fleet is planned to go down to 5.6 years by 2020. It is now 8.5 years.

Better integration into a global network is another component of the Air India restructuring. Last year, the airline finally managed to become a member of the Star Alliance. The step had been delayed several years because Air India management was preoccupied with trying to integrate Indian Airlines. The Star Alliance Chief Executive Board (CEB) later took the unprecedented step of suspending the application after Air India missed several deadlines in the joining process. In a surprise move in late 2013, the CEB said it would reconsider the application. The reversal was brought about for two reasons. Given how much Gulf state carriers are growing in the region, the time seems ripe to strengthen alliances, and the CEB was convinced that Air India management are well on their way to resolving some of the airline's problems.

Air India became a Star member last year, and the alliance's CEOs held their most recent board meeting in New Delhi, an indicator that the airline is firmly ensconced in the alliance. However, senior Star sources concede that while Air India has managed to improve operational reliability, much more work needs to be done.

On-time performance is still lagging. Only 59.8% of Air India's flights were on time in December, compared to 77.1% at IndiGo and 73% for Go Air. Jet Airways and Spicejet had poor showings of 60.9% and 64%, respectively. Air India attributes the latest performance to a cabin crew shortage. Government control of the airline is still very much in effect. The carrier was ordered by the civil aviation ministry to hire 800

additional cabin crew as soon as possible to improve the situation.

Service quality remains spotty as well. While the airline has started to address aspects of service delivery, catering and inflight entertainment, it is still far from matching the levels reached by its rivals.

Strategically, Air India faces two main challenges. First, it does not really have a way to compete with Gulf carriers that are siphoning off a huge number of long-haul travelers—via the three hubs in Doha, Dubai and Abu Dhabi—who previously would have either not flown at all or would have used Air India. Star Alliance integration may help to an extent, given the effect of loyalty programs and a broader (codesharing) network that it can now offer. But the defections are massive and probably cannot be stanchied.

The second challenge occurs closer to home. In spite of the fact that Air India has long incorporated Indian Airlines, formerly the government-owned domestic airline, its market share on domestic routes has fallen to a mere 18%. That compares to 32% for IndiGo and 2% for Jet Airways. Even SpiceJet, which almost collapsed at the end of 2014 when it was grounded for a day, attained almost the same market share as Air India last year. And the situation shows no signs of abating: AirAsia India began flying last year and is slowly becoming a powerful competitor. And in January, Vistara, the joint venture

of the Tata Group and Singapore Airlines, took to the skies after having received regulatory clearance in late 2014. Unlike AirAsia India, IndiGo or Spicejet, Vistara is a full-service carrier. By definition, it will be fully focused on domestic flying initially. In India, new airlines cannot fly international routes until they have been in operation for five years.

"It is a zero-sum game," Nandan says, referring to the domestic market. "Somebody leaves, somebody comes." But Air India's reaction to the launch of Vistara has been less relaxed. The established carrier offered rock-bottom fares on many of its domestic trunk routes in an extensive sale that was clearly aimed at undercutting Vistara. Observers have criticized the move as using government money to drive private competitors from the market and have called for an investigation by the country's competition commission.

But given that the government-funded Air India restructuring will continue for at least seven more years, the discussion about support will be an ongoing topic.

Whatever the motive was for the extended grounding of VT-ANI—a shortage of spares or a shortage of money to buy them, or a combination of the two factors—Air India now says the almost-new Boeing 787 is about to return to service. Then again, it has been "nearly ready to return to service" for months. ☼

Taking the Risk

Investors bolster India's aviation sector, hoping growth predictions are solid

Jay Menon **New Delhi**

India's aviation sector is a financial minefield, but that has not deterred foreign investors and international airlines from entering the country's air transport market.

Analysts are predicting India will be among the top four domestic markets worldwide before long. Airbus believes the country's domestic market will be the size of Europe's by 2023. The huge growth potential is related to the burgeoning middle class here, although air travel penetration is still low.

During the past year, two new airlines have emerged in the area: full-service carrier Vistara, a joint venture between Singapore Airlines and Tata Sons; and AirAsia India, launched by Malaysia-based low-cost AirAsia in association with Tata and Telestra Tradeplace.

"Indian aviation has enormous long-term growth potential and is expected to produce tremendous upside for first movers," AirAsia founder Tony Fernandes said before the launch of AirAsia India last July.



The Indian government believes more new carriers will help improve connectivity and engender competition, which will lead to more consumer-friendly practices in the domestic aviation market.

It therefore recently granted permits to several new airlines interested in launching operations. Ligare Aviation and LEPL Projects have already received their Air Operator's Permit; Air Pegasus is in line to receive one. Two other airlines, Air Carnival and Zav Airways, have been granted the Civil Aviation Ministry's initial No Objection Certificate (NOC) to start scheduled regional services. While Air Carnival proposes to operate in southern India, Zav will fly in the northeast-

ern and eastern regions. Other airlines that have been granted the NOC include AirOne Aviation, Zexus Air Ltd., Premier Air and Turbo Megha.

The Directorate General of Civil Aviation is considering allowing non-scheduled air operators and air charters to convert to scheduled operations on routes not served by the existing scheduled airlines to further promote air travel.

AirAsia was the first foreign operator to enter the market since India, in 2013, allowed international carriers to own up to 49% of domestic airlines. Singapore Airlines-Tata's Vistara followed and is now the third full-service carrier here after state-run Air India and privately owned Jet Airways.

AirAsia India is currently operating three Airbus A320s on domestic routes.

Singapore Airlines hopes India will further ease restrictions that are part of its aviation policy now that Vistara has been launched. "The 5/20 rule is a disadvantage for Indian airlines," Singapore Airlines CEO Goh Choon Phong says. The rule requires Indian airlines to operate a fleet of at least 20 aircraft for at least five years before international flights can be launched. "Foreign airlines can start flying to India the day after they have been set up," he points out.

India's airlines are divided over the rule. Whereas incumbents such as Air

Attend the Airline Industry's Premier Awards Event!



ATW'S 41ST ANNUAL
AIRLINE INDUSTRY
ACHIEVEMENT AWARDS

February 25, 2015
Omni Shoreham Hotel
Washington, DC

Established in 1974 to recognize excellence in the air transport industry, the ATW Airline Industry Achievement Awards are the most coveted honor an airline or individual can receive.

They are bestowed upon individuals and organizations that have distinguished themselves through outstanding performance, innovation, and superior service.

Categories include:

- Airline of the Year
- Airline Market Leader of the Year
- Value Airline of the Year
- Eco-Aviation Leader of the Year
- Regional Airline of the Year
- Technology Achievement
- Airport of the Year
- ATW's Lifetime Achievement Award

Learn more and reserve your place now www.atwonline.com/awards

India, Jet Airways, Indigo and Spicejet have lobbied for retaining it (to fend off additional competitors), AirAsia India and Vistara argue against it. Aviation Minister Ashok Gajapathi Raju Pusa-pathi says he sees no reason for the 5/20 rule and that it is soon coming up for reconsideration.

Goh says, "Vistara ought to go international in the future." He believes the recent drop in fuel prices will make the airline's launch easier. He is not concerned that lower fuel prices will lead to an additional influx of capacity. "Even with high fuel prices, Southeast Asia has been awash with capacity. That's why margins have been so low."

If successful, AirAsia India and Vistara undoubtedly will reinforce the attractiveness of the Indian market

for foreign investors and may open the doors for more overseas carriers, particularly from the Middle East, to explore opportunities for strategic tie-ups with existing local carriers, in a bid to attract more Indian passengers for their own international networks.

Abu Dhabi's Etihad Airways has purchased a 24% stake in Jet Airways, which was then India's largest publicly listed low-cost carrier (LCC), while cash-strapped LCC SpiceJet says it has held preliminary talks with several potential partners but declines to identify them.

In entering the market, any new airline will be competing for many of the same travelers with the existing local airlines and will have to fight aggressively for market share.

While AirAsia India has placed it-

self as an LCC to connect smaller cities as feeder routes for its international services, Vistara's full-service model is aimed at the burgeoning middle class.

Vistara started operations in January and plans to offer 87 flights per week during its first year. The new airline has taken delivery of two Airbus A320-200s, and is looking to have a five-aircraft fleet by year-end, and 20 aircraft by its fifth year.

AirAsia India operates a three-aircraft fleet and says it is on track to break even in the first half of the year. "We expect to take delivery of the fourth aircraft by March. We are already cash-flow positive and are expecting to break even between May to June," CEO Mittu Chandilya says.

The two new airlines already have

Turning Around

After years of losses, India's airlines are poised to begin making profits

Jay Menon **New Delhi**

After a turbulent 2014, the country's beleaguered aviation sector has started to see some positive signs that could possibly mark the onset of a turnaround in fortunes.

"The last few months have seen tailwinds converging for India's airlines—such as improvement in demand and therefore load factors, a largely stable rupee-dollar exchange rate and, most important, a steep fall in crude oil prices. That would mean airlines are set to post their best operational performance in the last five years," says Rahul Prithiani, director of Crisil Research.

India's seven airlines—state-owned Air India and six major private airline groups: IndiGo, Jet Airways, SpiceJet, GoAir and the two new joint ventures, Vistara and AirAsia India—are all struggling, except for privately owned low-cost carrier (LCC) IndiGo and newcomer Vistara.

But the situation is changing. Most of the debt-ridden carriers are likely to report profits in the October-December quarter on the back of falling global crude prices and growth in passenger traffic. Global crude prices have plummeted by almost 60%—to about \$45 per barrel from \$110 in June 2014. Jet fuel accounts for nearly 50% of Indian airlines' operating costs. Carriers here could save up to 24.80 billion rupees (\$400 million) in 2014-15 thanks to fuel prices, according to aviation consultancy CAPA. "After facing a constant stream of economic, regulatory and structural challenges that has resulted in India's airlines losing a combined \$11 billion over the last eight years, Indian aviation could be on the verge of entering a new era of profitable and sustainable growth," it states.

The biggest relief for the Indian aviation industry is the survival of cash-strapped LCC SpiceJet. The airline, which

was on the verge of being grounded, received a life-saving investment in mid-January when its owners Kalanithi Maran and his KAL Airways transferred ownership, management and control of the company to Ajay Singh, a co-founder of the airline who had sold his stake in 2010. Following the transfer, the LCC's board approved the sale of shares worth 15 billion rupees after a deal was reached among the previous majority owners and Singh, who is leading a rescue plan. "The worst is behind us. But we will be taking tough decisions. We are reviewing every aspect

of the business and a decision will be taken in the next few weeks," says Sanjiv Kapoor, chief operating officer of SpiceJet.

The airline's debts exceeded assets by 14.6 billion rupees as of Sept. 30, 2014. But the good news is that "lower oil prices have significantly reduced SpiceJet's third-quarter loss, which could have been otherwise significantly higher," says Kapil Kaul, CEO of CAPA-South Asia.

The woes continue at one of the country's three full-service airlines, Jet Airways. It is being turned into a "feeder carrier" now that United Arab Emirates' national carrier, Etihad Airways, picked up a 24% stake in the airline. Since the advent of Vistara, Jet Airways has scrapped its low-cost operations and revamped its fleet to focus on a premium-class product. However, the country's second-largest airline, which posted a loss of 36.67 billion rupees in 2013-14, has to address other key strategic errors.

"We plan to reduce losses in 2015, consolidate in 2016 and turn profitable in 2017," says Jet Airways CEO Cramer



unleashed intense competition within an industry plagued by high fuel taxes, poor traffic growth and a weakened rupee. Analysts say the launch of new carriers when the industry is suffering may push the sector further into the red.

“With new airlines coming in and existing airlines being financially in dire straits—everyone is vulnerable, except IndiGo,” says Kapil Kaul, CEO of the South Asia-Center for Asia Pacific Aviation (CAPA).

In the last seven years, Indian carriers, including state-owned Air India and now-grounded Kingfisher Airlines, have had a combined loss of more than \$10 billion after years of below-cost ticket pricing and overambitious expansion, according to CAPA.

India now has one state-owned air-

line—Air India—and six major private airline groups: IndiGo, Jet Airways, SpiceJet, GoAir and the new joint ventures Vistara and AirAsia India.

“Over the next 18-24 months we anticipate consolidation in the sector. We don’t expect more than four strong pan-India carriers. The others will operate as niche players or collaborate with the larger players,” explains Amber Dubey, partner and head of the aerospace and defense practice at KPMG in New Delhi.

The impact is already visible at Jet Airways. The direct competitor to Vistara scrapped its low-cost operations and revamped its fleet to focus on a premium-class product.

Rather than joining the low-fare bandwagon, the strategy of Vistara

has been to focus on cities where there is a demand for a full-service airline. “Vistara is well-capitalized and has a strong startup management team but will be severely tested in the market,” says CAPA’s Kaul. “Tata and Singapore Airlines may be in a position to establish a more competitive, hybrid business model, offering a high-quality product with a lower cost base than incumbent full-service carriers.”

The majority of Indians are used to flying without any frills, and any new entrant will have to be prepared to deal with the fact that LCCs control 65% of the market. “The average Indian passenger and the corporate sector are not really ready to pay a premium for domestic flights that last around 2 hr. or so,” Dubey adds. ☛

IndiGo has ordered a total of 530 Airbus aircraft in the past nine years.



AIRBUS CONCEPT

Another loss-making LCC, GoAir, is also expected to record its best-ever results, if the fourth-quarter (January-March) metrics come in as expected. For a change, national carrier Air India recorded a net profit of 146 million rupees in December, mainly driven by healthy growth in both passenger and cargo revenue. Officials say the airline’s total revenue rose by 6.5% to 20.70 billion rupees during December 2014, as compared to 19.44 billion rupees in the same period of 2013. Air India estimates passenger revenue of 165 billion rupees during fiscal 2014-15 and total revenue of nearly 215 billion rupees. Together with its subsidiaries, the consolidated revenue is expected to reach 250 billion rupees for the financial year ending March 31, 2015.

Fledgling low-fare airline AirAsia India, which was launched last year, hopes to break even by May-June, when it is likely to introduce its sixth airplane, CEO Mittu Chandilya says. Low-cost AirAsia India and full-service Vistara are, however, heartened by the government’s proposed move to replace the “5/20” rule, which makes it mandatory for airlines to have five years of domestic operations and a 20-aircraft fleet to become eligible to fly internationally. “This will help improve the balance sheets of the new airlines,” says a senior officer at the civil aviation ministry. According to Prithiani, at an aggregate level, the domestic carriers are expected to post an operating profit of 81 billion rupees in fiscal 2016, a total shift from the 15 billion rupee loss posted in fiscal 2014.

“Domestic air traffic has remained almost flat at about 60 million passengers over the past two years or so,” Prithiani says. “But growth is expected to soar to double digits by 2015-16, helped by economic recovery, relatively smaller price hikes and enhanced connectivity. Economic growth, after being sub-5% for two consecutive years, is expected to pick up in 2014-15 and 2015-16. Also, the launch of new routes and direct connectivity between smaller towns will help passenger traffic growth.” ☛

Ball. He notes that the international portion of its business has become profitable again. CAPA estimates that the airline will post a profit of 1.2-1.8 billion rupees in the October-December quarter, which excludes all extraordinary one-time costs. Jet had reported a loss of 2.7 billion rupees in the corresponding quarter of 2013. Both IndiGo and GoAir will be profitable in the third quarter, per CAPA’s estimates. “December was the best-performing month for all carriers—yields and passenger load factors rose due to SpiceJet’s challenges,” says Kaul.

IndiGo’s ascendancy continues with its market share rising to 36.1% in December. Airline President Aditya Ghosh attributes the carrier’s success to on-time departure, clean aircraft and an overall pleasant flying experience. The airline has placed three large orders with Airbus totaling 530 aircraft in the last nine years. It is estimated that IndiGo will continue to outperform and that its profit will rise significantly in 2014-15 compared to 2013-14.

A Glimpse Into Avic

Chinese industry pursues broad range of aircraft manufacturing technologies

Bradley Perrett **Beijing**

In China, things are often not exactly secret but still not much discussed. One of those things is aircraft manufacturing technology. Manufacturers all over the world are circumspect when talking about their processes. The various factories that make up Avic, imbued with Communist military thinking, are a good deal more close-mouthed than most.

So it is helpful that two official technology associations have published a review of the country's advances in aeronautical technology, collating information that is probably already available but not too easily accessed. The picture that emerges from the manufacturing chapter of the report—from the China Association for Science and Technology and the China Society of Aeronautics and Astronautics—is much as observers of the Chinese industry would expect: Enjoying solid funding, the sector, dominated by Avic, is looking into just about every fabrication technology that it can.

For example, the industry is researching electron-beam, laser, friction-stir and linear vibration welding, says the report. It has achieved breakthrough progress in these technologies and applied them to production.

"Manufacturing of a variety of titanium and large and complex key metal parts directly through laser [forming] has been applied to new fighters, large transport aircraft" and the Comac C919 narrowbody airliner, it says. The "new" fighters are not named. China's main current-production fighter is the J-10, with the large J-20 in development. Both are from Avic's Chengdu works, while the Shenyang operation is promoting the J-31 as an export product.

The Chinese-language *Report on Advances in Aeronautical Science and Technology*, published in 2014, reviews the state of the industry in 2012-13. Frequent mentions of "breakthroughs" show where the industry is making the most important progress—but allowance must be made for the positive spin that Chinese officialdom habitually includes in public documents.

Basic research into electron-beam welding of thick titanium pieces is underway, the report says. Other research, apparently beyond basic, is looking into using the technique with titanium-alloy load-bearing frames, beams, rails, tail structure, fan cases, combustion chamber cases and the structural parts of drive trains.

Research into linear vibration welding is focused on titanium alloys used in engines. This work involves blisks and single-crystal components.

As to more conventional fabrication techniques, "in recent years, all Chinese aeronautics enterprises have added numerically controlled machining equipment of large sizes and high speeds and with multi-axis operation," the report states. "Numerically controlled machining capability has increased greatly." Breakthroughs have been made in

Tails They Win

Canberra will not demand offsets, but its F-35 suppliers have them

Bradley Perrett **Melbourne, Sydney and Adelaide, Australia**

Australia, with little commitment to industry policy, has given up major state support for aerospace manufacturing. It is lucky for local industry then, that the rest of the world has not. The F-35 program's early acceptance that export customers would demand production work resulted in

the Australians automatically being offered participation their government would probably not have fought for.

This is resulting in one Australia manufacturer upgrading its skills, a small but advanced company building up its size and perhaps having an opportunity to apply radical cost-saving technology, and most surprisingly, a newcomer entering the industry. From the point of view of Australian economic efficiency, the program is all the more satisfactory because F-35 contracts, though offered to customer countries, are subject to competition; a company cannot simply hold out its hand and declare that it is entitled.

The bulk of Australia's involvement is building tail fins under contract to major F-35 program partner BAE Systems. The industry is due to make 722 sets of fins, while the Royal Australian Air Force takes delivery of at least 72 F-35A Lightnings





Chinese industry is using laser-forming for manufacturing parts in fighters. This aircraft is a prototype of Shenyang Aircraft's J-31.

YAN SIMING/INTERNATIONAL AVIATION

research into high-speed machining chatter, the optimization of operation parameters, the prediction and control of deformation, and working on difficult materials. According to the report, this know-how is already being used in producing detail parts. Tolerances of 0.1-0.3 mm (0.004-0.012 in.) have been achieved for large aircraft structural components, and 0.01 mm for engines.

Aluminum alloy milling speeds have reached 1,000 meters (3,300 ft.) per min. and material removal 25-30 kg (55-66 lb.) per hr. Large aircraft parts 1.5-2 mm thick are being precisely milled on both sides. For titanium, the milling speed has reached 60-80 meters per min.

There has been breakthrough progress in shot-peen forming of large fuselage panels, creep forming, superplastic forming of engine

blades and diffusion bonding. Some of these technologies have gone into production use, such as numerically controlled shot-peen forming of large supercritical wings for regional aircraft—presumably, the Comac ARJ21 regional jet. Superplastic forming and diffusion bonding is being used on panels, while the process, combined with diffusion bonding, has been applied to engine vanes.

“The use of resin-based composites in Chinese aeronautics is rising rapidly,” states the report. “For small- and medium-size aircraft, composites have reached 30% of the structural weight. For large aircraft it is about 15%.” For small and medium aircraft, the industry is widely using prepreg tape, automatic cutting, laser-assisted positioning, manual lay-up and autoclave curing.

Co-curing has been applied to the

load-bearing structure of main and tail planes. The more advanced techniques of resin transfer infusion, resin film infusion and vacuum-assisted resin infusion are being used for canards—presumably of the Chengdu J-10 multirole fighter—and for beams, cabin doors, and aft pressure bulkheads.

Research is ongoing for applying such technology for complex shapes such as engine disks and large blades. Automatic tape laying is being used in research projects. And development work has begun for key technologies of automatic fiber placement.

The industry has engineered carbon-carbon composite technology for application in brakes equipment and heat-protection for (unnamed) high-speed aircraft. Critical technology for ceramic-based composites has been acquired. ☛

and becomes one of the largest non-U.S. users of the type.

Considering the high standards required for stealth fighter production, it is perhaps surprising that the tails will be assembled by a newcomer to aircraft building, formerly a specialist tool supplier to the automotive industry. That Melbourne company, Marand, has also been deeply involved in the program by building tools for Lockheed Martin and BAE Systems, lending its automotive-based knowledge on high-rate production, while also building the elaborate engine trolleys that will soon be common sights at F-35 bases worldwide.

Marand is assembling the tails as a second supplier, alongside the BAE plant at Samlesbury, England. The company delivered its first set of fins in March. It is ramping up from three sets last year to four this year and 10 in 2016. The peak rate in Australia will be 70 sets a year.

General manager Rohan Stocker declines to discuss the technologies used, except to note that the temperature of the assembly room is tightly controlled to ensure precise part size during assembly. Tolerances are unstated but Stocker confirms they are unusually tight, as may be expected for parts of a stealth fighter, the surface of which must be near perfect to minimize the reflection of radio energy in the direction of the transmitter.

So how has a company that has mainly served the automotive industry managed to get the work, and how can it do the job adequately? Part of the answer is that, as a tool maker, Marand already had experience in aerospace, because from the 1980s it supplied equipment to an Australian government aircraft company, now Boeing Aerostructures Australia.

This background led to Marand's participation in early

discussions, around 2002, about potential Australian involvement in the F-35 program. At that time, about 90% of the company's revenue was from the automotive sector, but this exposure to the program led to Lockheed Martin hiring Marand for production engineering at Palmdale, California. A key issue, says Stocker, was that Lockheed Martin had no recent experience in building aircraft at the rates planned for the F-35; automotive know-how in an aerospace supplier was useful.

Marand was also well placed to bid for tools for F-35 production. The company became probably the main provider of tools for Palmdale, building 500-600 tools used for composite wing fabrication, as well as supplying equipment to Samlesbury for tail fin production and to other members of the F-35 program, says Stocker. And it won the contract for the engine trolley for the F-35's Pratt & Whitney F135 engine.

Then, in 2010-11, the company, by then deeply involved in

a AU\$10 million (\$7.8 million) machine for making the largest parts of the tail.

Because Samlesbury had the same equipment, setting up the unit at Edinburgh Parks did not present great difficulties, says Peter Serdar, projects and performance manager of BAE's Australian manufacturing operation. The first piece it produced was good to use in an aircraft, he says. Edinburgh Parks is now in a position to feed some of its technical know-how back to Samlesbury. As the rate increases, a fourth machining center will be needed to supplement the two smaller ones. So far, the largest machine is working at a low rate, supplying Marand and the British assembly lines, but is building up to full-rate production.

Like other non-U.S. suppliers, BAE must now be enjoying the widespread fall in exchange rates against the U.S. dollar, since the contracts are presumably denominated in U.S. currency. This is particularly true for the Australians; their dollar has dropped about 20% against the U.S. dollar in the past few months.

The third member of the team, Sydney-based Quickstep, may eventually make the biggest Australian mark on the program. The small but rapidly growing specialist in high-grade composites for military aircraft is building the skins and spars of the fins. It is doing so with a conventional autoclave process.

Quickstep, while making F-35 parts with autoclaves, has the technology for quickly curing composites in small inexpensive equipment (shown).



QUICKSTEP TECHNOLOGIES

the F-35, was invited to bid for fin production—a few years before its Australian automotive customers said they would close their factories, with the flinty-eyed government making no offer to bail them out.

And how does Marand deliver stealth precision? First, road vehicle production is not exactly imprecise. In contrast to traditional aircraft manufacturing, car parts and assemblies must fit together first time, every time; the vehicle industry can hardly afford shimming. Second, Marand was building the fabrication tools, which were necessarily more precise than the car parts being made. Finally, Stocker says, it was already used to the particularly demanding tolerances of the F-35, because they were similar to Marand-manufactured gauges.

Titanium parts for the tail fins, including outer frames, are coming from BAE's Edinburgh Parks, Adelaide, site. The factory was working mainly in aluminum; the F-35 program gave BAE the chance to switch to titanium—higher-value work.

The BAE factory began supplying Samlesbury in 2009 with small pieces and then a year later commissioned a second machining center for medium parts. Support from the South Australian state government ensured that BAE could install

The autoclave business helps Quickstep to expand while it works on key technologies that do not use such expensive equipment. One production process uses glycol in a small, economical machine to quickly heat and then control the temperature of composite parts for curing. Typically, the cost saving is 10-50%, depending on the shape of the part, says Executive Director Philippe Odouard. The quality can be higher, because fast heating makes the resin very runny; it can soak the carbon fiber well before beginning to cure.

For a largely composite aircraft such as the F-35, these cost and quality advantages must seem very attractive. "The visibility of the Quickstep technology within the program is very high," says Odouard. But there is no firm plan to introduce the production method, he adds, even though Quickstep, with help from Lockheed Martin, has run tests on hundreds of pieces for preliminary confirmation that they are equivalent to autoclave parts.

Odouard declines to comment further, but a likely reason for Lockheed Martin not taking up the opportunity is that the program's immediate need is stability over cost saving. The technology will remain available, however, and not just for the tail fins. Part of Quickstep's business is licensing its know-how. ☺

Read more on Asia-Pacific defense: AviationWeek.com/Tejas and AviationWeek.com/FGFA

Not Just the State

HAL, which has been criticized for inefficiency, is running late on Flanker deliveries to the Indian air force.



Private defense industry in India sees a welcome turn of fortune

Jay Menon **New Delhi**

Until about 2011, Indian defense manufacturing was almost a fiefdom of government companies such as Hindustan Aeronautics Ltd. (HAL) and Bharat Electronics Ltd. These organizations have long been criticized for slow development programs and inefficient production.

Now the country will see if private enterprise can do better. By raising the limit on foreign ownership of Indian defense companies, the government has opened the way for global giants to inject know-how and funds into local operations. And the defense ministry is under pressure to spend more of its acquisition budget in India, as part of a government-wide campaign called Make in India. There is ample room for growth, because India is the world's largest arms importer, and has been spending only 30% of its equipment budget domestically.

"As Indian companies presently may not have adequate capabilities in terms of technology, they are encouraged to partner with foreign companies for joint ventures, technology transfer arrangements and tie-ups," says Defense Minister Manohar Parrikar. "In the days to come, import is going to be the rarest-of-the-rare option, and first opportunity will be given to the Indian industry to develop and manufacture the required systems."

Having a willing and encouraging customer is not always enough, however. For the biggest defense requirements, Indian private companies are still not willing vendors; the risks are too high. And even these businesses, new to complex defense systems development, do not yet have much experience.

Still, they are not all starting from zero. In the past decade, manufacturers here have increasingly won work from foreign companies, usually in contracts the government required as export offsets for an aerospace import. The contracts are raising skills, as they are intended to.

"The actual opportunities for Indian companies to manufacture weapons and weapons systems are very large," says Sukaran Singh, vice president of Tata Advanced Systems. "An entire ecosystem is coming together in the defense equipment market."

Tata Advanced Systems is building cabins for Sikorsky S-92 helicopters and it builds center wing boxes and tails for the Lockheed Martin C-130J Hercules. The Indian company

has factories at Hyderabad and New Delhi and is planning to build plants elsewhere. One of the latest activities, agreed last year, is production of airframes for PC-12 passenger aircraft, including cockpits, for Pilatus Aircraft of Switzerland.

Airbus and Tata Advanced Systems have agreed to jointly offer the C295 light airlifter as a replacement for the air force's 56 Avro 748s. This would be a revolutionary step for industry here—a private company would build a substantial aircraft for the air force.

The government should decide in the fiscal year beginning April 1 whether to award the production contract.

Conglomerate Larsen & Toubro, a naval shipbuilder, is anticipating opportunities by investing in training. "With the entry of the private sector in the defense sector, we're looking toward collaboration in manufacturing defense equipment," says the group's executive chairman, A.M. Naik.

But there is a limit to the industry's ambition, or bravery. The transport aircraft contract is the biggest to become available since the Make in India campaign began, but only Tata Advanced Systems bid, underscoring a reluctance on industry's part to take on the largest programs. Pilatus cannot find a private local partner to build 105 additional PC-7 basic trainers that the armed forces want to order, because no company has adequate capability. "The time taken to achieve the certification by any company in India is underestimated and needs to be considered," says Jim Roche, deputy chief executive of Pilatus.

The limited range of private companies that can do such work is a result of the former policy of feeding the great bulk of defense manufacturing to HAL and other state organizations. But these groups are often criticized for inefficiency. The forces and even the prime minister blame them for India's failure, after more than six decades of effort, to become an important manufacturer of aircraft and aeronautical systems.

In the most recent case, HAL is behind schedule in delivering Sukhoi Su-30MKI fighters to the air force. It is able to build only 16 a year, even though India and Russia agreed on license production and technology transfer more than 14 years ago. 🇮🇳

—With Bradley Perrett in Beijing.

Rafale Riposte

France will not warranty Indian-built aircraft

Jay Menon **New Delhi** and Caroline Bruneau and Amy Svitak **Paris**

After months of seeing Dassault Aviation being browbeaten in the Indian press, French arms procurement agency DGA defended its contractor, asserting that a 2012 agreement to provide India with Rafale fighter jets never committed the company to guarantee aircraft manufactured in India at state-owned Hindustan Aeronautics Ltd. (HAL). However, a recent senior adviser to HAL's management tells Aviation Week that guaranteeing HAL's work is not the issue, but that the French are being "rigid" and refusing to stand behind the integrity of the design.

"Dassault will not be responsible for the whole contract. It is a co-management setup," says French defense procurement chief Laurent Collet-Billon, who was clear that France will not assume full liability for HAL-built Rafales. "It cannot be a problem, because it was not in the request for proposals [RFP]."

Speaking to reporters during an annual media address Feb. 9, France's arms procurement chief said the €10.2 billion (\$12 billion) agreement—which has been under negotiation for more than three years—calls for the first 18 of 126 Rafale jets to be built in France. After that, HAL would take over production of the remaining 108 aircraft.

Dassault's responsibility for the latter has been the subject of heated negotiations between New Delhi and Paris in recent months. Pressure on the talks has increased because India, according to defense ministry officials, wants to make a final call on the Rafale project before Prime Minister Narendra Modi visits France in April.

"A lot of progress has been made since 2012," says Collet-Billon, adding that he wants to believe negotiations will give way to a contract for the 126 fighters plus 63 options. But Collet-Billon says talks with the Indian government have become bogged down over questions of production of the fighters on Indian soil. "India has its own pace," he said of New Delhi officials. "It's not useful to put pressure on the client. We have to live with our differences."

French officials are increasingly optimistic that a Rafale deal will be signed shortly with Egypt, and an order from Qatar is still considered likely. Those deals would end Rafale's export drought and reduce India's negotiating leverage.

But even as a French official in India insists that "everything is at its normal pace," Indian officials are stoking speculation that the acquisition process could be delayed again, and that India could choose to acquire more Sukhoi Su-30MKI fighters as an alternative to the Rafale.

Moreover, a retired senior Indian military officer who was involved in the drafting of the original RFP and has been a senior advisor to HAL, tells Aviation Week that "the French don't want to be accountable in any way. The original equipment manufacturer [OEM] has to stand guarantee with respect to design and integrity of design. The French are trying to get away from the OEM's responsibility." He added that the defense ministry would eventually have to choose between the Rafale and the Fifth-Generation Fighter Aircraft (FGFA), a HAL-

developed variant of the Sukhoi T-50.

Defense minister Manohar Parrikar told a local television channel in January that "the Su-30 choice is always there. Upgrade the Su-30 to make it more capable by equipping it with state-of-the-art electronic warfare systems."

The Indian defense ministry is complaining about Dassault's alleged unwillingness to guarantee the performance of the HAL-built aircraft. According to Indian officials, the original RFP required bidders to transfer technology for production to HAL as well as provide a warranty for HAL's work. "The offer of the French firm for technology transfer is compliant to the requirements specified in the RFP," the minister said, but Dassault's guarantee terms—which are limited to the first 18 aircraft—are inadequate.

"Irrespective of anything, the RFP terms have to be met. . . . They cannot be diluted," Parrikar added. However, the minister also ruled out the possibility of re-opening the competition.

Dassault's response to the RFP was influenced by a planned partnership with Reliance Industries, a \$75 billion private-sector energy-based conglomerate that planned to expand into aerospace and defense. Reliance would have performed much of the manufacturing work on the locally built Rafales in new-build facilities. However, the Indian government has insisted that HAL build the aircraft. The original manufacturers of the Su-30MKI and Jaguar were not asked for similar guarantees.

Amber Dubey, head of defense and aerospace at KPMG India, commented that "to drag the selection process for eight long years and then question the very need for the product may not reflect very well on India. A flexible approach, without compromising India's interests, is needed here." ☛

A French air force Rafale fighter departs from St.-Dizier AB to take part in Operation Chammal, France's contribution to strikes against Islamic State forces.



SpeedNews 5th Annual

**Aerospace Raw Materials & Manufacturers
Supply Chain Conference**

March 2, 2015 • Beverly Hills, California

SpeedNews 29th Annual

**Commercial Aviation Industry
Suppliers Conference**

March 2-4, 2015 • Beverly Hills, California

Please visit SpeedNews.com for more information or to register for these events.
Tel: +1-424-465-6501 • jspeed@speednews.com

Training Wheels

Northrop turns to Scaled Composites for a new T-X prototype, abandoning a modified Hawk

Amy Butler **Washington and Nellis AFB, Nevada**

A Northrop Grumman-led team is dashing its plan to propose a modified BAE Systems Hawk trainer for the U.S. Air Force's T-38 replacement program, opting instead for a clean-sheet design for the \$1 billion program.

The shift is more bold than it is surprising. The team is paying for a brand-new prototype despite a slump in defense spending. But it has become increasingly evident that the Hawk is unsuited for the mission due to shortfalls in the fast-jet trainer's ability to sustain Gs, perform high angle-of-attack maneuvering and execute tight turn rate and radius.

Scaled Composites, wholly owned by Northrop Grumman since its purchase in 2007, formed a small team to build a suitable aircraft from the ground up.

This marks the third U.S. company to propose its own new-build aircraft

for a competition that began with three foreign-built, modified off-the-shelf designs: the Hawk, Lockheed Martin/Korea Aerospace Industries T-50 and General Dynamics/Alenia Aermacchi M-346. Boeing planned since entering the competition to offer a new-build design; it is teamed with Saab. Textron Airland is looking at three variants of its company-developed Scorpion demonstrator for the T-X mission, says President Bill Anderson. Boeing declined to comment about progress on its prototype.

The Air Force has been openly pursuing a T-X plan since 2011, but the fiscal 2016 budget proposal sent to Congress Feb. 2 indicates that a request for proposals will finally be released in fiscal 2016. The plan calls for \$575 million in fiscal 2016-19, with an estimated total program cost at \$1.04 billion and a source selection by the end of fiscal

2017. The winner stands to dominate a global fast-jet trainer market, especially for countries planning to buy the F-35. Nine partners already are teamed to develop the stealthy fighter and another three are foreign military sales customers.

The so-called T-X will eventually be used to train future F-22 and F-35 pilots with advanced skills. Adding to the requirements is an Air Force decision in the fiscal 2016 budget plan to expand T-X to cover a requirement for a new "red air" aggressor.

BAE's Hawk (bottom) would struggle to meet sustained G, high angle of attack and tight turn radius requirements sought in the U.S. Air Force's T-38 (top) replacement program.

nor "stores aircraft interface" kit to include adding a radar, datalink and hard points for weapons and a jamming pod. The T-X aggressors will replace F-16Cs used in that role now at the Air Warfare Center at Nellis AFB, Nevada. The Hawk would be unable to meet the demands of an aggressor aircraft.

The "red air" T-X is needed to tax the technology and skills of future F-22 and F-35 pilots, says Col. Adrian Spain, commandant of the Air Force Weapons School at Nellis. During live-fly training, the aggressors not only use enemy tactics but the aircraft must also emulate adversary platforms well enough to "fool" the Air Force's aircraft into "thinking" they are an actual enemy system.

"The potential near-peer threat has improved pretty substantially over the last decade, [and] we want to be able to replicate that threat here so we can train against a threat that is realistic and relevant," Spain tells Aviation Week. "With an older, fourth-gen system, you can probably trick it into thinking [an aggressor] is something else. But in an F-35 and an F-22, the sensors are advanced enough that they'll know the difference. So we need to have capability on the range to fly against."

Budget cuts forced the service to deactivate a squadron of F-15Cs last year, leaving only one F-16C aggressor

JIM WILSON/BAE SYSTEMS

squadron for advanced tactics and pilot training of U.S. and allied pilots at Nellis's Air Warfare Center.

The Air Force budget proposes to begin funding for the aggressor modification kit in fiscal 2018; a total of \$220.5 million is included through fiscal 2020 for the work.

The challenge is for a T-X aircraft to emulate the fifth-generation aircraft qualities without accruing the high cost of replicating them. "As a team—and I want to stress with you that everything was as a team—we entered the fight with the Hawk and as time went on . . . we just kept an eye on the requirements," says Marc Lindsley, Northrop Grumman's T-X program director. "And as we saw the requirements evolve and become more clear, we looked at options. It became more and more clear to us that the Hawk wasn't the optimum solution in terms of requirements and affordability. . . . So we started studying it."

Northrop turned to Scaled Composites, renowned for its innovative designs and rapid fabrication cycle time, to build the prototype. The team is preparing to assemble the aircraft at Scaled's facility in Mojave, California, with an eye toward first flight by year-end. Budget constraints are driving the Air Force and competitors to search for affordable options. Tom Vice, president of Northrop Grumman Aerospace Systems, says this is partly achievable with speed in designing and manufacturing aircraft coupled with innovative designs that take life-cycle cost into account upfront.

"We have tremendous agility in the marketplace to bring innovation much, much faster," Vice told reporters during a tour last month to showcase the company's facilities in California. "We are setting a tone inside the organization and backing it up with investment that allows us to think about innovation for affordability."

Until now, Northrop has kept its plans for the new aircraft under wraps. The company teamed first as a subcontractor to BAE Systems in 2011; it quietly shifted roles to become the prime last June. The core team will remain intact, Lindsley says. L-3 Communications will continue to handle the ground-based training system. Northrop is "in discussions with BAE Systems to include their training system in our aircraft solution," says Northrop spokesman

Bryce McDevitt. The goal is to port the air vehicle training system from the Hawk to the new design. It would include a reconfigurable cockpit system to allow for various training scenarios as well as software to allow for insertion of various mission scenarios. BAE has declined to comment on its plans and has not explained how its air vehicle system will interface with L-3's ground-based equipment.

Northrop is taking lessons from Detroit-based Kuka Systems in designing its assembly line. Kuka started teaming with Northrop in 2012 and has experience in low-cost auto manufacturing techniques. A location for the work has not been announced, although if Northrop wins, the program will be based at its Melbourne, Florida, manned aircraft center of excellence.

Lindsley provides scant details of

us to directly engage industry as we develop an understanding of how to best evaluate our objective and our threshold requirements," James said. Today's procurement process is linear, with requirements developed by one unit and handed over to another for a development and buy. James hopes that by opening a dialog with industry early in the process, the service can tailor the requirements not only for operational needs but with a realistic budget in mind.

Lindsley and Anderson welcome this approach. Lindsley cautions, however, that the Air Force must provide industry enough time to adjust its designs accordingly when allowing for such trades, especially when the Pentagon is relying more heavily on contractor research and development funding for prototypes and risk reduction. He

says thus far there has been a "very healthy dialog" on T-X with the Air Force; Northrop notified the service it was building its own prototype last year.

"The big issue for us is we can debate the requirements, . . . but then we need the time . . . to

meet those requirements," Lindsley says. "Have the dialog, understand those trades, publish the requirements and lock them in, and then we need the time to design, develop and field that solution . . . at our investment."

This model is a departure for the Pentagon. With three contractors offering company-funded, clean-sheet options for T-X, industry is clearly keen on it. But the Defense Department's history in this area includes failures. Despite contractor-funded designs for an Army Armed Aerial Scout helicopter, the service ultimately ended a demonstration effort without selecting a design. Likewise, four bidders have heavily invested in risk reduction for a Navy Unmanned Carrier-Launched Airborne Surveillance and Strike aircraft, and it has been continually delayed, prompting Northrop Grumman and Lockheed Martin to halt or scale back their work substantially.

The Air Force intends to buy as many as 350 of the trainers as part of a larger T-X system, including advanced training aids such as a sophisticated ground-based training platform and aids. ☼

The challenge is for a T-X to emulate fifth-generation aircraft qualities without accruing the high cost of replicating them

the actual prototype design, including a "no comment" on whether it would require one or two engines, because of the competitive landscape. The company has not offered a name for the prototype.

The Northrop team's decision to abandon the Hawk leaves a dim future for the program. BAE moved its Hawk work from Brough to Warton, England, in 2011 despite having few orders for the aircraft. Subsequently, however, it won a contract with the Royal Saudi Air Force for 22 aircraft and a deal with Oman for eight. The Hawk design evolved over time since its first flight in 1974. More than 1,000 Hawks have been built. BAE declined to comment about the future of the program.

Air Force Secretary Deborah Lee James announced in January that T-X will be a pathfinder for her Bending the Cost Curve initiative, which is designed to allow for dialog with industry on requirements and cost trades with a goal of reducing weapon-system cycle time and cost. "When it comes to T-X, we are about two years away from a request for proposals stage, and this new process should allow

Slow Clap



NH90 customers remain troubled by spares and reliability problems

TONY OSBORNE/AW&ST

Tony Osborne London and Paris

With 250 helicopters in service and almost 70,000 flight hours achieved fleet-wide, it would seem that global NH90 operations would finally be gaining traction.

Several customers have flown the NHI Industries (NHI) helicopter in Afghanistan and carried out anti-piracy missions off Somalia, and France is flying it in Central Africa.

Yet small problems that blighted the helicopter in its earliest days of operation are still causing concern as operators struggle to procure spares and move rotorcraft out of the hangars and onto the flightlines for service.

The NH90 had a troubled upbringing. It first flew in 1995 and made it into limited operational use in 2007. Deliveries of full-operational-capability helicopters began in 2013, and production was ramped up, allowing the delivery of 53 NH90s during 2014. It is also a highly complex machine, being the first operational military helicopter to incorporate a fly-by-wire control system.

Finland, which has ordered 20 NH90s in the troop transport (TTH) configuration and will soon take delivery of its last of the type, was an enthusiastic early customer. The country worked to bring the helicopter into operation quickly following first deliveries in 2008, but seven years later, Finnish officers remain frustrated by reliability and spares support.

"The amount of maintenance is amazingly high," Lt. Col. Tuure Lehtoranta, the army's chief of aviation, said at the International Military Helicopter Conference in London last month.

"Industry has launched a program to reduce spares turnaround times," Lehtoranta told conference attendees, but he pointed out that the army had sent a main rotor gearbox for overhaul, a process that took three years. Turnaround time on other components takes an average of 200 days, an issue he called "totally unacceptable."

"For the army, it [the NH90] is performing very well; it can do the mission. . . . Once it is on the line, it's very effective," Lehtoranta said.

But the spares situation meant that at one point during 2014, fleet serviceability fell to just 19%—equivalent to just two NH90s available for operations. Lehtoranta said the army had envisioned serviceability rates of around 75% at this point in the helicopter's career, but that expectation had to be adjusted. Army aviation officials are now aiming for around 50% serviceability by year-end. Rates are currently around 40%, Lehtoranta added.

The issues have interfered with Finland's plan to integrate the NH90s into the European Nordic Battle Group, but they may also lead the Finns to cooperate more closely with

other NH90 operators such as Sweden. Reliability issues have been reported by Sweden as well, however, and it received its NH90s late, which forced its air force to invest in the Sikorsky UH-60M Black Hawk.

NHI, the consortium of AgustaWestland, Airbus Helicopters and Fokker that builds the helicopter, is also working

Finland managed to get its NH90s into service in 2010, but operations have been hindered by spares issues.

to tackle the corrosion problems that afflicted two NH90s operated by the Netherlands. The Dutch defense ministry last June halted deliveries of the type until NHI developed fixes for the 90 occurrences

of corrosion found by engineers from the Netherlands' National Aerospace Laboratories.

The Hague, encouraged by NHI's response, announced it would restart deliveries in December 2014, after the manufacturer said it would take full responsibility for developing modifications, repairing corrosion damage and designing preventative measures.

NHI President Vincent Dubrule tells Aviation Week that many of the required design changes are underway and a number are in the process of being certified. Other concerns will be addressed with improved maintenance processes and procedures.

He notes that at no point was flight safety compromised and that NHI is pushing to improve spares availability as well as overall helicopter availability. Senior officials at Airbus Helicopters echo this, although they point out that spares-related issues are often complicated by military logistics systems.

Key milestones for the NH90 in the coming months include final signature of a contract for 22 helicopters for the Qatari air force and approval of a long-awaited restructured deal with Germany that includes 18 naval versions of the NH90, called the Sea Lion (AW&ST Dec. 29, 2014-Jan. 15, 2015, p. 38). The NH90 also could be offered for Singapore's expected requirement for 15 new utility helicopters to replace its AS532 Cougars. ☛



Beware of Delays

U.S. Army warns further budget cuts could threaten development of advanced rotorcraft

Graham Warwick **Washington**

With a new program on the horizon after decades of making and remaking old designs, the industry risks being unable to deliver an advanced rotorcraft if further U.S. Army budget cuts slow modernization and delay the Future Vertical Lift (FVL) program, says a senior aviation branch officer.

"If we have to delay FVL low-rate initial production beyond 2030, I am concerned for the industry, which has to provide us some advanced capabilities," says Maj. Gen. Mike Lundy, commander of the Army Aviation Center of Excellence. U.S. industry has not developed a new army rotorcraft since the 1970s.

Sikorsky and Boeing are testing initial parts for the SB-1 Defiant Joint Multi-Role demonstrator.

Bell Helicopter and a Sikorsky/Boeing team are to fly high-speed rotorcraft technology demonstrators in 2017 under the Joint Multi-Role (JMR) program, but Lundy is concerned that any delay in starting the follow-on FVL acquisition program could lead to the breakup of engineering teams and the loss of design capability.

The Aviation Restructuring Initiative (ARI), under which the Army is divesting older helicopter fleets to free up funding for long-term modernization, is based on avoiding across-the-board budgets cuts known as sequestration. If sequestration returns, more draconian cuts will be needed, Lundy says.

ARI includes retiring the Army's Bell OH-58D Kiowa Warriors and filling the armed scout role with existing Boeing AH-64D/E Apaches teamed with unmanned aircraft. Freed-up funding is expected pay for fully modernizing the AH-64, Sikorsky UH-60 Black Hawk and Boeing CH-47 Chi-



Demonstrating that a tiltrotor can be light, agile and affordable enough is key for Bell's V-280 under JMR.

BELL HELICOPTERS

nook fleets, and developing FVL.

The ARI fleet of AH-64Es, UH-60M/Vs and CH-47Fs is expected to be complete by around 2027, with the production of the FVL Medium replacement—first for the UH-60 and then the AH-64—planned to begin around 2030. The Apache and Black Hawk are scheduled to be retired around 2060.

FVL is not a single program, but a suite of common technologies the Pentagon hopes to apply across what are being called “capability sets.” Lundy says Capability Set 1 is

light rotorcraft; Sets 2 and 3 are the medium-attack and utility missions; and Set 4 is the cargo mission now performed by the Chinook.

During the coming decade, the Army must find funds to develop not only the FVL Medium but the Improved Turbine Engine Program (ITEP) to reengine the AH-64E and UH-60M plus the Future Affordable Turbine Engine (FATE) to power the planned Block 3 upgrade of the CH-47F.

A competition for the ITEP development program is planned to begin this

year. Lundy says the Army’s expectation is that the 3,000-shp-class turbo-shaft also will power the Capability Set 2 attack FVL. The 5,000-10,000-shp-range FATE also will power the Capability Set 3 utility FVL.

But key to finding the funds to develop ITEP, FATE and FVL and to field degraded visual environment (DVE) operating capability across the Army’s helicopter fleet is the ARI, which has proved politically controversial because it involves transferring Apaches from the Na-

SPACE

Playing It Safe

European air safety regulators skeptical of space-based navigation for aircraft

Amy Svitak Brussels

Europe’s Galileo satellite navigation constellation differs from the U.S.’s GPS in that it will guarantee reliability of its signal in return for a fee. But civil aviation authorities are skeptical that Europe’s space sector can meet navigation and communications safety standards, and they question who among Galileo’s public and private stakeholders is willing to sign off on such guarantees.

When Galileo enters full service in 2020, it will comprise a civilian-controlled constellation of 30 navigation, positioning and timing satellites offering both free and fee-based services, with the latter including encrypted navigation signals that resist interference and ensure continuity of service.

Patrick Ky, executive director of the European Aviation Safety Agency (EASA), says he sees great potential for satellite navigation to aid the civil aviation sector, notably for small aircraft operating in remote locations and—in the future—autonomous drones. But he says such opportunities will come with responsibility, both for ensuring air passenger safety and providing aircraft navigation services at a competitive price.

“Aviation is a demanding user in terms of cost—it’s a very competitive

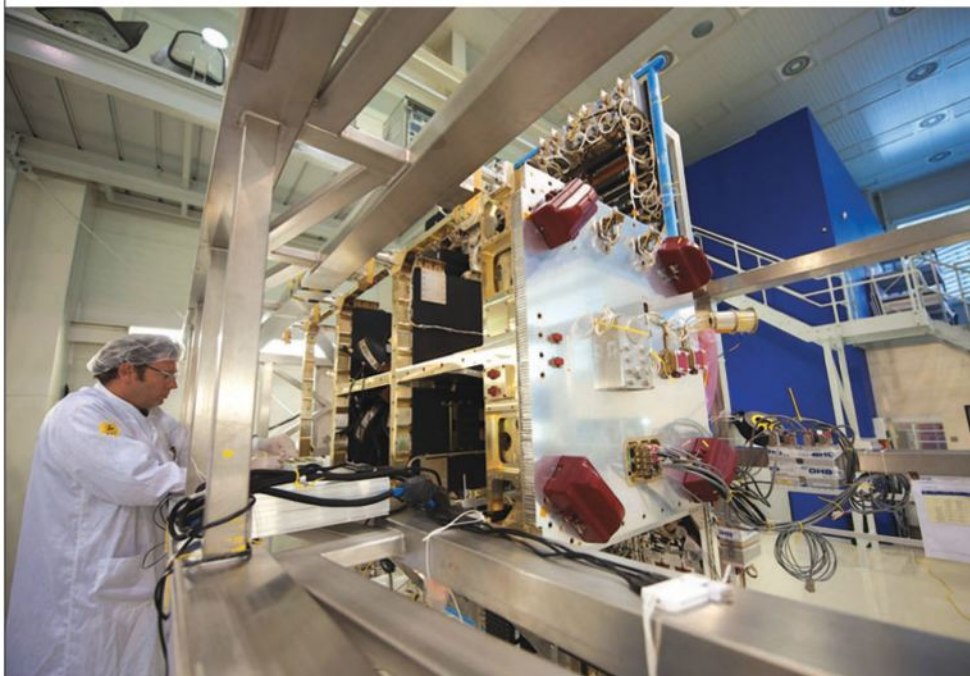
sector, where satellite technology competes with ground-based technology for communications, navigation and other applications,” Ky said during a European space policy conference here last month, adding that the market for such services in the civil aviation community is still emerging, and it remains to be seen how competitive Galileo will be against other space- and ground-based navigation options.

“We are only able to implement satellites if the business case is clear and proves there is an equal level of service quality for the price,” Ky says.

In addition to costs, safety could prove a major obstacle for Galileo services in the aviation sector, and Ky questions whether the European space industry is able to guarantee safety on the same level as companies such as Airbus and its suppliers. For example, EASA, which is responsible for certifying all technologies used to operate aircraft, targets a safety level for components of one defect for every one billion hours of flight.

“Considering a plane flies 35 years, it would fly about 100,000 hr., so you’re looking at one breakdown every 100,000 aircraft,” Ky says. “The

OHB System of Germany is building 22 of Europe’s Galileo navigation, positioning and timing satellites.



ESA

tional Guard to the active Army.

New engines will improve hot-and-high performance, new survivability systems will enable the aircraft to operate in high-threat environments, and DVE sensors will enable 24/7 operations, “and the only way to do this is ARI,” explains Lundy. “We have gone through thousands of models, and only ARI works.”

“We need 20 AH-64E model battalions, and the Guard needs its UH-60s modernized. ARI does that,” he notes. “We can’t wait 25 years [until FVL] for

“We have gone through thousands of models, and only ARI works.”

24/7 capability in all visual conditions. ARI allows us to bring that capability earlier than 2037, [when the first FVL brigade is scheduled to be fielded].”

Retirement of the OH-58D and shelving of its replacement, the Armed Aerial Scout, has also attracted criti-

cism from politicians and industry officials hopeful of a new program. “We eventually will replace the Kiowa Warrior, but it will be under FVL and not until the mid-to-late 2030s,” says Lundy.

“But if some off-the-shelf capabilities emerge, we are agile enough to relook at this,” he adds. Sikorsky continues to push its S-97 Raider high-speed light tactical helicopter, which is expected to fly within the next two months, as an all-new replacement for the OH-58D. ☛

way we ensure this at all of the companies supplying an aircraft is to make sure that all of the operations are done in a way that guarantees this level of safety.”

He explains that EASA has had no such involvement in the manufacture of Galileo satellites, development of which was led by the European Space Agency (ESA) on behalf of the European Commission through industrial prime contractor OHB System of Germany. As a result, Ky says, if Galileo is to provide navigation services, either the satellite contractor or ESA should guarantee its safety.

“Do you think the components of the satellites or of the space industry and the companies there want them to become critical components in the aircraft sector?” he asked at the conference. “It all depends on the use we want to make of Galileo. But then someone is going to have to guarantee they can meet our level of safety. Who could give me that—ESA? OHB? Once we have the guarantee, we’re going to check up and verify that it’s based in evidence. On that, I think there’s a great deal of progress to be made.”

Ky says the same is true for satellite telecom services to the aviation sector.

“If we replace VHF radios with satellite technology and consider it a critical piece of componentry on an aircraft—which we do—then we have to guarantee the same figure of one breakdown every one billion hr,” Ky says. “This is about linking two very different worlds that use similar tools but don’t speak the same language. In space, you don’t have an equivalent to our safety targets.”

Alain Bories, director of strategy at OHB System, says when the specifica-

tions for the Galileo satellite constellation were drawn up in 2003, the needs of civil aviation users were not widely considered. “What civil aviation wanted was to a certain extent ignored, because they were asking too much of the satellites for an uncertain return, due to the 10-15-year certification process and the question of liability, which hasn’t been cleared up,” Bories said.

Carlo des Dorides, head of the European GNSS Supervisory Agency (GSA), which manages the development phase of the Galileo program, says his organization is cooperating with European air safety regulators to guarantee Galileo certification for civil aviation. He cites the steady progress GSA has made in implementing the European Geostationary Navigation Overlay Service (Egnos)—a satellite-based GPS-augmentation service—as an example of tackling barriers in meeting civil aviation standards.

“About three years ago, we were close to declaring the Egnos service open to civil aviation,” des Dorides says. “We had a system performing quite well but realized this was not enough in order to get buy-in from the civil aviation community.”

Des Dorides says his agency then started a dialogue with air navigation service providers and airports on the one hand, and air carriers with a need to update their avionics for Egnos on the other. “We developed a business case with them, and on this basis conceived a project which co-financed the development of Egnos approach procedures as well as the replacement of avionics systems,” he explains. “This project received a high number of subscriptions and was a good example of developing a spe-

cific answer to the needs of the users.”

As Europe’s first venture into satellite navigation, the EU-owned Egnos has been providing a certified safety service for aviation users since 2011. Des Dorides says it is showing excellent results—close to 250 airways are using the space-based GPS-enhancing system, a figure expected to double by 2018. For Egnos, he notes, “the civil aviation sector is now on track.”

As for who signs off on the technological and operational safety of Egnos, des Dorides says that job falls to GSA, as the public-sector owner; and ESSP (European Satellite Services Provider), the limited-liability contractor established to operate the Egnos system.

“We have a very ruled environment coming from Single European Sky,” he says. “The ESSP has to develop the two safety cases needed, one related to the technology and one related to the operation. And with these, the operators go to the certifiers, in this case EASA, which will assess the overall appropriateness and certify that all these safety requirements are met.”

In the meantime, says Ky, the closest that the space community comes to meeting civil aviation safety standards is with suborbital flights aimed at space tourists, which assume one accident for every 10,000 flights.

“The two are in no way compatible,” Ky adds. “If you really want Galileo to be positioned as the service of choice, the service with the highest level of performance and a critical component on aircraft, then we urgently have to start talking about how we can guarantee safety, what the distribution of liability is—including legal liability—and how you can guarantee a level sufficient to ensure the safety of our passengers.” ☛

Empty Seats

Regionals and mainline airlines face a pilot supply threat



CAPE AIR

John Croft **Washington**

A bubble of impending pilot retirements among major carriers over the next seven years is forcing the entire pilot supply chain to unify in a search for solutions to keep the industry due to stalling due to open cockpit seats.

There is still debate about the magnitude of the problem, but its incipient effects are already showing in the form of canceled flights, parked regional aircraft and a 10% cut in service to 86 communities, says Roger Cohen, president of the Regional Airline Association (RAA). Cohen says that in the past, pilot shortages were like Bigfoot sightings—everyone had heard about them but no one had seen any. “There’s almost a universal acknowledgement now that there is a shortage,” he says.

Long-time industry observer Louis Smith, a principal at the Future & Active Pilot Advisors (FAPA) service, says the true sign of a shortage will be when the airlines “begin paying people to learn how to fly.” That has not happened yet, but he does expect major airlines soon to spend money on advertisements for pilots, which they have not had to do since the pilot strikes at Continental and United in the 1980s.

While airlines were proactive in 2014 by hiring more than 3,000 pilots, according to FAPA (see chart on page 63), and getting ahead of the retirement curve, there are indications that the pace cannot be sustained. A Delta representative speaking at a recent jobs summit at Embry-Riddle Aeronautical University (ERAU) in January said the carrier is concerned about what it calls a “limited pool of applicants,” adding that it had already hired “the cream of the crop for now, but that will be forced to change as the applicant pool decreases.”

In the “pool” are 6,000-7,000 regional airline pilots who are the most desirable, with 1,000 hr. or more of turbine pilot-in-command time. “All the majors are pulling from this pool of pilots,” says Rocky Calkins, manager of pilot hiring for Southwest Airlines. Another participant says airlines have “reached the bottom of the applicant pool.”

From a top-down view, large airlines

University graduate pilots at Cessna 402 operator Cape Air have access to a “gateway” program that leads to a first-officer job at JetBlue Airways.

will have to replace more than 18,000 pilots due to mandatory age 65 retirement over the next seven years, along with hiring pilots for newly delivered aircraft. The FAA is predicting a modest 1.3% total growth in the fleet of 3,800 jets in the same timeframe. The airlines largely take pilots leaving active military service or graduating from flight schools and universities (see page 68), with new civilian pilots first flying for regional airlines for several years at relatively low pay scales to build flight time.

Traditionally, about 60% of pilots came from military backgrounds, but the ratio has now shifted to roughly 60% civilian and 40% military. Fearful that its ranks are being poached, the military is contemplating its own initiatives for keeping pilots (see page 70), putting more pressure on a civilian training path that has provided a growing portion of the hiring pool as defense has downsized and previously furloughed pilots have been called

back to work. The lure of a vast number of lucrative piloting jobs in foreign countries, particularly the Asia-Pacific region, is also a concern, but not so much for U.S. pilots (see page 64) who generally prefer to remain in the U.S. Large numbers of foreign pilots coming to U.S. schools for training could become an issue if and when a surge in domestic applications occurs, but so far that has not been a problem.

Even with an expected 0.4% decrease in the regional jet fleet of 2,200 by 2023, a figure computed by the FAA, the pool of regional pilots will in theory have to be completely replaced in seven years due to retirements. While some could see that as a promising sign, given the normal career path from regional to major, the pilot pipeline into the regionals from schools is not running at rates high enough to keep the seats filled, in part due to the average \$50,000 per year cost of a four-year education including flight training, compounded by a flagging interest in the profession.

The result is a situation that could force the industry to park aircraft or defer deliveries as the pilot ranks decrease and opportunities abound for those that remain in the business. Some regional airlines are reporting that pilot candidates are not showing up for interviews or training classes, presumably because they are able to choose the best of several options without notifying the others. And, some say the airlines' weak position could lead unions to demand better collective bargaining conditions given that there are no other options for replacing the pilots.

Cohen says the regionals are doing as much as they can. "Our members are doing everything within their control to manage the pilot supply issue, but many of the issues that are causing it, and the solutions, are out of our control."

Republic Airways, an operator of more than 250 Bombardier Q400s, Embraer regional jets and E-Jets for United Express, Delta Express and American Eagle and US Airways Express, sends a team of "road warrior" pilots to universities, flight schools and industry events to "build a pipeline" into the carrier. Jody Scott, director of talent acquisition, says Republic is most interested in 15 universities offering four-year aviation degrees to find new pilots; she expects that to be 480 this year. She says hiring is "more difficult than in prior years," and the airline is using social

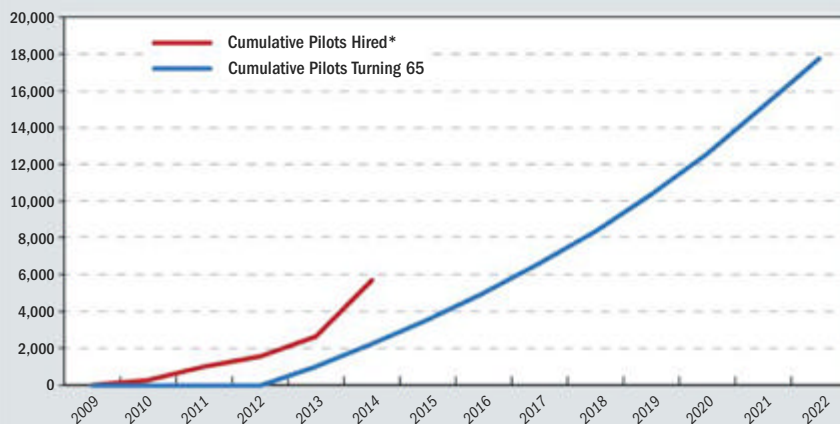
media and other innovative channels to reach out. "We are turning over every stone we possibly can," she says.

Turnover among Republic's pilots is less than elsewhere—Scott says fewer than 15% of 2,300 pilots left last year for the majors. Republic, which starts first officers at around \$20,000, according to FAPA, is offering a sign-on bonus of \$7,500 to help pay off student loans as well as the cost of acquiring the Airline Transport Pilot's license, a requirement for first officers since last year. The company has no specific "flow-through" agreements with the majors to accelerate the transition from regional to mainline, nor is one needed. "If you have Republic on your resume, majors will

into the program to go back and fly the line with existing Endeavor pilots who were not given the same opportunity.

One pathway program widely held up as the gold standard within the industry is Cape Air's "gateway" program with JetBlue Airways, now in its eighth year. To date, 17 Cape Air captains have transitioned through the program to become first officers with JetBlue, says Cape Air President Linda Markham. The program begins as an internship when the students are sophomores at seven colleges, followed by a job at Cape Air, whose fleet type is chiefly the piston-powered Cessna 402. There, the pilots build 2,500-3,000 hr. before interviewing with JetBlue,

Pilot Hiring by U.S. Majors vs. Age 65 Mandatory Retirement



*Hired by the following airlines: Alaska, American, Delta, FedEx, JetBlue, Southwest, United, UPS and US Airways
Sources: Future & Active Pilot Advisors, Regional Airline Association and Akin & Associates

Pilot hiring will have to climb to cover retirements, a daunting issue with fewer applicants entering the training pipeline.

snap you up in a heartbeat," says Scott.

A promising flow-through agreement between Delta and its regional subsidiary, Endeavor Air, an operator of Bombardier CRJs for Delta Connection, fizzled out shortly after it started. Under the Endeavor to Delta (EtD) program launched in June 2014, new pilots hiring into Endeavor using a combined Delta/Endeavor interview process could automatically fly for Delta after two years as a captain, an overall length of about five years including first officer time.

However, a Delta official at the ERAU hiring summit said the program "did not work out because union was against it, and feedback showed that people weren't committed to Delta specifically." A pilot at Endeavor said it was also a problem for applicants accepted

despite having no turbine time in the logbook. Markham says most of the sophomores already have a certified flight instructor rating when entering the program, and internships along the way include office work to produce "a well-rounded student who understands the business as well."

While JetBlue would like to take up to 50 pilots per year through the program, Markham says the current capacity is 4-6 per year, but the number should increase as there are more than 80 participants in the program. Cape Air is also reaching out to more universities to boost throughput. Markham says Cape Air has not yet had to implement bonuses to attract pilots yet, but the Part 135 carrier is currently about 25 pilots short of its desired size of 175

pilots. She says the number of pilots applying for jobs plunged from 1,050 in 2013 to 522 in 2014, a drop she attributes to the “flood gates opening” at the regionals. “Most aviators’ long-term aspiration is jet or large aircraft. We have always understood that,” says Markham. “We are a stepping stone. But we also have long-term employees who like to be home with their families.”

Southwest would like to create its own pathway programs with regionals that are not wholly owned subsidiaries, possibly including Ameriflight or SkyWest. “We’re unique in that we don’t have a feeder airline,” he says, noting

that American Airlines can bring new pilots in through subsidiaries including Envoy. Calkins says it’s difficult to sell a pathway program to the “compliance people and business side” of the airline. In the interim, the carrier is trying to make inroads at universities and is “being more visible” at collegiate events including fly-ins, he says.

Southwest hired close to 400 new pilots last year, but is scaling back to approximately 250 this year as its training center will be full through March with the remainder of the transitioning AirTran Airways pilots. The hiring boom last year has training centers at

most carriers overflowing, says Calkins, particularly at carriers with multiple aircraft types. “All of us are hamstrung by the number of people we can put through the training center,” he says.

Calkins says airline executives have to “make an investment” in the pilot workforce. “If you want to grow the airline, we can buy airplanes and we can make deals, and all of the sudden we can’t get anybody to operate these airplanes. That’s what we’re facing.”

“At the major level, I think we all agree that we’re OK for three, or four, or five years, but it’s going to catch up with us.” ☛

No Ceiling

Rich outlook for ex-pat pilots in Asia-Pacific

John Croft Washington

Supply and demand in Asia translates to premium pay and opportunities for expatriate pilots: An Airbus A319 or A320 captain willing to move to China for Beijing Capital Airlines right now can earn starting pay of \$290,000 a year, including various allowances, safety and retention bonuses. The same pilot could “commute” to work at Beijing Capital—one month on, one month off—and make \$193,000 a year.

For the subset of pilots willing and able to work in the Far East, the money and rapid job advancement are there for the taking, and will be for the next five years or more, says Michael Johnson, president and CEO of Paramount Aviation Resources Group, a flight crew procurement company based



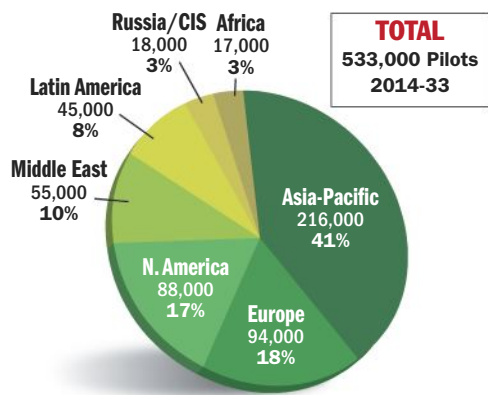
KEITH BURTON

Expatriate first officers can upgrade to captain at Asia-Pacific carriers such as Vietman’s VietJet Air in far less time than it takes at seniority-driven U.S. airlines.

in Virginia. Pilots at U.S. majors, where seniority dominates, can make similar salaries over time but typically have to fly as a first officer for more than 15 years before moving to the left seat, says Johnson. By contrast, at Vietnam’s VietJet Air, ex-pat A320 first officers today can transition to captains in as little as 1-2 years. “They can upgrade at a much faster rate on the same equipment than they presently can in the U.S.,” he says.

Johnson, a former U.S. airline pilot, knows the routine well. He started out flying for TWA, went to American Airlines and, after the furloughs hit, went to work for a subsidiary of Japan Air Lines based in Honolulu, serving as chief pilot for a long-haul fleet of McDonnell Douglas DC-10s and Boeing 747s. He says Paramount is placing pilots with 10 “strong” customers in a variety of Asia-Pacific countries, including China, South Korea, Japan, Vietnam and India. “They have access to capital but have a difficult time getting pilots from within their countries, so they rely very heavily on ex-pat pilots to fly their aircraft,” says Johnson of the countries. “With this

New Airline Pilots by Region, 2014-33



Source: Boeing

Schedule at a Glance



April 14-16, 2015

Miami Beach
Convention Center

Miami, FL

MONDAY, APRIL 13

(pre-event activities only)

7:00 a.m.

Golf Tournament

(separate registration required)

8:00 a.m. - 5:00 p.m.

Registration

2:00 p.m. - 5:00 p.m.

Marketing Services Briefing

*(There is no fee for the Briefing but
registration is required.)*

TUESDAY, APRIL 14

7:30 a.m. - 5:30 p.m.

Registration

8:30 a.m. - 1:15 p.m.

Conference Sessions

1:00 p.m. - 5:30 p.m.

Exhibition Hall Open

WEDNESDAY APRIL 15

7:30 a.m. - 5:30 p.m.

Registration

8:30 a.m. - 1:00 p.m.

Conference Sessions

9:30 a.m. - 5:30 p.m.

Exhibition Hall Open

4:00 p.m. - 5:30 p.m.

MRO Tweet Up/

MRO Birthday Bash at

Aviation Week Booth #2433

THURSDAY APRIL 16

8:00 a.m. - 2:30 p.m.

Registration

9:00 a.m. - 12:35 p.m.

Conference Sessions

9:30 a.m. - 2:30 p.m.

Exhibition Hall Open

Celebrating 20 Years of Changing How MROs and Airlines Do Business!

MRO Americas - the most comprehensive
conference & exhibition program on
aircraft maintenance.

- Case Studies
- Better Business Practices
- Industry Experts
- New Products
- Partnership and Growth Opportunities

Register early for best rates!
mroamericas.aviationweek.com

Follow us on:   



kind of demand, it's very hard for agencies throughout the world to place pilots fast enough to keep," he says. "There is absolutely no ceiling to the number of pilots we can submit to our customers in Asia. They just keep calling us, saying, 'Send more pilots, send more pilots.'"

Nowhere is that need stronger than in China. Johnson notes that 42% of commercial aircraft deliveries in 2014 went to the Asia-Pacific region, and China took 45% of those, representing about 25% of the total deliveries. "Introduction of new aircraft means demand for new crews," he says. Boeing, in its most recent pilot-hiring forecast, estimates the region will need 216,000 pilots over the next 20 years, representing 44% of the 533,000 needed worldwide. Europe will have the second-highest demand, with 94,000 pilots needed, and North America places third, requiring 88,000, mostly for the U.S.

Johnson says there are "thousands" of ex-pat pilots flying in the region, with most of the new recruits coming from Europe, South America, Australia and New Zealand. In some cases, pilots move when carriers go out of business, but in other cases they go because the "terms are so favorable," says Johnson. He says 5-10% of the pilots Paramount places come from the U.S., where domestic opportunities are on the rise with major airlines hiring in large numbers (see page 62). The U.S. pilots who do take the jobs generally come from regional airlines or defunct carriers, such as ATA and USA3000 in recent years, Johnson adds. He says the company does not place many former military pilots. "They don't assimilate easily," he says.

The ex-pat pilot demand could be a relatively short-term phenomenon. Johnson says countries are training indigenous first officers in flight schools around the world, includ-

Training Down Under

Flight schools in Australia are playing a major role in supplying Asian airlines

Adrian Schofield Auckland

Australia's pilot training industry is benefitting from a surge in demand from Asian airlines, as these carriers look southward to help provide the stream of trainees needed for the massive number of aircraft they have on order.

A potential shortage of pilots is one of the main challenges facing Asian airlines. Australian training organizations already have a strong tradition of supplying pilots to overseas carriers, and they are now playing a larger role in addressing the rising demand from full-service and low-cost carriers in Southeast Asia and China.

Locally and foreign-owned academies in Australia have training contracts with many of the major Asian airlines, and some carriers from the region have formed joint-venture relationships with Australian training schools.

Australia has many advantages as a training location for the Asian carriers, due to its geography and the nature of its aviation industry. It is obviously close to Southeast Asia, and unlike many Asian countries, has plenty of airspace available for training. The general aviation and training industries are strong, and have built a good reputation.

Being in a similar time zone to Southeast Asia is a selling point, says

Pine Pienaar, CEO of Flight Training Adelaide. This makes it much easier for Asian airlines to get quick responses from providers, whereas they may have to wait several hours if their training schools are in North America. In addition, the weather tends to be conducive to flying in Australia, and this predictability means airlines can generally pencil in finishing dates for cadet courses, Pienaar says.

As well as having vast amounts of airspace, Australia has numerous small airports and airfields with good facilities that are ideal for pilot training operations, says Kevin Khoo, president of ST Aerospace Academy. The Singapore-based company established its flight school in one such smaller airport in Ballarat, Victoria.

Another plus is that training in Australia is in an English-language environment. Khoo says a by-product for foreign airlines is that trainees have improved English proficiency by the time they return to their home countries.

The extensive network of smaller airports and aviation facilities in Australia is a direct result of a strong general aviation industry, which is not always the case in Asian countries, Khoo observes. This also means there is a good supply of flight instructors. It would be difficult for a startup compa-



Singapore's ST Aerospace Academy operates 20 Cessna 172s as part of its training fleet at Ballarat.

ny to hire 50 instructors in Singapore, and most would probably be expatriates, he says.

Michael Drinkall, general manager of CAE Oxford Aviation Academy in Melbourne, notes that Australia's general aviation industry includes "many well-established flight training organizations operating under tight regulations designed to ensure a high level of safety and compliance." In general terms, the country "has the physical and regulatory infrastructure" needed for a thriving training sector, Drinkall stresses.

These three flight academies are among the largest in Australia to offer training services to major domestic and overseas airlines, graduating hundreds of new commercial pilots a year.

ing the U.S. (see page 68), and putting them in the right seat to gain experience with the ex-pat pilots, who provide mentoring. Eventually, those first officers will transition to captain, reducing the necessity for foreign pilots. In the next 5-10 years, however, the demand for ex-pats can only increase. "It's not feasible for airlines to fill all those seats," Johnson says.

Contracts are typically for 3-5 years, although most are renewable, with mandatory retirement at 60 years of age for pilots working in China. Paramount finds potential applicants using a database of "tens of thousands" of pilots who have registered with the company and through advertising on aviation job-posting sites. "The majority of our job is making sure the pilot is who he says he is," says Johnson. "Ninety-nine percent of the time it's not a problem, but 1% lie about their experience. Our job is to screen out the 1%."

Many customers in the Asia-Pacific region are looking for "turn-key" pilots for a particular aircraft type in order to accelerate the process of getting them onto the line to fly. Paramount screens job candidates by checking with the regulators and phoning the applicants to test their knowledge. For those that pass, the company compiles a binder with documents, licenses, validation letters and employment references that it sends to the airline customers. Paramount then coordinates interviews with the pilots in which the airline has expressed interest.

As to quality of life, Johnson says flying schedules are generally equivalent to those of U.S. carriers, and pilots are pleased with the money, vacations and stability of the jobs. "East vs. West" cultural and perception issues can arise, but it helps that the large numbers of ex-pats "work together and really bond," he says. ☛



ST AEROSPACE

Canada's CAE has nine Oxford Aviation Academies around the world, two of which are in Australia—one in Melbourne and the other in Perth. CAE announced in January that it is selling 50% of the Melbourne academy to Shanghai Eastern Flight Training Co., a subsidiary of China Eastern Airlines. The Perth operation is already run as a joint venture with China Southern Airlines.

As part of the Melbourne deal, China Eastern will send more than 650 pilot trainees to the facility over the next five years. The Melbourne academy currently trains about 200 pilots a year, with its other airline customers being Jetstar Airways, Jetstar Asia and Singapore's Tigerair. The Perth

facility only handles China Southern cadets, training about 300 per year.

In Melbourne, CAE operates 22 Cessna 172s, four Piper Seminoles, two American Champion Decathlons, and a Beechcraft King Air C90. The Perth academy has 37 Grob G115s, seven Seminoles, two Embraer Phenom jets and a Cessna Citation.

ST Aerospace began training at its Ballarat academy in 2008, starting with 30 students. It had 130 on campus last year, and by the end of this year will be training 200. It has graduated more than 300 pilots since its inception. About 85% of students are from airlines, and 15% private, says Khoo. STA also conducts ground school training in Singapore, and has recently acquired a U.S. flight school in Hondo, Texas.

Airline customers include Qatar Airways, Tigerair Singapore and Chinese carriers such as Xiamen Airlines, Juneayo Airlines and SF Airlines.

The academy's fleet began with eight Cessna 172s and two Piper Seminoles; it now has 20 Cessnas, five Piper Seminoles and four Piper Arrows. The school plans to phase out the four Arrows within the next few months, and will then transition students directly from the Cessnas to the Seminoles, says Khoo. There is also a Cessna Aerobat in the fleet for upset recovery training.

At Flight Training Adelaide (FTA), airline trainees comprise about 70% of its business. The school generally works with long-term airline customers, says Pienaar. It has trained pilots for QantasLink since the early 1990s, Cathay Pacific has been a customer

for 20 years, and Dragonair for 16 years. Virgin Australia is a more recent addition, sending pilots to FTA for the past 3-4 years.

FTA trains up to 240 students at a time, although the number tends to vary depending on the financial health of the airline industry, Pienaar says. The academy operates about 45 aircraft, including single-engine Socata TB10 Tobagos and Diamond DA40s, and twin-engine Diamond DA42s. The plan is to have only DA40s in the single-engine fleet within four years.

Other schools in Australia also cater to Asian airlines. For example, the Singapore Flying College trains pilots for the Singapore Airlines group at a facility near Perth.

Despite the advantages the flight training industry has in Australia, there are some caveats. For example, fuel and employee costs tend to be higher than in the U.S., according to Pienaar. CAE's Drinkall notes that the high Australian dollar hurt the local industry's competitiveness, and it lost out on some contracts to countries such as the U.S. However, the recent drop in value of the Australian currency has helped.

A longer-term issue could involve the practice of airlines relying on cadets to fund their own training through banks, family assistance or government grants and loans. "We expect this model to come under significant pressure if the predicted global pilot shortages become a reality," Drinkall says. "If this happens, airlines may need to invest more in ab initio training to ensure their pipeline of new pilots into the future." ☛



Back to School

Industry to reexamine, reinvent the pilot supply chain

John Croft **Washington**

By 2022, mandatory retirements will gut the pilot ranks at the biggest U.S. airlines, creating a need for more new pilots than currently exist in the entire regional airline system. The exodus—along with continued growth in air travel—is putting pressure on aeronautical universities and flight-training schools to produce more pilots to replace empty seats in the regional airlines, whose pilots generally move on to the majors. Military pilots continue to be a significant source for airline recruitment, but those numbers are shifting more toward civilian-trained regional airline pilots as the services continue to scale back.

A sudden hiring frenzy by the majors, recruiting more than 3,000 pilots in 2014—the most since 2001—is leaving regional airlines in a pinch. St. Louis-based GoJet Airlines, a regional operator of Bombardier CRJ700s flying for United Express and Delta Connection, hired 162 pilots in 2014, but lost 170, or 34% of its 500-pilot workforce. Envoy Airlines, a subsidiary of American Airlines that flies Bombardier and Embraer regional jets, is losing 40-50 pilots per month. Like most other regionals, GoJet and Envoy are now offering hiring or retention bonuses to draw in new pilots and to keep them longer.

“The pilot supply is getting critical for regional airlines,” says Tim Brady, dean of Embry-Riddle Aeronautical University’s (ERAU) College of Aviation in Daytona Beach, Florida. “It’s only a matter of time before it affects the majors.” In years past, a pilot could be hired as a first officer with as little as 250 hr., but new rules created after the 2009 Colgan Air crash require a pilot to have an Air Trans-

port Pilot license, which generally means 1,500 hr. and a significant new investment. The FAA does, however, give credit for college-level courses, and ERAU is one of more than 60 colleges where pilots can qualify for a restricted Air Transport Pilot (R-ATP) license to begin flying as a first officer with fewer hours. The university graduates 200-250 pilots per year, many of whom stay on as flight instructors for a year or more to gain the 1,000 hr. required for the R-ATP before taking a job with the regionals. The University of North Dakota graduates about 160 pilots per year, most of whom also accept jobs at the flight school to build time, a task that can be accomplished in 12-18 months.

At an ERAU pilot supply summit in mid-January, attended by both regional airlines and majors, the educators, carriers and training organizations agreed to work together to explore how to solve a big problem: not being able to refill regional airline seats quickly enough to meet demand. Complicating factors include the new FAA flight-hour rules, declining levels of interest among students, high entry cost in terms of training, low starting salaries at the regionals and the specter of former tough times for pilots when furloughs and pay cuts were common.

Some ideas the summit participants are pursuing include gaining more credit for coursework in qualifying for the R-ATP, deploying public-awareness campaigns on the prestige and earning potential of the career path despite high start-up costs, creating a dedicated ticket tax to augment training fees, creating new loan mechanisms, and having the regional airlines or the

majors provide financial support to students at the university level in return for a commitment to work for them afterward.

Roger Cohen, president of the Regional Airline Association,

Embry-Riddle provides future airline pilots with four-year degrees and flight training at its Prescott, Arizona, campus using Cessna 172s and other aircraft.

says the four major network carriers in the U.S.—American, Delta, United and Southwest—will lose 61%, 47%, 40% and 18% of their pilot workforces, respectively, by 2022, as a result of mandatory pilot retirements. These figures behoove the hiring of 18,000 new pilots to keep pace with attrition alone. Given that there are only 16,000 pilots flying for the regionals, the impending need is both a challenge and an opportunity. “If you are studying to be an airline pilot, you’re guaranteed a good job,” says Cohen.

While major carriers will be buffered for the next 3-5 years due to a readily available supply of regional airline pilots ready to move up, their recruiters are worried about the longer-term prospects. “We as majors understand that we have to start partnering with universities and those with big aviation programs,” says Rocky Calkins, manager of pilot hiring for Southwest Airlines. “We are being more visible at their job fairs.”

Like most major airlines, Southwest looks “almost exclusively” for pilots with four-year degrees. “That is huge,” he says. “When someone throws me a resume without a college degree, it’s a tough sell.” Calkins says of the 400 pilots the carrier hired last year, only one did not have a college degree. “People who’ve had the college experience tend to perform better (in training), and that’s probably true for the regionals, who are looking at group that’s a little younger and greener, and they have to be real efficient with their training programs.”

According to a Government Accountability Office (GAO) study of the issue published last year, aviation colleges in 2012 graduated approximately 1,000 students with four-year degrees and another 1,000 with associate degrees or certificates. About 25% of the four-year degrees per year come from ERAU’s main campus, in Daytona Beach, where training capacity is be-

ginning to increase after a long slide. In 2001, there were 1,900 students in the program, but the number dropped off after 9/11, and again after the financial crash of 2008. Brady says the school met its strategic goal of 1,160 students in 2014, and he is optimistic about reaching 1,200 by 2016. A college degree with flight training costs about \$50,000 per year, and as of yet, there are no tuition subsidies for flight training, nor are there loans available from the airlines or the industry at ERAU or the other universities. The college's Prescott, Arizona, campus had 414 flight students last year, with an upward trend that started in 2012. A new program at ERAU—unmanned aerial systems—is growing faster than projected, with almost 200 students enrolled in 2014.

Brady says 90%, “if not more,” of the students come in with the goal of being an airline pilot, and 90% go to the airline industry within one year of graduating. Students typically graduate with a four-year degree and 250-350 flight hours, depending upon whether they complete flight-instructor training. The college currently has 170 flight instructors, but lost 65 to regional airlines in the past six months. “It’s a high turnover, but it’s a happy problem to have,” says Brady.

To entice graduates to become flight instructors, ERAU provides the ATP training for free, a value of about \$5,000, that includes the required simulator training in the school’s CRJ200 full-motion simulator. Brady says about 18% of the student population is from foreign countries, with a mix of self-funded and country-funded training. He says the program is “male dominated,” in that 17% of the students are female.

Overall, the students have a positive outlook about a career with the airlines. “They know that when they have 1,000 hr., they have a job,” Brady says. Part of that optimism is the college’s analysis showing that over a lifetime, a pilot will earn more on average than his or her peer entering fields like engineering. “That’s not an excuse of low starting salaries (at the regionals),” he says. “If salaries were better, the problem would go a long way toward being fixed.” Starting pay at U.S. regional airlines is in the low \$20,000s per year, although new signing and retention bonuses can increase that amount to more than \$30,000.

At the University of North Dakota,

Kent Lovelace, a professor and the director of aviation industry relations, says about 55% of the 1,300 undergraduate students in the aviation program are interested in flying for airlines. While the number of undergraduate students has remained fairly constant, the percentage wanting to fly professionally has decreased from about 75% a decade ago, Lovelace notes. He says it’s too early to tell if the hot market for pilots will boost the percentages, as enrollments typically lag industry trends by several years.

Based on interviews with students, Lovelace says “convincing people to fly is more difficult” than in the past, in

by the airlines that send them, whereas U.S. students are primarily self-funded. The self-funded students typically stay on after they complete the flight-training program, which can be done in one year, working for Aerosim as a flight instructor for 2-3 years to build up enough hours to earn an ATP.

Hank Coates, president of Aerosim, says the 1,500-hr. rule for first officers has had a positive effect on the industry: In addition to providing a source of flight instructors for the school, he says the experience as instructors also gives airlines “a bit more mature pilot.” As with the other schools, Aerosim loses its flight instructors rapidly to the re-



NEIL NOVATZKY/UNIVERSITY OF NORTH DAKOTA

The University of North Dakota graduates about 250 degree aviation professionals each year, about half of whom want to pursue airline-pilot careers.

part due to the cost of training and the low starting salary, but also because the travel requirements of the profession mean being away from social networks. That contrasts with a highly motivated contingent of foreign flight students, about 200-250 at any time, who are sent from foreign airlines, including Air China and Shandong Airlines, to receive training but not degrees. Lovelace notes that foreign airlines are able to place new pilots with 300-400 hr. of flight time.

At the Aerosim Flight Academy in Sanford, Florida, international students from 20 different countries account for approximately half of the 400 students, with Chinese students in the majority. Most of the foreign students are funded

regionals, and has begun paying a \$5,000-7,000 bonus to encourage new instructors to sign on.

While the international students could be seen as impacting the ability to train U.S. pilots, Coates says Aerosim “can’t get enough domestic students to fill the school.” He says there are two main reasons: problems with loans and funding, and a changing culture. “Kids used to want to be pilots,” he says. “The people who want to be pilots are just as passionate, but there aren’t as many of them.” While Aerosim students cannot earn an undergraduate degree at the school, they can earn a flight instructor’s rating and begin teaching in the space of one year. “Some kids aren’t cut out to go to college,” Coates says. ☼

Talented Pool

High ops tempo, unmanned pilot morale possible contributors to pilot retention issues facing USAF

Amy Butler Washington

After more than a decade of robust pilot retention, the U.S. Air Force is anticipating a dip in the coming years. Major airlines are poised to lure these highly trained pilots—many with extensive cockpit experience due to the intense operational tempo—into service. The Air Force is continuing its incentive programs for traditional pilots and is also boosting efforts to retain aviators flying unmanned vehicles, known in the Air Force as remotely piloted aircraft (RPA). This area in particular has been under duress because the Air Force was simultaneously growing the RPA pilot cadre while fielding ever more unmanned aircraft. Service officials say they have “surged” to meet increased RPA demand nine times since 2007.

USAF SSGT RICHARD EBENBERGER



RPA pilot training is not as directly transferable to the commercial airlines, but recruiters recognize that the extensive cockpit time and solid sense of airmanship garnered by these pilots make them prime candidates for commercial airline job training.

Noting that their pilot pool has been strong ever since 9/11 [but mindful] “of what the airline industry holds for us, we anticipate a decrease in our retention over the next couple of years,” says Col. Rob Romer, chief of the service’s military force policy division. Contributing to the anticipated loss are regulations for the airline industry that call for larger pools of qualified pilots. Also, the service’s unrelenting tempo supporting wars in Iraq, Afghanistan and Syria as well as combat in Yemen and worldwide humanitarian efforts can be taxing for pilots and their families. “The airline industry has exited a decade of consolidation and restructuring, positioning itself for greater stability and growth,” a service official says, noting this will “exert a significant pull on their pilot pool.”

“Over time we will see the picture come together that the draw to the airlines will entice folks to separate,” Romer says.

The Air Force is an obvious choice for airline recruiting, as its training program is both exacting and sets a global standard. Approximately 19,300 pilots are in the pool, including those on active, Guard or Reserve duty, says Col. Farley Abdeen, chief of the Air Force’s Total Force Management Integration Div.

It can take up to 2.5 years to become a USAF pilot. Each candidate must complete one year of undergraduate training. A C-17 pilot requires another three months of specialized training to operate the four-engine transport. Fighter aircraft pilots need 2.5 years for basic qualification.

RPA pilots, who control the MQ-1 Predator, MQ-9 Reaper and RQ-4 Global Hawk UAVs, undergo about one year of training, including specialized undergraduate courses. However, two-thirds of USAF’s 1,000 RPA pilots are also trained in other, traditional platforms. Many are “on loan” from other aircraft programs—meaning they fly another platform but are temporarily flying RPAs to help ease manning demands. This, coupled with comparatively low morale by RPA pilots who see no clear career path for their high-demand expertise, makes them vulnerable to the lure of commercial airlines.

USAF pilots must serve for 10 years after completing specialized undergraduate training; by then, most have achieved a major rank. At the 10-year mark, they can separate or re-up, and the service is as aggressive as statute allows to keep them in the fold.

Pilots are eligible for two incentive programs. Aviator Career Incentive Pay entitles them to no more than \$840 per month (or \$10,080 per year). The Aviator Retention Program (ARP) is selectively offered to pilots approaching their 10-year milestone. It is capped at \$25,000 annually; however, pilots are sometimes able to collect half of the ARP bonus up front if they sign up for additional service.

Two U.S. Air Force pilots complete a flight in an upgraded Boeing B-1B.

Air Force Secretary Deborah Lee James has initiated immediate retention programs for RPA pilots, in an attempt to both retain the force that has grown as more unmanned aircraft have been purchased as well as relieve some strain on the force. “These pilots . . . fly six days in a row . . . working 13- [and] 14-hr. days on average. And to give you a contrast, an average pilot in one of our manned Air Force aircraft flies between 200 and 300 hr. per year,” James said at a Jan. 15 press conference. “In the RPA world, pilots log four times that much, ranging from 900 to 1100 flight hours per year. And these are very stressful operations because mistakes can cost lives,” she noted.

Defense Department policy prohibits the Air Force from extending ARP benefits to RPA pilots. James says the service is working to change this. In the meantime, in fiscal 2015 pilots that have completed six years of aviation service after RPA undergraduate training will see their monthly incentive pay go from \$650 to \$1,500.

To ease strain on the RPA pilot force, the service plans to draw on the National Guard and the Reserves and to seek recently qualified active duty RPA pilot volunteers to deploy for six months of duty in RPA units. RPA time for pilots “on loan” from other weapon systems will also be extended, James said. ☛

CLASSIFIED ADVERTISING

To Place Your Classified Ad Contact: Diane Mason; Tel: 913-967-1736 • diane.mason@penton.com

AIRPLANE DESIGN AND ANALYSIS



**Airplane Design
and Analysis**

Consulting Services
Preliminary & Detailed Design
Structural Design & Analysis
CAD & CFD
Wind Tunnel Testing
Aircraft Prototyping & Testing

Software & Books
Advanced Aircraft Analysis
Aircraft Performance
AeroPack-CAD
FAR 23 Loads

DARcorporation
1440 Wakarusa Drive, Suite 500
Lawrence, Kansas 66049 USA
Phone: (785) 832-0434
info@darcorp.com • www.darcorp.com

EQUIPMENT

Ultrasonic Inspection C-Scan Systems for your High Performance Structures



- Automated Ultrasonic C-Scan Systems
- Multi-Axis Gantries and Immersion Tanks



(508) 351-3423 sales@matec.com

COURSES

Learn Design from Dan Raymer

Short Courses by the award-winning author of
AIRCRAFT DESIGN: A Conceptual Approach

Aircraft Conceptual Design April 20-24
Configuration Layout, Loft, & CAD April 27
Engineer's Management & Business April 28-29
Spacecraft & Launch Vehicle Design April 30-
-May 1



Distance-Learning Course - Certificate
Program in Aircraft Stress Analysis
Tel: 1-208-772-7721 www.psa1.com

RECRUITMENT



Engineers wanted to help make history.

JOIN US IN INTRODUCING PRACTICAL AND EFFICIENT SUPERSONIC FLIGHT. Advanced design of the Aerion AS2 is underway, with first flight planned for 2019, certification in 2021, and with variants to follow. Our engineering group will grow rapidly this year and we need to fill key positions in our Reno, Nevada engineering center including:

Chief Design Engineer
Chief Structures Engineer
Chief Systems Engineer
Chief Propulsion Systems Engineer

In addition, we are looking for the best and brightest in the following disciplines.

- Structures
- Propulsion
- Electrical
- Certification
- Aerodynamics and Performance
- Avionics
- Mechanical Systems
- ECS and CPCS
- Fly-by-Wire
- CATIA Design

Job descriptions available at: www.aerionsupersonic.com.
Please submit resumes and cover letters to: careers@aerioncorp.com.



1325 Airmotive Way, #370, Reno, Nevada 89502

Penton Revised Privacy Policy

At Penton, we constantly strive to improve our products, including by changing our use of the information we collect from you. We now share information with other subscribers to our services and/or third party vendors who are our partners so that they can provide you additional opportunities and benefits. Some partners may analyze our sites to identify future improvements or to offer additional products you may want.

Visit <http://www.penton.com/privacy-policy/> to read our updated Privacy Policy.

ADVANCED COMPOSITE TRAINING



ADVANCED COMPOSITE
TRAINING & SERVICES

CONTACT US

AVIATION WEEK

& SPACE TECHNOLOGY

ADVERTISING

President/Publisher: Gregory D. Hamilton;
+1 (212) 204-4368; hamilton@aviationweek.com

Managing Director, Global Media: Iain Blackhall (U.K.);
+44 (0)20 7152 4495; iain.blackhall@aviationweek.co.uk

U.S. Sales Offices

Director, Business Development: Matt Holdreith;
(646) 719-0767;
matt.holdreith@aviationweek.com

Strategic Account Manager: Tom Davis;
(469) 854-6717;
tom.davis@aviationweek.com

Strategic Account Manager: Tim Reed;
(949) 650-5383;
tim.r.reed@aviationweek.com

Northeast U.S.: Chris Salem;
(203) 791-8564; chris.salem@penton.com

Southwest U.S.: Sean Fitzgerald;
(202) 383-2417;
sean.fitzgerald@aviationweek.com

Northern Mid-West to Northwest U.S.: Leah Vickers;
(949) 481-4519;
leah.vickers@aviationweek.com

Southern Mid-West to Southwest U.S.: Miguel Omelas;
(818) 834-4232;
miguel.omelas@penton.com

Canada: Richard Brown;
(416) 259-9631;
r.brown@victorbrownmedia.com

International Regional Sales Offices

Publisher, Defense, Space & Security:
Andrea Rossi Prudente (U.K.): +44 (207) 176-6166;
andrea.rossiprudente@aviationweek.co.uk

Germany, Switzerland: Robert Rottmeier (Switzerland);
+41 (21) 617-44-12;
robert.rottmeier@aviationweek.co.uk

Europe: David McMullen; +44 (0)1925 596176;
david.mcmullen@aviationweek.co.uk

Strategic Account Manager: Ann Haigh;
+44 (0)1628 526324; ann.haigh@penton.com

Eastern Europe, India, Pakistan, Russia and the CIS, Middle East, Scandinavia, Africa, Mediterranean, Turkey and Asia
Vittorio Rossi Prudente (Italy): +39 0 (49) 723548;
prudente@aviationweek.co.uk

Japan: Yoshinori Ikeda;
+81 3 3661 6138; pbi2010@gol.com

United Kingdom, Ireland: Michael Elmes, Aerospace Media (U.K.); +44 1206 321639;
mike.elmes@aerospacemedia.co.uk

Israel: Tamir Eshel, Eshel Dramit Ltd. (Israel);
+972 (9) 8911792; eshel_tamir@yahoo.com

Business/Production

Group Production Manager: Carey Sweeten;
(913) 967-1823; carey.sweeten@penton.com

Production Coordinator: Donna Brown;
(913) 967-7203; donna.brown@penton.com

Production Coordinator: Kara Walby;
(913) 967-7476; kara.walby@penton.com

Advertising/Marketing Services

For Media Kits, Promotions or Custom Media:
www.aviationweek.com/mediakits or Elizabeth Sisk;
(860) 245-5632; elizabeth.sisk@aviationweek.com

Advertising Operations Manager: Casey Carlson;
(610) 373-2099; casey.carlson@aviationweek.com

SUBSCRIPTIONS & CUSTOMER SERVICE

Subscriber Service:

U.S.: (800) 525-5003

Outside the U.S.: +1 (847) 763-9147;
Fax: +1 (844) 609-4274

Outside the U.S. Fax: +1 (847) 763-9682

Email: awcustserv@halldata.com

Subscription Inquiries: Address all inquiries and requests to Aviation Week & Space Technology, P.O. Box 1173, Skokie, IL 60076-8173. Include address label from recent issue when writing. Allow three to six weeks for address change. Include both old and new address and zip or postal codes.

Manage your Subscription (and claim Digital Edition) at:
www.aviationweek.com/awstcustomers

Register & claim access to AWST Online at:
www.aviationweek.com/awstregister

Digital Editions

Support Service: (888) 946-6666

Email: Support@zinio.com

Web: www.zinio.com/help

Subscribe at: www.aviationweek.com/awstdigitalsub

Order single copies at: www.aviationweek.com/awstdigitalsingle

Manage your Subscription (and claim Digital Edition) at:
www.aviationweek.com/awstcustomers

Single Copy Sales

Toll-free (U.S. only): (800) 525-5003

Outside the U.S.: +1 (847) 763-9147

Fax: +1 (844) 609-4274

Subscription Information for other Aviation Week Products

Aviation Week Intelligence Network,

MRO Prospector and Fleet Data:

(866) 857-0148 or outside the U.S.: +1 (847) 763-9147.

Fax: (844) 609-4274 or outside the U.S. +1 (847) 763-9682

Web: www.aviationweek.com/awin

Email: aw_intelligence@aviationweek.com

Business & Commercial Aviation: (800) 525-5003 or
+1 (847) 763-9147

SPECIAL PRODUCTS & SERVICES

Conferences/Exhibitions

www.aviationweek.com/events:

To Sponsor/Exhibit: Beth Eddy;
(561) 862-0005; betheddy@aviationexhibits.com

To Register: Alexander Zacharias;
(646) 392-7883; alexander.zacharias@aviationweek.com

AW&ST Mailing List Rental and Sales

Zach Sherman;

(212) 204-4347;
zach.sherman@penton.com

Justin Lyman;

(913) 967-1377;
justin.lyman@penton.com

Reprints, Photocopies and Permissions

Custom Reprints: Nick Iademarco;
niademarco@wrightsmedia.com

Wright's Media, 2407 Timberloch Place, Suite B
The Woodlands, Texas 77380

Office: (281) 419-5725
Toll Free: (877) 652-5295
Cell: (281) 853-5434
Fax: (281) 419-5712
www.wrightsmedia.com

Black and White Photocopies: Copyright Clearance Center;
(978) 750-8400; www.copyright.com

Copying without the express permission of the Copyright Clearance Center or Penton Media is prohibited.

Requests for other rights and permissions: Michael Stearns
at Aviation Week Permissions Department,
stearns@aviationweek.com

Social Media

Join the conversation! Follow us at:

Facebook: www.facebook.com/AvWeek

You Tube: www.youtube.com/AviationWeek

Linked In: www.linkedin.com/groups?gid=2104198

Twitter: www.twitter.com/AviationWeek



For more information visit us online at
www.aviationweek.com/awst

Aviation Week & Space Technology
February 16-March 1, 2015 VOL. 177, NO. 3
(ISSN 0005-2175)
1166 Avenue of Americas, New York, N.Y. 10036

Member of Audit Bureau of Circulations and Magazine Publishers of America. Published biweekly by Penton Media Inc., 9800 Metcalf Ave, Overland Park, KS 66212-2216. Periodicals postage paid at Kansas City, MO and additional mailing offices. Canada Post International Publications Mail Product Sales Agreement No. 40026880. Registered for GST as Penton Media, GST # R126431964. Title reg. ® in U.S. Patent Office. Copyright © 2014 by Penton Media. All rights reserved. All rights to these names are reserved by Penton Media. **Postmaster:** Send address changes to Aviation Week & Space Technology, Attention: Subscription Services, P.O. Box 5724, Harlan, IA 51593-1224



AVIATION WEEK EVENTS

FACE-TO-FACE COMMUNICATION
HIGH-LEVEL CONTENT
RELATIONSHIP BUILDING

We deliver the professional development you need.

Learn more! www.aviationweek.com/events



Future Events

- March 5**—Laureate Awards, Washington.
- April 14-16**—MRO Americas, Miami.
- June 17**—Commercial Aerospace Manufacturing Briefing, France.
- Oct. 13-15**—MRO Europe, London.
- Nov. 3-5**—MRO Asia, Singapore.
- Nov. 3-5**—Aerospace Defense Chain, Arizona.

Aerospace Calendar

To submit Aerospace Calendar Listings

Call +1 (703) 997-0227

e-mail: kyla.clark@aviationweek.com

Feb. 24-March 1—Australian International Airshow and Aerospace & Defense Exposition-Avalon 2015. See www.airshow.com.au/airshow2015/index.asp

Feb. 25—ATW Airline Industry Achievement Awards. Omni Shoreham Hotel, Washington. See atwonline.com/atw-airline-industry-achievement-awards

Feb. 26—Australian Helicopter Industry Association Technical Conference. Avalon Airport. Write secretary@austhia.com

March 2—SpeedNews Fifth Annual Aerospace Raw Material & Manufacturers Supply Chain Conference. Beverly Wilshire Hotel, Beverly Hills, California. See speednews.com/aerospace-raw-materials-and-manufacturers-supply-chain-conference

March 2-4—SpeedNews 29th Annual Commercial Aviation Industry Suppliers Conference. Beverly Wilshire Hotel. See speednews.com/commercial-aviation-industry-suppliers-conference

March 2-5—Ground System Architectures Workshop, "Perspectives on Ground Services," Renaissance Los Angeles Airport Hotel. See gsaw.org

March 5-7—Women in Aviation. Dallas. See www.wai.org/

March 8-10—International Society of Transport Aircraft Trading Americas 2015. JW Marriott Desert Ridge, Scottsdale, Arizona. See www.istat.org/events

March 10-11—Air Charter Safety Foundation Safety Symposium. NTSB Training Center, Dulles, Virginia. See www.acsf.aero/symposium

March 10-12—American Astronautical Society's 53rd Robert H. Goddard Memorial Symposium: "On the Cusp: What's Next?" Greenbelt (Maryland) Marriott Hotel. See www.astronautical.org

March 10-15—World ATM Congress (Canso). Madrid. See www.canso.org/worldatmcongress2015

March 17-21—Langkawi (Malaysia) International Maritime & Aerospace Exhibition. See www.lima.com.my/

ADVERTISERS IN THIS ISSUE

ATR	15
ATW's 41st Annual Airline Industry Awards	47
Aviation Week Events	
MRO Americas	65
MRO Baltics, Eastern Europe, Russia	29
Aviation Week's 2015 Fleet & MRO Forecast*	21
Boeing	11
Breitling	9
CFM	23
Embraer	7
IDEX 2015	27
Kony Co., Ltd.	43
L-3 Aviation Products	5
MBDA**	21

Ontic	3
Orbital Sciences	2nd Cover
PPG Industries	17
Rockwell Collins	4th Cover
Space Symposium 2015	25
Speed News Additive Manufacturing Briefing	3
SpeedNews ARMM Conference*	55
The NEW Aviation Week & Space Technology	3rd Cover
United Technologies**	55

DEFENSE TECHNOLOGY EDITION:

(Between pages 38 & 39)	
Aviation Week Events	
Aviation Week Laureate Awards	DTI23
DSEi 2015	DTI5

Dynamit Nobel	DTI10
Elbit Systems	DTI9
Eurofighter**	DTI13
IAI/ELTA Systems Ltd.	DTI2
RUAG	DTI11
Singapore Airshow 2016*	DTI13
SpeedNews Conferences	DTI3, DTI7
Textron Aviation	DTI24

CLASSIFIED ADVERTISING	71
Abaris Training-NV	71

Aerion	71
Aircraft Design	71
DAR Corporation	71
Matec	71

*Domestic edition

**International edition

Act Now to Avert A Pilot Shortage

With upward of 20,000 cockpit seats expected to open up at U.S. airlines over the next seven years due to FAA-mandated age-65 retirements, the scene should be set for the pilot pipeline to work as designed: Regional pilots working for low wages finally get their chance to move quickly up to the big leagues of heavy metal and significantly higher salaries—and college and flight school graduates gain access to the right seats of regional jets.

There is a major problem with this scenario, however. Too few bright-eyed students are opting for careers in the cockpit, despite the promise of readily available jobs. The crunch is already hitting regional airlines, which are losing increasing numbers of pilots to the major carriers and are not able to fill new pilot training classes (see page 62). In some cases, regionals have had to park aircraft for lack of pilots. This should be a concern beyond the aviation world, too. The impact might lead to some smaller U.S. cities losing their air service. The dearth of pilots is a problem in other parts of the world, too, though the causes and potential cures will vary by country and region.

Decades ago, most U.S. airline pilots were plucked from the ranks of retiring military cockpit crews, but a gradual decline in those numbers has shifted the onus to civilian-trained pilots. Of that group, airlines prefer graduates of four-year aviation schools such as Embry-Riddle Aeronautical University or the University of North Dakota. Enrollments by U.S. students in professional pilot programs at both schools are down significantly from pre-2002 levels, however. And the expense of the training—about \$50,000 per year, including flight time—is not the only issue. Filling many seats in schools and flight training outfits are foreign students, particularly from Asia-Pacific countries, where the airline industry is booming. They earn their licenses and move directly to the right seats of jets with several hundred hours of flight time, far below the minimum of 1,000 hr. now required for a new U.S. pilot with a four-year degree from an aviation college.

It is not just the expense of the college degree or the low starting salary at the regionals that underlies the slump in the U.S. Starting pay at regionals, long-held at about \$20,000 a year (lately increasing to approximately \$30,000 thanks to signing bonuses, retention pay and other incentives), is low but not unheard of—just ask a newly minted teacher or journalist. What is different from many other start-low career paths is the promise of pay increases that ultimately can reach hundreds of thousands of dollars per year. Over the course of a career, a pilot's pay will often exceed that of an engineer.

The apparent lack of interest on the front side of the pipeline could simply be the long lag between low starting salaries and a comfortable lifestyle later. But it is likely more complicated than the peculiar pay path. Some aviation college officials say the students are no longer enamored of the lifestyle of a pilot that can be affected by the heavy travel schedule and the quickness with which the industry can be turned upside

down by major blows like 9/11, Chapter 11 bankruptcy reorganizations or recessions. Thrown in the mix are resulting furloughs and pension cuts.

Simply berating the regional airline industry to pay more will not work. Its salaries are locked by two main drivers: cost-fixed contracts that the regionals hold with mainline carriers, and pilots' collective bargaining agreements. Consolidation in the airline industry has meant regionals have less leverage in increasing contract amounts. "The airline has little control to raise pay unilaterally because they won't

“ Simply berating the regional airline industry to pay more will not work. ”

get the contract,” explained Roger Cohen, then-president of the Regional Airline Association.

The RAA says it is aggressively trying to stimulate interest in piloting careers at high schools and universities, and working with regional airlines to set up so-called bridge or gateway programs whereby carriers make early connections with potential pilots and give them clear career paths. Mechanisms include hiring college graduates who will build hours as flight instructors on an airline's payroll.

Those steps are encouraging, but they may not be enough. The FAA should consider allowing more college credit hours at approved schools to offset flight-time requirements. Regional and major airlines and pilot unions might consider structuring a new voluntary career path in which the lower portion of the pay scale is higher but the senior pilots do not reach the heights of today. Or regionals and majors might lock arms and offer scholarships in return for specific service commitments to flying for them both.

Regulators, and perhaps Congress, might need to provide an antitrust exemption to allow the necessary players to work it all out. But it would be worth it. This coming problem is serious, and it could adversely affect the U.S. as a whole because aviation is so critical to economic activity and many citizens' lifestyles. It's time to take this seriously, bring some creativity to bear on solutions and get on with implementing them. ✎



AVIATIONWEEK & SPACE TECHNOLOGY

step inside

DAILY COVERAGE/
instant delivery



ACCESS/
anywhere



ENHANCED/
in-depth read



Welcome to Your New Subscription!

Step inside a whole new way to experience the most trusted source for in-depth insights within the aviation, aerospace and defense industry.

For more details, visit:
stepinside.aviationweek.com

Need assistance?
aviationweek.com/awst-faq

Get Started Today:

Unlock your access in two simple steps.

1: Log In Online

Access articles online at aviationweek.com. Click "LOG IN" in the upper right of the page and enter the email address associated with your subscription and your password.

2: Download The App

DOWNLOAD. Download the *Aviation Week & Space Technology* app to your iPad or iPhone device* from the App Store at bit.ly/AWSTiOs.

OPEN. Once downloaded, open the app and tap  on the intro ad to access the homepage.

LOG IN. Tap any locked article  to access the log in screen. OR tap the menu icon  in the upper right corner of the app screen and log in using the same email and password as above.

*Not an iPad or iPhone user? The app will be soon be available in Google Play for Android devices, please stay tuned...

Maximizing your vision is our vision.



At Rockwell Collins, we're always looking forward – and so are our solutions. Like the head-worn technologies that provide unprecedented situational awareness to military aircraft pilots via fused sensor imagery. Or our head-up guidance systems (HGS™) that combine synthetic and wide-spectrum infrared vision to make whiteout conditions appear clear as day. And even the predictive features of our new MultiScan ThreatTrack™ weather radar, helping you see threats of turbulence, lightning and hail, before they happen. All to help you see the right information at the right time, every time.

rockwellcollins.com/maximizingvision

© 2015 Rockwell Collins. All rights reserved.

**Rockwell
Collins**

Building trust every day