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**RICH MEDIA
EXCLUSIVE**

No Easy Options On Syria

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ON THE COVERS

This week, Aviation Week publishes two editions. On the far left cover, a worker assembles a Mitsubishi MRJ regional jet. The repeatedly delayed program is a leading example of Asia's attempt at climbing the value chain, but elsewhere in the industry the main struggle is to improve efficiency (page 50). Mitsubishi photo. The Defense Technology Edition cover photos by its chief editor, Bill Sweetman, show some of the new air defense hardware Russia unveiled at the MAKS air show near Moscow: the S-350E surface-to-air missile system and the unique 55Zh6ME multiband radar with its massive VHF array (page 35). Elsewhere in both editions are reports on Cathay Pacific Airways (page 44), a jet-powered backpack (page 38) and the implications of fighting in Syria (page 26).

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On the Web ✨

A round-up of what you're reading on AviationWeek.com



Germany's e-Volo has completed the first prototype of its unconventional vertical-takeoff-and-landing VC200 and plans to fly the hybrid-electric two-seater by the end of the year. Read the post and watch a video on our Things With Wings blog (ow.ly/oyMBm). AviationWeek.com/ThingsWithWings

E-1010

Systems experts have yet to find the root cause of **a spacesuit leak** that allowed water to invade the helmet of European Space Agency astronaut Luca Parmitano **during a July 16 extravehicular activity** outside the International Space Station. Read our **On Space** post about the steps taken to identify the problem so far and **what will be done next**. (ow.ly/oyOvI) AviationWeek.com/OnSpace

DSEI 2013

Aviation Week will be covering DSEI, billed as the world's largest fully integrated defense and security exhibition, in London this week. **Watch our dedicated web page** for the updates: AviationWeek.com/DSEI2013

READER COMMENT

On our defense technology blog, a reader whose online handle is **X-Planes** writes of Boeing's F/A-18E/F Advanced Super Hornet: "This is why you build in room for growth into a solid, sensible, capable airframe. **While with F-35, it's already down to cutting (or not) 2 lb. worth of safety valves.**" ow.ly/oyHEQ



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LINGERING DARKNESS

John Croft's "In the Dark" (AW&ST Aug. 26, p. 35) about last month's crash of UPS Flight 1354 was very informative and covered many aspects of the hazards of flying an approach at night, but it did not address the danger posed by the terrain on the approach to the runway in question at Birmingham (Ala.) Shuttlesworth International Airport (BHM).

A glance at the airport diagram for BHM shows the high terrain at the north end of the airport, but remarkably, the approach chart does not. The only other reference material available that would provide a clue as to the hazard posed by this approach is the Jeppesen 19-05 Airport Familiarization page, which indicates the high terrain

prior to the runway. In fact, the photograph on a recent cover (AW&ST Sept. 2) illustrates the problem vividly.

A comparison between the height of the terrain

on the approach and an aircraft following the 3.2-deg. glidepath to remain on the precision approach path indicator, shows that at a range of 4,500 ft. from the runway, terrain clearance can be as little as 77 ft. Trees and other obstructions would reduce this margin, making this approach a hazard even when flown precisely.

A NASA Aviation Safety Reporting System document from 1999 vividly describes the problem—see ow.ly/ox3q5. The report indicates that there has been concern in the past about the approach to Runway 18 at BHM, particularly at night. This runway should never have been offered to the crew of the accident flight and should not be considered a suitable approach for any commercial flight going forward.

It would be prudent for the relevant authorities to run this approach through the FAA's Safety Management Process system. I have no doubt that it would fall into the unacceptable risk category.

Bill Whyte

LEESBURG, VA.



ALARMED BY NO ALERT

As a retired corporate pilot, I am somewhat puzzled about the crash of UPS Flight 1354. Surely the aircraft was equipped with a radio

altimeter and a ground proximity warning system which should have given the crew ample time to respond to a "Whoop, Whoop, Pull Up" audio alert, if the system was working properly.

Thomas Brandau

EDEN PRAIRIE, MINN.

BIZJET 'CRED'

Unlike readers Mike Canty and Bob Walker (AW&ST Aug. 26, p. 8), I salute USAF Lt. Gen. (ret.) Thomas McInerney's out-of-the-box thinking on using business jets to fix readiness (AW&ST July 29, p. 54). Having flown military, commercial and corporate aircraft for more than 40 years, I can attest that flying different types of aircraft does not hinder mission effectiveness. Some days I would fly a Boeing 737 in the morning and that afternoon I would strap in my ANG C-130 and fly either a tactical or proficiency training mission.

In the 1980s, Strategic Air Command started a program where pilots gained experience and proficiency flying T-37s or T-38s, because B-52s and KC-135s were on alert. It was also a way to maintain pilot morale. Of course you cannot simulate tactical missions in bizjets, but using them for proficiency (precision and nonprecision approaches, holding patterns, go-arounds, cross-country flights, etc.) would be cheaper than flying military aircraft.

Numerous types of bizjets could be used to maintain proficiency based on the military aircraft the pilots fly. As far as purchasing them, why bother? The military could negotiate a flying time contract, say with NetJets, to supply aircraft and instructors as necessary.

USAF Lt. Col. (ret.) John A. Crocker

TAVERNIER, FLA.

PRIX-FIXE ASSURED?

Referencing "Connecting Flight" (AW&ST Aug. 19, p. 24) about the U.S. Justice Department's decision to

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challenge the US Airways/American Airlines merger; it is worth mentioning that history has proved that with fewer players in the game, price-fixing cartels will almost always result. With low-cost carriers in the mix for duplicated markets, there is a potential of lower prices in those markets—initially.

Phil van Leeuwen

LAWRENCEVILLE, N.J.

ARTISTIC LICENSE

The concept of the Comac C919 that accompanies "Not Just Inexperience" (AW&ST Aug. 19, p. 39), shows an airliner with square windows. Didn't we already learn about pressurized airliners with square windows on the Comet? This seems like an unnecessary risk of pressure fatigue

and explosive decompression. Even if the odds are low, the consequences could be dire.

Dale Gibby

COLUMBUS, IND.

(The Comac illustration appears to be approximate. Other concepts depict the C919 with conventionally rounded windows—Ed.)

TAILHOOK LEGACY

In reading "Feast of Fixes" (AW&ST Aug. 19, p. 28) I am amazed that Lockheed Martin has not yet solved its tailhook problem. The recent tailless UAV trials seemed to go very well, and at the de Havilland Museum I weekly pass the "tailless" de Havilland D.H.110 Sea Vixen with its arrestor hook dangling on the ground (as is true for the de Havilland Sea Venoms).

What trick is Lockheed missing?

Ken Pye

TODDINGTON, ENGLAND



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Robert Cohen



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Gunnar Kleveland has become senior vice president-integrated operations, **Cathy Ferrie** senior vice president-engineering and **Matt Hasik** senior vice president-commercial programs, all at Fort Worth-based *Bell Helicopter*. Kleveland succeeds **Pete Riley**, who will be retiring. Ferrie and Hasik follow **Jeff Lowinger**, who is leaving Bell and whose position as executive vice president-engineering and commercial programs has been divided. Kleveland was head of supply chain optimization; Ferrie was vice president-Xworx and research, development, test and evaluation; and Hasik was V-22 program manager.

Phil Anderson has been appointed senior vice president-defense and contracts of Wichita-based *Spirit AeroSystems Inc.* He was senior vice president/CFO and has been succeeded by **Sanjay Kapoor**, who was vice president of the Integrated Air and Missile Defense Div. of Raytheon and had been CFO of divisions of Raytheon and United Technologies Corp.

Mark R. Baker (see photo) has been named president/CEO of the Frederick, Md.-based *Aircraft Owners and Pilots Association*. He succeeds **Craig Fuller**, who was president/CEO for five years.

USMC Gen. (ret.) **James N. Mattis** has become a member of the board of directors of *General Dynamics*, Falls Church, Va. He was commander of U.S. Central Command and had been commander of the U.S. Joint Forces Command.

Samuel Vlodinger and **Ron Ben-Haim** have been appointed to the board of directors of *TAT Technologies Ltd.*, Gedera, Israel. Vlodinger is a senior partner and Ben-Haim a partner in the FIMI Opportunity Funds.

Nagakazu Sagara (see photo) has been named vice president-Japan and South Korea for *AirBridgeCargo Airlines* as vice president-Japan and Korea. He succeeds **Katsuhiko Sagami**, who will continue as mentor and coach for the region until year-end. Sagara was deputy general manager of Mitsui-Soko Express and had been senior vice president-export for Japan Airlines.

Mohan Sadashiva has become senior vice president-product management for Boeing subsidiary *Narus Inc.*, Sunnyvale, Calif. He was vice

president/general manager of the cloud services broker business unit at the Intel Corp. and had been senior vice president-marketing at Synchronoss.

Leo Mendoza has been appointed Latin America sales leader for airlines and fleets for *StandardAero*. He was Vancouver-based head of technicians and buyers for MTU and had been supply chain manager for Avensa Airlines.

Paul Strack (see photo) has been promoted to vice president-acquisitions from aircraft sales director for *Piedmont Aircraft*, Winston-Salem, N.C.

USAF Lt. Gen. **James M. Kowalski** has been named deputy commander of U.S. Strategic Command, Offutt AFB, Neb.

He has been commander of Air Force Global Strike Command, Barksdale AFB, La. Maj. Gen. **Stephen W. Wilson** has been nominated for promotion to lieutenant general and to succeed Kowalski. Wilson has been commander of the command's Eighth Air Force at Barksdale. Brig. Gen. **Scott A. Vander Hamm** has been selected for promotion to major general and appointment as commander of the Eighth Air Force (Air Forces Strategic) of Air Force Global Strike Command, Barksdale AFB, La. He has been director of plans, programs, requirements and assessments at Air Education and Training Command, Headquarters Joint Base San Antonio-Randolph, Texas.

Vander Hamm will be succeeded by Brig. Gen. **John L. Dolan**, who has been commander of the Kandahar Airfield in Afghanistan/ commander of the 451st Air Expeditionary Wing of Air Combat Command.

Andrew C. Bradley has been promoted to Washington-based president of global sales from the division's senior vice president at the *Aujet Corp.*, Burbank, Calif.

Mike Medeiros (see photo) has been named vice president-Seattle for *Delta Air Lines*. He was vice president-global human resources and talent de-

velopment and had been head of Delta's New York operation. **Patricia Ornst** has become director of New York state and local government affairs for Delta. She was Northeast U.S. managing director for state and local government affairs for American Airlines.

Michael Faber has been appointed to the board of directors of *CPI Aerostructures Inc.*, Edgewood, N.Y. He is CEO of the NextPoint Management Co. and senior adviser to law firm Akerman Senterfitt.

Robert Cohen (see photo) has been promoted to president/CEO of the *TECT Corp.*, Fort Mitchell, Ky. He was president of TECT Power and has been succeeded by **Anthony Ratica**, who was an executive at Standard Aero.

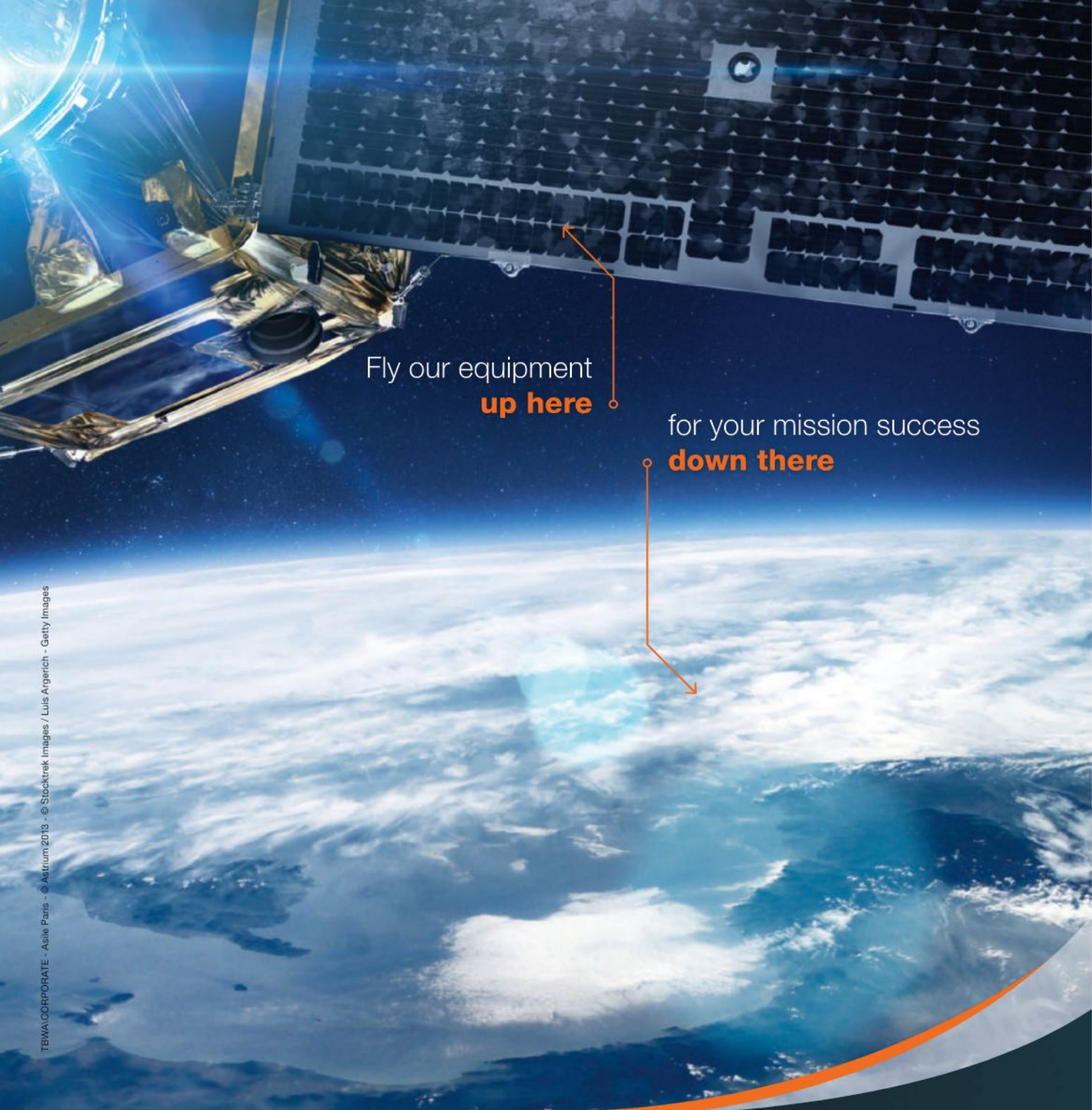
Michael D. New has been named vice president-safety, security and compliance for *Ericksen Air-Crane Inc.*, Portland, Ore. He was senior vice president, corporate safety, security and compliance for Korean Air.

HONORS AND ELECTIONS

Robert S. Span (see photo) is now chairman of the *American Bar Association's Forum on Air and Space Law*. Span, a partner in the Los Angeles law firm of Steinbrecher and Span, succeeds **Steven H. Taylor** of FedEx Express.

Lisa Sasse, an executive at VisionSafe, has been named vice chair of the Business Advisory Committee of the Al-

exandria, Va.-based *Flight Safety Foundation*. **David Bjellos**, who is aviation manager for the IS-BAO Stage 3 flight department at Florida Crystals Corp., has been appointed special liaison from FSF to the Helicopter Association International. ☼



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Deal on Emissions Measures

The Council of the International Civil Aviation Organization (ICAO) had agreed on a compromise solution about the introduction of a global market based measures (MBM) system to be used in tackling the problems of aviation emissions. The council accepted the principle of regional emissions trading systems (ETS) and agreed to have a single global MBM for aviation to be implemented in 2020. The principles for a global MBM should be adopted at ICAO's next assembly in 2016. The EU has committed to not fully rolling out its own ETS until 2020 although the scope of its proposal has changed: Airlines must offset their emissions by having all of their departing or arriving flights that use European airspace participate in the ETS. Overflights will not be included, but operations from London to New York will be included for the segment in European airspace. All 191 ICAO member-states will be able to vote on the council's draft working paper at the body's assembly in Montreal Sept. 24 to Oct. 4.

What Goes Around . . .

The Flight Safety Foundation (FSF) says data and anecdotal information are showing increases in aircraft performance and air-traffic-control instruction violation rates during airline approaches. The information comes from the FSF's International Advisory and European Advisory committees as part of a new survey of aborted approaches, also known as "go-arounds." Of particular interest in the preliminary data is that, on average, only 4% of unstabilized approaches result in go-arounds, the FSF says. The study is expected to conclude in a report that recommends guidelines for safe go-arounds. It is not clear if the FSF's work is related to the final report by French aviation safety agency BEA last month on accidents and incidents that have occurred in many cases during go-arounds. BEA makes 34 recommendations (see page 46), including changes to aircraft thrust modes, airspace procedures, pilot training and full-flight simulator fidelity.

Quieter CSeries Plan in Works

Porter Airlines has submitted a second proposal that calls for further noise reductions, as public consulta-



Japan's ATD-X Fighter Demonstrator in Static Testing

Static strength testing of the airframe of Japan's ATD-X stealth-fighter technology demonstrator has begun, says the Defense Ministry's Technology Development & Research Institute. The ATD-X, which is not intended to lead directly to a combat aircraft, has been scheduled for flight testing between 2014-16. Built by Mitsubishi Heavy Industries, the ATD-X is expected to demonstrate technologies that the ministry hopes to apply to its proposed F-3 fighter. Development would begin around 2017 for entry into service about 10 years later.

tions begin on its request to extend the runway at Toronto's downtown island aircraft and allow the carrier to operate Bombardier CSeries jets. The original plan, submitted in April when Porter placed a conditional order for up to 30 107-seat CS100s, is to extend the runway by 168 meters (500 ft.) at each end. The new proposal would increase that to 200 meters at each end to allow a reduced-thrust departure to lower noise further. Porter argues the CSeries jets will have noise levels comparable to the Bombardier Q400 turboprops it now flies from Billy Bishop Toronto City Airport, but requires both a runway extension and the lifting of a 30-year-old ban on operating jets there. A vote by the Toronto City Council is expected in December.

PROPULSION

Leap's First Run

CFM International started up the first version of its new-generation Leap engine at General Electric's test site in Peebles, Ohio, on Sept 4. The test came two days ahead of schedule, says CFM, a GE-Snecma joint-venture company. The Leap-1A is in development for the

Airbus A320neo, and is the first all-new CFM engine to enter testing since the original CFM56 of the 1970s. The Leap-1A is set to begin flight tests on GE's Boeing 747 testbed in September 2014, with FAR33 engine certification expected the following summer. First flight on the A320neo is due around the third quarter of 2015 with entry into service the following year. The first run marks the start of a fast-paced test and certification program involving 60 test engines for this architecture and other variants. In conjunction with the Airbus engine, CFM is developing an almost identical -1C variant for the Comac C919 in 2016. The -1B version is in development for the Boeing 737 MAX, which is scheduled for service entry in late 2017.

BUSINESS AVIATION

Bombardier To Sell Fractional

The business-aircraft fractional ownership industry is continuing to reshape with the decision by Bombardier to sell its Flexjet operations to Flight Options parent Directional Aviation Capital in a deal that includes a new order for up to 245 Bombardier aircraft valued at \$5.2 billion. The sale is expected to close

AW&ST/S&P Market Indices as of 9/4/2013

by year-end. Directional is paying just \$185 million for the Flexjet assets, but is agreeing to place firm orders for 85 Learjet and Challenger aircraft valued at \$1.8 billion and options for another 160. The firm orders comprise 25 Learjet 75s, 30 Learjet 85s, 20 Challenger 350s and 10 Challenger 605s. Firm-order deliveries are expected to begin in 2014 and continue through 2018. As part of the sale, Bombardier is selling its 49% stake in JetSolutions, which held the Part 135 operating certificate and provided charter flights for Flexjet. The 51% stakeholders of JetSolutions are buying the remaining portion, but will maintain their strategic relationship with Flexjet, says its president, Deanna White. The acquisition would boost Flexjet's fleet, which has held steady at about 80 aircraft in recent years, with new aircraft added slowly and for replacement only. Flexjet has begun to grow again, with revenues increasing 96% in the first half and fractional sales rising 112%.

ROTORCRAFT**Avicopter's Next Step**

Avicopter's next step in filling out a product range will be a 3-metric-ton helicopter, provisionally named AC3X2. This follows the indigenously developed 1-ton AC310 piston-engine type and the AC311, a 2.2-ton turbine-engine aircraft apparently derived from the Eurocopter Squirrel, with considerable local changes. Avicopter officials are giving no details of the AC3X2 except for its gross weight, but displayed a model of the aircraft at the China Helicopter Exposition on Sept. 5. Avicopter has said it intends to build a range of helicopters with gross weights from 1-13 tons.

Tiltrotor Enhancements

AgustaWestland says it has reduced drag on its AW609 tiltrotor by 10% as it aims to reduce acquisition and operating costs of the aircraft, which is due to be certified in 2017. The second prototype, based in Italy, has a new-design vertical stabilizer and tail cone, more aerodynamic engine exhaust nozzles and changes to the rotor-spinner cones. The manufacturer says these changes have yielded substantial weight reduction.

DEFENSE**Tanker Design Set**

Boeing has been cleared by the U.S. Air Force to begin building four developmental KC-46 aerial refuelers following completion of a 10-month critical design review (CDR). The Air Force announced that the CDR was finished Aug. 21, one month ahead of the contractual requirement. Flight testing for the 2C version of the 767-200ER, the platform on which the refueler will be housed, is slated for the middle of next year. First flight of the actual tanker is

planned for early 2015. Delivery of the first of 18 refuelers is expected in 2017.

SPACE**Houston Eyes Spaceport**

Aiming to continue the city's spaceflight legacy, officials in Houston are poised to seek a commercial spaceport license from the FAA to establish a runway-based complex supporting reusable launch vehicles, spacecraft assembly and flight training, as well as aerospace research and education. The proposed spaceport would occupy 439 acres of Ellington Airport property close to NASA's Johnson Space Center. The municipal Houston Airport System (HAS), which manages a financially successful three-airport network, this summer received Houston City Council approval for a consulting agreement to help guide the FAA application and environmental impact statement process, which is expected to take 12-15 months. The effort is driven in large measure by the close ties forged between NASA and the city during the earliest days of U.S. human spaceflight. Interest in commercial space has surged with the end of the space shuttle program in 2011, falling space agency employment and the national discussion over NASA's future strapped by tight budgets, explained HAS Director Mario Diaz. Though full-scale development of a suborbital/orbital spaceport could be 5-10 years away, Diaz and others involved in the push presented a preliminary master plan for an environmentally sensitive facility with a runway—but no launch pads—to support space tourism; small satellite launches; medical, materials and energy research; spaceflight education and training; and point-to-point global deliveries.

OBITUARY: Record-breaking autogyro pioneer Wing Cmdr. Ken Wallis died at home near Dereham, Norfolk, England, on Sept. 1. He was 97. A Royal Air Force (RAF) Wellington bomber pilot during World War II, Wallis spent 20 years in weapon research for the RAF, but was best known for his exploits with autogyros, working on them in his spare time at home. His experience with the machines helped him set 34 autogyro world records between 1968 and 2002, several of which still stand today, including the speed record for an autogyro: 207.7 kph (129 mph). Wallis retained a collection of 18 autogyros at home and regularly flew them for visitors even until recently. Although his hopes of wider success with gyroplanes never came to fruition, the capabilities of the aircraft and Wallis were spotted by producers of the James Bond films and in 1967, Wallis doubled for actor Sean Connery in a dramatic dogfight scene where Bond's autogyro, named "Little Nellie" fights off helicopter-borne attackers over Japan in the film, "You Only Live Twice." In October 2012, Wallis was honored for his lifetime contribution to aerospace by the Guild of Air Pilots and Air Navigators.



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COMMENTARY

Revolution From Below

Tier 4 consolidation is reshaping supply chain

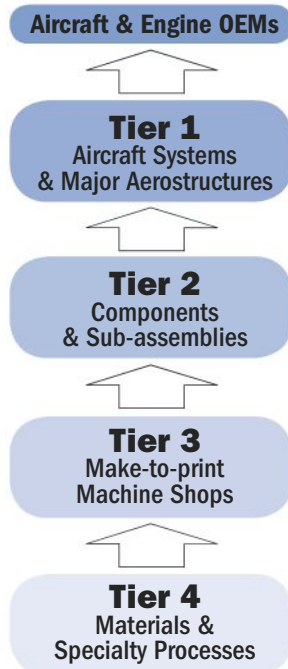
Industry press is full of stories highlighting changes in the aerospace supply chain driven by globalization and mega-deals like United Technologies-Goodrich. While these changes are noteworthy, a silent revolution is reshaping the supply chain from below: Tier 4 consolidation. This stage of the supply chain comprises raw materials (mill product) as well as products from specialty processes such as forgings, castings and extrusions. Tier 4 suppliers sell their goods to aerospace manufacturers of all stripes—from Tier 3 machine shops to aircraft and engine OEMs. In aggregate, the aerospace industry consumes \$15-20 billion of Tier 4 products per annum.

Tier 4 consolidation has taken several forms: raw material suppliers expanding market shares and vertical integration where specialty-process suppliers move into raw materials or vice versa. Major deals in recent years include:

- Raw material giant Allegheny Technologies acquired Ladish, a leading forging and casting supplier
- Casting supplier Consolidated Precision Products acquired ESCO's Turbine Technologies Group, an investment casting specialist
- Carpenter Technologies acquired Latrobe, bringing together two leading specialty alloy suppliers
- Titanium supplier RTI acquired Remelle Engineering, a precision component supplier
- Alcoa acquired Transdigm's fastener business, the most recent of a string of fastener acquisitions

While these are all consequential deals, it is the unprecedented acquisition binge by Precision Castparts Corp. (PCC) that has captured the industry's attention. PCC made eight acquisitions in fiscal 2013 alone, and more than a dozen in recent years to build a portfolio that stretches from Tier 4 through Tier 2 components. Today, PCC boasts revenue of \$8.4 billion, and is one of the top two suppliers of nickel alloy, rotating-grade titanium, investment castings, forgings, fasteners and large structural castings. Its shipset revenue

The Aerospace Manufacturing Supply Chain Structure



Source: ICF SH&E

is an eye-popping \$10 million for the Boeing 787, and \$5 million for both the Airbus A380 and Boeing 777-300ER.

Several factors are driving Tier 4 consolidation. First, downstream customers are trying to simplify their supply chains and demanding more “near net shape” and finished compo-

nents. By vertically integrating, Tier 4 suppliers are addressing this need.

“We don’t want to be measured by how many pounds of raw material we sell, but by the value we create,” one leading supplier recently told me. Second, Tier 4 consolidation allows suppliers to capture the massive amount of scrap raw material, also known as revert, that is generated by aerospace manufacturing by recycling it with their raw material mills. Some \$8 billion in raw material—80% of total raw material consumption—ends up on shop floors as revert rather than finished aircraft and aeroengines. The new mantra is “closed-loop raw material ecosystems” that are more efficient and greener. This is especially true for parts made from more expensive raw materials like superalloys and titanium. There are also product development benefits derived from vertical integration, including materials tailored to advanced production processes, and in some instances, shorter certification cycles.

Despite the advertised benefits of Tier 4 consolidation, it is also a growing source of angst for customers as it potentially creates stronger pricing power and bargaining leverage. In many instances, there are now just one or two qualified suppliers for Tier 4 goods. It also increases dependence on certain suppliers at a time of high-production tempo.

How should aerospace manufacturers respond? Clearly, supply chain management capabilities must be upgraded to monitor Tier 4 market trends, assess vulnerabilities and revise supply chain strategies accordingly. Many OEMs now consider supply chain management to be a strategic, indispensable functional capability for the coming decade. Gone are the days of procurement as a backwater function.

Tier 4 consolidation will also lead to broader restructuring of the supply chain. We expect significant attrition of independent Tier 3 machine shops and increased competitive pressure at even the Tier 2 and Tier 1 levels.

Tier 4 suppliers, in turn, must remember that vertical integration is risky. Adding new capacity or capabilities may look ill-advised when the production cycle turns and today’s capacity scarcity becomes abundance. ☛



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By **Graham Warwick**

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COMMENTARY

Dynamic Flight

Advanced control technique integrates aerodynamics and propulsion for simpler F-35B vertical flight

YouTube videos make it look easy, and for pilots, it is easier than in a Harrier. But landing vertically at night, in crosswind, on the moving deck of a ship relies on the highly integrated and automated flight and propulsion controls of the Lockheed Martin F-35B.

Sea trials ending Aug. 30 were the most severe tests yet for the short-takeoff-and-vertical-landing (Stovl) variant of the Joint Strike Fighter. Earlier trials showed the F-35B has better handling qualities than the AV-8B Harrier II it will replace, but the latest flights involved higher crosswinds and sea states, and night landings.

A design requirement for the F-35B was to make conversion to Stovl mode “as simple as lowering the landing gear,” says Steven Wurth, Lockheed Martin’s technical lead for F-35 propulsion. There were to be no adverse flying qualities due to conversion and the time required to change modes had to fit in with carrier procedures.

The resulting integrated flight and propulsion control (IFPC) crosses boundaries into several aircraft systems, including hydraulics to operate the doors, electrics to power the flight-control actuators, the integrated power pack for emergency power and even the seat, to provide auto-ejection after certain failures.

Where the Harrier has a vectored-thrust engine and bleed-air puffer jets mechanically linked to the aerodynamic surfaces for control in the hover, the fly-by-wire F-35B has a thrust-vectoring engine, shaft-driven lift fan and bleed-air roll posts in the wing. The combination is capable but complex, and managed by a control technique called dynamic inversion.

IFPC relies on a high-fidelity on-board aircraft aero-propulsion model. Dynamic inversion inverts the model in real time to identify what roll, pitch and yaw moments will produce the



LOCKHEED MARTIN

desired trajectory. An online control-effectiveness matrix then blends the effectors, imposes any rate and position limits, and generates commands in each axis. If any go out of limit, the matrix redistributes control to other effectors. “It’s a clean way of doing failure management,” says Wurth.

There is no shortage of control effectors on the F-35B. In addition to the aerodynamic controls—flaperons, stabilators and rudders—there are the three-bearing swivel nozzle (3BSN) on the engine, variable-area vane box nozzle (Vavbn) on the lift fan, and the roll posts. The engine and lift fan each produce 18,575 lb. of vectorable thrust, and the roll posts 3,400 lb., that must be controlled with the same thrust precision as the puffers on a Harrier.

All the effectors are controlled by triple-redundant vehicle-management computers and full-authority digital

electronic controls (Fadec) for the engine and lift fan. These allow the pilot to control the F-35B the same way in jetborne as in wingborne flight: stick to descend, ascend and roll; throttle to accelerate and decelerate; pedals for directional control.

A single button push begins conversion, automatically converting the aircraft from wingborne to jetborne mode by first opening the doors and pre-positioning the clutch, then engaging the clutch and locking the shaft. The lift fan spools up in 9 sec. Another button push begins conversion back to wingborne flight, unloading the fan, disengaging the clutch and closing the doors, all within 7 sec. “The pilot always has ability to reverse the process during the sequence,” says Wurth.

IFPC disguises that a simple input has a complex output, combining aerodynamic and propulsion controls to provide virtual effectors in each axis. Pitch control involves not only vectoring the 3BSN and Vavbn, but varying the thrust split between the engine and lift fan.

“Thrust-split frequency response is important for pitch and heave, and bandwidth is critical to Level 1 handling qualities,” Wurth explains.

The system provides automation that Harrier pilots will envy, including ground modes to avoid foreign-object and runway damage, and short-takeoff modes optimized for shore, ship or austere bases. There is Stick STO, where the pilot pulls back to take off; Button STO, where the aircraft rotates at a finger push; and Auto-STO, where it autorotates a pre-defined distance down the deck. Returning to a vertical landing, the system controls speed to maximize bring-back payload.

Another design driver was redundancy, and the need to minimize any transients the pilot might detect as the system transitions automatically to a backup after a failure, “so they do not feel they have to get out of the aircraft,” says Wurth. Here dynamic inversion plays a key role, automatically compensating for effector failures. “Control laws developed for the X-35 have pretty much stayed intact. Dynamic-inversion control has worked well.” ☺



By Pierre Sparaco

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COMMENTARY

Charles de Gaulle Airport handles more than 66 million passengers per year. An express rail link between it and downtown Paris is being proposed again, to be funded partly by a tax on airline tickets.

However, mass transit to airports remains a weak point for Paris, despite inextricable traffic jams frequently paralyzing access routes to CDG. Last year, the four-runway hub handled 61.6 million passengers and, including local business parks, generated as many as 86,000 jobs, further aggravating traffic difficulties.

As frequently happens in France, meetings, consultations, public debates and feasibility studies resulted in multiple reports and tentative plans to create the long-overdue 32-km (20-mi.) CDG Express connection. The estimated cost to build it, including partly new tracks and a tunnel section, is reportedly €1.7 billion (\$2.2 billion).

But the CDG Express plan shows how fragile the airline industry can be, even in a country like France, which is proud of its major gateway's role and has political desire to support the efforts of Air France and its affiliates to remain a leading European airline group. Obviously, the cash cow is being treated well, but governments are lagging in understanding airlines' business needs. Cuvillier has adopted an extremely cautious attitude, putting off decisions on a plan to construct an all-new airport in Brittany, referred to as Notre-Dame-des-Landes (NDDL).

NDDL is surrounded by a fierce environmental controversy and the need for the envisioned airport has not been demonstrated, but politics are interfering with ongoing discussions. Ironically, Vinci, which was initially slated to manage CDG Express construction, is also NDDL's prime contractor. But no time frame has been determined as yet for NDDL and the project may end up being canceled.

France's lack of a strong and realistic aviation strategy is clearly evidenced by the poor handling of the CDG Express and NDDL plans. The cash-cow policy it continues to pursue is hardly a stopgap measure and, to say the least, it is deeply disappointing. ☹

Failure of Imagination

The cash-cow strategy is a losing proposition

Tony Tyler, the International Air Transport Association's chief executive, said recently that "too often governments see aviation as a luxury and milk it as a cash cow." Giovanni Bisignani, Tyler's provocative predecessor, has also in the past several years repeatedly accused governments of implementing a narrow-minded cash-cow policy toward airlines. Although the airline industry gradually evolved into a form of mass transport and now carries more than 3 billion passengers per year, governments still harbor an unrealistic image of air travelers: They are envisioned as healthy people willing to pay high prices, including taxes of all sorts, and put up with many inconveniences.

Frederic Cuvillier, France's transport minister, who has been remarkably silent since he joined the government of Prime Minister Jean-Marc Ayrault, last month endorsed a tentative plan to create an all-new tax to help fund a nonstop train link between downtown Paris and Charles de Gaulle Airport (CDG) dubbed the CDG Express. The idea has been discussed for several years but failed to be realized in the absence of a sound financing plan. An industrial consortium led by the Vinci construction group agreed to become the prime contractor, but has since canceled the plan, being unsure about the CDG Express's ability to generate a robust return on investment.

Cuvillier is seeking to relaunch the plan and, in the absence of political or commercial imagination, intends to implement the infallible cash-cow method. A group of independent French

carriers headed by Laurent Magnin, chairman/CEO of XL Airways France, is outraged by this move. Cuvillier's plan would further increase fares, as does a tax funding a humanitarian organization that failed to be adopted by European Union member states. If instituted, the CDG Express tax would be unfair, requiring passengers using provincial airports to contribute to funding a strictly Parisian initiative.

Rail links to airports have been built by a number of capital cities over the years to avoid traffic jams and attempt to provide seamless travel. Belgium's state-owned railway operator, SNCB, encouraged by Sabena Belgian World Airlines, was a celebrated innovator when it inaugurated a train link between downtown Brussels and Melsbroeck (now Zaventem) Airport in May 1955. The station was located below Sabena's corporate headquarters.



By Cathy Buyck

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COMMENTARY

Accept or Reject

Pilot flight and duty-time changes are in the European Parliament's hands

The legislative proposal to harmonize and revise EU rules on flight and duty limitations and rest requirements (FTL) for air crews has entered its final stage, and the European Parliament (EP) and Council are reviewing the draft regulations.

The outcome is not clear, however. The European Cockpit Association (ECA) and pilot unions across Europe have stepped up their lobbying of EP members to reject the proposal.

"The European Parliament is where we see our last—and biggest—opportunity before these rules come into being," the ECA writes in a letter to the presidents of its member-associations. "Having examined the options of various strategies and messages that we could adopt with the Parliament, we have . . . come down firmly in favor of a major and intensive push to have the European Parliament reject the commission's proposal."

ECA notes in the letter that if its "advocated changes were made on night flights, a standby cap and an unambiguous safety-enhancement clause," it would not need to call for rejection.

Drafting the new EU-wide FTL guidelines has been a lengthy process. A European Aviation Safety Agency (EASA) committee started evaluating the current regulations on flight and duty-time limitations, and rest requirements for commercial air-transport (CAT) operations laid down in Subpart Q of Regulation (EC) 1899/2006, also known as EU-OPS, in 2009. EASA consulted all stakeholders on new FTL requirements in December 2010 and again last year.

The commission presented its draft proposal to the EASA committee on July 11. The text included adjustments discussed with member-states, the EP and all stakeholders on several occasions since last October, says Matthew Baldwin, director of aviation and international transport policy at the European Commission's Directorate-General for Mobility and Transport



LUTJANS/UDO KRONER

The EASA committee generally is composed of representatives of the civil aviation authorities and/or the ministries of transport of the member-states: all 28 EU nations plus Norway, Lichtenstein, Iceland and Switzerland.

The majority of the member-states participating in the meeting voted in support of the draft proposal. Only Austria and the Netherlands voted "no" due to political pressure. All large member-states voted for the new FTL rules.

"We are determined to see stronger, safer rules applied across Europe, whether in relation to nighttime flying or on rest periods," EU Transport Commissioner Siim Kallas said following the EASA committee's support for the proposal, which he says, "will bring about major improvements across Europe for the safety of our citizens and flight crews."

Most of Europe's airlines support the proposed FTL changes. "The new regulation, once adopted and implemented, will create one common set of rules for the aviation market," noted the heads of the Association of European Airlines, European Regions Airline Association and International Air Carrier Association in a joint statement, while calling for a prompt adoption

of the proposal. They applauded that "Europe will continue to have among the strictest FTL rules in world."

In contrast, the proposed changes to EU safety rules governing the fatigue of pilots and cabin crew have been fiercely criticized by Europe's pilots unions, including the British Airline Pilots Association (Balpa), which say the proposal disregards scientific advice on night flight-time limits. Pilots and cabin-crew unions have organized campaigns to demonstrate their opposition, which began after EASA started its review.

Balpa, which represents more than 80% of British airline pilots, in July accused EASA of "gross maladministration" and submitted a formal complaint to the European ombudsman that EASA had breached its own charter in the way it has put together its FTL proposals.

The proposed rules contain 30 changes and a 45-min. reduction to 11 hr. of the maximum nighttime duty, as well as the requirement to use fatigue-management principles to manage active-duty rosters. Airlines must provide initial and recurrent fatigue-management training to crewmembers, crew-rostering personnel and management.

So what will happen now? Coordinators of the EP TRAN committee were scheduled to discuss the draft regulations in its first meeting on Sept. 5. Members of the European Parliament (MEP) can only accept or reject the proposed regulations. A vote on the draft is scheduled for next month in a plenary session in Strasbourg, France.

MEPs often follow the advice of the dedicated committee, but this is not a rule. They may agree with the pilot lobby and its deceptive message that the new rules "force human beings to go beyond the limits of safe performance overnight and because they force pilots to land aeroplanes after being awake nearly 24 hours" or "they force operations in many countries to become more dangerous—with air-passenger safety at stake."

Also, the Council has to vote on the draft regulation, but this vote is widely seen as a formality since the member-states endorsed the proposal in the EASA committee. If the EP endorses the rules, they will become law at the end of the year and implemented by the end of 2015. ☛



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By Frank Moring, Jr.

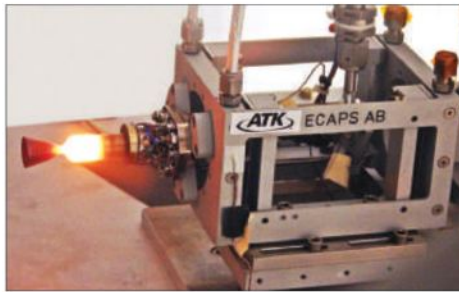
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COMMENTARY

Incubating Innovation

University labs crank out technology ideas

New technology can be surprisingly inexpensive. In the U.S., the Pentagon and the intelligence community spend billions of taxpayer dollars pushing the envelope on creative new hardware and software concepts that may never emerge from behind the black curtain of secrecy. That is probably a good thing for bombs and bullets, but it keeps a lot of potential dual-use technology out of the economy. Fortunately, there are means for innovation at the other end of the funding scale that can drive economic growth with actual, and significant, return on investment. University laboratories provide science and engineering students with hands-on experience, and ideas are emerging at an impressive rate—many with serious commercial potential.



ATK

This has not escaped notice in corporate boardrooms and government executive suites. At the recent Small Satellite Conference in Logan, Utah, a hotbed of student innovation based on the burgeoning cubesat industry, major aerospace companies and the federal agencies they serve were well represented in the exhibit hall and in the auditorium where papers were presented.

The papers tell the story. Many of the most innovative came from engineering students and professors, the products of shoestring budgets and free labor. Some of the ideas could wind up flying in space, and perhaps even turning serious profits. A good example came from Utah State University, which has hosted the annual SmallSat Conference since it started in 1987.

Stephen Whitmore, an associate professor of mechanical and aerospace engineering who joined the Utah State faculty after 28 years at NASA, outlined a serendipitous discovery he and his students made that may ease adoption of a new family of “green” propellants for spacecraft. Based on ionic liquids

such as ammonium dinitramide and hydroxyl ammonium nitrate, the monopropellants offer a non-toxic alternative to hydrazine. That means technicians can fuel satellite attitude-control systems without the expensive precautions necessary today, and perhaps even ship them—already fueled—to the launch site instead of doing the job in special safe facilities there.

“If we can go to systems that are able to be serviced using conventional personal protection equipment, the potential life-cycle cost of this system will go down considerably,” Whitmore says.

Unfortunately, in solid form the ionic liquids are explosive, so they must be diluted with water to be safe. That works just fine, but it makes the green propellants hard to ignite. Present practice, already demonstrated in space by a unit of the Swedish Space Corp. (AW&ST Aug. 15, 2011, p. 12), requires a catalyst bed heated to about 350C to fire up the green propellant. That adds cost and weight to the green thrusters.

In the school’s propulsion lab, Whitmore and his students accidentally set

fire to grains of acrylonitrile butadiene styrene, a plastic, when they inadvertently passed high-voltage current through it. Combined with an oxidizer flow, they found, the hydrocarbon grains are “a really good way to seed ignition,” Whitmore says. With support from NASA’s Marshall Space Flight Center, the Utah State group is refining its “cold-start” technology for a possible spaceflight test in a 3U cubesat. The Swedish company and ATK, which has ground-tested the technology for the U.S. market (see photo) are sure to be interested, as is Pratt & Whitney Rocketdyne, which is developing an alternate approach with a NASA technology grant (AW&ST July 22, p. 20).

Satellite constellations were the focus of this year’s SmallSat Conference, and in the view of a student team from the University of Michigan and Pennsylvania State University, small is beautiful. Iverson Bell, a doctoral student at Michigan, presented his team’s findings on the feasibility of using relatively short electrodynamic tethers to control constellations of miniature spacecraft that make 10-cm cubesats look large by comparison.

“Picosats” weighing 100 grams to 1 kg, and “femtosaurs” that weigh less than that can be mass produced and launched in “swarms” for a fraction of the cost of their larger smallsat cousins, Bell says.

The technology for miniaturizing sensors is keeping pace, but miniature propulsion remains a problem. Without it, swarms of femtosaurs are at risk of becoming swarms of space debris.

Bell and his colleagues have calculated that 10-meter conducting tethers between pairs of femtosaurs fall in a “sweet spot,” overcoming drag to reboost themselves by converting electrical energy to kinetic energy as they move through Earth’s magnetic field. In a miniature arena, every gram saved is crucial, and the tether can be used as an antenna with the appropriate coating.

“We’re looking at low-cost constellations,” Bell says. “We want to unlock the potential for multi-point simultaneous measurements, for rapid remeasurement with a single location, for unique multipoint remote sensing capabilities and for unique multipoint in-situ measurements.” ☼



By Michael Bruno

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COMMENTARY

Air Cover

With budget cuts about to become an annual affair, next-gen aircraft find sanctuary

A lot of Pentagon programs are about to take a major hit to their bottom lines, and some smaller projects seem destined to be delayed or canceled, the Defense Department's acquisition chief warned loudly here last week. But a few futuristic aviation efforts might be shielded as Washington passes through the coming nadir of budgets, according to Frank Kendall, and they include future rotorcraft and the Defense Advanced Research Projects Agency's multiyear air-dominance study toward a post-Joint Strike Fighter aircraft (AW&ST May 20, p. 52).

The moves stem from a desire to ensure U.S. military technological dominance in the future. That requires continued investment now, despite spending caps or automatic budget rescissions known as sequestration—as mandated by the 2011 Budget Control Act. With that law looking increasingly unalterable on Capitol Hill, even in the face of widespread criticism of its reliance on relatively blind across-the-board cuts, Pentagon planners are beginning to consider how to live under its constraints so they can at least begin to craft some strategic decisions. While no surviving defense program is likely to get funded at its desired level, officials are willing to make force reductions—fewer soldiers, aircraft carriers, etc.—to redirect scarce dollars toward next-generation weapons and systems to stay ahead of adversaries. “I do not want to be in a position of technological parity or inferiority with anyone in the world,” says Kendall, the undersecretary of defense for acquisition, technology and logistics.

U.S. DEFENSE DEPARTMENT



‘I do not want to be in a position of technological parity or inferiority with anyone in the world.’

—FRANK KENDALL

He also says he recently saw an estimate of the number of engineers—“tens of thousands”—who might leave the defense sector under the full effect of budget cuts. “These are engineers we need,” Kendall says. “Once people leave, I don’t think they’re coming back.”

Kendall’s comments at a couple of high-profile news events last week came as the Pentagon readies to implement another round of sequestration after fiscal 2014 starts Oct. 1. He says the next round, which could be implemented in December or January, will see cuts of about \$20 billion more than the \$37 billion rescinded this fiscal year—meaning roughly \$57 billion (10% of the entire baseline budget) in reductions from the earlier plan. With military personnel accounts exempted from cuts under an option taken by President Barack Obama, procurement, research and development will be cut even deeper to meet the law’s mandate. Meantime, officials are craft-

ing their 2015 budget request at three different levels, from no cuts to about the same as 2014, and that plan will serve as a template for several more years. The 2015 budget request is due in February along with several other strategy documents, including the latest Quadrennial Defense Review and a report on proposed changes to the structure of the Air Force. ☛

BUDGET FLAK

With deeper budget cuts to procurement, research and development expected as the Pentagon implements sequestration cuts in fiscal 2014, the Navy will drop 25 aircraft from its aviation acquisition plan, according to the chief of naval operations, Adm. Jonathan Greenert. A reduction of \$14 billion in those accounts for the year starting Oct. 1 means less of each kind of aircraft than had been planned, including fewer carrier-based Joint Strike Fighters, P-8 maritime patrol aircraft and helicopters. The equivalent 2013 reduction was \$11 billion, but was mitigated by using unobligated funds to help meet sequestration payback amounts. ☛

CAMPAIGN LAUNCHED

Supporters of federal financing for the commercial space industry, as well as backers of the U.S. Export-Import Bank, are gearing up for a public relations campaign to renew the U.S. export credit agency (ECA) before its current congressional mandate runs out in a year. The bank has been bombarded with unrelenting criticism in Washington from some politically conservative and free-market critics who believe any ECA distorts free enterprise and should be eliminated—and next year’s charter debate will happen weeks ahead of congressional elections. The Aerospace Industries Association recently announced an advocacy campaign, including a promotional statement for every official announcement of a proposed aerospace product export loan worth more than \$100 million. Ex-Im officials say satellite financing is its “most prominent standout sector.” This year will be the third consecutive year in which satellite-sector authorizations by Ex-Im will exceed \$1 billion, versus \$50 million in 2010. ☛

Blowing Up the Budget

Just as political gridlock looked certain to cement historic changes to the U.S. military, Syria happens

Michael Bruno **Washington**

Like a live grenade thrown into a munitions storage room, a vote in Congress on President Barack Obama's proposal for limited U.S. military strikes on Syria's dictatorial regime is quickly gaining the potential to reshape the budget-battle-scarred landscape of U.S. defense and intelligence decision-making, possibly for years to come.

The catch: No matter how lawmakers vote, the fact the debate is taking place on Capitol Hill as the federal government races toward the beginning of fiscal 2014 on Oct. 1 and its all-but-certain budget constraints is forcing many in Congress to confront the implications of recent deficit-fighting decisions and indecisions faster than most expected. While the results are far from clear, the Syria issue's interplay with another round of automatic sequestration budget cuts due under the 2011 Budget Control Act's spending caps has opened up outcomes that affect aerospace and defense in ways that were until recently, unimaginable.

"The president's move added several new branches to the



President Obama meets with congressional leaders and cabinet members over potential U.S. strikes on Syria.

Syria decision tree for defense investors," says Capital Alpha Partners analyst Byron Callan.

"Think of this as a federal budget debate get-out-of-jail-free card," says Stan Collender, a former staffer on both House and Senate Budget committees and now a partner at Qorvis Communications.

In late July, Pentagon officials unveiled stark options for reshaping the military under the full effect of the budget law, which mandates almost across-the-board cuts if Congress does not appropriate money to individual programs within its budget caps on its own or rewrite the budget law, neither of which is expected (*AW&ST* Aug. 5/12, p. 21).

Now with potential Syrian strikes, the possibilities become more complicated. The first scenario is that Congress approves and the president executes a limited strike of 200-300 cruise missiles, like the Tomahawk Land-attack Missile (TLAM). "We appreciate views that there may be a 'rally-

MIXED BAG OF SAMs

Bill Sweetman **Washington**

Syria's ability to defend its airspace against U.S.-led attacks depends largely on its surface-to-air missiles. Its air force is big but obsolete—the most numerous types by far are the MiG-21 and MiG-23—and some main air bases are in rebel-controlled areas. Mobile missiles belonging to the ground forces have likely been kept out of rebel hands.

The feared transfer of Russian Almaz-Antey S-300PMU-2 (SA-20 Gargoyle) long-range SAMs from Russia has not taken place, leaving Syria with at most eight batteries of the old

S-200 (SA-5 Gammon)—a fixed-site weapon that, along with its radars, is vulnerable to destruction of enemy air-defense operations. The same limitation applies to the 1960s-era V-750 (SA-2 Guideline).

Syria's credible SAMs start with the S-125 Pechora (SA-3 Goa). It was one of these ancient systems that shot down a Lockheed Martin F-117 over Serbia in 1999, and Syria's force (estimated at up to 40 batteries) is reportedly being upgraded to the Pechora-2M standard. The upgrade package in-





DENNIS BRACK/DPA/PICTURE ALLIANCE/NEWS.COM

around-the-flag' mood in Washington, but a strike that uses 10% of the TLAM inventory on hand is not going to place new pressures on defense, and the action in Syria may not reshape or diminish the fiscal 2014 sequestration cut," Callan says of this option.

If Congress votes against strikes, but Obama goes ahead, the ensuing debate—which is likely to get into constitutional matters and even calls for impeachment by tea party legislators—could consume time otherwise spent examining the Pentagon's choices, and Congress might place further restraints on use of military force, as well, Callan explains. But the most interesting outcome would be if Obama followed congressional rejection and did not strike Syria. "One reaction to this would be a confirmation that a libertarian-liberal block in Congress is reshaping U.S. national security policy," he says, making currently mandated cuts to the defense budget permanent and a far cry from even a few years ago.

Still some A&D sectors—like ballistic missile defense—could ultimately see a boost. If U.S. inaction emboldens Iran and its suspected nuclear program, or North Korea's, then missile defenses could be sought by their neighbors. "Another by-product might be an accelerated move by Saudi Arabia [or] other regional states to acquire nuclear weapons and associated delivery systems in anticipation that Iran's program will proceed unhindered," Callan says.

If limited TLAM strikes are approved, Collender posits, the Syria debate makes a stop-gap funding measure and debt-ceiling deal likelier, assuming far right or left opposition is overridden by most other U.S. lawmakers. That would set the stage for another budget showdown for mid-November. And with Syrian operations possibly a memory by then, it does not indicate changes to the current trajectory of budget forecasts. "Syria doesn't mean that the military-spending sequester will be canceled," Collender says. "Anyone hoping or just assuming that U.S. actions in Syria mean additional funds for the Pentagon will be extremely disappointed."

But that is not stopping some lawmakers from trying. Amid a flurry of explanations last week on their planned votes, a few defense hawks have begun to tie their opposition to cuts to the Pentagon's current budget. "We know this could be open-ended; we know that an attack on Syria could have repercussions on Israel; but no one is talking about the decimation of our military," said Sen. Jim Inhofe (Okla.), the ranking Republican on the Senate Armed Services Committee.

"I also find it concerning that the president is again seeking to use military power even while he has accepted nearly a trillion dollars in cuts from our national defense over the last four years," said Rep. Randy Forbes (R-Va.). "The president's willingness to use our military without ensuring that it is properly funded should alarm all who view the maintenance of unparalleled American military power as a principal constitutional duty of our commander in chief."

Shadowing everything is the political calendar. With elections for control of Congress in 2014, analysts say any deal on defense, the budget and debt ceiling has to occur this year. ☛



A wheeled version of the Buk-M2E air defense system was displayed at the 2013 MAKS exhibition near Moscow last month.

BILL SWETNAM/ANAST

creases the weapon's range and ability to detect and attack targets with reduced radar cross-section, according to the supplier, Russia's Defense Systems JSC. The Pechora is associated with the VHF P-18 (Spoon Rest) radar, for which the Belarus company KB Radar offers a P-18R upgrade suite, including a new receiver, clutter cancellation device and automated tracking.

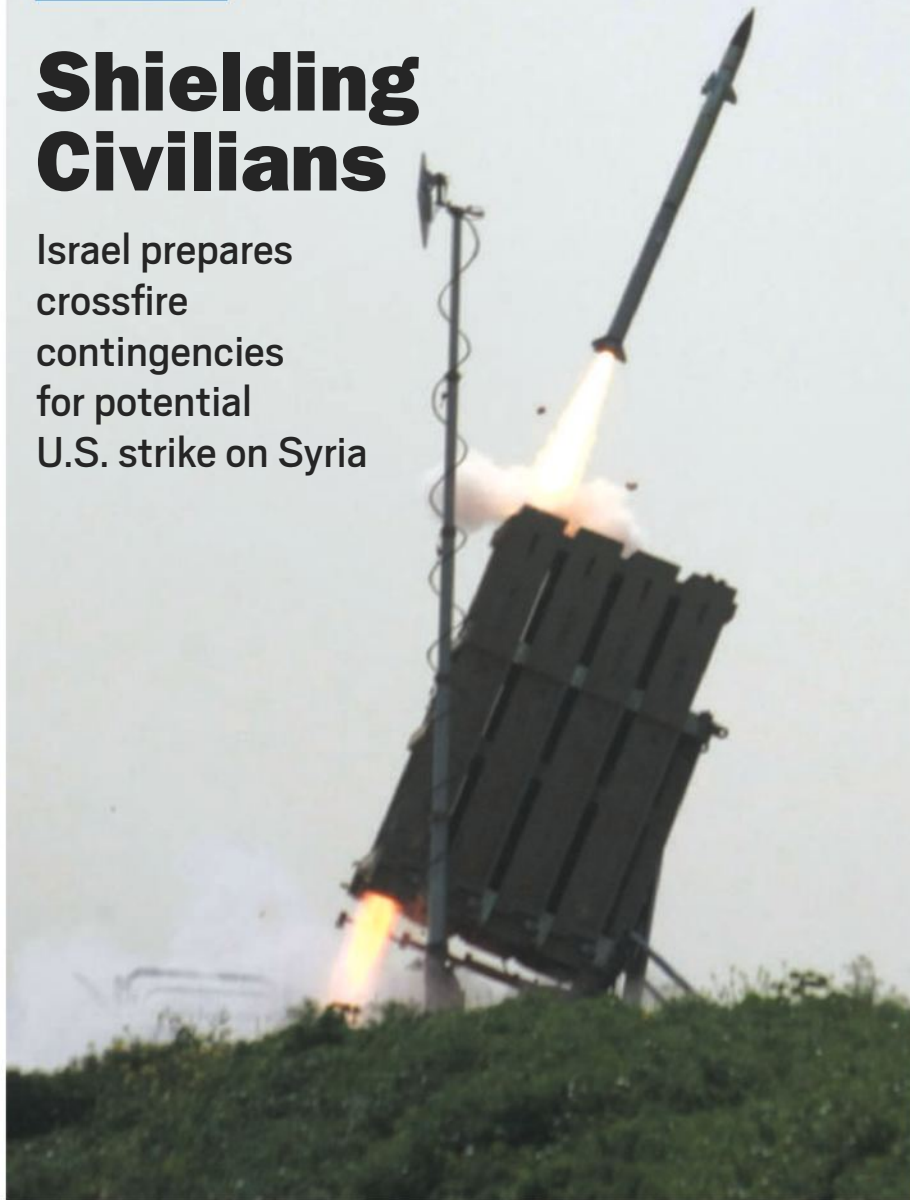
The most modern medium SAM in Syrian use is the Almaz-Antey Buk-M2E. Israeli sources estimate that eight batteries, including 18 launchers, were sold to Syria in 2011. With a listed maximum range of 45 km (30 mi.), the Buk-M2E is carried on tracked vehicles and is highly mobile; the manufacturer

says it can be set up or taken down for transport in 5 min. It uses semi-active guidance and has an NIIP 9S36 passive, electronically scanned array radar built into the launcher that can guide multiple missiles concurrently. The four-round launcher is teamed with a "transloader" that can carry eight rounds, four of which can be fired under guidance from the launcher.

Another weapon not previously encountered by the West is the Pantsyr-1 gun/missile short-range system, combining 12 ready-to-fire two-stage missiles and two 30-mm revolver cannon on a single turret. Syria is reported to have nine Pantsyr batteries with 36 vehicles. ☛

Shielding Civilians

Israel prepares crossfire contingencies for potential U.S. strike on Syria



Alon Ben-David Tel Aviv

RAFAEL/SHAUL GOLAN

Disappointed with the delay in the U.S. decision to launch a strike against the Syrian regime, Israel is bracing for possible consequences. The Israeli air force is on high alert, having taken delivery of a sixth counter-rocket Iron Dome system and preparing to deploy a seventh.

Israeli intelligence agencies do not see a Syrian attack on Israel in response as likely. Still, as Israelis prepared to celebrate Rosh Hashanah Sept. 4-6 and observe Yom Kippur Sept. 13-14, queues for gas masks formed outside the Home Front Command distribution stations. Fearing that a U.S. strike could provoke Syria to launch a chemical attack on Israel, many civilians were rushing to receive personal protection kits provided by

the military, with a gas mask and atropine syringe against nerve gas.

Repeated calming messages from the state's leaders did not soothe the public's anxiety. Many Israelis fear that if Syrian President Bashar Al-Assad was not deterred from using chemical weapons against his own people, he might try to use them against Israel as well.

"Israelis should carry on with their daily routine," declared Prime Minister Benjamin Netanyahu, but at the same time he allowed the Israel Defense Force (IDF) to draft 1,000 reserve servicemen, mostly from the Air Defense Corps. The Israeli air force took delivery of a sixth Iron Dome battery from Rafael and deployed the entire arsenal in northern, central and southern Israel. A seventh battery is expected to

be ready for deployment by the time the U.S. is prepared to strike. The Arrow 2 anti-ballistic missile system was placed on high alert, too, as were the Patriot MIM-104 surface-to-air missile batteries.

Syria has already used half its arsenal of Scud missiles in the civil war, but it is believed to still possess a stockpile of 500 Scud B/C/Ds, with ranges

Israel has taken delivery of its sixth Iron Dome battery and expects to receive the seventh in time for a potential U.S. strike on Syria.

of 300, 500 and 700 km (186, 310 and 435 mi.), respectively. While the liquid-propellant Scuds require a long fueling time, which exposes them before launch to potential strike, Israel is more concerned by the Syrian army's vast stockpile of solid-fuel M600 missiles. A clone of the Iranian Fateh-110 missile, the Syrian-made M600 can carry a 500-kg (1,100-lb.) warhead 300 km, which means it could reach all of Israel's population centers and strategic sites. Those, as well as tens of thousands of 302-mm rockets with a range of 150 km, are all capable of carrying chemical warheads.

The Arrow system was originally designed to counter Scud missiles and the Iron Dome to counter short-range rockets. The middle-tier system—David's Sling, which is supposed to deal with medium-range missiles like the M600—is still under development. Israel's Patriot PAC-2s were deployed to fill in this gap, until David's Sling achieves initial operational capabilities. "We do have some capabilities in countering ballistic threats," commander of a Patriot battalion, Lt. Col. Amir (last name classified), tells Aviation Week.

Israel still considers the Syrian air force a viable threat, despite its constantly degrading capabilities. At Ramat David Air Base in northern Israel, sirens go off every 2 hr., and fighters are sent scrambling, signaling that a Syrian fighter has taken a course toward the Israel border. "The last thing we should do is to underestimate the enemy," says the commander of an F-16C/D squadron at Ramat David, Lt. Col G. (name classified). "We don't trust luck or coincidence. If there's an aircraft flying toward Israel, we will be there to make sure it will not enter our airspace."

In its last encounters with the Syrian air force in 1982-86, the Israeli air force



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scored 100:0 hits. Still, says the commander of an Israeli air force air control unit, Lt. Col Assaf (last name classified), “We monitor [their] every action and take extra precautions, especially in times like this. They still fly. They’re operational, and we take them seriously.”

When Syria began receiving advanced Russian air defense systems in recent years, such as the SA-17 (Grizzly/Buk) and the SA-22 (Greyhound/Pantsyr), the Israeli air force was apparently concerned. After reports on seven strikes the Israeli air force con-

ducted in Syria in 2013, those systems no longer pose a challenge. That is why Israeli intelligence and decision makers confidently believe that Assad would not dare to challenge Israel.

“Assad knows that Israel could swiftly deny him of everything he still has,” a senior Israeli defense source tells Aviation Week. “He would be suicidal to try anything against us, and he’s not.” Nonetheless, in the last two weeks the IDF was simulating scenarios of proxy organizations launching rocket strikes against Israel from Syria

or Lebanon in response to a U.S. strike.

“We will respond and respond harshly,” Netanyahu has warned repeatedly. Israeli leaders are ambivalent about whether the U.S. should strike Syria. On one hand, they would like the U.S. to decisively enforce the red line it declared. On the other hand, they do not want to see an intervention in Syria that could change the course of the civil war. Israeli leaders consider Assad a bitter enemy, but looking at the Syrian opposition, they fear the alternatives could be worse. ☛



Rafal's Blue Sparrow, a precursor to the recently tested Silver Sparrow, helps simulate the movements and maneuvers of a variety of ballistic missiles.

RAFAEL

Sparrow Flies

Israel, U.S. test missile defense system in tense Eastern Mediterranean

Alon Ben-David Tel Aviv

Amid rising tensions in the Middle East, Israel and the U.S. conducted a test of a ballistic target, alarming Russia's warning systems.

The Israeli Missile Defense Organization and U.S. Missile Defense Agency (MDA) test-launched a new generation of ballistic target dubbed “Silver Sparrow” on Sept. 3. The governments say the tests had been scheduled before the recent gas attacks on civilians near Damascus, Syria. Developed by Israeli defense company Rafael, the target simulates a 1,500-km-range (932-mi.) ballistic missile, similar to the Iranian Shahab-3.

The 3-ton, 8.40-meter-long (28-ft.) target was launched eastward from an Israeli F-15A above the Mediterranean, west of Crete. Upon reentering the atmosphere, the missile separated the engine from the reentry vehicle and both crashed into the sea off the Israeli coast. It was the Silver Sparrow's

first fly-out test, and no attempt was made to intercept it.

A Russian radar station in Armavir, near the Black Sea, detected the test and, uncharacteristically, the Russian defense ministry issued a statement noting that “two ballistic missiles were fired above the Mediterranean eastbound.” Just 2 hr. after the Russian statement, as international media were speculating on the incident, the Israeli defense ministry and Pentagon confirmed the joint test.

“The test was long planned to help evaluate the Arrow ballistic missile defense system's ability to detect, track and communicate information about a simulated threat to Israel,” stated the U.S. Defense Department.

Asked whether it was prudent to conduct the test in such tense times, a senior Israeli official tells Aviation Week: “All times are tense in the Middle East. If we wait for calm times, we will never be able to conduct tests.” ☛

AVIATION WEEK

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Defense Technology Edition

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NATION BUILDING

OVERWATCH

French Forces Pacify Mali

Page DT13

An AMX 10RC guards a patrol looking for IED factories in Mali.



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at the Russian A&D industry's biennial MAKS air show at the end of August, or go to AviationWeek.com/maks

The next Defense Technology Edition will be dated **October 14/21**.

NAVAL LOGISTICS

Shore Duty

Amphibious operations anchor naval fleet plans

Michael Fabey Washington

For decades, the naval community has tried to justify mounting expenses for amphibious operations against criticisms that such tactics and equipment are no longer needed to face modern threats.

Now, with the littoral focus and growing interest in delivering humanitarian aid in the wake of natural disasters, navies are finding a solid anchor for amphibious aspirations. Their sails are filling quickly with plans for larger amphibious fleets and other ships to support those missions. The U.S. Navy in particular is searching for innovative ways to buttress such operations while refining equipment to move forces from ship to shore.

Two promising vessels for amphibious support operations, Navy brass say, are the Littoral Combat Ship (LCS) and Joint High Speed Vessel (JHSV), which provide transit of more than 40 kt. into shallow coastal waters.

The LCS-1 USS Freedom proved it can perform amphibious support in June, during the Cooperation Afloat Readiness and Training 2013 exercise with the 31st Marine Expeditionary Unit (MEU) aboard USS LSD-46 Tortuga, in a mock raid with Malaysian army paratroopers in the Asia-Pacific region.

Sailors acted as safety observers from the ship's 11-meter (36-ft.) rigid hull inflatable boat, while the crew of Helicopter Maritime Strike Sqdn. HSM-73 provided aerial support with Freedom's MH-60R (Romeo) helicopter. With its shallow draft, Freedom

anchored closer to the beach than other units and monitored landings.

"The Romeo was able to provide maritime support to the amphibious force," says Lt. Mike Roselli, attached to HSM-73. "We could, if needed, provide Hellfire rockets, torpedoes or a search-and-rescue swimmer."

Adm. Jonathan Greenert, U.S. chief of naval operations (CNO), is optimistic about using the JHSV in amphibious support with the vessel's capacity to carry more than 300 Marines or other personnel. "Our ability to conduct amphibious operations is an asymmetric capability," he said in May during the International Maritime and Defense Exhibition in Singapore.

The CNO touts that capability as one of the keys to success for the U.S. Pacific pivot. And there is little doubt about the importance of amphibious operations in that area, where regional powers are investing in mid-range amphibious fleets.

"The region is the clear growth leader for amphibious platforms, with 117 new ships and craft expected at a market value of over \$13 billion," AMI International says. "By hull count, the 16 nations in AMI's Asia-Pacific re-

With growing interest in amphibious missions, U.S. Navy LCACs are becoming workhorse vessels for ship-to-shore operations.



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gion are set to acquire more of these platforms than the rest of the world combined (outside the U.S.). Of note are ongoing and future large amphibious ships capable of operating landing craft from floodable well decks and fixed-wing strike aircraft from hull-length flight decks.”

AMI says the top Asia-Pacific spenders for amphibious ships over the next 20 years will be, in order: China, India, Australia, South Korea and Indonesia. “These ships are key to sustaining more distant naval operations. They also provide a flexible capability to respond to a range of missions.”

There is little doubt about the importance China’s People’s Liberation Army (PLA) puts on amphibious operations. “The PLA Navy also increased its amphibious force in 2012,” the Pentagon notes in its recent annual China report. “Two Yuzhao-class amphibious transport docks were accepted into service during the year, bringing the total Yuzhao LPDs to three.”

U.S. Navy officials say the Chinese want to develop amphibious and other logistical capabilities to support far-flung operations.

Meanwhile, the U.S. needs to maintain its ship-to-shore capability, especially with cancellation of the Marines Corps Expeditionary Fighting Vehicle. The Navy and Marine Corps rely on amphibious assault vehicles for ship-to-shore transit while they await development of the Advanced Amphibious Assault Vehicle.

The landing craft, air cushion (LCAC) vessel has also been a workhorse during exercises such as Bold Alligator 2012 off the North Carolina coast. The Wasp-class amphibious assault ship LHD-3 USS Kearsarge participated, and Capt. Dorian Jones, commanding officer, said during the exercise that the combination of LCACs, aircraft and shore-landed marines underpins the expeditionary nature of such ships and their flexibility to handle diverse missions.

The LHD-6 USS Bonhomme Richard also made use of LCACs—as well as CH-53E Super Stallion helicopters and MV-22 Osprey tiltrotor aircraft—with the 31st MEU as part of the biennial combined joint-training exercise Talisman Saber 2013, off Australia in July. During the exercise, the Navy honed the SH-60 Seahawk’s ability to provide operational overwatch by gathering intelligence, surveillance

and reconnaissance and transmitting the data to ground troops.

“Sea control and air superiority are critical to successfully carry out an amphibious landing . . .” the Navy notes in a blog about Bold Alligator. For this reason, the Pentagon is working on programs for amphibious assault support.

The Defense Advanced Research

Projects Agency, for example, is developing the Captive Air Amphibious Transporter (CAAT), a tracked vehicle that moves through water with air-filled pontoons on the tracks. CAAT shows potential for transporting 20-40-ft. containers from ship to shore, enabling commercial ships to relieve military vessels. ☛

GOING MOBILE

Michael Fabey Washington

The Future Mobile Landing Platform (MLP) looks far different than typical U.S. Navy ships. But its capabilities are game-changing.

Leveraging float-on/float-off technology and a reconfigurable mission deck, the MLP provides a seagoing pier when access to on-shore bases and support are unavailable. Platform modules support a vehicle staging area, vehicle transfer ramp, mooring fenders and three LCAC (landing craft, air-cushioned) lanes.

The MLP can operate 25 mi. from shore and transfer equipment in 1.25-meter (4.1-ft.) waves. When the mission deck is removed, it serves as a semi-submersible platform, offering salvage and point-to-point capabilities.

Even the crew is outside the norm—33 contract mariners working for a company under charter to Military Sealift Command (MSC). It is similar to the setup for the Joint High Speed Vessel, which also belongs to MSC.

MSC operates 110 noncombatant, civilian-crewed vessels that replenish Navy ships, conduct specialized missions, strategically preposition combat cargo at sea, and move cargo and supplies used by deployed forces and coalition partners. The MLP class of modular, flexible ships belongs to MSC’s Maritime Prepositioning Force as a mobile sea-base option that provides the Navy with critical afloat capability, supporting the flexible deployment of forces and supplies.

Delivered to the Navy in May, MLP-1 USNS Montford Point departed San Diego July 12 for Naval Station Everett, Wash. The Montford Point is to be fully operational in fiscal 2015. The ship is scheduled for final contract trials this month, and its core capability set will be installed later this year.

“Montford Point will provide the key link that permits the military to engage in seabasing sustainment of equipment and supplies to our troops ashore, from beyond the horizon,” says Mike Touma, assistant engineering officer in MSC’s Prepositioning Program.

MLP ships are 765 ft. long with 164-ft. beams and draft of 29 ft. Deadweight tonnage exceeds 60,000 tons. Upgrades could enable berthing, medical operations, command and control, mission planning, vehicle transfer, connected replenishment, container-handling and aviation. ☛

The Military Sealift Command’s first mobile landing platform ship USNS Montford Point floats out of General Dynamics’ Nassco shipyard in San Diego.



U.S. NAVY



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Red Alert

Budget cuts challenge Israel's defense exports

David Eshel Tel Aviv



ISRAELI DEFENSE FORCES

The Israeli defense industry is being buffeted—some might say battered—by winds of change. In this case, it is a perfect storm of budget cutbacks by many countries, including Israel, that are shrinking defense expenditures concurrently with the winding down of wars in Iraq and Afghanistan.

Reduced spending is evident in most regional markets including East Asia, which has been recording solid growth in recent years. Countries that fielded substantial military capabilities are reevaluating the size and cost of their forces, while some are downsizing them and adapting to the requirements of cash-strapped economies.

Many of Israel's defense exporters face decreasing market share and growing international competition for programs. Hardest hit are companies that supply armor technology. Those with the best chances of prospering are contractors with air-defense systems and unmanned aerial systems (UAS).

The state of the export business is evident in the surplus market, which is saturated with unused military equipment. Much of this is materiel being phased out by Western forces, and some of it is almost new.

"Sales of such equipment is increas-

ingly difficult," says Shmaya Avieli, head of Sibet, Israel's defense export directorate. "To succeed in this market, we must be more creative to maintain, much less grow, our market share."

Avieli notes that "although the market is withering, it isn't dead." And he points out: "We are addressing requests for information and proposals that keep arriving from countries all over the world, but the difference now is that there are many more competitors for each opportunity. Industry giants from Europe and the U.S. that ignored small segments in the past are competing on every tender, even in countries they never entered before.

"This situation is not exclusive to Israel," Avieli continues. "When there is rain, everyone gets wet. Other companies, competitors and potential partners also feel the heat, including Americans, Europeans and Koreans. In some situations, this opens a door for cooperation that was not available in the past."

This competition, along with the requirement of customers to keep an increasing share of their spending at home via offsets and other measures, is pushing contractors to find creative solutions for collaboration, such as working with other international companies

and local partners, that will sweeten their bids in specific countries, Avieli explains.

Israel's defense exports in 2012 totaled a record \$7.47 billion. The results were surprising, Avieli says, particularly in light of economic pressure and reduced demand for military hardware.

In 2012, Israel exported missile systems with a value of more than \$1.6 billion, the largest segment of foreign sales. The main driver was Rafael Advanced Defense Systems, which sold a number of weapons including the Spyder air-defense system, Spike mul-

Israel has reduced production of Merkava tanks and outsourced the Namer armored vehicle to the U.S.

tipurpose guided missile and Spice air-to-ground guided weapons. And, even though Israel Aerospace Industries' Barak 8 missile is still in developmental testing, it was reportedly part of a \$1.6 billion deal between Israel and Azerbaijan. IAI also tallied sales of its Harop missile.

As major new systems reach maturity in coming years—for example, David's Sling, the advanced Iron Dome air defense system, Arrow-3 missile defense system and Spice 250 autonomous guided weapon—the missile segment of Israel's defense exports will be on track for growth.

Missile systems are typically dependent on specialized subcontractors and require significant investments in R&D. Subcontracts are regulated, and therefore, the level of competition in this segment is small.

Brig. Gen. Eitan Eshel, head of the defense ministry's R&D directorate, says current sales are the fruits of research investments that were made in the early 1990s. "It is important that we continue to invest in R&D, especially when budget cuts hit every sector," Eshel says.

Despite the dramatic budget cuts announced in Israel recently, R&D funding remains intact so as not to damage applications and future work.

In contrast to the growth in missile sales, the once dynamic armor-protection market has diminished. This reflects lower demand, as recent customers for ballistic protection, such as the International Security Assistance Forces, draw down in Afghanistan.

The decline is devastating a large

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WHEN RESULTS MATTER

industrial base that evolved in Israel over the past decade. The impact has been exacerbated by Israel's reduction in procurement of armored fighting vehicles. The shifting of production of the Namer armored infantry fighting vehicle to General Dynamics in the U.S. slowed demand for kits, while lower production of Merkava tanks, due to budget cuts, brought local demand to a near standstill.

Most affected are tens, maybe hundreds of providers of composite, ceramic and transparent armor; fire-suppression equipment; blast-protected seats; as well as chemical, biological, radiological and nuclear equipment; and heating, ventilation and air-conditioning equipment. These suppliers flourished in the small market, carried by a wave of demand for protection of coalition forces in Iraq and Afghanistan, and domestically during and after the Second Lebanon War of 2006. In 2010, for example, Plasan's sales (attributed exclusively to armor protection) soared to \$850 million. A year later, sales dropped dramatically as orders for armored vehicles and their armor kits dried up.

The market pressure is driving mergers and acquisitions in Israel among companies that were slow to adapt to this trend. In recent years, several defense companies came close to bankruptcy, driving management changes and acquisitions. The main beneficiary was Elbit Systems, which acquired a group of companies including artillery and mortar manufacturer Soltam, along with armored vehicle specialist Saymar and IT, which was a small but persistent competitor of Elbit in the electro-optics market.

Another way to survive and prosper in the current market is to seek opportunities where Israel's unique products, technology, know-how and operational experience add value. "We are reevaluating our coverage of the world conflict map, assessing where new requirements could emerge and realigning our coverage of these markets," says Avieli.

Unmanned aerial systems, tradi-

Global air defense needs keep orders coming for Rafael's Spyder and other intercept weapons.



NOAM ESHEL/ANAST

'We are reevaluating our coverage of the world conflict map, assessing where new requirements could emerge,' says Shmaya Avieli, head of Israel's defense export directorate

tionally a strong export business for Israel, accounted for slightly more than \$200 million in 2012. Nevertheless, UAS are becoming part of more

entire C4ISR segment now accounts for 17% of exports, or \$1.27 billion.

Avieli says the unmanned systems domain is positioned for growth. "Israel is already the largest global provider of UAS outside the U.S." On Nov. 26-28, many of Israel's unmanned systems manufacturers will demonstrate capabilities to foreign delegates at the Autonomous Unmanned Systems and Robotics (AUS&R) exposition and conference in Rishon, Lezion, Israel. (Aviation Week is a media partner in the event.)

"Due to the growing threat of ballistic attacks, there is also interest in rocket and missile defense," Avieli says. "There is interest in more capable defenses, spanning multiple layers and covering longer distances. This is a mature market, but it could signal big

Demand remains strong for unmanned aerial systems such as the Hermes 900 from Elbit Systems.

deals. It is also complex to address, both for the buyer and the seller.

"The threats each country faces may be different than those of others," he explains. "We are addressing these opportunities creatively, fostering close cooperation and partnerships with potential customers that are interested in our solutions." ☛



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Path of Least Resistance

Cassidian's mobile nodes automatically optimize data transmission

Angus Batey **London**

A five-year project to automatically transfer data around the battlespace comes to fruition this month when Cassidian, the defense and security arm of the Airbus Group, launches the Mobile IP Node at the Defense and Security Equipment International (DSEi) exhibition here.

Originally part of the company's contribution to the U.K.'s Autonomous Systems Technology Related Airborne Evaluation and Assessment (Astraea) program, created to streamline the entry of unmanned aircraft into civilian airspace, the Mobile IP Node has applications across multiple domains.

Cassidian officials at first feared the system was going to arrive to the market too late. "At DSEi two years ago, four companies had mobile IP [Internet protocol] nodes on their stands," says Max Baldwin, head of strategy for the U.K. and Nordic countries. "We thought we had missed the boat. But when we investigated what they did, it was mobile or deployed fixed networks."

The key to the Mobile IP Node is its ability to continuously update and adapt itself to ensure data find the path of least resistance across a network. Each platform with a node—which will eventually fit in the palm of the hand—automatically connects to other nodes within range of the platform's onboard radio. Once linked, a node works as a data hub, receiving or transmitting in-

Nodes are monitored in vehicles with a dashboard-mounted tablet computer.

formation, but also acting as a transit point for data in the network.

The network establishes the best route for data transmission, depending on priorities set before an operation. No operator action is required after mission priorities are assigned to the system. Users do not need technical expertise, nor will a mission be interrupted to adjust network settings or performance. The system is radio-agnostic.

"By understanding what communications the radio-frequency side can



CASSIDIAN PHOTOS

The current generation of Cassidian's Mobile IP Node was installed in an Iveco track-laying vehicle at the Defense Vehicle Dynamics show.

achieve, then through cryptography to the applications side, we can inform applications about what they are capable of achieving," says Gary Clayton, U.K.



head of research and technology. "The application tailors what it sends. For example, instead of trying to force high-definition video down a link that cannot take it, the node sends it in low resolution and only the part of interest in high resolution. Or it will crop the stills, then go back to video when the link changes."

The best route through the network changes as each platform moves. The initial problem the system set out to solve was eliminating communication latency when pilots of remotely operated aircraft liaised with air traffic controllers.

Demonstrating this capability in an air environment is expensive, time-consuming and complicated, so Cassidian developed a ground-based demonstration. The company put Mobile IP Nodes in five Mini Cooper automobiles and drove them around a communications "black spot" in the Brecon Beacons mountains in Wales. Two more nodes were placed in the test area—one fixed, the other on a train.

Data-transfer routes and network strength information were recorded, along with GPS coordinates for all platforms. These were compiled in 3-D animation, with strong links shown as green lines connecting nodes, weaker links in yellow and the weakest in red. Links change color and direction as the network selects the optimum means of delivering pre-assigned priorities.

"We had wet trees, high-sided mountains, a lake with a big curve and water reflections," Clayton says. "It was a difficult environment. What we saw was that the links all changed and used the train, because that was the best route to get data through."

The same capability was demonstrated in real time at the Defense Vehicle Dynamics show in Millbrook, England, in June, with nodes installed on Iveco trucks and the links changing as the vehicles drove around test tracks. Potential user scenarios included

emergency response, particularly in bandwidth-constrained environments, as well as aviation and ground-based military use.

"We are talking to Iveco about military and non-military uses, because there is no other nodal network that works like this," says Baldwin. ☒

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Working the Details

A touch of refinement appears at Auvsi

Bill Sweetman Washington

New U.S. unmanned systems programs are fewer in number and smaller than in pre-sequester days, but user demands are still pushing technology for payloads and upgrades. Last month's Association for Unmanned Vehicle Systems International (Auvsi) show here highlighted a mix of innovation, upgrades and perennial technological pursuits.

One possibly historic innovation was disclosed by AeroVironment: what could be the first operational air vehicle to use solar power. The company announced that it had flown its Solar Puma for 9 hr., 11 min, using film-type

body types. With more upper surface area relative to total wetted area, they may be better adapted to solar power than a conventional wing/body design.

The quest for a small UAS engine that burns diesel or JP-5 fuel rather than aviation or automotive gasoline has been underway since the 1980s. The latest bump in this long road was the acquisition in July of Thielert, manufacturer of the diesel engine for the U.S. Army's MQ-1C Gray Eagle UAS, by China's Avic.

This has forced the Army and General Atomics to adopt Lycoming's DEL-120 diesel—an engine that Ly-

tactical systems—were also in evidence. Latitude Engineering of Tucson showed a prototype of a hybrid quadrotor: A piston engine drives a generator, turning four electrically powered rotors (on the prototype) mounted in front of and behind the wing on booms that carry the tail. The 60-lb. next-generation vehicle will have eight lift rotors installed in pairs, above and below the booms. Latitude says three of the latter vehicles have been ordered by Naval Air Systems Command for a test program.

Tail-sitters are vertical-takeoff-and-landing (VTOL) aircraft that are mechanically simple, but difficult for a pilot, so the layout is not a problem for a UAS. Swift Engineering, the California-based composite company that produced the KillerBee UAS some years back, showed a tail-sitter prototype that comprised a high-aspect-ratio wing with three lifting propellers and a cruise propeller.

Another VTOL concept came from Swiss/Swedish newcomer Unmanned Systems Group in the form of the ATRO-X helicopter UAS, shown in the form of a one-third-scale model.

Unmanned Systems Group debuted a model of its tip-jet-powered ATRO-X UAS at the Auvsi show in Washington last month.

Slightly bigger than rivals such as the Schiebel Camcopter and Saab Skeldar, the ATRO-X revives the hot-cycle tip-jet concept last flown almost 40 years ago: A simple gas-turbine engine is mounted on the rotorhead and exhaust is ducted along the blades to nozzles in the tips. ATRO-X designers point out that the helicopter needs no transmission or tail rotor. The jet engine is simple, inexpensive and easy to remove for maintenance, and burns JP-5 or diesel fuel.

There is a counter for every weapon system, and UAS are no exception. The U.K.'s Plextek Consulting has been testing its Blihter series of active, electronically scanned array radars—including vehicle-mounted and man-portable systems for ground surveillance—in the ground-to-air role and is rolling out a software and human-machine-interface package that can detect small UAS. One application is for airport or facility security, where the same radar can detect ground-moving or airborne intruders. Another is to clear airspace for friendly UAS operations and to reduce the risk of collision. ☼



BILL SWEETMAN/AW&ST

gallium arsenide solar cells, produced by Alta Devices of Sunnyvale, Calif., and built into the upper wing skin under a transparent layer. According to Alta Devices, the solar array adds only 127 grams (4.5 oz.) to the mass of a Puma-sized unmanned aerial system (UAS) and is 28.8% efficient. The endurance is 4.5 times that of a standard aircraft.

AeroVironment has flown fuel-cell-powered versions of the Puma, but the Solar Puma has two advantages: It does not need the operator to carry a fuel supply, and the technology can be added to any Puma via an upgrade kit that includes new wings. The company plans to have the kit in production early next year.

Alta Devices' documents show how solar cells can be applied to different configurations such as blended wing-

coming did not show at Auvsi, instead bringing its smaller, 63-hp EL-060 (a spark-ignition multifuel two-stroke). One question is when the new DEL-120 will be able to attain the time between overhauls needed for UAS use. The Thielert engine became notorious in the personal-aircraft market for frequent and expensive inspections and overhauls.

Britain's Cosworth has been marketing a smaller diesel engine, the 10-hp AG, for some years, but has yet to score a sale. The engine has been test-flown in an Arcturus T-20 UAS (with a launch weight around 175 lb.) and has an impressive 0.435-lb./hp/hr. specific fuel consumption. The latest version has electronic fuel injection.

Different ways to achieve vertical takeoff and landing—almost essential for shipboard UAS and valuable for



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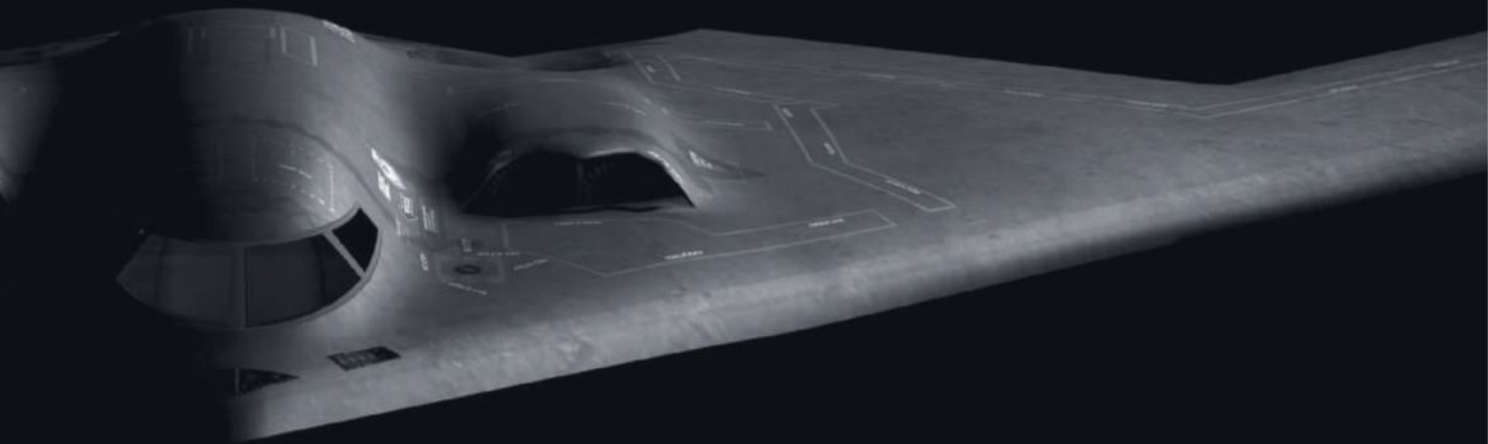
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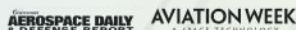
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Carte Blanche

French forces are free to attack anywhere in Mali

Christina Mackenzie Paris

France has the upper hand militarily in Mali following a July 13 agreement between Herve Ladsous, United Nations undersecretary general for peacekeeping operations, and Gen. Didier Castres, deputy chief of operations for the French military. The agreement stipulates that French troops can conduct combat operations at will in the African nation.

The French deployment called Operation Serval and a U.N. force are in Mali to stabilize the government and provide security after Tuareg and Islamist militants seized the northern part of the country last year. Two rounds of presidential elections have been held, the most recent on Aug. 11.

The agreement also establishes that if the 6,200 soldiers of the U.N.'s Multidimensional Integrated Stabilization Mission in Mali (Minusma) are threatened and need assistance, French troops will respond. They will use any weapon, including air strikes, and can call up additional troops, whether from Chad, Cote d'Ivoire or France. In addition, French troops will provide Minusma with logistical support.

The need for the agreement became apparent when Minusma deployed in April, leading to a situation where two international forces were operating in one country.

According to intelligence analyst Stratfor, "with this agreement, the U.N. is . . . circumventing its own mandate and rules of engagement by allowing the French to conduct combat operations without [adhering] to the same limitations and constraints of . . . African forces. This unconventional approach likely stems from the fact that the peacekeepers are facing a more complex militant threat than in most . . . operations, compelling them to employ the French to project firepower that U.N. forces . . . cannot [under their mandate]."

France has withdrawn some of the 4,000 troops it deployed to Mali at the height of Operation Serval in February but is maintaining troop strength at 3,200 until all parties accept results from the presidential elections. U.N.



MINUSMA/MARCO DORMINO

forces are responsible for security during stabilization. However, only half of the 11,200 troops that could be deployed are in country.

Stratfor estimates that "at this level, the troops are capable of continuing to secure population centers." Moreover, attacks by militants in the cities or against security forces throughout the



EMA/FRENCH ARMY

country have not occurred in recent months, the analyst notes, even though tensions between the Malian military and northern Mali's Arab and Tuareg populations pose security threats and jihadists retain an offensive capability.

Since its establishment, Minusma has been implementing its mandate in terms of political offices, electoral support, human rights and support

for the restoration of state authority. On July 1, Minusma attained initial operational capability (IOC). Sector headquarters, in Gao and Timbuktu, should soon be operational, with all headquarters staff built up over the next two months.

Ladsous stated in June that Minusma was suffering from capability shortfalls including medium utility helicopters, armed helicopters, intelligence, information operations and special forces. "We count on the continued support of both our traditional

French and U.N. generals meet in northern Mali (from left): Gregoire de Saint-Quentin, commander of Operation Serval; Ibrahima Dahirou Dembele, Malian armed forces chief of staff; and Minusma commander Jean-Bosco Kazura of Rwanda.

and new troop-contributing countries to help fill these critical gaps," he said.

Providing logistical support to Minusma troops in northern Mali presents "formidable challenges," Ladsous said, given the harsh desert climate, the state of infrastructure and the vast area. "We must be realistic and understand that not all of these capabilities will be immediately available."

Ameerah Haq, U.N. undersecretary general for field support, says the immediate priority is Minusma's IOC. Efforts are focused on providing rations to troops, fuel for vehicles and premises for work and living. "Minusma is one of the most logistically challenging missions the U.N. has launched," she says.

Sandstorm engulfs a column of armored vehicles in northern Mali.

With no functioning power grid in Gao, generators are necessary. Mobile communication systems cannot be deployed to Kidal because sensitive components would melt, she explains. "Information and communication technology, vehicles and refrigeration would be exposed to climatic conditions that expedite their decay."

Military helicopters provide most air transport since large aircraft cannot use airfields in northern Mali. Most roads, in fact, are little more than sand.

Haq says security is also a challenge because, despite an agreement with the National Movement for the Liberation of Azawad, there are armed groups sworn to attack U.N. forces. ☛



On Track

CTAI reaches a milestone in development of a 40-mm gun and ammo

Angus Batey **Radway Green, Cheshire, England**

The reorganization of BAE Systems' British munitions factories, facilitated by the Munitions Acquisition Supply Solution (MASS) contract with the U.K. Defense Ministry, is nearly complete.

The Radway Green plant, which produces small-arms munitions, has been transformed, and new lines have been built. Savings are being realized from automation and other production efficiencies that the agreement mandates.

MASS, signed in 2008, is a 15-year contract. It assures the ministry of general munitions supplies and a price ceiling for 10 years. BAE agreed to upgrade factories and, in turn, is assured of sales and growth.

Against this backdrop, the timing of the maturation of one long-term development project is propitious. The Anglo-French cased telescoped armament system (CTAS) was announced in 1994, when the partners were GIAT and Royal Ordnance. Today, CTA International is a 50/50 partnership between successors BAE and Nexter, and its innovative cannon and shell designs have completed a qualification milestone.

"Qualification is split into three phases," says David Coughtrie, CTAI's

business director. "We've done all the trials and supplied the trial reports to the Defense Ministry and to DGA (the French procurement agency).

"After they come out with their view, we will issue a certificate of design, saying we are qualified for the cannon and armor-piercing and target-practice rounds. The second phase is the point-detonating general-purpose round, and we are delivering rounds into trials for that. The third phase will qualify the airburst round."

The CTA design limits the footprint of the cannon inside a vehicle, minimizes recoil and allows for different-purpose rounds to be fed as needed into the gun. This means a 40-mm gun can be fielded on platforms that would otherwise be limited to smaller calibers and—without the case telescoped design—fewer rounds of ammunition.

CTAI has long interested a range of potential customers, but has been integrated in just three programs: the French EBRC armored combat reconnaissance vehicle and the British Warrior up-

The 40-mm CTA cannon has a small footprint and low recoil. It fires multiple ammunition types.

grade and Scout projects. The French program is not scheduled to produce a vehicle until 2018, while the British procurements have suffered delays and other difficulties.

It has been a challenge for CTAI, which has to fire-wall development efforts with the different consortia, with each using separate solutions for the ammunition carousel, system electronics, gun drives and turret mounts. Test-firing programs have slipped. But the delays may be to CTAI's advantage.

"Now is probably right for us," Coughtrie says. "We're in advance of the programs. If we'd been behind them in qualification, they may have

booted us off and kept the old guns."

Cost reduction is among CTAI's objectives. "We're developing a TPRR-T (target-practice reduced-range tracer) round," says Coughtrie, "because it is low-cost. And since it is fired in training so much, it wears out the barrel less. Now that we are through qualification with the cannon, we are looking at the system to see where we can drive down cost."

The demonstration programs are generating significant business—the U.K. programs alone have seen 11 guns and 20,000 rounds supplied, with a further three cannons, 48 barrels and 50,000 rounds under contract. Ad-

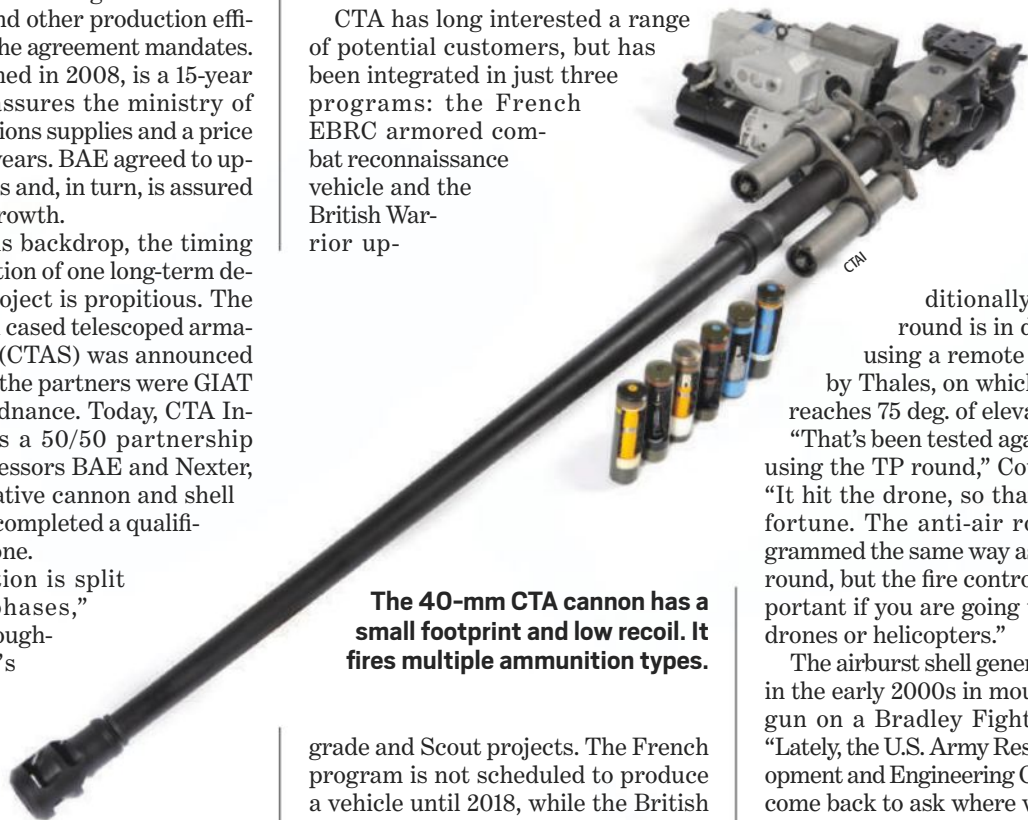
ditionally, an anti-air round is in development, using a remote chassis built by Thales, on which the cannon reaches 75 deg. of elevation.

"That's been tested against a drone, using the TP round," Coughtrie says. "It hit the drone, so that trial cost a fortune. The anti-air round is programmed the same way as the airburst round, but the fire control is more important if you are going to go against drones or helicopters."

The airburst shell generated interest in the early 2000s in mounting a CTA gun on a Bradley Fighting Vehicle. "Lately, the U.S. Army Research, Development and Engineering Command has come back to ask where we are [in development]," says Coughtrie. "Airburst is a capability they don't have."

Inquiries are also coming from beyond the land domain.

"Someone was looking at putting the gun on a C-130 gunship," he says, declining to identify the individual. "It was a U.S. company that got our data somewhere, and maybe it will give them an advantage over other bids. I was surprised when I got it. But the cannon is 300 kg (660 lb.) and has very short recoil. Of course, you have to control the pulse, but why not [put it on an aircraft]? We'll see what happens next." ☛





Hunter-Killers

U.S. Navy zeroes in on mine countermeasures

Michael Fabey Panama City, Fla.

LOCKHEED MARTIN

Naval mine countermeasures (MCM) operations are an all-or-nothing bet: Either they are done well or ships are destroyed.

"Mine warfare is either not important, or the most important thing in your life," says U.S. Navy Rear Adm. (select) John Ailes, in charge of integrating the Littoral Combat Ships (LCS) with mission-module packages.

The LCS will be the Navy's front-line MCM vessel, and right now mine warfare is one of the most important concerns in Ailes's life.

MCM is a priority for the Navy, and for good reason. "Since World War II, mines have damaged more U.S. warships than missiles, guns and bombs combined," writes Bradley Peniston in his 2006 book on a mine-ravaged ves-

The RMMV is a centerpiece of the U.S. Navy's mine countermeasures.

sel, *No Higher Honor: Saving the USS Samuel B. Roberts in the Persian Gulf*. "Yet the Navy still afforded its surface combatants no mine-detection gear more sophisticated than a pair of binoculars and a sharp-eyed lookout."

The Navy wants to do a lot more than that with the MCM mission-module package. This has a "detect-to-engage" system that employs aviation and unmanned undersea vehicles (UUV) that are loaded with state-of-the-art sensors and equipment for destroying mines.

But the most important element of the MCM measures aboard LCS, Navy officials say, is that they will keep ships and sailors out of minefields.

The centerpiece for MCM operations is the remote multimission vehicle (RMMV). "In some ways, the RMMV is the vehicle that replaces the Avenger-class [MCM] ships," Ailes says.

Built by Lockheed Martin, the unmanned, autonomous, high-endurance semi-submersible vehicle weighs 14,500 lb.—including the AN/QS-20 sonar—and is 23 ft. long, with 4-ft. diam-

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eter and mast-extended height of 18 ft.

"With the [RMMV] it's not just the speed of getting there, but also [the] speed of being inside the mine field," says Bob Benjamin, MCM technical program manager for the Naval Surface Warfare Center here.

The vehicle, Ailes notes, handles the roughest sea states. The UUV also needs to generate the 290 hp and 3,000 lb. of force necessary to pull a 3.8-in.-dia. cable—nearly 1,900 ft. of it—tethered to the mine-hunting sonar through the water.

The UUV was initially for destroyers. Now the Navy and Lockheed Martin are adjusting designs and procedures to operate it off the smaller LCS. The program also had to report a Nunn-McCurdy cost breach when unit price rose after the Navy cut its planned purchase by half because the service opted against using RMMVs for antisubmarine missions.

The service and contractor have had to fix significant reliability issues, and now the UUV is due for communication and sensor improvements that supporters say will make the vehicle a more powerful MCM weapon, and

one that is easier and safer to operate.

The RMMV is to be tested for the Navy's new networked multi-vehicle, communication-adaptive Wi-Fi system. "We've done shore-based systems and testing at Lockheed Martin with radios operating off LCS," says Navy mine warfare analyst Tracy Nye.

"One of our next areas of focus is launch and recovery," Ailes says. "We've designed tests to address that and seen progress." The work entails hardware and software upgrades, as well as a tweaking of procedures. For example, operators now release the RMMV tow line and vehicle "capture spine" sooner after putting it in the water, resulting in less equipment damage.

The Navy and Lockheed Martin are also studying the ship's wake field to develop tactics and procedures for easier recoveries.

After completing testing in 2015, Ailes says, the Navy will be ready to deploy the RMMV and the rest of the MCM mission module on the USS LCS-2 Independence. The module package will include RMMV, MH-60S Sea Hawk helicopter, and mine-sensing or -destroying equipment.

MCM operations currently involve detecting and classifying mines. But the AN/AQX-20A sensor detects and classifies in the same mission, Benjamin says. When fully implemented, the MCM module package will include AN/AES-1 sonar, Airborne Laser Mine Detection System and AN/ASQ-235 Airborne Mine Neutralization System.

Recent Sea Hawk MCM tests "were surprisingly successful," Nye says. "We were able to fly that helicopter on and off the ship. We tried different tactics of launching and recovery. They really pushed the envelope on helicopter operations on the ship."

Nevertheless, developmental testing shows ongoing performance problems, according to a report from the U.S. Government Accountability Office (GAO). The GAO also notes that some systems do not meet performance requirements.

The Navy has also had to halt some helicopter towing operations because of concerns about the potential for engine failure, Ailes says. However, the helicopter has repeatedly proven it could perform the mission, after modifications. ☛

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Fire Safe

Thermal coating resists high-heat ignition

David Eshel Tel Aviv

Fire protection is an essential requirement in the design of military platforms. The need has increased in recent years with the growing use of combustible materials such as composites and high-power-density batteries.

There are, of course, many fire-protection techniques. One new measure, developed by LMJ Systems of Herzliya Pituach, Israel, uses a thermal coating to reduce an object's vulnerability to fire. The coating, which is said to be non-toxic, non-corrosive and biodegradable, can be applied to protect materials that would be damaged by fire and susceptible to explosion, such as conventional paints and coatings, camouflage nets, propellants and ammunition, certain composites and lithium batteries.

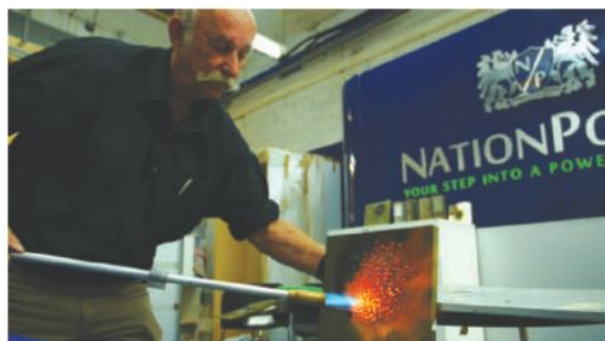
The patented "smart coating" has

the ability to prevent flammable materials from catching fire even at extremely high temperatures. One version, called SM-P4, is applied like paint to any type of material, at a typical thickness of 150-625 microns. Such a layer totally isolates the protected surface from heat even if exposed to open fire for hours.

LMJ has several versions of the material. SM-P6 is optimized for military applications. When painted on non-flammable materials, such as

metal, concrete or fiberglass, coated bulkheads or pipes provide heat shields that prevent fire from spreading.

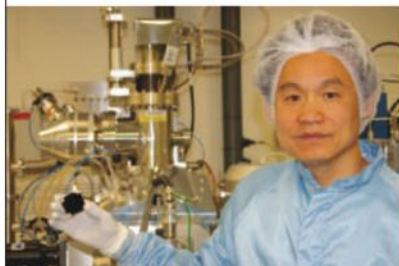
The material also keeps flammable materials such as wood or cardboard from catching fire. Certain composite materials, such as Kevlar or ultra-high-molecular-weight polyethylene, are susceptible to fire caused by incendiary ammunition or combat actions. When burning, these materials release toxic fumes that can put personnel at risk, especially in confined spaces. Encapsulation of these composites within an SM-P6-impregnated



NOAM ESHEL PHOTOS/AW&T

REALLY DEEP BLACK

Surrey NanoSystems of Newhaven, England, has developed what it calls the "world's blackest material." Formulated primarily as a coating for optical instruments in space, the material, which derives its properties from a special carbon nanotube formulation and structure, is for applications that will benefit from its extreme light-absorption properties (more than 99%) across visible, ultraviolet and infrared (IR) spectra. This last is especially important because the structures of pre-



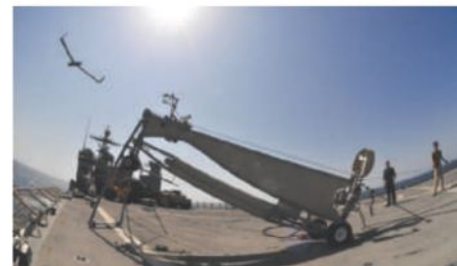
SURREY NANOSYSTEMS

vious black materials were not large enough for optimal IR absorption. When applied to an optical device, the material reduces reflections, thereby increasing its sensitivity. The ultra-low reflectance enhances calibration and other

specialized operations. The coating is produced with an innovative low-temperature catalyst process that accurately deposits vertically aligned nanotube arrays on substrates including 3-D surfaces. The company does not disclose catalyst temperature, but it is well below the 750C (1,382F) normally used for such coatings. The temperature is low enough that the material can be applied to lightweight aluminum components, rather than heavier, and more expensive, substrates of silicone, titanium and stainless steel, which have high thermal stability.

ATMOSPHERIC UPDATES

The U.S. Navy is experimenting with a network of unmanned vehicles in the air, on the ocean and undersea to provide near-continuous data on atmospheric anomalies that affect radar, communications and weapons performance. The most recent experiment was during Trident Warrior 2013, a fleet exercise off the U.S. East Coast. ScanEagle unmanned aerial vehicles (UAV) from the Office of Naval Research deployed with undersea and surface robots to detect and measure fluxes and turbulence created by the interaction of air and sea, along with atmospheric "ducts" that trap energy. Such disturbances affect the paths of electromagnetic waves in radar and communications. When ducts occur at low levels, radar and



U.S. NAVY

communications can transit longer distances than intended, revealing the location of a ship or even a battle group. When they happen in the upper atmosphere, they trap radar energy and blind the Navy to threats that would otherwise be detectable. ScanEagle UAVs were equipped with sensors developed by the Scripps Institution of Oceanography. Flying as low as 100 ft., they measured wave height, wind speed, humidity and temperature, as well as fluxes in mass, momentum and energy, for analysis by ship personnel.

envelope would negate fire risk while preserving their ballistic properties, the company says.

According to the inventor, Joseph



LMJ's SM-P4 can be applied like paint or formed into containers to protect materials from fire.

Labock, the material could be suitable for aerospace applications, where it would protect electrical wiring and exhaust pipes, as well as critical structural elements made of composites.

It can additionally be used to create

fireproof containers for flammable or potentially explosive objects such as lithium batteries. Such batteries are particularly vulnerable in airplanes, as they tend to overheat and explode when exposed to sudden environmental changes.

In fact, LMJ has offered to apply a thin coating of the material to protect lithium-ion batteries that have shown a tendency to combust when damaged, ruptured or otherwise impaired. Such batteries are widely used in civilian and commercial applications, and increasingly by the military for man-portable gear and in hybrid-propelled vehicles. ☛

Correction: *The U.S. Army is not canceling the XM25 Counter Defilade Target Engagement system (AW&ST Aug. 5/12, p. DT20). Funding for the weapon has been cut by Congress, but development is ongoing by the Army.*

REGENERATING BLOOD

Battelle and two subcontractors have received a contract to develop a portable medical device that treats the blood of wounded soldiers. The goal is to prevent sepsis, a condition that results in life-threatening infections in 10% of combat wounds, and which can within 30 days kill 50% of those who go into shock from it. The contract was awarded by the U.S. Defense Advanced Research Projects Agency as part of its ongoing Dialysis-Like Therapeutics (DLT) program. Battelle, of Columbus, Ohio, is working with NxStage Medical and Aethlon Medical. The device, as envisioned, will remove blood from the body, cleanse it of harmful agents and return it in a process similar to kidney dialysis. Battelle, as team leader, is responsible for systems engineering, integration of DLT technologies and pre-clinical testing. NxStage will design, develop and manufacture the device, while Aethlon is responsible for blood-separation technologies. The contract

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Tech Scan

has several phases and could be worth \$22.8 million over four years. The resulting device and technology would also have civilian applications. (An exercise conducted by the U.S. Army's 212th Combat Support Hospital is pictured here.)



U.S. ARMY

BUILDING A BETTER BATTERY

Unmanned underwater vehicles (UUV) may soon achieve substantially longer battery life as a result of research by students in an engineering systems design course at the Massachusetts Institute of Technology's Lincoln Laboratory. Capitalizing on the high-energy density of aluminum, the students found that dissolving the metal into gallium and then reacting it with seawater generates a level of hydrogen gas and heat that exceeds the energy storage density of lithium-ion batteries. The students applied this concept to a prototype system that generates 86 kw, 20 times the energy storage density of Li-ion batteries. As a result, the prototype system is reportedly capable of powering UUVs for 30 days, compared with the 72 hr. that is typical with conventional Li-ion batteries. No word yet on potential trade-offs in weight or cost.

The U.S. Office of Naval Research and Woods Hole Oceanographic Institute observed a recent demonstration of the technology. (Deployment of a MK18 Mod 2 Kingfish UUV by civilian contractors is pictured here.)



U.S. NAVY

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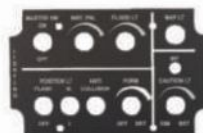
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**AIR MARSHAL PAUL EVANS**

Surgeon General, U.K. Defense Medical Services

Born: 1954**Education:** Qualified as medical doctor, 1978; Diploma in aviation medicine, 1987; RAF Staff College, 1996; Royal College of Defense Studies, 2004.**Background:** Commissioned into the medical branch of the RAF in 1975; positions include medico-legal advisor to the director general of RAF Medical Services, medical officer for clinical policy and healthcare director, Surgeon General's department.

U.S. ARMY

Lesson Plan

Critical injury care is among the biggest success stories of British military operations in Iraq and Afghanistan. A range of measures, from mandating the use of tourniquets to employing Chinook helicopters to deliver medical emergency response teams (MERT), has brought a higher echelon of care closer to the battlefield than ever before. AW&ST Contributing Editor Angus Batey discussed the challenges of the transition from combat to contingency with the surgeon general of the U.K. Defense Ministry, Air Marshal Paul Evans (far left, above).

Defense Technology: How can the medical gains made in Afghanistan be sustained once combat operations end?

Evans: Defense medical services are at their peak in times of war and major conflict. You will always get an element of skill fade [afterward]. What you've got to do is minimize it. And I think there are a number of ways to do that. The first thing is you must log lessons learned, and, while I can't replicate Afghanistan in the U.K., we have to look at what else might be available to maintain the skills as best we can.

What role would simulation play in this?

Simulation is very important—both individual techniques, such as learning to sew arteries and veins together, and collectively. So running exercises is one way, maybe in a tented light-manuever environment. But we already have some people working in London hospitals, for instance, and will look at opportunities to deploy our people [within the civilian National Health Service (NHS)], when they are not deployed elsewhere.

There are examples of frontline requests for specific pieces of relatively inexpensive, off-the-shelf equipment sometimes being

delivered within hours. How has defense medicine managed to streamline the acquisition process?

It's about the ability to recognize the important things in-theater. People all along the care chain are always asking if something could have been done better. That is then fed from [Camp] Bastion [the main British base in Afghanistan] back to the U.K., to the medical directorate and our defense professors. If the argument looks valid and if there are mistakes, we'll adapt. It can work through the system very quickly.

Are MERT and CCAST (critical care air support team, currently delivered on C-17 and C-130 platforms) capabilities theater-specific, or will they be retained?

I would expect them to be retained. Of course, we have air superiority in Afghanistan, and may never have it in a new environment, so we must not be dogmatic in assuming that what we've done in Afghanistan applies everywhere else. But the principles will remain: very good immediate care from the team medic and combat medical technician, pushing forward the advanced-resuscitation capability, and the ability to extract to a reasonable place of safety. It's then about applying

the principles to the new environment you are working in.

The U.S. Dustoff casualty evacuation helicopters are not armed. MERT carries RAF regiment personnel onboard, who secure the scene while the MERT crew work. Why is your approach different?

MERT uses a bigger helicopter and is therefore more vulnerable. It always flies with Apache helicopter support, but it probably wouldn't go into as hot an environment as a Dustoff or a Pedro [rescue helicopter]. We carry regiment guys, because you don't want your medical people to be damaged, as they've got to provide the care. I think that the Americans will start to develop a MERT capability of their own, but it will be part of a spectrum of capability that you'd look to provide in a different environment. The use of reservists, whose normal jobs may be in the NHS, is another area where defense medicine seems to be ahead of the rest of the military.

Do you see those relationships altering post-Afghanistan?

I think there is a careful balance that has to be applied. Clearly, the whole principle of the regular is that he is always at high readiness, whereas the reservist is more to reinforce the regulars as the operation sustains. That is still the principle. But we are going to have to subtly [ask], is there then a wedge of reservists who are on a higher level of readiness than the standard reserve? That's a work-in-progress as we speak.

Some of your combat care techniques are now in use by civilian emergency response teams, and areas such as prosthetics have seen improvements based on combat experience. Do you see that read-across continuing as well?

That's the plan. "Status" is a heavy word, but the status defense medicine now has within U.K. medicine is such that it will be our fault if we let that fall off. ☒



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Best Defense

Russia promotes anti-access systems

Bill Sweetman **Moscow**

As U.S. planners debate options for aircraft or missile attacks against Syria (see page 26), Russian industry—still dependent both on domestic and export sales—is continuing to develop new systems that will allow its customers to strengthen anti-access and area-denial capabilities.

Among the weapons displayed for the first time at the MAKS air show at Zhukovsky near here in late August was the Almaz-Antey S-350E Vityaz (Knight) surface-to-air missile (SAM) system. The S-350E is intended as a replacement for the 1980s-era S-300, with an emphasis on countering saturation attacks by both aircraft and munitions. It is being developed with export in mind, as well as part of a layered, mobile defense system for Russia that is topped by the new S-400 long-range SAM and the in-development S-500 ballistic missile defense system.

The system is carried on three BAZ wheeled vehicles: a 6 X 6 truck for the 50N6E multifunction radar and 50K6E control station, and an 8 X 8 for the 50P6E 12-round launcher. This continues the trend to migrate SAM systems from tracks to wheels for better on-road mobility.

The radar and control station vehicles are, like other new Russian SAMs,



BILL SWEETMAN AWAST PHOTOS

fitted with the NK Orientir precision location system, comprising three multiple satellite-navigation receivers mounted on a rigid frame, about 2.5 meters (8.2 ft.) apart. Using the differences between the signals received by the three units, the system is capable of precisely and rapidly determining the absolute and relative orientation and position of the radar and control system, enabling quick set up (an estimated 5 min.) and sensor fusion without using pre-surveyed sites.

The S-350E radar and launcher can be located as far as 2 km away from the control station. The radar is controlled remotely from the control vehicle, and the entire system can operate either autonomously (with up to two missiles and eight launchers, with 96 missiles in all) or as part of a larger, integrated air-defense system. The company says its effective range is 60 km.

The active, electronically scanned

The Demonstrator BMD radar's camouflage netting belied its "civilian" description.

array (AESA) radar can track 100 targets over a 360-deg. field of view, while providing intercept-grade tracking of eight targets and 16 missiles. The 50P6E carries 12 vertically launched Fakel 9M96E2 missiles (also used as the close-range element of the S-400), Mach 3.5 weapons using inertial midcourse guidance with radar updates and active radar terminal homing. Weapons can be launched at 2-sec. intervals.

Another MAKS newcomer was a full-scale mock-up of a transportable ballistic missile-defense radar. Named simply Demonstrator, the radar was developed by Almaz-Antey and Radiofizika, which was responsible for most Soviet-era experimental and deployed missile-tracking radars. The antenna resembles the Raytheon TPY-2, but Russian radar is bistatic, with separate AESA transmitter and receiver antennas linked by fiber-optic cables, giving some advantages against some low-radar-cross-section targets. While the TPY-2 is an X-band system, the Russian radar apparently works in the K_a-band, like some earlier large radars from Radiofizika.

The Demonstrator system is designed to be deployable in 30 min. and has a 1,500-km detection range and 600-km tracking range against a 1-sq.-meter target, with a 5-meter accuracy

The S-350E launcher vehicle can fire 12 medium-range missiles in 24 sec.



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in range and the ability to track 25 targets at once. One possible application is long-range targeting for the S-500 air and missile defense system, due to enter service in 2018. It was described at MAKS as a civilian system for tracking space objects. Vocal Russian opposition to U.S. plans to locate ballistic missile defense radars in Eastern Europe may explain reticence about the system's military utility.

Another potential threat to aircraft and missiles comes from passive detection and tracking systems. The NII Vektor research institute in St. Petersburg has developed a passive sensor associated with the Agat/Novator Club-K coastal defense system, which compris-



NII Vektor says its Club-K passive detection system has an 800-km range against airborne radars.

es missiles and control systems built into standard shipping containers. It is understood that Malaysia is the first export customer for the Club-K.

The Vektor sensor has an antenna with eight sub-arrays carried on a scissors-type elevating platform. By using two or more units, separated by some distance, the system can locate emissions using time-difference-of-arrival processing, and can locate a target in "one or two pulses," an NII Vektor engineer says. The company says the sensor is able to detect an airborne warning and control aircraft at 800 km, air warfare cruiser at 220-400 km and submarine using a satellite data link at 30-90 km.

A truck-mobile version of the system was first deployed with Russian forces in 2002 and is now being superseded in domestic use by a version that is claimed to be able to provide target range

The Avtobaza-M system, displayed in model form, uses time-distance-of-arrival processing to locate emitters.

within 10% accuracy, with a single station. The means by which this is done are undisclosed. The system primarily uses target emissions for detection, but could also work bistatically with "emitters of opportunity," such as other radars or TV stations. A similar system, Avtobaza-M from JSC Defense Systems, was shown in model form at MAKS and is being delivered to Russian forces. ☛



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Refueling tests could be first of many alternate V-22 mission demos to come

Amy Butler **Washington**

BELL/BOEING

The V-22's price is hovering millions above the original target and Pentagon orders have stabilized at a lower-than-anticipated rate, but the Bell/Boeing tiltrotor team is optimistic about its sales prospects.

The largest forthcoming tender could be for the U.S. Navy's Carrier Onboard Delivery (COD) replacement program, but Bell/Boeing is making the case that the Osprey is more than just a high-priced transport. The company is testing its ability to conduct aerial refueling missions as the Pentagon considers other possible missions, such as hosting communications hardware or electronic-attack systems on the platform.

The Bell/Boeing team is eyeing sales around the world; U.S. Marine Corps Col. Greg Masiello presented a list of at least 15 prospects at the Paris air show in June, and near-term candidates include Israel, the United Arab Emirates and Japan. But each of the potential customers—largely countries in the Pacific or Middle East—are likely to only purchase a handful. In aggregate, these sales could carry the program forward. Masiello said foreign sales could account for 100 aircraft over 10 years.

But a Navy buy would bolster the production lines at Boeing in Philadelphia and Bell in Amarillo, Texas. The Navy signed a \$6.5 billion, multiyear contract with the team this summer for the next 99 V-22s at a target price of \$70 million, more than \$10 million higher than government and industry officials hoped for while the program was in development. That price is locked in despite a production-rate drop from 40 V-22s delivered this year to 35 next year, and then a slump into the 20s.

Against this backdrop, the industry

team is pressing forward with plans to expand the Osprey's capabilities. Among its future missions is aerial refueling. The industry team is confident the tiltrotor can potentially fill what one official calls a "capability gap" in tactical aerial refueling and safely refuel F/A-18 aircraft midair. Bell/Boeing funded the first midair proximity test between the two Aug. 29. That mission is now handled by the KC-130 series operated by the Marine Corps, although Navy fighters can also be refueled by the KC-10 fleet and select KC-135s with a hose-and-drogue delivery system.

During an Aug. 29 flight trail, a Hornet flew within 30 ft. of the MV-22's drogue chute in a lateral offset position at 8,000-ft. altitude, says Chad Sparks, advanced derivatives manager for Bell/Boeing. This was the fourth in a series of tests paid for by Bell/Boeing as the team examines alternative missions.

The Marine Corps is the primary customer for the aircraft with a program of 360 aircraft, with the U.S. Air Force's fleet at 50 to replace its retired MH-53 Pave Lows. Pentagon officials have always said the Navy anticipated buying 48 or more Ospreys, but a competition is likely to come for the C-2 Greyhound replacement. Northrop Grumman is proposing a refurbished C-2 that incorporates improvements from the E-2D program.

The Bell/Boeing team hopes the Navy or Marine Corps will fund more tests to include contact between the refueler and receiver and, eventually, passage of fuel between the two, says Ken Karika, business development manager.

Prior to the Aug. 29 flight, the company validated the ability to extend and retract the refueling hose and drogue, a Cobham model also used by the Marine

A U.S. F/A-18C flew into a pre-contact position—30 ft. from the drogue—during an Aug. 29 flight to characterize the V-22's ability to refuel tactical fighters in the air.

Corps KC-130 fleet. The team had collected data on the behavior of the Super Hornet in the MV-22's wake as well. "Pilots didn't report any significant wake turbulence," Sparks says, noting that the feedback validated models and earlier input from the pilot of a surrogate used to study the MV-22's wake.

During the Aug. 29 test, the two aircraft were traveling at 210 kt. The high-speed version of the hose/drogue refueling system is designed to be deployed at 185 kt. and function up to 250 kt., Sparks says.

For that test, the V-22 was functioning in airplane mode. Sparks explains the company prioritized testing for the Super Hornet specifically to address concerns that the Pentagon could need more refuelers for high-speed receivers. The Osprey could be used, like the KC-130, as a refueler for rotary-wing aircraft, as well.

A preliminary test is slated for this week, Sparks says. Officials will extend and retract the hose and conduct low-speed proximity tests with no contact between the refueler and receiver.

Rotary-wing refueling will require a separate drogue specific to helicopters, and Sparks says the target is to operate around 105 kt., with the aircraft in helicopter mode operating with a partially converted nacelle.

The refueling system makes use of onboard tanks as well as a roll-on/roll-off bladder, adds Sparks. The hose extends 90 ft., about 80 ft. from the end of the ramp of the MV-22. The operator must open the ramp to extend the refueling hose; once extended, the ramp is then raised back up with the top ramp door left open, he says.

Depending on mission profile, the system can off-load up to 12,000 lb. of fuel, says Karika.

The prototype design used in the Aug. 29 test includes a refueling system operator station near the ramp, but Karika says this can be placed where the customer requires.

The aerial refueling concept grew out of technical work done in 2007 to support operations in Iraq to enable Marine operators to use the Osprey as a ground-based refueler for helicopters and ground vehicles. ☛

Strap-on Flying

Jetpack could serve emergency responders and thrill seekers alike

Graham Warwick **Washington**

Border patrols, first responders and bungee jumpers looking for a new thrill are all potential users of what developer Martin Aircraft says will be the first practical jetpack when deliveries begin in 2014. The military is also interested, for use on manned or unmanned missions ranging from radio relay to personnel insertion and cargo resupply.

The Auckland-based company has conducted initial manned test flights of the latest prototype of its ducted-fan Jetpack after receiving a permit to fly from New Zealand's Civil Aviation Authority. The single-pilot machine is being developed to comply at first with rules governing microlights, but new CEO Peter Coker acknowledges Martin will have to work with individual regulators around the world if the Jetpack is to fulfill its promise as a "motorbike in the sky."

Designed for a cruise speed of 30 kt., range of 30 km (19 mi.) and endurance of 30 min., the vertical-takeoff-and-landing Jetpack is attracting interest for uses as disparate as search and rescue, pipeline inspection, corporate events, flying displays and a "jetpack experience" for thrill seekers. As an unmanned heavy lifter, with the ability to carry a 150-kg (330-lb.) payload, the machine is being looked at by the agricultural and film industries, Coker says.

Flight tests of the company's 12th and latest prototype are underway. After initial manned hops, prototype P12 is being flown unmanned to expand the low-altitude envelope as Martin modifies the engine, after which manned flights are planned to resume. The modification adds a balance shaft to reduce vibration inherent in the 200-hp. V4 two-stroke, designed and built by Martin itself after it could not find an engine powerful, light or compact enough.

Mounted behind the pilot, the engine powers a pair of ducted fans that provide both vertical thrust and flight control. Compared with P11—the previous prototype that had center-of-gravity challenges, says Coker—the ducts have been moved down and increased in size, and a "robust" fly-by-wire system added to increase flight performance. Martin is aiming for a maximum speed of 40 kt. Empty weight manned is 180 kg and maximum takeoff

weight 330 kg, for a payload with full fuel of 100 kg.

Altitude is limited to 3,000 ft. by microlight rules but, in May 2011, P11 was flown unmanned to 5,000 ft. to show the machine could fly out of ground effect and "prove this is an aircraft," Coker says. That flight ended with the first deployment of the ballistic recovery parachute, a standard safety feature of the Jetpack. "The parachute is part of the system, and is connected to the engine so that, if it is not performing correctly, it will deploy automatically," he says.

"We are developing an active parachute to get the dead-man's curve down to a very low level," he adds. Normally associated with helicopters, the dead-man's curve is the lower corner of the height/velocity chart where a power failure can be fatal. "We'd like the parachute to be usable down to 6 meters or so." Below that, the carbon-fiber landing gear would absorb the impact. "The undercarriage can withstand a fairly reasonable arrival, and the pilot is enclosed in carbon fiber for safety," Coker says. A flotation collar will provide buoyancy in a water ditching.

Martin is not yet taking orders, but it expects to have a production plan in place by year-end. "P12 is a testbed for pre-production processes," Coker says. "Out of P12, we will make a couple of minor mods, and by the end of this year have the spec for the pre-production aircraft. We are having conversations with preferred suppliers of the main parts, including the carbon-fiber ducts and body, and in the new year will move into production."

Martin completed a pre-initial public offering round of financing in May, but needs additional funding to launch production. "We are looking for cornerstone investors now," Coker says. While Jetpack pricing has yet to be set, Martin is targeting \$250,000 for military and \$150,000 for commercial versions. The initial model will be aimed at first responders, such as fire services. The company has begun looking at a personal jetpack. "That will happen later, as we gain experience with supportability," he says.

Perhaps the biggest barrier Martin faces is regulatory, as microlight rules prevent them flying below 500 ft. and overpopulated areas. "Class 1 microlight is the 'box' that we originally targeted, but this does curtail its usefulness," says Coker. "[But] the first responder who is our first targeted [customer] does not require the aircraft to fit into the microlight box, nor do our potential military customers," he adds.

Martin will work to meet the differing requirements of regulatory authorities in New Zealand and other countries.

"[But] I suspect it will be a while before regulatory authorities see this as a motorbike in the sky," Coker says. ☛

Martin Aircraft's latest prototype of the ducted-fan Jetpack has made initial manned hops.



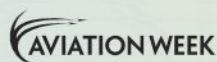
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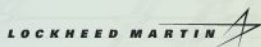


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Learn what space and defense leaders are doing to assure program success, and profitability despite economic pressure and uncertainty across the enterprise.



Tap hear to learn more about these and all of the speakers featured at A&D programs.



Jeff Babione, VP/Dep PM,
F-35, Lockheed Martin
Aeronautics Co.



Brad Botwin, Dir Industrial
Base Studies, US Dept of
Commerce



Dan Collins, COO, United
Launch Alliance



Phil Dunford, COO, Boeing
Military Aircraft



Darrell Durst, VP Cyber
Solutions, Lockheed Martin
Information Systems &
Global Solutions



Barry Matsumori, SVP
Business Development,
SpaceX

Leadership and technology tracks will address the latest developments in A&D programs — sequestration issues, how programs are affected and where government will hedge its bets. Drill down with subject matter experts on the most up-to-date developments in A&D programs.

- Supply chain
- Strategy and forecast
- Innovation/engineering
- Program performances
- Manned and unmanned flight
- Space exploration and defense
- Cyber security and non-traditional threats

Special features:



**The 2013
Aviation Week
Program
Excellence
Awards** bring
together

program executives, their customer counterparts, and leaders from across the industry to recognize the best in performance and leadership. Finalists and winners will be identified in system and sub-system level categories. **Find out who the winners are on Thursday, November 14!**



A&D Companies to Watch

Working with
defense and
space leaders,
Aviation Week

is identifying companies that will make a difference in the future. Companies with less than \$100 million in annual revenues will be vetted by a panel of aerospace and defense editors and executives, in terms of future partnerships, M&A, emerging technologies and capabilities. The top five companies to watch will be spotlighted and all qualified companies will be included in a one-stop-shop buyer's guide at the conference!

Wednesday, November 13, 2013

8:30 a.m. **Welcome**

Greg Hamilton, President, Aviation Week

8:35 a.m. **Preparation for the Quadrennial Defense Review — Strategy & Forecast**

Every four years the Defense Department turns to industry, subject matter experts and its own leadership to develop an assessment of threats to national security and the structure needed to respond. In this session we'll hear about some of the initial thinking and concerns that will play a role in developing the future defense posture.

Sponsored by **Deloitte.**

MODERATOR: Tom Captain, Vice Chairman,
Deloitte LLC
Alan Estevez, Assistant Secretary of
Defense [Logistics & Materiel Readiness]

9:15 a.m. **The Sequester: How Real Is It? — Strategy & Forecast**

A year ago three of the industry's leading analysts debated whether a sequester would occur and how it would affect the industry. It's a year later. And they're back to review what did happen and projections for the coming 18 months.

Sponsored by **Deloitte.**

MODERATOR: Carole Rickard Hedden, Special
Projects Editor, Aviation Week
Byron Callan, Director, Capital Alpha Partners
Pierre Chao, Managing Director/Co-Founder,
Renaissance Strategic Advisors
Steven Grundman, George Lund Fellow, Atlantic
Council
The Honorable Kenneth J. Krieg, former
Undersecretary of Defense/AT&L and Founder,
Samford Global

10:30 a.m. Break

10:45 a.m. **Production Forecast & Analysis — Strategy & Forecast**

Aviation Week will provide its annual forecast, providing production values for the coming five years, as well as an analysis of forecast and government budget volatility.

Sponsored by **Deloitte.**

Michael Bruno, Sr. Policy Editor, Aviation Week
Graham Warwick, Managing Editor-Technology,
Aviation Week
Jim Mathews, Exec. Dir., Aviation Week Intel-
ligence Network

11:45 a.m. Lunch



Sponsored by

1:30 p.m. **Navigating through Sequestration — Supply Chain**

No challenge has been greater for government contractors than dealing with budget uncertainties and the prospect of massive changes to contracts and requirements for the future. Many companies "baked in" plans to deal with the worst-case scenarios, while those with more flexibility had alternative plans in place. In this session we'll hear how organizations of varying size dealt with and still are dealing with critical budget changes and the impact to the enterprise value chain.

MODERATOR: Michael Bruno, Sr. Policy Editor,
Aviation Week
Dan Collins, COO, United Launch Alliance
Phil Dunford, COO, Boeing Military Aircraft
Philip J. Jasper, EVP/COO, Government Sys-
tems, Rockwell Collins

2:30 p.m. Break

2:45 p.m. **Industrial Base — Supply Chain**

Since 2009 Aviation Week has worked with industry leaders to assess and report on the health of the industrial base. In this session we'll look at performance up and down the supply chain to unearth where unique capabilities are threatened and where they are building.

MODERATOR: Michael Bruno, Sr. Policy Editor,
Aviation Week
Brad Botwin, Dir Industrial Base Studies, US
Dept of Commerce

3:30 p.m. **Companies to Watch — Supply Chain**

Technologies and processes from small companies are the foundation of innovation in every industry. Aviation Week has identified some of the unique and emerging players that will play a role in the space and defense programs of the future.

4:00 p.m. Day Ends

Thursday November 14, 2013

8:30 a.m. **Welcome**

Michael Bruno, Sr. Policy Editor, Aviation Week

8:45 a.m. **Getting It Right: Applying Speed, Agility — Program Performance**

As NASA and DoD reset strategies and set new priorities, program leaders must be able to respond quickly in replanning and re-establishing relevance. This year's Program Excellence evaluation identified some of the best, who are learning to change course and run faster.



Tap here to hear Carole Rickard Hedden talk about the importance of the Program Excellence program.

Sponsored by Deltek Know more. Do more.™

MODERATOR: Kevin Carr, SVP, Deltek
Scott F. Norr, Integrated Space Command & Control Program, Lockheed Martin
Trevor Overton, MicroGRAM Design & Development, Rockwell Collins
Robert Zmarzlak, Space Tracking & Surveillance System Demonstration Program, Northrop Grumman

9:30 a.m. **Program Challenge: Priorities and Requirements for the Future — Program Performance**

One of the industry's leading experts will share perspectives about threats, requirements and priorities as we move toward the next era in American defense.

Sponsored by Deltek Know more. Do more.™

MODERATOR: Graham Warwick, Managing Editor-Technology, Aviation Week
General Charles "Chuck" Wald, Director
Deloitte Services LP and Leader, Deloitte DoD Practice, Federal Govt. Services

10:00 a.m. Break

10:15 a.m. **Program Challenge: Future of Manned and Unmanned Flight — Program Performance**

As the F-35 moves into production and service, the Tanker takes off and UAVs land on aircraft carriers, what are the prospects for manned and unmanned flight in the coming decade? We'll hear from two of the industry's leaders on their perspectives.

Sponsored by Deltek Know more. Do more.™

MODERATOR: Amy Butler, Sr. Pentagon Editor, Aviation Week & Space Technology
Jeff Babione, VP/Dep PM, F-35, Lockheed Martin Aeronautics Co.
Janis Pamiljans, Sector VP/GM Unmanned Systems, Northrop Grumman Aerospace Systems

11:00 a.m. **Program Challenge: Vertical Lift — Program Performance**

Of all the capabilities in the defense portfolio with the most disruption in the past decade, rotorcraft/vertical lift claim the slot. In this session we'll hear about the Joint Multi-Role demonstration program being undertaken by a joint venture sewn together by Boeing and Sikorsky.



Tap here to See video of X-47B Arrested Landing.

Sponsored by Deltek Know more. Do more.™

MODERATOR: Amy Butler, Sr. Pentagon Editor, Aviation Week & Space Technology
Patrick Donnelly, Director - Future Vertical Lift Program, Boeing
Doug Shidler, Program Director JMR Demonstration, Sikorsky Aircraft

11:30 a.m. **Program Challenge: Cyber Security/Non-Traditional Threats — Program Performance**

Cyber security isn't a new division of your company; it's a capability to be baked into every program, project and service. It's one of many non-traditional threats under the microscope as industry works with defense and security leaders to define a roadmap to technologies and capabilities needed for the future.

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MODERATOR: Graham Warwick, Managing Editor-Technology, Aviation Week
Darrell Durst, VP Cyber Solutions, Lockheed Martin Information Systems & Global Solutions
Harry Radeuge, Sr. Counselor to The Cohen Group

12:00 p.m. Lunch

1:30 p.m. **Program Challenge: Space — Program Performance**

We celebrate exploration and pioneering spirit, as an industry and as a people. With the money and pressure placed on today's space programs, what are the program issues and best bets for the future? We'll look at status of current efforts, and at the priorities for the future.

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MODERATOR: Graham Warwick, Managing Editor-Technology, Aviation Week
John Mulholland, VP/ Prog Mgr, Commercial Crew Program, Boeing
Barry Matsumori, SVP Business Development, SpaceX
John Olson, VP, Sierra Nevada Corp.

2:15 p.m. **Innovating the Future — Innovation/Engineering**

Our panel of engineering leaders will share insights on the challenge of establishing what is most needed to keep technology moving across the space and defense sectors. We'll include some facts about engineering practices — from in sourcing/outsourcing decisions to the people skills that will deliver.

MODERATOR: Graham Warwick, Managing Editor-Technology, Aviation Week
Gene Fraser, Corp VP Engineering, Program Mgt & Quality, Northrop Grumman
Nan Mattai, SVP Engineering & Technology, Rockwell Collins
Daryl Pelc, VP Engineering, Phantom Works, Boeing
Jeff Wilcox, VP Engineering, Lockheed Martin Corp.

3:15 p.m. **Engineering Capacity Breakdown — Innovation/Engineering**

As budgets have tightened, layoffs have had an impact on the STEM workforce. However, hiring continues to fill the requirements for the future and companies continue to develop strategies surrounding global wholly owned engineering centers and utilization of engineering services suppliers. Aviation Week and ICFI SH&E partnered to develop an overview of what and how these decisions are being made.

Kevin Michaels, VP/Principal, ICF SH&E
Carole Rickard Hedden, Special Projects Editor, Aviation Week

3:45 p.m. **Taming the System Tempest — Innovation/Engineering**

Advanced technologies represent their own form of complexity, but so too do operating environments, timing, and market timing. This year's Program Excellence evaluation revealed how several programs took adapting to complex systems to a new level.

MODERATOR: Stephen Hayes, CEO, International Centre for Complex Program Management
Stuart Linsky, AEJF SV1-3 Payload, Northrop Grumman
Allan Little, Mars Science Laboratory EDLI, NASA Langley Research Center
Scott F. Norr, Integrated Space Command & Control Program, Lockheed Martin

4:30 p.m. **They Are Our Future — Innovation/Engineering**

In addition to an overview of the findings of the 2013 Aviation Week Workforce Study — including high-demand engineering skill requirements, hiring, impact of the sequester, and retirements — this session will feature a panel of engineers under age 35. They'll put a face to the data gathered as part of the 2013 Young Professionals Study.

Jennifer Halford, The Aerospace Corp.
Jeff Hill, Lockheed Martin Corp.
Alex Nakahara, Systems Engineer, Future Technical Leaders, Class of 2015, Northrop Grumman Information Systems

5:30 p.m. Conference Ends

Get the most up-to-date information www.aviationweek.com/events/adp

6:30 p.m. **Program Excellence Awards Reception and Banquet with Presentation of the Twenty20s**

Join us on Thursday evening to honor program leaders who are delivering for customers in a quality way and the student(s) whose collegiate projects and work are creating a buzz ... and the promise of the future.

Twenty 20s Sponsored by Raytheon
Raytheon

WELCOME: Mike Madsen, President, Honeywell Defense & Space
MASTER OF CEREMONIES: Michael Bruno, Sr. Policy Editor, Aviation Week

This is an outstanding conference for aerospace professionals who can share ideas to improve program management, affordability and performance."

John Tylko, VP, Aurora Flight Sciences

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**Linda Weiss, VP Talent Acquisition,
BAE Systems**

Combination Is Key

Boeing's aviation diversity nets \$12.8 billion in U.S. defense contracts

Michael Fabey **Washington**

While F-35 Joint Strike Fighter (JSF) contracts and modifications may make Lockheed Martin the leading fixed-wing contractor for the Pentagon, Boeing's combined rotary-wing, airframe and UAV deals were enough to make it the Defense Department's leader for aviation-related transactions in 2011, according to an Aviation Week Intelligence Network (AWIN) analysis.

Boeing secured \$12.8 billion in aviation-related work in 2011, the most recent year for which data were available, as aggregated by the National Institute for Computer-Assisted Reporting. Lockheed had \$10.8 billion worth of transactions, while Sikorsky came in a distant third, with \$2.4 billion.

Most of Lockheed's deals were for fixed-wing aircraft contracts, at \$10.1 billion. Boeing ranked second in the fixed-wing department, at \$8.6 billion.

With about \$20.6 billion in transactions, fixed-wing contracts ranked first among overall Pentagon spending for 2011. While fixed-wing expenses have traditionally ranked at the top in previous decades, in 2010 they ranked only third, at about \$5 billion, or less than a third of what those expenditures have averaged in previous years.

Engineering and technical services ranked first in 2010, at \$8.3 billion, and logistics and support services were second with \$7.9 billion. Neither of those expenditure types ranked among the top Pentagon expenses a decade ago, but they have been creeping higher in the rankings during the past few years, garnering larger shares of what had been a growing Pentagon pie. But in 2010, that pie diminished and the analysis suggests these types of service expenses ate directly into contractual-obligation funding for stalwart programs such as fixed-wing aircraft.

While acquisition deals are again providing greater lift for aviation-related expenses, increased aircraft maintenance and modification work also is driving funding, and is expected to continue to do so for some time.

Boeing is seeing a lot of support for

F-15 and F/A-18E/F programs from the U.S. Air Force and Navy, respectively, especially for upgrades or sustainment. USAF is set to spend \$5.8 billion on F-15 programs in fiscal 2008-17, with F-15E Strike Eagles accounting for \$3.2 billion of that total, according

to an AWIN analysis of data provided by Avascent Analytics. Most of the work—about \$3 billion—is for sustainment/modification of the Strike Eagles.

The Navy is projected to spend about \$31.9 billion for F/A-18E/F-related programs in fiscal 2008-17, according to the analysis. Modification/sustainment of the F/A-18E/F fleet is expected to cost \$9.3 billion.

Despite lawmakers' efforts to block the U.S. from purchasing Mi-17 helicopters from Russian-owned Rosoboronexport for the Afghan air force, the company ranks ninth among Pentagon defense contractors. ☛

Leading U.S. Contractors for Fixed- and Rotary-Wing Aircraft, Airframes and UAVs in 2011

Contractor	Number of Contracts or Modifications	Total Value	Average per Transaction
1. Boeing	5,926	\$12,831,314,345	\$2,165,257
2. Lockheed Martin	1,145	10,808,630,269	9,439,852
3. Sikorsky	2,154	2,439,074,680	1,132,347
4. Northrop Grumman	856	1,138,468,767	1,329,987
5. General Atomics Aeronautical Systems	152	911,433,342	5,996,272
6. Bell Helicopter Textron	1,003	693,579,281	691,505
7. EADS North America Defense	115	424,437,005	3,690,757
8. L-3 Communications	275	411,506,206	1,496,386
9. Rosoboronexport	4	377,499,442	94,374,861
10. Beechcraft	122	364,501,430	2,987,717
11. AAI	65	339,372,089	5,221,109
12. Bell Boeing Joint Project Office	194	320,644,107	1,652,805
13. Rolls-Royce	16	147,175,456	9,198,466
14. AeroVironment	59	129,822,110	2,200,375
15. TCOM	9	88,542,514	9,838,057
16. Cessna Aircraft	6	88,308,292	14,718,049
17. Composite Engineering	40	84,492,118	2,112,303
18. Miscellaneous Foreign Contractors	34	53,901,933	1,585,351
19. Robertson Aviation	26	52,041,510	2,001,597
20. BAE Systems	44	51,377,934	1,167,680
21. Honeywell	34	50,523,908	1,485,997
22. Orion Air Group	1	50,000,000	50,000,000
23. Radant Technologies	1	44,803,800	44,803,800
24. Maritime Helicopter Support	4	40,119,686	10,029,922
25. Middle Georgia Diversified Industries	9	39,668,011	4,407,557
26. Sierra Nevada	18	39,039,682	2,168,871
27. AgustaWestland	4	37,813,451	9,453,363
28. Raytheon	20	32,842,597	1,642,130
29. Alliant Techsystems	18	30,101,201	1,672,289
30. Thales Avionics	8	25,842,813	3,230,352

Sources: Aviation Week Intelligence Network, National Institute for Computer-Assisted Reporting

Testing Times

The Airbus A350 is nearing the start of certification trials

Jens Flottau **Frankfurt**

The first Airbus A350 entered the preliminary flight-test phase on June 14, and made its much publicized flyover at the Paris air show only one week later. Now the initial part of the flight-test campaign is drawing to a close.



AIRBUS

Airbus expects to be able to freeze the final configuration for flap settings in various flight phases, including takeoffs, approaches and landings, within 4-6 weeks. Once the optimum configuration has been determined and validated against simulation data, the manufacturer will have passed a crucial milestone, which heralds the start of the actual certification testing later this year.

MSN001 resumed its test program on Aug. 15 following a planned break in the schedule to allow for more test equipment to be installed. Additional instrumentation was added to measure loads, and more cameras were put onboard. As of last week, the aircraft had logged more than 150 flight hours and was flying almost daily. This amount of test hours is at the upper limit of expectations, according to Airbus officials.

Following the temporary break, the average flight times have regularly exceeded 6-7 hr. When the aircraft made its debut at the Paris air show, that excursion was included in a test flight that exceeded 9 hr.

Last week, Airbus CEO Fabrice Bregier became one of

the first non-test crew to fly onboard the A350. The sortie he was on flew close to 4 hr. Not surprisingly, Bregier promptly announced that he liked the smooth ride and was impressed by the large flat-panel screen displays in the cockpit.

Having initially devoted most of the time to open the full flight envelope (all expected speeds and altitudes), MSN001 is now mainly undergoing performance testing at various configurations (flap settings) to determine the best angle for each setting in a trade-off between lift and drag. While most settings will be identical for takeoff and landing, the slats setting in "position flaps 3" will be slightly different, according to Patrick du Che, head of flight-test development. Data generated in the tests is used to run a series of models to determine the optimum configuration.

The minimum unstick speed test, or VMU (velocity of minimum unstick) is planned for mid-month. This highly intense maneuver is used to determine what the lowest speed is at which the aircraft can still take off.

Once the configuration is frozen, performance and certification testing begin in earnest. MSN003, the second A350, due to make its first flight in October, is mainly tasked with the performance and engine testing. Autoland and landing performance trials are set to commence following the freeze. The first realistic figures on fuel burn will become available in that phase, too.

Not all of the current flying is devoted to establishing the right configuration; systems-test-

Airbus CEO Fabrice Bregier was onboard when the A350 took off for one of its test flights last week.

ing and handling-quality work is also included, particularly when external factors do not allow programs such as climb performance runs. These took place in late August, says Airbus Chief Test Pilot Peter Chandler.

Twenty of Airbus's 28 test pilots have already flown the A350, and the remaining few will have logged at least one A350 flight by the end of the month, when they return from summer vacations.

With MSN003 in place, the program until the end of the year will include engine and performance testing, and all the flutter testing, including those run at the highest speeds.

Icing trials are planned for November and will likely take place in France, given the expected weather conditions. The Dubai Airshow, which opens Nov. 16, might be the first occasion for the A350 to land at an airport outside of Europe.

The A350 will be spending more time abroad for hot-and-high tests. These could still happen before the end of the year or they could shift into early 2014, depending on progress achieved in the other areas. These trials are to take place in South America, possibly in La Paz, Bolivia, although Airbus has not confirmed the site. La Paz has been used for such trials in previous campaigns, including for the A340-600.

Airbus plans to use a fleet of four aircraft to achieve certification by the middle of 2014. Overall, 2,500 flight hours will have been devoted to the test program. Qatar Airways will be the first airline to take delivery of an A350, likely in third-quarter 2014. Airbus holds 682 firm orders for the A350, 448 of which have been placed for the -900 baseline version. ✎

Cutting Deeper

Europe's large airlines are implementing more cost-saving initiatives



JOE PERSIMMONI/NET

Jens Flottau Frankfurt

The three big European airline groups have been in restructuring mode for years. While International Airlines Group (IAG) has seen some improvement in the turnaround of Iberia, Air France-KLM and Lufthansa are discovering that they need to do more to reach sustainable cost levels.

Lufthansa has been working through a list of hundreds of previously identified cost-saving items as part of its Score restructuring program, which is meant to improve operating results by €1.5 billion (\$1.97 billion) in 2015. Two core company aspects it has been reluctant to touch are pensions and bridge financing for pilots, many of whom opt to retire before the mandatory retirement age.

But in an abrupt about-face, the airline decided to unilaterally terminate collective-bargaining agreements covering company pensions and early retirement provisions for flight crew.

The move affects 60,000 employees based in Germany and is expected to provoke serious labor dissension. Lufthansa argues it can no longer afford to spend up to €400 million annually to address a widening pension deficit created by the difference between expected and actual interest rates. Exacerbating the problem is that average life expectancy has grown significantly in the past decades, so pensions have to be paid out for a longer span. Many large German corporations have already implemented lower-cost pension plans.

But one aspect of retirement regulations specifically affects flight crews. Lufthansa and its pilot union Vereinigung Cockpit (VC) have historically agreed on a mandatory retirement age of 60 for pilots. Pilots could retire at 55, but on average, flight crews opted to leave at 58. The company and its

Elements of the restructuring plan for Lufthansa subsidiary, Austrian, have been ruled illegal.

pilots have contributed to a transition fund that bridges the time between a pilot's last flight at the controls and age 63—the earliest possible general retirement age in Germany.

However, Lufthansa argues that the fundamentals for this arrangement are now moot, since a high court has ruled that requiring pilots to retire at 60 is discriminatory.

The airline wants to phase out the bridge financing arrangement, saying those who are closest to retirement should be affected the least. But new hires will likely have to fly much longer than their older cohorts, unless they accept lower pensions.

Lufthansa tried to appease its workers by stating that whatever has been contributed to the pension plan so far is not lost and will be counted against future payouts with no deduction. Vereinigung Cockpit's position is that it is "disgusted" and will actively defend the status quo. VC argues that since pilots have already started to retire later, the airline is actually saving money.

The airline and its union also have to negotiate a new pay deal. VC told Aviation Week it will demand significantly higher raises in light of the future pension shortfalls.

In another issue, Lufthansa is again facing uncertainty over the restructuring of its subsidiary, Austrian. A Vienna "first instance" (regional) court ruled that last year's transition of operations and employment from Austrian to its former regional subsidiary, Tyrolean, was illegal. The move was the cornerstone of the strategy to return Austrian to operating profit within five years.

If that ruling holds, Austrian's future would be in limbo. Star Alliance CEO Jaan Albrecht says the airline was "surprised" by the ruling. Austrian has no alternative plan. Its legacy pilots are still receiving the same pay at Tyrolean, but their pensions are greatly reduced. They

also had to agree to a multiyear pay freeze, which will remain in place until the former regional pilots have caught up to the same pay level.

That whole arrangement has not only been the basis for extraordinary charges to last year's financial result, it was also the key to lower unit costs and, ultimately growth. Lufthansa has said it will only back financing of additional aircraft if Austrian is profitable.

Austrian is appealing the decision—a process likely to take years—so there is significant uncertainty about the airline's long-term viability.

By contrast, Air France-KLM still sees a need to focus on network issues to improve its situation. Air France is the main cause of the shortfalls. With losses of nearly €1 billion in 2012, the French unit was responsible for around 80% of the entire group's deficit. The airline has been slashing short- and medium-haul capacity, but this has not yet lead the airline back into profitability. Air France has been split into several units. Its regional bases in three French cities—Nice, Toulouse and Marseille—are major contributors to the airline's financial headaches. The carrier has tried to retain its own service at airports with a high level of business travel, while the more leisure-oriented markets have been assigned to Transavia France, the group's low-fare affiliate. More cuts are likely soon at the regional bases.

Rival Lufthansa has transferred all non-hub short- and medium-haul flying to its lower-cost subsidiary, Germanwings.

Also, regional unit HUB may see more changes soon. The division, comprising Brit Air, Regional and Airlinair, has been merged on paper, but a lot of overlaps remain and are causing

further inefficiencies. Air France has also been trying to sell its unprofitable subsidiary City Jet to Intro Aviation, an airline turnaround specialist based in Germany, but the process has been moving much slower than anticipated.

On the other hand, SAS Group is proving that decisive measures can have a positive effect. The airline, which was only hours away from bankruptcy early in the year, has posted a small net profit in the third quarter,

admittedly its seasonally strongest period. The airline pushed through double-digit wage cuts for flight crew and ground staff and is in the process of selling Widerøe, its Norwegian regional unit. SAS predicts it will reach

Long-Range Vision

Qantas and Virgin Australia play waiting game on 787/A350 decisions

Adrian Schofield **Auckland**

Australia's two major airlines both intend to place new orders for long-haul aircraft, but with their financial performance still far short of target, firm commitments remain elusive.

Qantas holds 50 options and purchase rights for Boeing 787-9s, but it will not convert these to orders until its international unit returns to profitability, which is projected to be around 2015. Virgin Australia, having slipped back into the red, is weighing whether to order 787s or Airbus A350s. However, its decision timetable appears to have lengthened and it may not come for a year or more.

That is not to say that Australian carriers are standing still on fleet renewal. Qantas has revealed details of a major refurbishment of its Airbus A330 fleet, and it has a large orderbook earmarked for its Jetstar low-cost subsidiary. Virgin also has a hefty backlog of Boeing 737-800s, and is due to receive more A330s.

But during their earnings calls for the fiscal year ending June 30, the CEOs of the two airlines emphasized they are in no hurry to add to their long-haul orderbooks. Their focus is honed on attaining a more solid financial position.

Qantas has tentatively reserved delivery slots starting in 2016 for its 787-9 options and purchase rights, and the carrier is sticking to its assertion that it will not convert any of these to firm orders until its international operation is back in the black. The airline says it is making good progress toward reaching that goal, but it appears that it must be fully achieved before the orders can be made official.

The carrier previously had 35 firm orders for the -9s, but about a year ago Qantas canceled these while retaining the options it held for the aircraft. By doing this, the airline could delay the 787-9s by a few years and give itself more flexibility with deliveries. These -9 options are separate from the 14 787-8 firm orders that are destined for Qantas subsidiary Jetstar, and are due to begin arriving in late September.

CEO Alan Joyce says the plan is to get the international unit back to break-even by fiscal 2015, "then we'll make a call" on the 787-9s after assessing global market conditions. Until that time, the airline will not comment on whether the likelihood of firming the orders is growing stronger or receding.

Qantas wants to "maintain complete flexibility" regarding these options,

Qantas could receive Boeing 787-9s as early as 2016, but the options have not yet been confirmed.



Joyce says. While the first potential deliveries would be in 2016, others are spread over subsequent years—"so decisions can be made on an aircraft-by-aircraft basis."

In the meantime, the carrier will be advancing with other fleet moves. It plans to install new interiors on its 30 A330s from late 2014, including an upgraded inflight entertainment system and newly designed business-class seats. The 10 A330-300s used on international routes will also be outfitted with new economy seats, while the

FLEET FUNDING

Strong financial results from Air New Zealand are supporting the extensive fleet spending that the carrier intends to execute in the medium term.

Air New Zealand's net profit of NZ\$182 million (\$143.8 million) for the year through June 30 was its highest in five years, and its third best in its history. The carrier's senior executives

emphasize that this influx aids its reinvestment in the business.

The carrier revealed that it will be spending NZ\$1.8 billion on its fleet in the next three years, covering new deliveries and cabin upgrades to Boeing 777-200ERs and ATR 72-500s. The deliveries over that period will include two leased 777-300ERs, six 787-9s, nine Airbus A320s and four ATR 72-600s.

an operating margin above 3% in its fiscal 2012-13, which ends in October.

However, while the airline appears to have resolved its labor cost issues, it still suffers from the low-yield high-competition European short- and me-

dium-haul market; SAS's long-haul network is subscale compared with others.

And things appear to be getting worse: Last week, rival Norwegian announced new services to Orlando, Fla., Los Angeles, and Oakland, Calif. And

Icelandair, which pulls a lot of Scandinavian traffic over its Reykjavik hub, will fly to more North American destinations, too, adding Edmonton, Alberta; Vancouver, B.C.; and Anchorage, Alaska, to its network soon. ☛



BOEING

remaining 20 -200s, used for domestic service, will have refurbished economy seats.

Three Jetstar 787-8s are scheduled to be delivered by the end of 2013. As the 787s arrive, Jetstar A330s will be transferred to Qantas mainline, and all of Qantas's Boeing 767-300s will be retired by mid-2015.

Four new 737-800s will enter the mainline fleet in the current fiscal year, and the last of the domestic 737-400s will be retired during this period. Two more 747-400s will also be retired in

the 2014 fiscal year, following five that were phased out in the previous year.

Qantas achieved a slim net profit of A\$6 million (\$5.5 million) for the fiscal year ending June 30, which was a turnaround of A\$250 million from its loss a year earlier. The international unit saw the biggest improvement, halving its loss from the previous year. The mainline domestic operation and the Jetstar subsidiary contributed healthy profits, although they declined from the previous year.

Virgin Australia has been stating for

several months that it is considering an A350 or 787 order, and executives have previously indicated they would make a decision by year-end. However, CEO John Borghetti now says a 6-12-month timeframe is more likely, or perhaps beyond that.

Borghetti says there is "no urgency as such" to make a commitment on these aircraft types. "There is nothing holding us" to the 6-12-month estimate, and Virgin Australia would be "quite happy to push it out further" if necessary, he notes. "We want to make a considered decision" based on what will best fit the airline's route structure.

Virgin Australia is scheduled to take delivery of 18 737-800s through 2016, part of its total orders of more than 60 737-family aircraft. It has one more A330-200 due this year, and another next year.

The airline reported a net loss of A\$98.1 million for the fiscal year, which was a significant drop from the previous year's profit of A\$22.8 million. It incurred A\$105 million in pre-tax costs from its major restructuring and transformation program, including Virgin's switch to a Sabre reservations system, and the acquisition of regional carrier Skywest and a controlling share in Tigerair Australia. In addition, a new carbon tax cost the airline A\$47.9 million.

Virgin Australia's major airline stakeholders—Etihad Airways, Singapore Airlines and Air New Zealand—have committed to provide an A\$90 million term loan to Virgin to help boost its liquidity. ☛

The first of the 787-9s is due to be delivered in June 2014, and there will be a total of three in the fleet by the end of the fiscal year ending June 30, 2015. Another three deliveries are expected in the following fiscal year, and two more in the next. Air New Zealand has 10 787-9s on order, and is the launch customer for this variant.

CEO Christopher Luxon says all parts of the network are performing well, and the financial results for this fiscal year are expected to

improve further. New destinations will be announced over the next year, and the carrier is also talking to prospective airline partners.

The airline has gained approval from Australian regulators to lift its shareholding in Virgin Australia by about six percentage points to 26%. Luxon says the financial results of Virgin Australia have been "disappointing," but stresses that holding a stake in this carrier will be a long-term advantage as it gives Air New Zealand a way to tap into the quickly growing Australian domestic market. ☛

Testing Times

Cathay's next CEO looks to North America to boost long-haul fortunes

Adrian Schofield **Sydney**

Cathay Pacific Airways veteran Ivan Chu will face some complex strategic challenges when he takes over as CEO, as the carrier grapples with new sources of competition and a weak cargo market that continues to hobble its financial performance.

The next few years will be critical for Hong Kong-based Cathay. It is increasingly coming under pressure from fast-growing rivals from the Middle East and mainland China, as well as the low-cost carriers that are spreading their networks across Asia—and even into Hong Kong.

Cathay is looking to combat these threats by strengthening its own network, adding services to its most profitable markets such as the U.S. The carrier is also making major fleet changes to help its long-haul operation become more cost-effective.

However, these steps will mean little unless Chu can drag Cathay's extensive cargo operation back into profitability. A sustained downturn in the freight market has hit Cathay and other big

freight carriers hard—particularly since Cathay is making some major investments in this side of its business.

Chu, who is currently chief operating officer, will assume responsibility for all of these issues when he becomes CEO in March. He takes over from John Slosar, who has been CEO since 2011 and is moving up to become chairman of Cathay and a slate of other Swire Group companies.

Speaking to Aviation Week in Sydney just before his promotion was announced, Chu highlighted transpacific routes to the U.S. as a focal point for Cathay. The carrier has “seen good growth” in the U.S., and is “very bullish” about the market, Chu says. He cites Boeing estimates of 4.5% annual growth in transpacific traffic. Cathay is “well placed to take advantage of that [demand growth],” says Chu.

The airline plans to add both frequencies and new destinations in the U.S. market, Chu says. U.S. East and West Coast cities are under consideration. One such new point is Newark

(N.J.) Liberty International Airport, which the airline will begin serving in March. Four daily flights to New York John F. Kennedy International Airport are already offered.

Cathay is also ramping up its Los Angeles and San Francisco services again as it takes delivery of more Boeing 777-300ERs. These markets saw a dip in capacity thanks to the airline's decision to accelerate the retirement of some of its 747-400s in 2012.

As well as the U.S. West Coast cities and New York, Cathay flies to Chicago and Canadian destinations Toronto and Vancouver.

Generally speaking, Cathay “sees a lot of potential going forward” in North America, says Chu. The scheduled arrival of Airbus A350s in 2016 will open up the possibility of more long, thin routes into secondary markets in North America and Europe, he says.

The airline's executives were also upbeat about the North American market during a recent analyst briefing. They say the recovery in business traffic has been strongest on Cathay's North American routes. Yields were up dramatically in this market, although year-on-year capacity was down 15% due to last year's cuts.

Cathay does not have antitrust immunity to cooperate closely with another airline on transpacific routes as rival carriers do, although it has a



Cathay Pacific is rapidly replacing its Boeing 747-400s with more efficient 777-300ERs.

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code-share relationship with American Airlines that Chu says is working well.

Other markets are also appealing. Australia is one of these, although Cathay has reached the cap of 70 flights a week allowed by the current air services agreement between Australia and Hong Kong. Cathay is hoping this limit can be raised during government negotiations, Chu says.

Closer to home, Chu describes the potential for growth in the mainland China market as "exponential." Cathay already serves about 20 destinations there, mainly through its Dragonair subsidiary. He notes that even so-called second-tier cities in China have populations in the millions.

Elsewhere in Asia, low-cost carriers are posing an increasing challenge to the established legacy airlines as they push into new markets. A good example is the Australia-based Jetstar group, which is attempting to launch a joint-venture LCC in Hong Kong.

The Jetstar Hong Kong proposal was listed in the Hong Kong government gazette on Aug. 23, opening the public comment process. Cathay says

it will make a submission, which will undoubtedly oppose the LCC's entry. Cathay claims the new carrier does not comply with laws requiring airlines to have Hong Kong as their principal place of business, and says the LCC will be controlled from overseas by Jetstar.

Ownership of the joint venture is split equally among Jetstar, China Eastern Airlines and Hong Kong's Shun Tak Holdings. Jetstar executives say they are confident the new LCC will be approved and operating by year-end.

Chu downplays the effect Jetstar Hong Kong will have on Cathay if allowed to proceed. He notes that Hong Kong has always been a highly competitive market, which is currently served by more than 100 carriers—including 17 LCCs. None of these LCCs are based in Hong Kong, although local airline Hong Kong Express intends to transform itself into an LCC from October.

While many Asian full-service airlines have launched LCC subsidiaries, Cathay is still assessing the market. The carrier is "not jumping into the water yet" with its own LCC, Chu says.

The move by Qantas subsidiary

Jetstar into Hong Kong is also straining relations with fellow Oneworld Alliance partner Cathay. While Cathay has a relatively loose affiliation with many Oneworld members, it has close partnerships with some Star Alliance carriers—particularly Air China; the two carriers have significant ownership cross-holdings.

A greater immediate concern for Cathay is the poor financial performance of its freight operation. The global cargo market has experienced a long-term slide, which is particularly painful for airlines like Cathay that have dedicated freighter fleets.

Cargo demand has been weak since April 2011, according to Cathay. The airline's revenue and yield in this sector fell again in the six months through June 30, offsetting improvement in passenger demand. While there are not yet any signs that the cargo market is improving, Cathay executives are hopeful there will be a pickup late in the year as new electronics product shipments increase.

Despite the downturn, Cathay is making major investments on the car-



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go side. It is spending HK\$5.9 billion (\$760 million) on a new cargo terminal, which is opening in stages. The final stage is scheduled to be completed in the fourth quarter of this year.

The carrier is also modernizing its cargo fleet as it takes delivery of new Boeing 747-8Fs. Three more of the type are due by the end of the year, giving it 13 -8Fs which will comprise about half of its 747 freighter fleet. Older 747-400BCF converted freighters are being phased out.

Chu says these investments are justified since cargo demand is certain to rebound, and Cathay will be well-positioned when it does. He notes that it is never easy to time long-term investment with market cycles.

The -8Fs will improve cost-effectiveness. Chu observes that the economic assumptions of the cargo business have changed, and freighters have to be modern and fuel-efficient. "High fuel prices have ended the days of old freighters making money," he says.

Another challenge is the increasing level of congestion at Hong Kong International Airport. The airport is planning to add a third runway, but the project is tied up in the bureaucratic process. Chu stresses that Cathay's hub is "near capacity," with some experts estimating that this point will be reached as soon as 2017. "The need for a new runway has never been more clear, [but] there are still some challenges to overcome," Chu says.

As well as its freighter acquisitions, Cathay is also making major changes in its passenger fleet that will improve its competitiveness on long-haul routes and reduce the impact of high fuel prices. The airline is phasing out its 747-400s as new 777-300ERs arrive. It is due to receive six more -300ERs this year, with eight to come in 2014 and four in 2015, to give it a total of 50. The airline will cut its 747 fleet to 13 by year-end, and will phase out another six in 2014 and the remainder by 2017.

The 777-300ERs will be significantly more fuel efficient than the 747s they replace. Cathay Finance Director Martin Murray says the difference is so great that some routes that would be unprofitable with 747s would be profitable with the 777s.

The carrier is also slated to receive 10 more Airbus A330-300s by 2015. In the longer term, it expects to take delivery of 22 A350-900s in 2016 and 2017, and 26 A350-1000s between 2018-20. ☛

Pressure Zone

French BEA calls for training, simulation upgrades to counter go-around accidents

John Croft Washington

When pilots abort an approach and perform a go-around, the action compresses and accelerates the elements of airmanship and automation into a 1-min. window, leaving little margin for error in either.

A new study published last month by the French aviation safety agency, BEA, concludes that pilots are ill-prepared for the rare events, which are often initiated by air traffic control or the non-flying pilot who is monitoring the approach. In either case, the pilot at the controls can be startled by the order, initiating a chain of events that can lead to loss of control after a go-around is initiated.

In a BEA questionnaire answered by 831 pilots, 60% said they had encountered difficulties with go-arounds in the air or in a simulator. The predominant reasons for initiating go-arounds were weather, including tailwinds, unstabilized approaches or air traffic control commands. Troubles during the maneuvers included the higher-than-normal acceleration with take-off/go-around (TOGA) thrust and all engines operating due to the lower weight of the aircraft at its destination, unnoticed disengagement of the automatic systems, and unexpected air traffic control requests, increasing workload and stress.

Based on its findings, the agency has made 34 recommendations to regulators and airframers, including a call for additional initial and recurrent go-around training with higher-fidelity simulators, modifying the aircraft's go-around thrust to account for actual flight conditions, and studying "the means required to detect and correct erroneous mode selection during a go-around."

BEA says that between 1985 and 2010, there were least 25 accidents or serious incidents attributed to situations the agency now defines generically as errors in aircraft state awareness during go-around (Asaga), claiming 954 lives. Three fatal accidents the BEA investigated in 2009 and 2010—involving a Yemenia Airbus A310 at Moroni, Comoros; an AeroUnion A300 freighter

in Monterrey, Mexico; and an Afriqiyah A330 in Tripoli, Libya—alerted the agency to potential issues with go-arounds and prompted the study.

BEA says the loss-of-control crashes occurred either during go-arounds or at full-thrust configuration with high nose-up angle, considered Asaga-type events. More broadly, BEA says an Asaga-type accident is marked by inadequate management by the flight crew of the relationship between pitch attitude and thrust in any situation at low altitude.

On average, Asaga-type events accounted for 3.67% of airline fatalities per year from 1985-2010, though in 2009 and 2010 the number was significantly higher at 20% and 27%, respectively. "Thus, even though the number of Asaga-type events is relatively low, each of them produces a high number of casualties, which justifies taking specific prevention measures," says the BEA.

Included in the forensics the BEA used for the study were the August 2000 crash of a Gulf Air A320 in Bahrain and a problematic, previously unreported go-around of an A380 at John F. Kennedy International Airport in New York on Oct. 11, 2010. According to the study, the first officer was at the controls of the A380 during a poorly executed visual approach to Runway 31L, with the captain performing the monitoring function. At 480 ft. altitude and 1 mi. from the runway, the captain ordered a go-around as the aircraft was flying too high and too fast to meet standard operating procedures for a stabilized approach. The first officer initiated the go-around, pushing throttles forward to the TOGA position. Due to a relatively low initial go-around altitude requirement of 1,000 ft. and the first officer's inability to properly control thrust, the aircraft experienced several flap overspeed warnings and experienced vertical speeds as high as 4,200 ft. per min. during the 45-sec. ordeal.

Along with the questionnaires, the 13-year effort included a broad survey of accidents in BEA and International Civil Aviation Organization (ICAO) databases, a detailed analysis of 16



French investigators used flight simulators with eye and head-tracking devices to analyze how Boeing 777 and Airbus A330 pilots react to go-around scenarios.

accidents or incidents, including six narrative descriptions of events, and 13 full-flight sessions on the Boeing 777 and Airbus A330 simulators.

Pilots in BEA's questionnaire revealed that go-arounds are relatively rare and training is not comprehensive or representative. There are approximately 2-4 go-arounds per 1,000 flights, which translate to about one per year for short and medium-haul pilots and one every 5-10 years for long-haul pilots.

Combined with the rarity of the event is a training environment that does not provide physiological realism. According to providers that BEA interviewed, go-around training for a type rating "takes place in an environment that imposes very few constraints," including no or limited interaction with air traffic control, no major system malfunctions and no environmentally sensitive flight paths. A physiological aspect of go-arounds—somatogravic illusions—is not "systematically covered during the training" and the effects are not modeled in simulators. BEA is recommending that the effect be incorporated into simulators.

Somatogravic illusions occur when acceleration along the flight path is combined with a nose-up pitching moment, both of which take place when

an aircraft with under-wing engines begins a go-around. Pilots may counteract the perceived nose-up pitch with a strong desire to put in a nose-down control input. BEA's analysis shows that the difference between the actual pitch attitude and perceived

'Even though the number of Asaga-type events is relatively low, each of them produces a high number of casualties, which justifies taking specific prevention measures,' BEA says.

pitch attitude during a go-around can be as much as 25 deg. "Pilots may try to counteract this perception of a climb by pitching down the aircraft nose until the dive counterbalances the apparent backward tilt caused by the acceleration," says the BEA, noting that the effect can be compounded by a false visible horizon, for example a shoreline or unlit background terrain.

Given that go-around training for initial type rating takes place in simulators and most recurrent training

simulates a go-around with a failed engine (reducing the acceleration effects that worsen somatogravic illusions), BEA is concerned that pilots are not experiencing the phenomena until it is too late. "Although no objective standard exists for somatogravic illusions, the major simulator manufacturer indicated that this issue has been studied, but never implemented," says the BEA, not identifying the simulator manufacturer it had talked to. "However, it seems possible to tailor the motion cues to the specific context of a go-around." The idea would be to use an exaggerated nose-up angle to simulate the somatogravic illusion during a go-around. BEA says the pitch capability likely exists given that the typical operational pitch range is 10-15 deg. nose up or down, though the simulator can move as far as 20-25 deg. in pitch. "This should be researched so that illusions can

be simulated more accurately, and to define the associated regulatory criteria for the qualification of simulators," the BEA says. Of concern to the BEA is that "some American airlines are putting pressure on the FAA" to authorize pilot training with fixed-base simulators to save money.

"In view of the simulator issues discussed, this would appear to be inappropriate for this phase of flight," says the BEA.

Reducing go-around thrust levels could help with Asaga-type incidents, in part by reducing the acceleration levels that could lead to nose-up illusions.

According to BEA, Airbus recently certified a reduced-thrust TOGA mode called "GA SOFT" on the A380, and is working to certify the same mode in the A330 and A340. Boeing on the 777 and 747 already has a reduced thrust mode that limits vertical speed to 2,000 fpm. "The main objective of this thrust limitation is to limit the effects of somatogravic illusions," says BEA. "But by also inducing a vertical speed limitation, it can give extra time for the completion of the go-around." ❧



Lockheed Martin's P-3 Orion provides surveillance for counterterrorism in Yemen.

Prying Eyes

U.S. steps up surveillance of Al Qaeda in the Arabian Peninsula

Casey Coombs **Sanaa, Yemen**

The unexpected appearance of an unarmed, conventional U.S. aircraft only added fuel to already simmering online opposition to the American UAV campaign. "It caused a [public relations] nightmare," a Yemeni official in Washington says, referring to the audible drone emanating from the Lockheed Martin-made P-3 Orion circling overhead.

Some panicked Sanaa residents mistook the unidentifiable object for one of the Pentagon or CIA-operated UAVs that had reportedly killed four suspected Al Qaeda suspects earlier that morning, including one featured on the "25 Most-Wanted Terrorists" list announced by Yemen's supreme security committee.

Despite the image problems created by the aircraft, the Yemeni official says it works. "It's perfect for pin-pointing and intercepting signals. On the spot. Instantly," the official says. "We need it."

The escalation of U.S. security actions in Yemen accompanied the State Department's Aug. 2 worldwide travel

alert, warning of the increased potential for terrorist attacks in the Middle East and North Africa and the temporary closure of 19 U.S. embassies and consulates, including in Sanaa.

The extra precautions taken here are a function of the Yemeni government's acknowledged inability to contain Al Qaeda in the Arabian Peninsula (AQAP) since the 2011 Arab Spring uprisings divided the government and military forces. This culminated in the transfer of power from President Ali Abdullah Saleh, who served for 33 years, to his deputy of almost two decades, Abd Rabu Mansur Hadi, in February 2012.

Despite a year and a half of reforms and capacity-building efforts under Hadi, the Yemeni official says, "We don't have a functioning military."

AQAP's insurgent tactics during this period have further raised its profile as the principal terrorist threat to U.S. homeland security, owing to a series of attempts to bomb U.S. bound-airliners, beginning with the "underwear bomb"

plot on Dec. 25, 2009.

Washington responded to that near-miss with record levels of counterterrorism aid, totaling \$181 million in fiscal 2010. The majority of the funds, allocated from the Defense Department's Section 1206 train-and-equip authority created in the 2006 National Defense Authorization Act, benefitted Yemen's dilapidated air force with the purchase of four Bell Huey II helicopters, upgrades and parts for about 10 existing helicopters and a CASA CN235 twin-turboprop transport aircraft upgraded with intelligence, surveillance, target acquisition, and reconnaissance

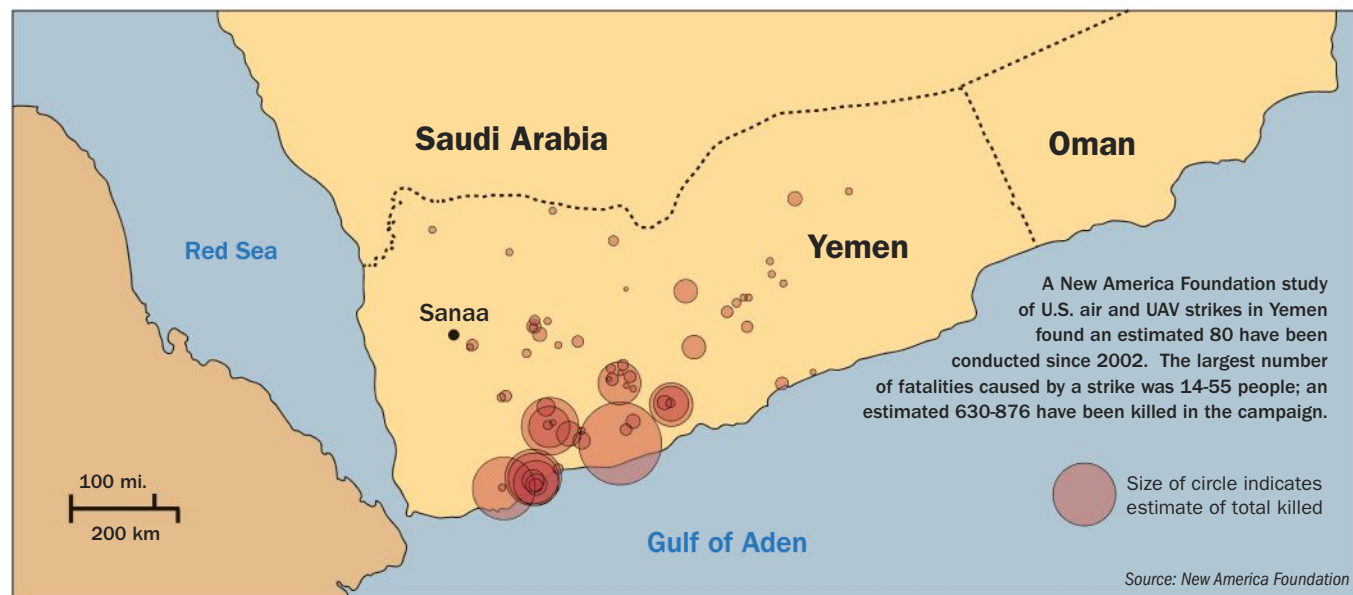
(Istar) capabilities.

Two single-turboprop Cessna C208s purchased under Section 1206 Authority in fiscal 2012 will be furnished with weapons and a signals-intelligence system comparable to the P-3 Orion, the Yemeni official confirms.

Last summer, U.S. officials told Aviation Week that they expected the C208s' eight pilots and eight maintainers, along with the CN235's six pilots and 22 maintainers, to be finished with training and ready for combat in Yemen by June or July of this year. But deteriorated security conditions since 2011 have forced virtually all military-to-military cooperation to take place outside of Yemen, which has contributed to delays.

When the short-takeoff-and-landing transports eventually do arrive, they will be in high demand. Yemen's elite U.S.-trained and -equipped counterterrorism forces have been largely unable to reach remote high-altitude areas where AQAP sanctuaries are concentrated due to the dearth of both fixed- and rotary-wing aircraft. The number of helicopters now on hand, according to the Yemeni official, can barely mobilize units in and around major cities. On Aug. 6, aggrieved tribesmen in Marib province east of

U.S. UAV/Air Strikes in Yemen Aug. 1, 2002-Aug. 12, 2013



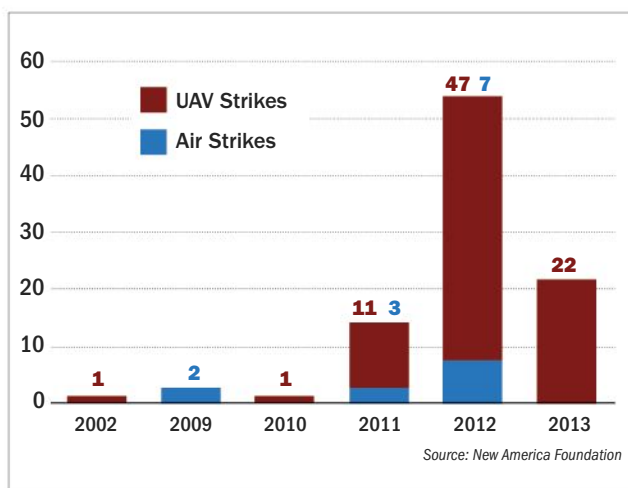
Sanaa shot down a military helicopter responding to clashes involving the repair of state oil infrastructure that locals had sabotaged.

To accommodate these competing demands while accounting for U.S. budget constraints, U.S. Navy Naval Air Systems Command is seeking donor support for the purchase of five additional used transports—three CN235s and two Lockheed 100s—in fiscal 2013.

According to Yemen's state news agency, SABA, the Pentagon announced in early July a military assistance package to Yemeni border guards,

which includes 12 Seabird Seeker light observation aircraft equipped with electro-optic and infrared sensors enabling night-vision capabilities and an integrated air-ground-maritime communication infrastructure, which will include 48 maritime, land- and vehicle-based surveillance stations. SABA stated that the aircraft have been designated to counter arms- and drugs-smuggling, as well as thwart terrorist militants sneaking into the country.

How much of an impact these investments will make is unclear, however, given the volume of contraband flowing ashore along Yemen's 1,906-km (1,184-mi.) coastline and across its porous 1,458-km land border with Saudi Arabia. The \$40 million counterterrorism package is part of fiscal 2013 Sec-



tion 1206 Authority outlays, according to a Pentagon statement. The ongoing show of U.S. air power is a direct reflection of Yemen's divided, under-trained and under-equipped security forces in the face of these challenges.

Yet, despite 11 reported U.S. UAV attacks since July 27, which Hadi said in an Aug. 22 speech had killed 40 militants, AQAP's senior operational leadership appears to remain intact. In the speech at Sanaa's police academy, Hadi defended the legitimacy of the U.S. UAV campaign and announced he had requested this technology from Washington.

One significant effect of the combined upsurge in kinetic and non-kinetic aerial tactics has been to raise AQAP's operational risk while shrink-

ing its operational freedom. In response to the conspicuous presence of the P-3 Orion, for example, AQAP operatives were forced to limit all forms of electronic communication. According to a Yemeni intelligence source, this may have helped avert planned and potential attacks in the capital. Indeed, AQAP's senior religious figure attributed the recent death of the organization's co-founder and second-in-command, Said al-Shihri, to a U.S. UAV strike that had detected his mobile-phone signal.

The alleged promotion of AQAP's founding leader, Nassir al-Wuhayshi, to general manager of global Al Qaeda operations—roughly the equivalent of consigliere to Osama bin Laden's successor, Ayman Zawahiri—may have been linked to the Aug. 2 threat alert. As a result of the leadership shake-up, command of Yemen's franchise has devolved to AQAP's notorious Saudi bomb-maker, Ibrahim al-Asiri, who, like Shihri last November, reportedly survived an Aug. 10 UAV strike in southern Lahj province that killed two others, though U.S. officials have yet to definitively confirm or deny those reports.

In the meantime, according to the Yemeni official, Hadi is willing and able to sustain heavy UAV strikes. "Tier 2 [militants] are freaking out," the official says. "AQAP wants revenge." ☒

Reviewing the Asia-Pacific civil aerospace industry this week, we see the great range of challenges facing managers outside of the world's main aircraft building centers in the Americas and Europe. India's private aerospace industry, only 12 years old, is grappling with the usual problems of a startup in finding skilled people and volume contracts—although local company Dynamatic is succeeding in high-rate production for Airbus while other Indian companies are carving niches in engineering services.

At the other end of the scale, the region's most advanced industry, Japan's, is struggling with development of its own commercial aircraft, the Mitsubishi Aircraft MRJ. When the

aircraft is delivered—in 2017, according to the latest iteration of its delayed schedule—it will be the first Asian commercial jet that can compare technologically with the best from the rest of the world.

Between those extremes, we see factories in Japan and Australia engaged in full-bore efforts to maintain competitiveness against low-cost rivals, and a Chinese industry that, for all its technical ambition and proficiency, is still hampered in its quest for commercial profits by its Communist roots. Our survey omits the Southeast Asian industry, much of which lies between India and China in technology, and South Korea's, which is not yet at the level of Japan.

Target 2017

With the causes of delays now behind it, Mitsubishi Aircraft sees only normal development ahead for the MRJ

Bradley Perrett **Singapore**

In Asia, as elsewhere, aerospace managers repeatedly stress airworthiness certification among the top challenges of moving into commercial aircraft production. As if to prove the point, Mitsubishi Aircraft has now twice skidded on the certification banana peel in its effort to develop Japan's first airliner since the 1960s, the MRJ regional jet.

The cause of the latest delay to the program has been dealt with, Mitsubishi Aircraft says, predicting only the usual challenges as the development effort moves toward its new first-delivery target, early 2017.

The reason for the timing of the company's delay announcement on Aug. 22—only months before the previously scheduled first flight—remains unclear, especially since the Mitsubishi Aircraft team has been working on the issue, obtaining permission to perform certification processes, since 2009 and completed it almost a year ago. The task evolved over time, says the company.

Despite the delay, the orderbook, for 165 aircraft, is not likely to suffer cancellations, says Yuko Fukuhara, the project's head of sales.

Mitsubishi Aircraft has begun making six MRJ airframes, five for flight-test aircraft and one for static ground

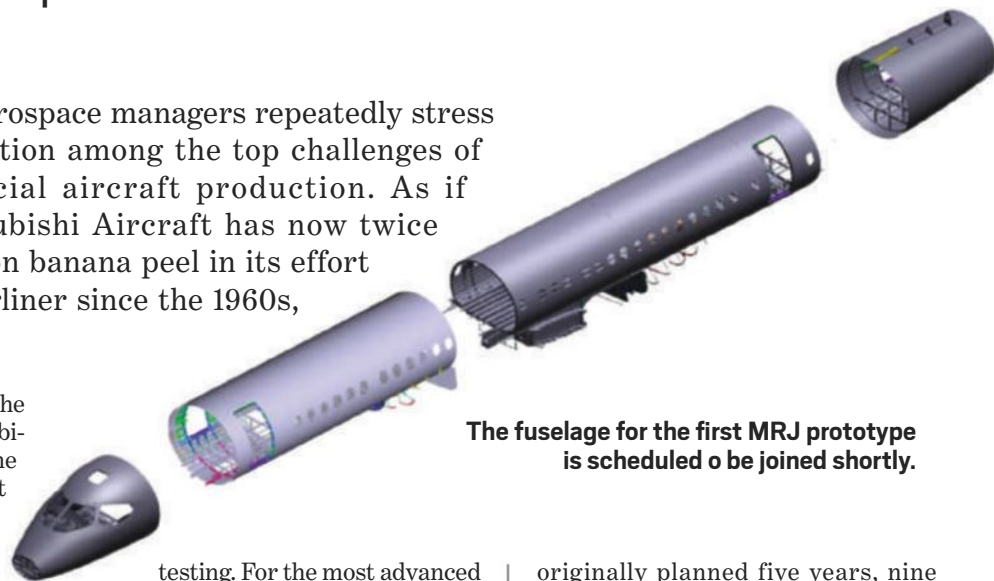
testing. For the most advanced airframe, that of the first prototype, 90% of the parts have been made and fuselage sections are to be joined “in the near future,” says the company. Final assembly of the whole aircraft is due in the northern fall. The first Pratt & Whitney PW1217G engines will arrive in spring and first flight should now take place in the second quarter of 2015.

Major shareholder Mitsubishi Heavy Industries is building the airframe for the aircraft, which will have standard seating for 92 and 78 passengers in two versions.

The latest delay to the MRJ extends development to nine years from the

originally planned five years, nine months. Its cause, not previously detailed, stems from 2009, Fukuhara told reporters in a conference call on Aug. 30. In that year Mitsubishi Aircraft learned that it needed company-wide organization delegation authorization (ODA), under which it would act on behalf of the certifying authority in the more routine aspects of approving designs and ensuring airworthiness standards. Mitsubishi Aircraft believes the MRJ program is the first to be fully covered by the ODA system.

And it underestimated the amount of effort involved in obtaining ODA from the Japan Civil Aviation Bureau, which locally instituted the FAA sys-



The fuselage for the first MRJ prototype is scheduled to be joined shortly.



tem to keep certification regulations internationally consistent. A key issue seems to be that achieving ODA is a once-only company effort. The company “was adopting the ODA-type system while our own program was also in development,” says a Mitsubishi Aircraft spokesman. “Therefore we had to handle both tasks at once.” Any later program by the company will rely on only updates to its ODA.

Still, it remains unclear why Mitsubishi Aircraft took until last month, more than five years after program launch and less than five months before its previous first-flight target, to announce that the ODA task, by then complete, had caused another delay of about 18 months. In 2009 Mitsubishi Aircraft delayed first delivery by about one quarter from the original target of late 2013 because of design changes. Last year it pushed the schedule out by an indefinite period—approximately a year and a half—because it discovered that it had not properly documented production processes for certification purposes. The ODA work was separate to that problem

and ended in September 2012 when the authorization was received.

Delegation of aspects of certification work has a long history in aircraft certification, but the ODA system is more extensive than the traditional approach, demanding that a whole organization, not just certain individuals in it, show its competence and its procedural compliance. At the level of a type-certificate holder, such as Mitsubishi Aircraft, the organization must also ensure that its suppliers comply. Satisfied that the manufacturer can be trusted for routine activities, the government authority can devote more of its resources to high-level supervision.

Since the MRJ’s ODA work is complete and the earlier problem of undocumented processes has been resolved, the program now has no hurdles except the usual challenges of moving through manufacturing to flight testing and certification, says Fukuhara.

Although Mitsubishi Aircraft appears not to have sought special assistance for its ODA work, Boeing has been an adviser to the program

Mitsubishi Heavy Industries has begun building the airframes for six MRJs.

and the Japanese company has hired many foreign experts, especially former Boeing employees, to help it with such development challenges as relations with suppliers, ground tests, flight tests and certification.

Since MRJ development is now due to due to last so long, the program must be greatly exceeding its original budget. The increased cost of delays can be absorbed within the business case, however, says Fukuhara.

Employing engineers and facilities on the MRJ for more than one-and-one-half times the intended period is probably not the only source of a cost blowout. A manufacturer would normally have to compensate customers for late deliveries and, although Mitsubishi Aircraft will not comment on the issue, suppliers are typically entitled to compensation when certification is greatly delayed. The causes of the three delays do not appear to be the fault of any supplier. ☒

Halving Labor Costs

Fuji Heavy Industries is in the midst of a massive efficiency drive

Bradley Perrett Tokyo and Nagoya, Japan

Production managers everywhere strive for process improvements. A 5% cut in labor costs is a commendable achievement, and 10% is considered really good.

The aerospace unit of Fuji Heavy Industries (FHI) is aiming to cut costs by nearly 50%. Indeed, it says it is already more than halfway there.

The intensive, eight-year effort that began in fiscal 2008 has two sides. One is to reduce labor expenditure by 30% via streamlining non-value time—minutes employees spend without working on the product—for example, by walking to fetch tools. Then the remaining labor is to be trimmed a further 30% by reducing value time, meaning that less work must be applied directly in creating a component, such as a Boeing 777 or 787 center wingbox. The two efforts combined will result in halving the amount of labor spent on a given value of output.

It sounds ambitious, to say the least, but FHI says it is now more than halfway through the process, mainly by the attack on non-value time, “factory kaizen” in Japanese terms.

The campaign against costs never ends, stresses Hiroshi Wakai, general manager of the aerospace company of Fuji Heavy Industries. At the end of fiscal 2015, when the current target should be achieved, the company will not stop pushing for improvements. Gleaning more results from each hour is important anywhere; it is all the more important when, as in Japan, labor is unusually expensive. Competitors such as GKN, Korean Air and Korea Aerospace Industries will surely take note of FHI’s progress.

Part of the Japanese company’s effort in re-

ducing non-value time is reorganizing dealings with suppliers, eliminating unnecessary handling of parts. And when parts arrive, they are now packed into more-complete kits.

Together, these efforts are strengthening FHI’s hand in bidding for its

FHI has developed a semi-automatic drill motor for robotic quality where robots cannot reach.

most important prospective production program, the 777X, which could extend the long relationship between Boeing and suppliers FHI, Mitsubishi Heavy Industries, Kawasaki Heavy Industries and composite raw material maker Toray. “The Japanese team of MHI, FHI, KHI and Toray is a good, proven team,” says Wakai, adding that FHI would again like to build the center wingbox. The company also integrates the wingbox with the KHI-built main-gear wheelwell structure.

In the factory kaizen program, the company, like other manufacturers, found that simply moving tools and parts closer to where they were

needed could greatly reduce the time employees spent walking, says Wakai. Some aerospace firms have made such changes as a result of suggestions from workers. FHI used time-and-motion studies, based on video recordings of the factory floor. The company revised the movement of parts through its factory, eliminating some activity, reduced packaging and changed processes to place parts and equipment in optimal positions. It looked for the shortest routes that parts could follow between their entry and exit doors. FHI Aerospace automotive sibling Subaru helped with advice.



FUJI HEAVY INDUSTRIES PHOTOS

Part of the reduction in movement was the adoption of more-extensive kitting, which was an early part of the reform process, begun in fiscal 2009. Now each station on the production lines has complete kits of all the parts it needs for each aircraft. Previously, there was only a very low level of kitting. The complete kits are better designed, too, says Wakai. “There is no confusion, no losses, and it is easy to control the number of parts,” he says. Skilled workers now spend more of their time using their talents.

This year brought a further change to parts handling. Formerly, FHI would receive a part from a supplier, inspect it and then send it to another supplier for further work. After the second supplier returned the part, FHI might then have sent it to a third supplier for more work, and so on. FHI has now arranged a so-called milk run: parts are passed directly from supplier to supplier, each inspecting its predecessor’s and its own work; the final supplier sends the part to FHI. At first, FHI assigned people to the suppliers to help with quality inspection and achieve airworthiness certification in doing so. Now the suppliers inspect alone.

New tools, including a variable drill motor with multiple functions, have been applied to FHI’s Boeing 787 program.



In comparison with the campaign against non-value time, the effort to reduce value time has further to go, perhaps because of the level of technical development.

To some extent, earlier progress is an obstacle. Managers and workers in a manufacturing program will routinely become better at what they do, in a process production engineers call “moving down the learning curve;” ordinary people say “practice makes perfect.” For FHI this is hard because in one of its biggest programs it is already very well practiced. “Improving efficiency for the 777 is a challenge,” says Wakai. “We have already made more than 1,000 center wingboxes, so the manufacturing line is very stable.” Yet the company has found ways to hold labor inputs on the 777 center wingbox steady while boosting output at its Handa plant from October 2012 to meet Boeing’s higher delivery rate—8.3 a month from first-quarter 2013, compared with seven a month previously. That alone implies a 19% rise in labor productivity.

In reducing value time applied to the 777 program, FHI’s emphasis has been on greater efficiency in making current parts with current equipment. For the 787, there is more automation and progressively improving part design to reduce manufacturing time.

The company has revised the programming of the automatic riveter it uses in making the center wingboxes of 777s, with the result that the machine is getting its work done faster. Similar changes to the routines of machining centers are making them produce parts in less time.

The 787 program, meanwhile, is still ramping up production rates; it should be poised for a steep slide down the learning curve. FHI is giving it a good shove by applying more machinery to building the aircraft’s center wingbox than it has in previous programs.

FHI and a supplier have developed a long-life tool called the R-Drill for work on carbon-fiber reinforced plastic, the predominant material of the 787. The diamond-coated tool’s key feature is a smoother and more rounded shape that imparts and suffers less stress as it works. FHI says the R-Drill works five times faster than its predecessor and lasts 15 times longer. An upgraded version is oil-cooled for even faster operation. FHI is working on more versions—for making bigger holes and

The R-Drill works five times faster than its predecessors, according to FHI and a supplier. They jointly designed the tool specifically for work on carbon-fiber reinforced plastic.

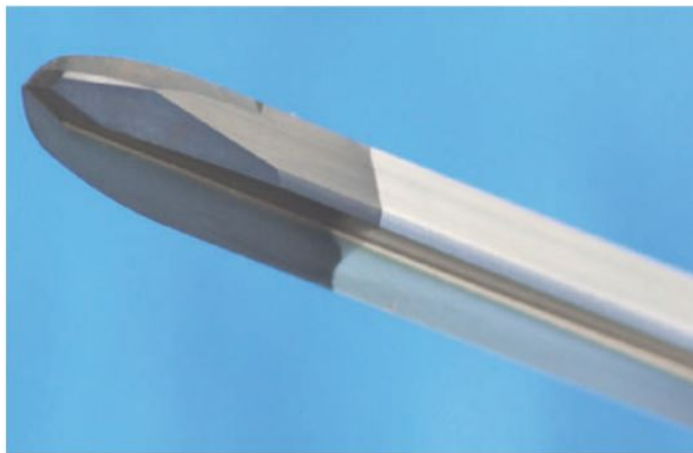
to further improve the drill shape. The company originated the idea, but it has authorized its supplier to manufacture and sell it for other customers.

Another new tool is a semi-automatic drilling motor. The alternative, a fully automatic drilling machine—some kind of robot—will not fit inside the 787 center wingbox, but fully manual drilling, previously used, required much more time to achieve the necessary quality. With the semi-automatic machine “the hole quality improves drastically,” says Wakai. The tool is used on the outside of the center wingbox, too.

FHI has also improved its water-jet-cutting processes for the 787s program. They are used mainly for trimming the upper and lower panels of the composite center wingbox. Giving no details, Keisuke Kamo says FHI is working to improve water-jet cutting and other manufacturing techniques. “Production rates are going up, so if I can make a small improvement there will be a big reduction in costs,” says Kamo, general manager of fixed-wing aircraft engineering.

An important element of reducing value time on the 787 has been a redesign of some of the aircraft’s parts so they are easier to make. FHI has done this, necessarily, with Boeing’s permission. The Japanese company is closely studying production methods that dispense with autoclaves, but this is unlikely to be applied to its 787 parts and probably not for major 777X components, if FHI gets to build them. Using autoclaves imposes considerable capital and operating costs, but Japanese aerospace engineers expect the great pressure cookers will still be needed at least into the 2020s to deliver the strength demanded of major wing structures.

FHI’s cost savings are not limited to increasing labor efficiency. The company is attacking its inventories. For all



of Japan’s reputation for just-in-time manufacturing, in which parts arrive only when they are needed, aerospace companies here have tended to keep big inventories. FHI is aiming to cut its stocks so they are sufficient for one year’s consumption. Capital costs may not be so big an issue in a low-interest country such as Japan, but storage expenses are significant. A key reason for the tendency to hold big stocks is a reluctance to throw away parts when design changes render them surplus, says a third FHI official, noting that most aircraft materials last forever.

One supplier reform remains elusive. For some parts, FHI contracts through an intermediary, which assumes the risks of building an inventory. Japanese industry officials say the intermediaries add considerable mark-ups for their services, but Wakai says FHI is still only looking at whether to bypass them. Relations between the parts manufacturers and intermediaries are strong, he notes.

In any efficiency drive, a standard approach is outsourcing some of a company’s core activities, which for FHI is manufacturing. FHI has done some, but not much.

The company has no plan to set up a plant outside of Japan, where it might benefit from cheaper labor rates, though it might order more parts from abroad. For the 787, it already imports composite parts from South Korean and U.S. manufacturers. Kamo stresses that the company’s strength is in assembly of complex and sophisticated parts. That is not easy for manufacturers in developing countries to compete against, but FHI is convinced it must keep pushing ahead with its efficiency drives to stave off the day when new competitors can approach its costs and quality. ☛

Many Hands

Chinese aerospace industry's technical skills are outpacing management expertise

Bradley Perrett **Beijing**

With obviously strong funding and rising technical skills, China's civil aircraft production is seeing marked advances in its sophistication. After decades of slow progress, the industry is now turning out large and technically difficult components of aircraft for foreign OEMs, while less assuredly developing its own.

Its great shortcoming, however, is in labor efficiency. Avic, the organization at the core of the industry, has more than 400,000 employees, compared

wings of the Airbus A320 and most of the fuselages of the Bombardier Q400 and CSeries. Composite work includes the rudder of the Boeing 787 and the enormous inboard flaps of the 747-8. Airbus has said the A320 wingboxes built by Avic Aircraft in Xian compare well with products of the plant at Broughton, England.

No one doubts that Avic can deliver quality. But things become harder for Avic when production rates must rise, say industry executives. Increasing the

of this practice are not only in the past; even now Avic takes no monetary risk on its defense programs, instead charging cost plus profit, say industry officials.

Yet, despite the application of large numbers of people to production, Avic managers frequently tell Aviation Week that the rising cost of labor is among their key problems. Others are the unfavorable movement in the dollar-yuan exchange rate and rising prices for raw materials. A senior Avic manager, highly critical of the group's labor efficiency, thinks in many plants only 10% of the workforce is needed. The reform of one factory last decade demonstrated that, he adds. In general, management quality in the Chinese industry is improving, industry officials say. But it has far to go.

None of this means Avic and Comac lack highly skilled people. "Even in the mid-1990s, there were people whose work and knowledge was very impressive," recalls a Western executive with longer experience than most in China. "They were world-class aircraft manufacturing guys." Two decades later, it is all the easier to find such experience. Avic could get more out of its employees if it had a better management culture.

Private ownership and control would make a difference, but the

Avic makes outer wings for the Airbus A320, but probably not much money doing so.

chance of that being instituted is remote, even if parts of the company are listed on stock exchanges. There was talk in 2008, amid a big reorganization, of greater private involvement.

Avic Aircraft, with a focus on large airplanes, now has affiliates at Shenyang and Chengdu (SACC and CACC, respectively) that focus on commercial work completely. They should, in principle, offer a chance to break free of wasteful habits. Consistent with that, SACC is taking a cautious approach to installing new equipment (*AW&ST* July 15, p. 33). On the other hand, some industry officials familiar with Avic think the new units will struggle to shed the culture of the rest of the group. Comac's position is similar, except that it is lavishly funded for the C919 narrowbody airliner program, a national priority, so penny-pinching is unlikely.

Spokesmen for Avic units were unable immediately to offer comments or did not respond to Aviation Week requests. ☛



to Boeing's 170,000. Even allowing for its military and non-aviation activities, Avic seems grossly overstaffed. Western industry executives consistently report that Avic employs inordinately large numbers of people in production. With so many workers to use, Chinese managers seem to have little incentive to increase labor efficiency. The result is high-quality civil aerospace production with doubtful profitability.

Technical capabilities at Avic and its commercial-jet offshoot, Comac, have been accelerating. From mainly small and simple structures up to the 1990s, Avic's subcontracting work this century has moved into impressively difficult aircraft assemblies, notably the outer

rate for A320 wings appears not to have been easy, for example. Since resources are usually not in short supply, Avic's problem in building things faster is evidently managerial.

Even when high-quality products are being built at targeted rates, profits are thin or non-existent because so many hours are spent on the work, say industry executives. To some of those observers, Avic managers have little awareness of the need to cut labor costs. "In their factories, one problem is that they are still struggling with the Soviet model, in which the more employees you have, the more important you are," says one. Moreover, "they want to give them all something to do." The military roots

Mutual Support

Boeing's Australian aerostructures plant works on advanced composite, robotic processes

Bradley Perrett **Melbourne, Australia**

“We have to be the best at getting better,” says Michael Dickinson, managing director of Boeing Aerostructures Australia, the largest Boeing manufacturing site outside of the U.S.—and one located in a country presenting considerable cost challenges for aerospace. With a currency and wage structure driven high by Chinese demand for minerals and 22 years of uninterrupted economic growth, Australia is facing a general decline in its secondary industry, a sector that has never been one of its strengths. Indeed, stories of struggling Australian manufacturers are so widespread that Boeing's evident success at its Melbourne composites plant comes as a surprise to locals.

Part of Boeing's answer is commonly seen in aerospace manufacturing in high-cost countries: Boeing Aerostructures Australia specializes in certain types of parts and uses advanced manufacturing technology that countries with cheap labor and lower skills have not widely adopted—or at least not yet. Hence the other element of Boeing's Australian strategy: The plant has a well-staffed research and development center that is tightly integrated with the factory and tasked with supplying it with technology to keep it ahead of the game, as well as serving Boeing operations globally.

The manufacturing operation may owe its continued existence to the R&D center, which devised the current advanced technology used at the site, a proprietary method of resin infusion with which the factory is making the trailing edge surfaces of the Boeing 787 without autoclaves. For the future, the R&D center is working on expanding the application of resin-infusion production, especially by making more complex shapes with it, while also adapting inexpensive industrial robots to difficult aerospace work.

Other focuses of development include better resins and new methods of heating them. Although plant managers will not say so, there are strong reasons for thinking that the forthcoming 777X

will exploit some of the new technologies from here.

Fully 14% of the staff of 1,700 of Boeing Aerostructures Australia are engineers, most of them working not in the factory but in R&D. That includes a team of 30 engineers focusing on long-term developments that are years from practical application. Importantly, the development engineers usually come from the factory. Michael Edwards, general manager of the R&D operation, the Melbourne Technology Center, empha-



BRADLEY PERRETT/AW&ST

Boeing Aerostructures Australia aims to use simple industrial robots for advanced tasks. This one is employed on more basic work.

sizes that it could hardly stand alone without a factory. To fully understand their tasks, production engineers need easy access to production work. That is especially true when the task is improving a current process. So the R&D center and factory support each other.

Making composite parts without autoclaves is a developing global trend, and it seems likely that Boeing's facility here will progressively move all of its production to that process. Heat is an unavoidable part of making parts of carbon-fiber reinforced plastic—it is needed to cure the resin—but the pressure that demands an autoclave

is unnecessary if the resin can be thoroughly infused between the fibers before heating, as is done by Boeing's method here and similar processes elsewhere.

The parts are cured in electric ovens, which cost about a tenth as much as autoclaves of the same size—say, \$2 million instead of \$20 million. Being inexpensive, they represent less of an obstacle to changing designs for larger pieces; it is not hard to justify installing a bigger one. All 787 parts made here are cooked in ovens. The R&D center is looking at ways of heating composites without ovens, says Edwards, declining to elaborate. Another Australian composites parts maker, Quickstep, has an out-of-autoclave composites process that heats and cools parts with glycol rather than in ovens (AW&ST Sept. 6, 2010, p. 52).

Like other researchers, Boeing's here are looking at applying resin-infusion composites to more complex shapes. During a visit to the plant in August, Aviation Week saw a full-scale sample 787 wing skin with integrated stringers, an alternative to a structure built up with a separate skin, stringers and fasteners.

It was made with resin-infusion technology—in fact, it probably could only be made that way—but represented work that the company had done several years ago. Photography was not allowed and no samples of the latest achievements were displayed. Edwards says the technology could be put into production this decade. That suggests it is a candidate for the 777X.

In Japan, Kawasaki Heavy Industries and compatriots Mitsubishi and Fuji have installed some of the world's largest autoclaves for their 787 work, which includes the main structure of the wing. But another Japanese company, Nippi, is using resin-infusion technology that it says has already reduced costs by 30% from the level of autoclave product; it aims to eventually bring the cost down to 50%. Nippi estimates that complex

shapes made integrally can be 10% lighter than those built up with fasteners (*AW&ST* Nov. 26, 2012, p. 37).

Melbourne's prospects for involvement in the updated 777 will depend on how its structure varies from the current versions, says Dickinson. Almost certainly, that means it will depend on how much composite is introduced and whether the applications suit the current and imminently applicable technologies of Boeing Aerostructures Australia. Since staff from Australia are working on 777X studies, the local technology appears to be relevant.

That may also include the resins that the plant here is working on. Edwards says only that they would offer greater strength, lower cost and faster curing.

Autoclaves here are used only for

is a leader in the trend to obtain such results much more cheaply with common industrial robots that the automotive industry, for example, may use, and that aerospace already uses for less demanding tasks. At maybe \$500,000 each, plus the same again for adaptation, they offer considerable savings over a bespoke machine that could easily cost \$10 million.

One function that the engineers here are working on is automatic laying of the fiber onto molds. Common industrial robots are not as precise in their operation as the most advanced aerospace manufacturing machinery, however. And even the casual observer can see that a machine no bigger than a horse, and maybe as small as a child, will lack the physical reach of a bespoke installa-

Robotic repairs could include fixing parts found to have been manufactured imperfectly.

Meanwhile, Melbourne has accelerated production of 787 surfaces. Boeing is delivering the aircraft at a rate of seven a month, with a plan to increase to 10. The plant here is already on its way to 10 partly because it wants to build up a stock so the parts can be transported to the final assembly lines by sea instead of air. Also, Boeing will need plenty of spare flaps, ailerons and flaperons, because such parts stand a good chance of being hit by ground vehicles.

The operation here is a remarkable case of focus imposed on a business—or, rather, two businesses. In 1997, Boeing bought what was then AeroSpace Technologies of Australia, which until the 1980s had been the Government Aircraft Factories, at Fishermans Bend in Melbourne. In 2000, the U.S. company added a Sydney plant to the Melbourne operation, buying the Bankstown facility of Hawker de Havilland. Between them, the two factories had a wide variety of aerostructures work, only some of it for Boeing. The decision was made to divest of everything except Boeing control surfaces; the plants exited such programs as the Bombardier Challenger 300, Lockheed Martin C-130J and a BAE Systems subcontract for Raytheon's Evolved Sea Sparrow Missile.

The latest step is to leave Bankstown, where Boeing has been a tenant, and concentrate at Fishermans Bend, where the company owns the land and has its R&D center. The Melbourne facility was also close to Australia's Defense Science & Technology Organization, which has facilities for fatigue- and static-testing. "We are in the final stages of consolidating the work in Melbourne," says Dickinson, noting that production can be expanded here by reducing area occupied by current activities. Quickstep is moving into the Bankstown facility.

The concentration on composites was determined by developments in aircraft design: On the latest Boeing aircraft, control surfaces are all composite. Equipment for building in metal was sold to newly established Indian manufacturer Mahindra Aerospace in 2010. According to the strategy, that will probably not be the last time that Boeing Aerostructures Australia leaves a less advanced technology to a rival in a lower-cost country. ☛



Control surfaces for the Boeing 787 are made at Melbourne without autoclaves.

earlier programs, the current-production 777 and 737. The technology employed on the 737, from the 1990s, is probably no longer difficult in the global industry. Dickinson says it eventually may be a candidate for transfer to other plants, presumably suppliers. Moving out of technology as it becomes very widely used elsewhere is part of the long-term strategy for the facility here.

Another technology that could be available on the 777X or, potentially, revised processes for earlier programs, is light robotics. The global aerospace industry is increasingly accustomed to employing enormous and enormously costly machinery that performs work with greater precision than people can achieve manually, with the same result every time and saving the cost of labor. Boeing Aerospace Australia believes it

tion bigger than a house. Applying common industrial robots therefore means adapting them, as well as the process and part design, Edwards says. Modification of the machine includes fitting it with an advanced working head for contact with the part.

The plant here has 14 ordinary robots now, but they are employed traditionally. One of their functions is drilling, the sort of work for which such machines are already widely used. Here, the process was developed for the 787 and then applied to the 737.

Another future robotic function is repairs to composite structures, especially sanding, which machines could perform more precisely than people and without risk to human health. A particular challenge is to make the robots adaptable to the many possible locations of damage on the aircraft.

Bouncing Baby

Private aerospace industry in India is making progress

Jay Menon **New Delhi** and
Bradley Perrett **Beijing**

India's private civil aerospace sector was born only in 2001, when the industry was deregulated, but today it looks like an increasingly robust child, although it is suffering from the common ailments of growing up in aerospace.

Leading the charge, Dynamatic Technologies of Bengaluru has built more than 1,000 shipsets of flap-track beams for the Airbus A320 family. The production volume is perhaps not its most impressive achievement, though. Since 2010, the company has been the sole supplier of the assemblies to Spirit AeroSystems (Europe) and Airbus.

Analysts also point to the potential of small and medium-sized Indian aerospace enterprises—some long-established suppliers of small components—that are now growing stronger.

Dynamatic is the sole-source for A320 family flap-track beams

But it is, after all, a young industry, facing the same types of problems that others have at a similar stage of development. More than anything else, technological expertise and achieving zero-defect targets are the most critical challenges faced by Indian companies, say consultants PwC. "India needs to keep pace with the increasingly high use of technology across the design life cycle," PwC says. High capital costs and low production volumes are also a problem, and it can hardly help that technology is continually advancing (see page 55).

"What's holding back the sector seems to be the lack of people with the necessary skills," says Ashok Saxena, a former managing director of state aircraft builder Hindustan Aeronautics Ltd. (HAL), who is now director of the U.K. advanced engineering office in India.

The private industry could not really blossom until 2001, before which regulation prevented private rivals to defense-oriented state firms such as HAL, although small suppliers had been permitted. But since then companies such as Dynamatic have grown. One of the latest to emerge is Mahindra Aerospace, offering complete aircraft, aerospace structural components and aircraft development services. The company is steadily developing a metallic aerostructures manufacturing capability through a combination of rented operational facilities and development of greenfield manufacturing plants.

The company activities stem from a 2007 agreement between conglomerate Mahindra and Mahindra, the National Aerospace Laboratories (NAL), Council of Scientific and Industrial Research and government for the design and development of a new general aviation aircraft. Something of a breakthrough, it was the first public-pri-



DYNAMATIC TECHNOLOGIES

vate joint venture in the aircraft design sector in India.

The acquisition of aerospace component manufacturer Aerostaff Australia and Australia-based aircraft manufacturer Gippsaero in 2010 gave Mahindra Aerospace an instant capability in manufacturing and an entry into the 2-20-seat aircraft segment. The company also bought the metallic airframe manufacturing equipment of Boeing Aerostructures Australia.

Mahindra says it has established an excellent relationship with aircraft builders. "Over time, our teams have moved up the value chain from providing design support to taking on responsibility for design packages, and are now getting into certification aspects for the original equipment manufacturers," says Anand Mahindra, chairman and managing director. "On the general aviation side of the business, we have already committed our efforts to developing and marketing a portfolio of light aircraft in the 2-20-seat range." The joint development with NAL, the NM5, is one initiative in that area.

Anand Mahindra also says the group is looking for opportunities in "the next higher class of civilian aircraft, regional transports." India is close to launching a regional turboprop airliner (AW&ST July 22, p. 54).

"Over the next decades, India undoubtedly has the potential to become a significant part of the global aerospace supply chain," says Vivek Lall, president and CEO of Reliance Aerospace Technologies, part of India's largest private-sector enterprise, Reliance Industries. "Indeed, there has been a remarkable growth of this sector, as a large number of private players have entered it."

Lall notes that “OEMs are not only farming out a big chunk of machined and sheet-metal parts production, but also expecting vendors to supply large aircraft subassemblies and even design expertise.”

According to the Center for Aviation, Boeing will bring more than \$1 billion of aerospace manufacturing work to India by 2017. Boeing has developed relationships with local suppliers and is actively pursuing technical and business partnership with Indian aerospace companies, says Pratyush Kumar, president of Boeing India.

Small and medium-sized private companies ‘are modernizing with cutting-edge technologies to become suppliers for global aerospace companies’

Honeywell has been working with Samtel Avionics & Defense Systems since 2007 to manufacture equipment for general aviation. The Indian company’s executive director, Puneet Kaura, says the relationship has since developed into a close partnership.

In the tier below the largest private companies such as Samtel Avionics, Dynamatics and Mahindra Aerospace are suppliers that have been nurtured on state contracts. “Fundamental strength in Indian industry already exists in the form of a large number of small and medium-sized enterprises, which in the past have been suppliers at the sub-component and component level, for aerospace defense public sector undertakings,” says Dhiraj Mathur, the head of the aerospace and defense practice at PwC India. “These companies are gradually transforming themselves into major players in this sector; modernizing with cutting-edge technologies to become suppliers for global aerospace companies vying to outsource products and components from India.”

Samtel Avionics & Defense Systems makes general aviation equipment in partnership with Honeywell.

The opportunity is there, but PwC also points out the challenges: “The aerospace business is highly capital-intensive. In the initial high-growth phase, capital needs to be injected rapidly and continuously to maintain the planned growth rate. Additionally, working-capital requirements, market development, brand building and awareness require significant ongoing investment and expenditure. Funding access can act as an entry barrier into this space.”

The other side of India’s role in global aerospace, receiving less attention than manufacturing, is engineering services. Airbus, for example, has brought India into the design and development of the A350, with the Airbus Engineering Center India in Bangalore. The center focuses modeling and simulation in such areas as flight management systems and computational fluid dynamics. It also works on digital simulation and visualization.

Similarly, Airbus has strategic agreements with Quest Global Engineering and Cades Digttech. While Quest, an aerospace engineering and precision manufacturing enterprise, is focusing on Airbus wing and pylon engineering activities, Cades has been working on fuselage engineering.

Signing the deal with Cades two years ago, the head of fuselage engineering at Airbus, Robert Nadine, said the selection process had been driven by the experience and performance quality of Indian suppliers.

Several foreign and private Indian companies have moved into research and development in the country by means of partnerships with public institutions, sharing technology, knowledge and the know-how of commercializing aerospace manufacturing. Prominent partnerships include one by Boeing, which agreed on wireless and other network technologies for aerospace with the Indian Institute of Science, Wipro and HCL.

Aravind Melligeri, co-founder and chairman of Quest, says India’s private sector should move up the value chain in terms of what is delivered to customers, especially in aerospace manufacturing. The ability to offer full subsystems or assemblies to global aerospace entities is a vital factor in turning India into a major aerospace outsourcing hub. ☛



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Corrigendum

The Closing Date of the Tender HMM/14/A320Lease/ENQ-001 dated 5th August 2013 for Dry Lease of Nineteen (19) New A320 Aircraft with Sharklets, powered by CFM56-5B4/3 PIP Engines, has been extended to 24th September 2013, 1500 Hrs IST. Technical Bids will be opened on **24th September 2013**.

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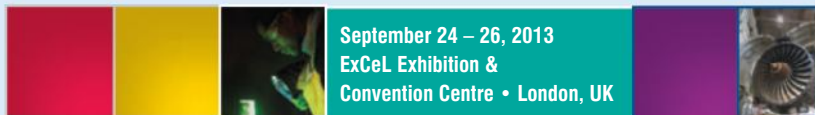


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Future Events

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Sept. 16-18—SpeedNews' 14th Annual Aviation Industry Suppliers Conference. Hotel Palladia, Toulouse.
Sept. 19-21—MRO IT Conference & Showcase. Miami.
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Feb. 10—Air Transport World's 40th Annual Airline Industry Achievement Awards. Pan Pacific Singapore Hotel.
March 3—SpeedNews' Fourth Annual Aerospace Raw Materials & Manufacturers Supply Chain Conference. Beverly Hills, Calif.
March 3-5—SpeedNews' 28th Annual Commercial Aviation Industry Suppliers Conference. Beverly Hills, Calif.

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Sept. 16—Southern California Aviation Association's 55th Annual Safety Stand Down Day. Carlsbad Sheraton Resort. To register: www.scaa.memberlodge.com/events?eventId=705920&EventViewMode=EventDetails

Sept. 16-18—AFA's Air & Space Conference. Gaylord National Hotel on the Potomac. National Harbor, Md. See www.expocad.com/host/Ex/afa/2013afa/default.html

Sept. 21-22—Winston-Salem (N.C.) Air Show. Smith Reynolds Airport. See www.wsairshow.com for more information.

Sept. 23-27—IAC and IISL's 64th International Astronautical Congress. Beijing. See www.iac2013.org/dct/page/70041 for more information.

Sept. 25—Royal Aeronautical Society and American Institute of Aeronautics and Astronautics National Capital Section's Joint Meeting "Unmanned Aerial Systems: Their Technology and Integration with Civil Airspace." British Embassy. Washington. Contact RAeS DC Branch Secretary qwhiteree@gmail.com or call 202-957-3019.

Sept. 25-27—ALTA Aviation Law Americas Conference. Miami. To register, see www.alt.aero/aviationlaw/2013

Sept. 25-28—Aviation Expo China 2013. China National Convention Center. Hall E2, E3 & E4, No. 7 Tianchen East Road. Chaoyang District, Beijing. See www.beijingaviation.com/en

Oct. 2-4—JEC America. Boston. www.jeccomposites.com/events/jec-americas-2013

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ATP Won't Make Airlines Safer



Jeff Schneider is a former U.S. Air Force pilot with more than 1,700 hr. in the F-16 who additionally holds ATP and multiple instructor ratings.

In direct response to Colgan Air's 2009 accident near Buffalo, N.Y., Congress passed the Airline Safety and FAA Extension Act of 2010, requiring all crewmembers to have an Airline Transport Pilot (ATP) license as of July 15, 2013. The rationale: The lack of flight time among pilots at smaller air carriers, also known as regional airlines, was leading to an unacceptable decrease in airline safety. While the FAA has proposed alternative minimums for ATPs, its stance is to keep the new mandate for such a license in place.

But looking at data about crashes suggests the FAA should reverse its 2013 ATP mandate for first officers. Not only will the requirement greatly reduce the available pool of airline pilots, but also there is minimal empirical evidence to suggest an increase in entry-level flight time leads to safer flights. Somehow we have developed a false notion that in air-carrier operations, younger, less-experienced pilots are dangerous.

Through analyzing more than 40 NTSB accident

“There is minimal evidence to suggest an increase in entry-level flight time leads to safer flights. Time in airframe is more important.”

reports from 1991-2012, including Part 91, 121 and 135 scheduled flights, I tested the hypothesis that inexperience was a root cause in aviation fatal accidents. Interestingly enough, there was no direct correlation between a single individual's inexperience and overall safety of the aircraft. Instead, it was the combination of flight-crew experience that correlated with fatal accidents. Since the majority of aircraft are flown by a crew, not just one pilot, it is the culmination of both pilots' mistakes that leads to mishaps.

Beyond 37,000 hr.-combined-aircrew time, the data suggest a low probability of fatal accidents caused by the pilots. For instance, in the case of the 2006 loss of a UPS DC-8 at Philadelphia, a 41,500-hr. crew's aircraft caught on fire. Even though the aircraft was later deemed destroyed, the pilots landed the jet and saved everyone onboard.

It made sense to look at aircrew experience in both fatal and non-fatal accidents. That is because in

the case of the non-fatal events, a great deal of luck was involved in whether an incident turned deadly. For instance, in the case of a 2007 runway overrun in Cleveland, the crew of an Embraer 170 operating a Delta Connection flight flew an illegal approach, landed long and fast, incorrectly applied the thrust reversers and departed the runway at 42 kt. Had the terrain not been covered in snow, fairly flat and with no obstructions, this situation could have easily turned fatal, as was the case when an American Airlines MD-82 departed a runway at 82 kt. in Little Rock, Ark., in 1999.

Additionally, when I analyzed the data for both total flying time and hours in airframe, a trend developed that demonstrated minimum individual flight time plays less of a role than hours in the aircraft type.

While it may be counterintuitive, it is actually safer for airlines to hire pilots with fewer hours so they can build time in the airframe under the scrutiny of established airline procedures. Additionally, it is safer for airlines to adjust their pairing model to avoid matching crews that fall near or below a “fatal trend line” I saw when I plotted the data on crew time.

Using this trend line, the culprit for the Colgan Air accident appears to be a lack of aircrew time in airframe and not the fact that they had little combined total hours. Those pilots only had a combined 885 hr. in the airframe—the captain 111 hr. and the first officer 772 hr. Based on their experience levels, they should have never flown with each other. Instead, they should have had 1,230 more combined hours in the airframe to be safely above the trend line.

The data suggest reversing the recent ATP mandate and instead instituting a mandatory aircrew-pairing avoidance model to reduce the likelihood of crew errors. In the Colgan Air case, the first officer actually had the requisite 1,500 hr. in all types, so it is doubtful whether the ATP rating would have prevented that accident. Instead of ATPs, by using an FAA-regulated avoidance tool, the airlines could reduce the airline accident rate substantially with no impact on the ensuing airline pilot-hiring deficit. ☛

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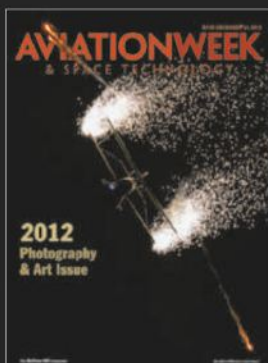
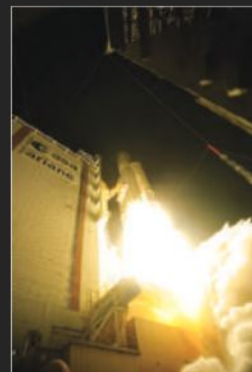
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