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For South Korea?**

**Dassault's
Next Big Bizjet**

**Beyond Voice Comms
For ATC**

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AVIATIONWEEK & SPACE TECHNOLOGY

LEAP YEAR

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for new engine**



**SPECIAL
REPORT**

**Supply Chain
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Show Update

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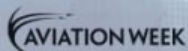
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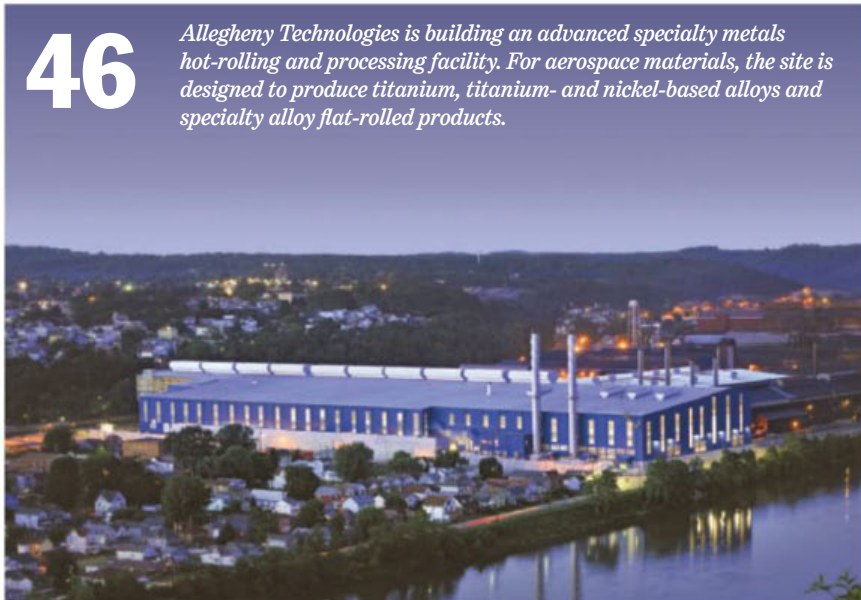
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ON THE COVERS:



This week, *Aviation Week* publishes two editions. On the cover at the far left, at GE's 7,000-acre Peebles, Ohio, test site, CFM's Leap-1A undergoes tests for the Airbus A320neo. Versions of the Leap family, CFM's first all-new design since the first CFM56 of the early 1970s, will also power Boeing's 737 MAX and the Comac C919 (page 42). CFM photo by Rob Butlet. Our MRO Edition contains additional coverage of maintenance, repair and overhaul. The cover shows CFM56-3 and CFM56-5B engines at AeroTurbine's Miami facility. AeroTurbine, an ILFC subsidiary, is expected to announce this week that Lufthansa Technik is taking a 15% stake in the company (page 52). AeroTurbine photo. Elsewhere in both editions are reports on the KF-X fighter (page 24), Dassault 5X (page 26), data link for ATC (page 41) and supply chain management (page 46).



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On the Web

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

Is the market ready for supersonic bizjets? **Not yet, says Gulfstream**, which recently set **the fastest westbound round-the-world flight** with its G650. Find out why on our **Things With Wings** blog (ow.ly/q67BK).

At the annual Association of the U.S. Army show in Washington last week, **Flir Systems demonstrated a prototype of an attachment for an iPhone** that allows users to see in the dark. Find out more about **the night-vision phone** on **Ares**, our defense technology blog (ow.ly/q7XXn).

READER COMMENT

Our **Ares** blog offers a visual tour of the **Adroit offshore patrol vessel**, which has been on loan to the French navy since the summer of 2011. Reader El Sid comments, "**Trust a French mess to have more wine bottles than books/DVDS.**" See more photos in **Ares** (ow.ly/q7XD5).



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GUY NORRIS/AV&ST



Snecma's 11,000-lb.-thrust Silvercrest will power Dassault's Falcon 5X (see p. 27). A mock-up of the engine was on display at NBAA last week. For more on Dassault's newest bizjet, check out our **Things With Wings** blog (ow.ly/q66Tb).



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SWING-BY SUPPOSITIONS

The Juno spacecraft's recent Earth swing-by provided inspiration for a concept that transfers the speed accumulated over time by a gravity-assisted object to an awaiting manned vehicle, accelerating it to a similar velocity (AW&ST Oct. 14/21, p. 16).

This would be achieved by employing the opposite of an electromagnetic rail gun: the electromagnetic rail target. As the high-velocity object approaches the target vehicle, it divides into electromagnetic "bullets" deployed as a linear chain.

These pass through the throat of the target vehicle for electromagnetic deceleration, accelerating the target vehicle into a high-speed interplanetary transfer orbit. The manned portion of the target vehicle separates and proceeds to Mars for aero capture into orbit.

The remainder of the target vehicle uses ion propulsion to decelerate and reposition itself into Earth orbit for the next mission. A similar arrangement at Mars facilitates the return journey. Bullet-object acceleration could be accomplished by ion propulsion as an alternative to, or in combination with, gravity assist swing-bys. Linear accelerators positioned on the Moon and Phobos also could serve as sources of bullet-objects.

Vince Creisler
KENT, WASH.

SITUATIONAL SUPERSTITIONS

Am I the only one that finds it a bit disconcerting that crewed commercial suborbital launches will depart from near the Jornada del Muerto (*Journey of Death*) White Sands, N.M., area, as mentioned in "Supersonic Trail" (AW&ST Oct 14/21, p. 36)?

Daryl L Bahls
RENTON, WASH.

HANG IN THERE, BOEING

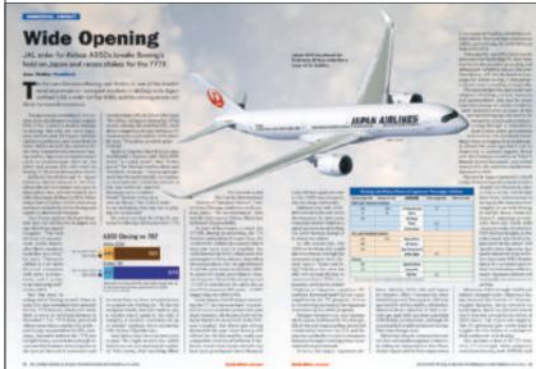
In "Wide Opening" (AW&ST Oct. 14-21, p. 32), your secondary headline states: "JAL order for Airbus A350s breaks Boeing's hold on Japan."

While none of the Airbus countries—France, Germany, Britain and Spain—would lift a finger to defend Japan, that country has for seven decades been sheltered under the U.S. military umbrella, which costs us 4.9% of our GDP (\$643 billion last year), allowing Japan to spend 1% of their GDP on their token military.

We've been able to do this because of our wealth, which comes in no small part from Boeing's international sales.

It is time to cut the Japanese off in order to encourage them to raise their military spending up to our 4.9%, at least—and let them defend themselves.

If they are unwilling or unable to do so, they could ask the Airbus countries to help.



The main reason Japan needs a defense force is because of its proximity to Russia and China, and as these truculent countries have nuclear arsenals, Japan, in our absence, would need one too.

A few years ago, Boeing-equipped El Al Israel Airlines considered buying new Airbus planes. Ultimately, El Al decided to stick with Boeing. It's fairly easy to read between the lines. Japan's government officials should be as astute as Israel's.

Given the past as prologue, Boeing shouldn't quit the game yet.

Brent White
SAN JOSE, CALIF.

ASSESSING FUTURE FORCES

Bill Sweetman, in his Commander's Intent column "A Wimp-Out With Style" (AW&ST Oct. 14/21, p. 22), makes a good case for South Korea (or anybody else) buying F-15 or Eurofighter aircraft—if you are thinking about now.

However, look 20 years ahead and who would bet them against what the F-35 will be like then?

John Farley
CHICHESTER, ENGLAND

WARTHOG DEFENDER

Reading "From the Ground Up" (AW&ST Oct. 7, p. 54) has me writing yet again to say if ever there was a weapon system that has proved itself worthy of remaining in the U.S. Air

Force inventory, it is the A-10.

Much like the F-4 it replaced, this aircraft did the job it was designed to do, without exception.

It can take a hit, bring the crew home and it has been thoroughly battle-tested in two major theaters of operations, for years on end.

Best of all, U.S. Army forces love the airplane for the close air support it provides.

The F-35 cannot match the A-10.

Clyde Romero
MARIETTA, GA.

A-10, AND ITS COMMUNITY, TOO

It's not just that the USAF wants to get rid of the A-10 Warthog, it seems as though it wants to get rid of the A-10 community. "Hog Drivers" just don't behave with Aim-High correctness. They seem to relish improvising Plans B and C when Plan A goes awry. This degree of shared independence flies in the face of "prudent" institutional constraint.

USAF, and certainly the U.S., need the venerable Warthog's unmatched firepower and resilience, but administrative angst will see to it that this does not happen.

Hank Caruso
CALIFORNIA, MD.

DESIGN VS. DEVELOP

I believe reader Robert J. Stewart is incorrect in his letter "Old Becomes New" (AW&ST Oct. 7, p. 10), in which he credits Alexander Kartveli as the designer of the Fairchild Republic A-10.

Pierre Sprey—working with Hans Rudel in the 1960s—was one of the early minds consulting on the A-10.

Kartveli may have been assigned to supervise production of the aircraft, but he was not the designer.

Karl Kettler
FLEMINGTON, N.J.

Who's Where

Jerome Bendell (see photo) has been appointed CEO of *Thales-Raytheon Systems France* in Massy. He succeeds **Philippe Duhamel**, who is now CEO of international joint venture *ThalesRaytheonSystems*. Bendell was director of naval communication systems for Thales and had been vice president-defense and security strategy for the Alcatel-Lucent Group.

Martine Ohayon has become director communications and events for Montreal-based *Airports Council International*. She held a similar position at the International Air Transport Association and was director of communications at Canada Steamship Lines. Ohayon succeeds **Cheryl Marcell**, who is now deputy director for business development at Norman Y. Mineta San Jose (Calif.) International Airport.

Mark Tucker has been named senior vice president-Enterprise Operations and Engineering and **Clyde Woltman** executive director of advanced programs for the Defense Business Development Div. of *Aerojet Rocketdyne*, Sacramento, Calif. Tucker was vice president-special programs for the Aerospace Systems Sector, while Woltman was director of U.S. Navy and Marine Corps programs at Pratt & Whitney.

USAF Maj. Gen. (ret.) **Douglas Raaberg** (see photo) has become the *Northrop Grumman Corp.*'s chief executive for the United Arab Emirates. He

was director of the battle management command and control campaign within Northrop Grumman's Aerospace Systems Sector.

Niklaes Persson has been appointed head of business unit research and development for *Avtech Sweden* of Stockholm.

Doug Gerull has been named chief operating officer of *Surrey Satellite Technology U.S.*, Englewood, Colo. He was cofounder and a director of DigitalGlobe and had been executive vice president of the Intergraph Corp.

Mark Hood (see photo) has become global market director for general aviation transparencies and succeeds **Arthur C. Scott** (see photo), who is now global market director for commercial transparencies, both at *PPG Industries*' Huntsville, Ala., facility. Scott follows **James Romano**, who is now business manager for the PPG Aerospace Los Angeles application support center.

Franklin Miller has been appointed chairman of the board of directors of the *Draper Laboratory*, Cambridge, Mass. He succeeds **John Gordon**. New members of the board are **Joanne Maguire** and **Lena Goldberg**. **Michael Wallace**, director of the nuclear energy policy program at the Center for Stra-



Jerome Bendell



Douglas Raaberg



Mark Hood



Arthur C. Scott

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

tegic and International Studies (CSIS), has been named a member of the Draper's corporation. Miller is a principal at the Scowcroft Group and member of the U.S. Strategic Command Advisory Group and the Defense Policy Board, as well as a director of EADS-North American and a senior adviser to the CSIS's International Security Program. He also has been a senior nuclear policy and arms control adviser in the administrations of the previous five presidents. Maguire is a former executive vice president of Lockheed Martin Space Systems. Goldberg is a senior lecturer at the Harvard Business School.

Jim Meier has been named vice president-government business development for the *Greenwich AeroGroup* of Wichita. He was senior vice president-aviation services for the Sabreliner Corp.

Bill Darbe has been appointed director of dealer programs for *Satcom Direct*, Satellite Beach, Fla. ☼



Laureate Awards

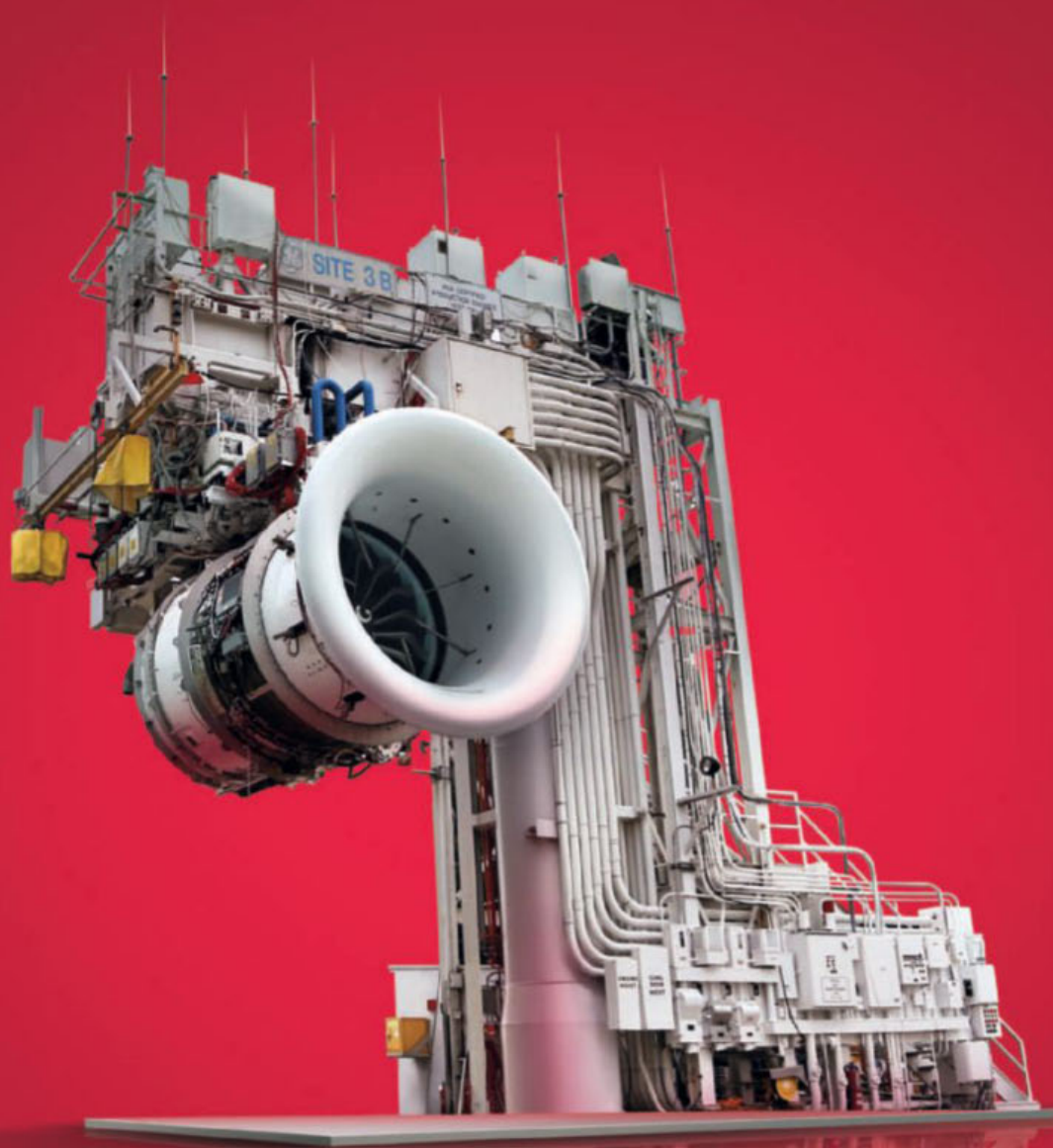
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March 6, 2014
Washington, DC





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Darpa and Shipboard UAVs

Five companies are designing long-endurance ship-based surveillance and strike unmanned aircraft under the U.S. Defense Advanced Research Projects Agency's (Darpa) Tactically Exploited Reconnaissance Node program. TERN is intended to demonstrate the capability to provide Predator-class medium-altitude, long-endurance, unmanned-aircraft capabilities from the flight decks of small ships, primarily the U.S. Navy's Littoral Combat Ship-2 (LCS-2). Phase 1 design contracts have been awarded to AeroVironment (\$2.3 million), Aurora Flight Sciences (\$2.8 million), Carter Aviation Technologies (\$2.2 million), Maritime Applied Physics (\$2.2 million) and Northrop Grumman (\$2.9 million). In Phase 1, which runs to next summer, the companies are expected to design objective systems to meet Darpa's goals of an operating radius up to 900 nm with a 600-lb. intelligence, surveillance and reconnaissance payload, and the

ability to launch and recover from an LCS-2 in Sea State 5 (wave heights of 9-12 ft. and winds up to 27 kt.).

AMDR Award Protested

In the wake of Lockheed Martin's protest, the U.S. Navy issued a stop-work order Oct. 23 on the contract it gave Raytheon earlier this month for its Air and Missile Defense Radar (AMDR). "We submitted a technically compliant solution at a very affordable price," Lockheed spokesman Keith Little said last week. "We do not believe the merits of our offering were properly considered." Lockheed was believed by many industry observers to be the incumbent as it is the Aegis combat system prime contractor. The Navy's seemingly transparent approach to conducting the AMDR competition, which attracted Northrop Grumman to bid as well, led many to conclude that a protest was unlikely.

Upgraded Mirage Flies

The Indian air force (IAF) has completed the flight of its first upgraded Mirage 2000H at the Istres-Le Tube air base in France, according to manufacturer Dassault Aviation. Faced with a depleted tactical air capability and a delay in signing the Medium Multi-Role Combat Aircraft deal, the IAF is pushing to expedite the upgrading of its Mirage 2000s. The first is likely to be delivered late next summer, says an IAF official.

U.K. Retires C-130K

The U.K. RAF will retire the last of its Lockheed C-130K Hercules transport aircraft this week as it prepares for the entry into service of the Airbus A400M Atlas. The RAF has operated 66 C-130Ks, the first entering service in 1967. Since then, the type has supported almost every British military operation.

The C-130K fleet has dwindled in size since the introduction of the modernized C-130J. The remaining 24 Js are expected to operate until around 2022.

BUSINESS AVIATION

NBAA's Annual Convention

The National Business Aviation Association annual convention, held last week in Las Vegas, is the largest industry event in the world, drawing more than 20,000 attendees. Manufacturers, suppliers and service companies typically use the show as a platform for news. A sampling follows. Additional coverage appears on pages 26-30.

Refurbished King Airs

Nextant Aerospace plans to remanufacture Beechcraft King Air C90s, replacing the Pratt & Whitney Canada PT-6 engines with GE H80 turboprops and the Rockwell Collins Pro Line 21 with Garmin's G1000 integrated avionics panel. The refurbished aircraft will carry a Nextant warranty. The Cleveland company said it chose to rework the C90 because of its large installed base of more than 1,500 aircraft, and so it would serve as a low-cost entry-level turbine aircraft. The projected price for what Nextant calls the G90XT is \$2.2 million, or about half that of a new model. The news is nettlesome to Beechcraft since Nextant's only other remanufactured model is the Hawker 400XTi, which competes directly with remanufactured Hawker 400XPr. Beechcraft says its extensive service network will not support G90XTs.

New BBJ Winglets

Aviation Partners Inc. (API) is offering to refit any Boeing Business Jets with its split scimitar winglet (see photo). The modification is already being adapted by airlines operating the Boeing 737, from which the BBJ is derived. The modi-



Another Profitable Week

ification is said to improve fuel burn by 2.5-3% and thus increase range by 200 nm. Gary Dunn, API's vice president of sales and marketing, says he expects operators of "a very healthy percentage" of the roughly 130 delivered BBJs to adopt the signature modification.

Learjet Turns 50

On the eve of the NBAA convention, Bombardier marked Learjet's 50th anniversary by presenting the first two Model 75s off the line to their new owners: a real estate businessman and a Canadian charter company. Both aircraft are replacing Lear 45s. The updated aircraft features a Garmin G5000 flight deck and Honeywell TFE-731-40B engines, and carries a price tag of \$13.7 million.

First Eclipse 550 Delivery

Eclipse Aerospace has delivered its first Eclipse 550 very light jet to Fred Phillips, president of Petrolift Aviation Services of Shreveport, La. Phillips has owned two Eclipse 500s. The upgraded EA550 features a synthetic vision, XM satellite weather, dual flight management systems with WAAS LPV and antiskid brakes.

'There Is No Future'

Skycatcher has caught a severe downburst with a dire outcome. Cessna's China-made light sport aircraft, which was launched by former CEO Jack Pelton to stimulate pilot starts, was never loved by Scott Ernest, his successor. And when asked about the future of the once-heralded two-seater, Ernest responded, "There is no future." A follow-up question about the aircraft elicited the same response.



AW&ST/S&P Market Indices as of 10/23/2013



More T-6s for Mexico

The Mexican air force has a follow-on order for a second batch of six Beechcraft T-6C+ turboprop trainers to continue replacing its Pilatus PC-7s. An initial six aircraft ordered in January 2012 are to be delivered soon, pending export licenses. The T-6C+ has a glass cockpit and wing hardpoints for external stores and practice weapons.

AIR TRANSPORT

Delayed Conclusions

The U.S. NTSB says there were 59 aviation accidents, 10 of which were fatal, that it did not begin investigating during the 16-day partial government shutdown when 383 of its 405 employees were furloughed. At least two major investigations were impacted: A two-day hearing on the Asiana Airlines Boeing 777 crash in San Francisco was postponed to December from November; and additional testing of a Boeing 787 lithium-ion battery that was scheduled during the shutdown. Chairman Debby Hersman says the NTSB "continues to assess the long-term impact of the shutdown on hundreds of other ongoing investigations," including the Aug. 14 crash of a UPS Airbus A300 in Birmingham, Ala. For the 59 new accidents, the NTSB says investigators will review reports from state and local officials to determine if there are additional safety concerns.

SPACE

Cygnus Heads Home

Orbital Sciences Corp.'s Cygnus demonstration resupply capsule departed the International Space Station (ISS) and returned to Earth with 2,850 lb.

of trash, concluding a 24-day stay that brings the Dulles, Va.-based company's participation in NASA's Commercial Orbital Transportation Systems (COTS) program close to its conclusion. Orbital plans to begin regular cargo deliveries to the ISS in December under the terms of a \$1.9 billion, eight-flight Commercial Resupply Services contract signed with NASA in late 2008. The resupply ship carried out a delayed berthing on Sept. 29 to deliver a noncritical, 1,543-lb. cargo of food, clothing and research equipment as the

last chapter in the company's nearly six-year COTS program participation. The mission's end qualifies Orbital for the final installment of a \$288 million NASA investment in a second U.S. space station commercial cargo provider. Cygnus's rendezvous and berthing unfolded a week late, following the capsule's Sept. 18 launch.

Mars Mission Delay

The launch of India's first Mars orbiter, which was postponed for eight days due to bad weather in the Pacific, has been rescheduled for Nov. 5. The Mars Orbiter Mission (MOM) will be boosted by a Polar Satellite Launch Vehicle, which was also used for the Chandrayaan-1 Moon mission, on Nov. 5 at 2:36 p.m. local time from the Sriharikota spaceport, Indian Space Research Organization Chairman K. Radhakrishnan says. The MOM will not use a direct trajectory to Mars. Once launched, it will orbit the Earth for 25 days before embarking on a nine-month voyage to the red planet. There are plans to insert the satellite in an orbit around Mars on Sept. 22, 2014. If successful, it will mark a major step in the Indian space program, which has already placed a probe on the Moon.

Raytheon Tests Rocket, Mortar Killer

Raytheon has completed flight tests of a low-cost missile that was developed rapidly to shoot down mortars, rockets and unmanned aircraft, but has yet to find a home for the weapon.

Developed under the U.S. Army's Accelerated Improved Intercept Initiative (AI3) program, the missile scored 22 successes in 24 "system intercepts" during testing at Yuma Proving Ground, Ariz., on Sept. 16-30, says Michael Means, senior business development manager for Raytheon Missile Systems. Targets for the tests were 107- and 120-mm mortars, improvised rocket-assisted mortars and unmanned aircraft. The 107-mm mortars were the principal targets—and the hardest to intercept.

"It has a low trajectory, very quick timeline and a thick nose that makes it hard to defeat. The missile has to get extremely close, if not hit it," says Means.

The tests came just 18 months after the AI3 contract was awarded to meet an urgent operational need in Afghanistan. But now the Army has no formal plans to field the weapon. Instead it is focused on deploying a ground-launched version of Raytheon's AIM-9X air-to-air missile to counter more-advanced cruise missiles and unmanned aircraft.



RAYTHEON



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COMMENTARY

The Art of Disruption

U.S. security planners should examine the side effects of new technologies

The Center for New American Security (CNAS) recently released a report entitled “Game Changers: Disruptive Technology and U.S. Defense Strategy.” That study considered additive manufacturing (3-D printers), autonomous vehicles, directed energy, cyber capabilities, human performance modification and other emerging technologies that the center believes need to be factored into U.S. security policy and planning.

Though it was not discussed directly in the report, emerging technologies potentially could have disruptive impacts on the defense-industrial base as it is now known. For example, directed-energy weapons could significantly alter demand for solid-propellant missiles, and additive manufacturing might upend spare-parts markets (once the intellectual property rights are sorted out). Those changes, in turn, could have profound impacts on the valuations and financial outlooks for publicly traded defense contractors. There are obvious examples from other sectors: the disruptive impact of the Internet on newspapers or shifting leadership in the cell-phone/mobile-device market.

Discrete technologies are rarely winners, and monopolies can be fleeting. The U.S. will continue to emphasize technological superiority in the way it plans to fight wars, but maintaining military technological monopolies may be more difficult than it was during the Cold War. A globally integrated economy allows potential adversaries more equal access to technologies, and arguably cyber has made espionage easier.

The technologies cited in the CNAS study are not U.S. monopolies, and the U.S. advantage may be transitory. Cyber is already practiced by a number of states. Directed energy may give the U.S. Navy the ability to eventually engage and destroy ballistic missiles, but an adversary equally could use directed-energy defense to degrade U.S. precision strikes.

Instead of focusing mainly on technologies as disruptors, policymakers and management should consider different business models within defense, as well as different acquisition models and practices. These could be far more disruptive to industry than any single technology.

Some companies have shown the willingness to take risk and invest in “good-enough” weapons at their own expense. The marquee example has been Harris with tactical radios. Textron’s investment in its Scorpion ISR/light-attack aircraft is another, although none have been sold. The external and internal pressures on defense spending may yet cause the U.S. and other states to consider “good-enough” weapons as opposed to programs of record.

Competition from private companies with different time frames, management compensation incentives and shareholder expectations than public ones could also emerge as a stronger disruptor. SpaceX in launch vehicles such as the Falcon 9 (see photo) and General Atomics in UAVs are two private companies that come to mind. They are not operating under expectations that they meet or beat quarterly estimates or return the vast majority of cash to shareholders.

In late August, Aviation Week reported on a survey that showed the top three employers for technological challenges, as rated by aerospace and defense professionals, were SpaceX, Analytical



NASA/BILL INGALLS FILE PHOTO

Graphics and Orbital Sciences (Aug. 26, p. 44). Orbital is a public company, but the other two are not. Defense is a business that rests on engineering, and so private firms or risk-takers that succeed may be in better positions to attract and retain talent.

Another source of disruption in global defense markets is emerging from China. U.S. investors have viewed international defense markets positively, but Turkey’s selection of China Precision Machinery Import and Export to supply its T-Loramids air/missile defense program is a wake-up call, even if NATO pressure may prevent the contract

from being signed. The Chinese bid \$1 billion less than Turkey’s expectation of a \$4 billion system. Defense is no more immune to low-cost, technically acceptable Chinese exports than other sectors. There are segments, such as fifth-generation fighters, where China is not now competitive, but that can change over 5-10 years. As China’s global interests expand, so too will its interest in building strategic partnerships and alliances.

A final source of disruption could emerge if the U.S. Defense Department changes acquisition policies. That may require a better trained acquisition staff that also is risk-tolerant. But then budget pressures will prompt the Pentagon to seek lower product and services costs.

One change could be to make permanent the rapid acquisition and fielding mechanisms that arose during the wars in Iraq and Afghanistan. These could provide more entry points for new competitors. The department could also shield second- and third-tier suppliers from prime-contractor pricing pressure by purchasing directly from the smaller businesses. Finally, though it now appears to be a small effort, the department’s emphasis on rapid prototyping—which promised a return to contractors—might prove disruptive to major programs. ☐

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COMMENTARY

Digital Night

Breakthrough in digital image intensification could revolutionize night vision

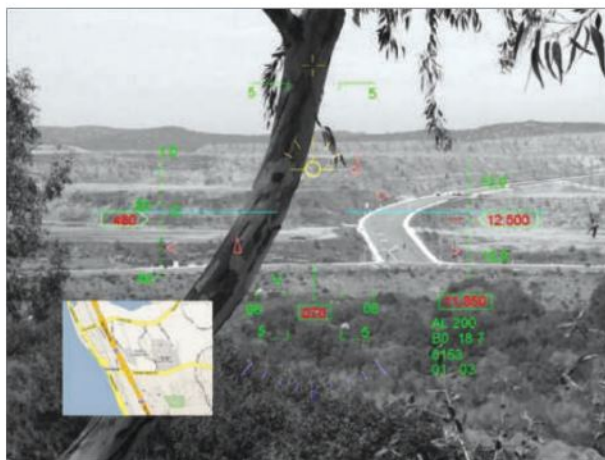
Digital imaging was more than just a replacement for photographic film. It enabled a revolution in how images are captured, stored, shared and manipulated. Night vision is beginning a similar metamorphosis, with digital devices emerging to replace the analog goggles now in use.

From soldiers on foot to pilots in flight, night-vision goggles (NVG) have transformed warfare, allowing operations with only starlight for illumination. They are based on analog image-intensifier tubes, augmented in the latest goggles with digital thermal-imaging sensors. But the development of digital image intensification promises to be “a game-changer for night vision,” equivalent to the photography revolution, says developer Intevac Photonics.

For the Santa Clara, Calif.-based company, the breakthrough has come with the F-35 Joint Strike Fighter program’s decision to stay with the original helmet-mounted display because an improved version of Intevac’s digital sensor now meets the night-vision performance requirements. “It has been shown to perform equal to or better than the best analog goggles,” says Drew Brugal, executive vice president.

Intevac’s latest ISIE-11 night-vision camera will be introduced with the next production lot of Lockheed Martin F-35s, and it is already being fielded on the U.S. Army’s Boeing AH-64 Apache attack helicopters. The company is now producing its own “digital fused goggles” for special-operations use.

Analog image intensifiers are vacuum-tube devices that amplify the scarce photons at low light levels. Inte-



INTEVAC PHOTONICS

vac’s electron-bombarded active pixel sensor (Ebaps) “uses a photocathode almost identical to analog image intensifiers, but a different anode,” says Brugal. The photocathode converts photons into photoelectrons, which are collected and amplified by the silicon-chip anode, producing a video signal directly from the sensor. This digital signal can be overlaid with symbology or other imagery (see photo), transmitted to another device or manipulated in various ways.

“There are other types of digital sensor, but they do not go down to the extreme low light levels that Ebaps does. Our sensor is better than analog goggles in overcast starlight,” says Brugal. Because of its extended dynamic range, Ebaps can operate “from dawn to dusk, which NVGs do not, and we can zoom, record and transmit.” The sensor will also work in lighting that blinds analog NVGs. But, for now, Ebaps is power-hungry and best used

where batteries are not required, on vehicles and aircraft.

Ebaps has been under development for more than a decade, and Intevac’s first production sensor was the ISIE-10. This was chosen for the F-35 helmet, but as a “placeholder,” he says, adding, “we knew it would not meet the requirements. The road map always led to the ISIE-11.” Compared with the 1-megapixel ISIE-10, the -11 is a 2-megapixel sensor that took longer to perfect than expected, consistently matching or bettering analog-NVG performance only in the past year or so.

Intevac has produced 400-500 ISIE-11 cameras for the AH-64’s modernized target-acquisition and designation system, where it is used stand-alone for the crew’s helmet-mounted displays and blended with a thermal imager on the multifunction display. Deliveries for the F-35 program will begin this quarter, says Brugal. Early in production the -11 will cost more than the -10, he says, “but not twice as much, and we have a manufacturing-technology glideslope down to the target cost assigned to us based on production of 400 a month.”

Intevac’s first NVGs, meanwhile, have been delivered to two customers for user testing, “and we are in discussions with some of the services on goggles for pilots,” Brugal says. “We believe our sensor is the right choice for the JHMCS [Joint Helmet-Mounted Cueing System] on the F-15, F-16 and F-18. JHMCS is a great visor display during daytime and, with digital goggles, they would have all the same information at night.” The current night-vision sensor for JHMCS, called QuadEye, is analog.

Intevac is working on its next generation of sensor, the 4-megapixel ISIE-4000. “We have a government customer funding development and will be delivering -4000-based goggles in the near future,” says Brugal.

With more pixels, the -4000 gathers more light for higher performance at extremely low light levels. Resolution is higher and field-of-view larger, but the -4000 can be retrofitted into any -11 camera. “A lot of learning from the -11 is being applied to the -4000, and we believe it will reach maturity much quicker than the -11,” he says, anticipating availability within two years. ☼



By Pierre Sparaco

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aviation and aerospace
since the 1960s.*

The Lockheed Martin F-16, created by General Dynamics in the 1970s, is the frontline fighter for 26 countries, including Belgium.

348 fighters: Belgium, the Netherlands, Denmark and Norway. Murphy returned to Fort Worth convinced that the YF-16 could evolve into a full-fledged fighter that the Europeans would buy. That's how the impressive Fighting Falcon program was born.

Of course, referring to the purchasing power of dollars from decades ago is meaningless. However, let's say that the proposals were centered on a light fighter with a fly-away price of a minuscule \$3 million, based on a 300-unit production run.

The key question today is this: Is the LWF inspiring Textron AirLand's initiative? After all, the military and industry are always evolving, and the Scorpion project is getting down to basic realism. The F-16 will approach the end of its brilliant operational life sooner or later (the 4,500th aircraft was delivered last year) and the F-35 is certainly not a low-cost product. An all-new candidate could well play a role in an increasingly tight market. And this is despite the fact that the unexpected candidate addresses requirements the Pentagon doesn't even say it has. But that's how the F-16 saga started.

If Textron AirLand is good enough at creating interest in the Scorpion abroad, on the condition that a domestic order will support export sales, it could become a marketing success. Moreover, if the Scorpion were to succeed the T-38A Talon, it could be a strong candidate to replace other advanced military jet trainers such as the BAE Systems Hawk and Dassault Aviation/Dornier Alpha Jet.

In other words, I cannot agree with the assertion by Teal Group analyst Richard Aboulafia that the Scorpion is a fallacy (*AW&ST* Oct. 7, p. 16). In the early 1970s, the Pentagon was convinced the YF-16 and YF-17 would remain mere demonstrators and end in an aviation museum. Today, the Scorpion deserves the benefit of the doubt. ☛



COMMENTARY

Reinventing the Lightweight Fighter

The Scorpion is poised to join the path blazed by the Fighting Falcon

The Textron AirLand Scorpion light attack aircraft, which is scheduled to make its first flight in the next few weeks, continues to capture—and hold—the attention of Europeans. Although its developers carefully avoid calling it a “low-cost” fighter proposal, it is obvious that their ultimate goal is to offer a two-seat twinjet costing a fraction of more conventional aircraft. This is an attractive proposition, of course, in an environment of increasingly restricted and uncertain defense budgets.

Development of new-generation combat aircraft in recent decades has brought augmented capabilities by ramping up technical sophistication—and sending costs skyrocketing. In the 1970s, in a prelude to current budget constraints, the danger of an insurmountable financial barrier was already looming, production runs were expected to decrease dramatically, and the need for innovative ideas had become evident. And this is how the Pentagon first conceived the so-called “hi-lo mix,” an inventory comprising highly capable air superiority twinjets and less expensive baseline fighters.

In an effort to advance ideas well beyond speeches, conferences and other theoretical discussions, a group of U.S. Air Force officers and defense analysts proposed the Lightweight Fighter (LWF) technology demonstrator program, budgeted at less than \$38 million at the time. By January 1972, this resulted in a request

for proposals covering prototypes of cheap single-seat fighters. Six manufacturers submitted designs; General Dynamics and Northrop were selected to build two aircraft each, the YF-16 and YF-17, respectively. Both flew in 1974, confirming that the concept was viable.

At the same time, four European air forces canceled a plan to participate in the envisioned multinational Multi-Role Combat Aircraft (the program that later gave birth to the Panavia Tornado) and considered other options to replace aging Lockheed F-104G Starfighters. Not surprisingly, they developed a strong interest in the LWF but were disappointed to hear that no production derivative was contemplated.

Shortly after the YF-16 won the competition, Jim Murphy, a young General Dynamics executive, visited the four small countries that had decided to jointly select and order a combined

DAVID WISE



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COMMENTARY

In for the Long Haul

Norwegian targets the competitive London–U.S. market

Norwegian Air Shuttle is slowly lifting the veil on its global expansion plans, and the next steps are bold. Just months after beginning long-haul operations from its bases in Scandinavia to Bangkok and the U.S., the Oslo-based low-cost carrier (LCC) confirmed it will launch transatlantic services from London Gatwick Airport next summer. Norwegian was the first of the current generation of European LCCs to enter the long-haul market, and now will be the first to do so from a base outside its home market.

The rationale behind Norwegian's planned London-U.S. routes is straightforward: It is Europe's largest transatlantic market, and the airline earlier this year established a base at Gatwick, where it offers 320 weekly flights on 25 European routes. They are expected to feed traffic for Norwegian's new routes to Los Angeles, New York John F. Kennedy and Fort Lauderdale-Hollywood (Fla.) international airports, which are due to start in July.

CEO Bjorn Kjos believes the new transatlantic services could also receive transfer traffic from other LCCs such as EasyJet and Ryanair, which operate extensive short- and medium-haul networks from Gatwick.

An additional advantage is the open-skies agreement between the European Union (EU) and U.S. Norway is not a member of the EU, but it is part of the European Economic Area (EEA) and the open skies with the U.S.

extends to all 31 EEA countries.

Norwegian's long-haul ambitions include routes to Asia. Kjos says India and China are "obvious goals," but the airline will need to obtain traffic rights under bilateral air services agreements if it wants to operate flights to these countries from EU airports. This will not be easy because most governments are protective of their own legacy carriers and they want to avoid the erosion of their long-haul yields due to a LCC entering the global scene.

For Kjos, the long-haul routes between London and the U.S. are "an important part" of Norwegian's strategy to expand its international network and develop a stronger foothold in markets outside Scandinavia.

"There's great demand for high-quality flights at a low fare between the U.K. and the U.S., particularly to and from London Gatwick, where no other airline currently offers these routes," he asserts.

Yet London-U.S. is one of the most competitive air travel markets in the world and generating profits will be challenging. Norwegian is betting on the twinjet Boeing 787-8 to deliver the correct economics to make these operations viable, and Kjos has never been shy to criticize other low-cost long-haul operators such as AirAsia X for using a four-engine Airbus A340 with high fuel prices on routes from Kuala Lumpur, Malaysia, to London Stansted Airport and Paris. The routes were abandoned after less than a year, confirming Kjos's assessment that the strategy was "as stupid as for a short-haul LCC to fly MD-80s."

Norwegian operates its 787-8s in a 291-seat two-class configuration with 37 premium seats featuring a 42-in. pitch and in economy class, the industry-standard 31 in. The airline now deploys two Dreamliners, and a third one is due to arrive before year-end. Four 787s will join its fleet next year and the last of an order for eight is due to be delivered in 2015. Norwegian believes the long-haul operation will have an efficient scale beginning in 2014, when the airline's projections show 4,300 departures carrying a total of 1 million passengers. It envisions enplaning 1.4 million travelers on its long-haul flights in 2015, representing 8% of the carrier's passenger volume.

Kjos remains upbeat on the aircraft's performance despite the introductory technical issues that have caused Norwegian's 787s to be grounded, and is equally confident that he can replicate the highly successful intra-European budget model on long-haul services. Meanwhile, Kjos has another pressing matter to address: a long-simmering pay conflict with its pilots, who have threatened to strike. ☛



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COMMENTARY

Commercial Potential

ISS research gains traction, attracts proposals

Julie Robinson, who oversees U.S.-side science on the International Space Station (ISS), names a one-time dark horse as her No. 1 research result to date from the orbiting laboratory. Medical researchers started running experiments in space more than a decade ago to see if working in microgravity would make it possible to encapsulate cancer drugs in tiny bubbles that could be targeted on specific tumors in the body. It turns out that it was, as the crew of ISS Expedition 5 discovered in 2002.

Tiny capsules generated by the Microencapsulation Electrostatic Processing System-II experiment (MEPS-II) on the station were tested in mice against human prostate-tumor tissue, with positive results. The capsules dispensed the drugs where they needed to go without damaging healthy tissue. Other possibilities raised by MEPS-II include treatment of deep-tissue infections, clotting disorders and conditions that could benefit from precisely targeted gene therapy.

But science being science, the technique is only now in development for clinical trials. The company that licensed the NASA patent was set to begin prostate trials at the M.D. Anderson cancer treatment center in Houston when its funding fell through. Now trials on breast-cancer tumors are in the works with new funding, and pre-clinical testing has begun. Robinson picked the research as the first of her Top 10 results “for duration of effort and for the compelling potential benefit,” she said at this year’s International Astronautical Congress in Beijing.

She notes that MEPS-II “is an example both of how long it takes and that every step along the way things can go wrong.”

Those time and uncertainty factors contribute to the “use-it-or-lose-it” urgency among researchers who need to work on the space station and among the officials who are trying to fill its underutilized experiment racks before it is deorbited. One of the latter



NASA/JSC

is Gregory Johnson, the newly named president and executive director of the Center for the Advancement of Science in Space (Casis). He hopes the ISS can be the incubator for a new type of commercial spaceflight just getting underway. The two private space-logistics vehicles NASA has shepherded into operation—the Orbital Sciences Corp. Cygnus (see photo) and the SpaceX Dragon, are harbingers, he says.

“Last time I counted, there were about 17 vehicles that are going to visit the space station in the next year,” notes Johnson, who started his new job Sept. 1. “So the more vehicles, the better. We’re at the beginning of a new generation of spaceflight, and I think on the cusp of something that is going to surprise people 10 years from now.”

A two-time space shuttle pilot, Johnson helped build the orbiting facility on the STS-123 and -134 missions. In his new job, he heads the nonprofit organization mandated by Congress to foster commercial use of the U.S.-controlled facilities on the ISS. Casis has had a difficult startup, but that period seems to

be coming to an end as Johnson and his growing staff of professionals carry out their “missionary” work.

Even before Johnson was hired, Casis had started promoting the station’s free facilities in research centers in Boston and Houston, among other places. Formal relationships have been established with the Baylor College of Medicine and the Broad Institute at the Massachusetts Institute of Technology/Harvard University, both reflecting the importance of microgravity research in biotechnology.

Still to come is outreach in California’s Silicon Valley; the aerospace-rich region around Denver; Chicago’s industrial and academic centers; and the Research Triangle area of North Carolina. This involves making potential users aware of the capabilities available to them on the unique microgravity laboratory, and fundraising to help defray the cost of hardware for research.

Casis has just awarded \$2 million in grants for research into how microgravity affects stem cells, including work at Texas A&M University that will develop a way to “co-culture” stem cells and bone tumor cells in orbit so researchers can seek molecular targets for drugs aimed at cancers that metastasize to bone. A call for proposals has just been issued on station-based remote sensing, primarily aimed back at Earth.

“Industry experts believe the ISS is well-suited for use in right-of-way inspections, urban planning and forestry remote-sensing applications in addition to other planetary opportunities,” Casis states.

There is some evidence that the terrestrial world is beginning to beat a path to the station’s common berthing mechanisms. Nanoracks, a start-up that pioneered commercial activities on the ISS by selling data and power accommodation for cubesat-sized experiments in 2009 (*AW&ST* July 22, p. 28), just passed the 100-payload mark with the 11 delivered Sept. 29 by the first Cygnus mission to ISS. The company’s 13-nation customer list includes private companies large and small, government agencies, universities and even high schools.

“We’re going into a new era where we’re actually commercializing space,” says Johnson. ☼



By Michael Bruno

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COMMENTARY

Procurement Holiday

Equipment not bought may be sorely missed later

One of the unintended consequences of the 2011 Budget Control Act (BCA) and its annual threat of sequestration—the automatic, widespread budget rescissions plaguing federal agencies since March—is the turnabout that will occur in the ratio of Defense Department procurement to research, development, testing and evaluation (RDT&E). According to analyst Todd Harrison of the Center for Strategic and Budgetary Assessments

think tank here, since fiscal 1955, the ratio has averaged 2.1, meaning the Pentagon was spending more than \$2 in procurement for every \$1 of RDT&E. While the actual figure has fluctuated over the decades, it never fell below a fiscal 2006 nadir of 1.1. But under decade-long spending caps mandated by the Budget Control Act, that ratio will drop below 1.0.

“For the first time in modern history, [the Pentagon] would be spending more on developing new technologies and systems than procuring equipment,” Harrison says in a report on sequestration in fiscal 2014 and beyond. Just last week, leading generals, admirals and civilian officials were testifying to Congress and in public about the so-called procurement holiday on the horizon. In a hearing before a House Armed Services subcommittee, top acquisition officials from the Air Force, Army, Marine Corps and Navy noted how the next round of sequestration, slated to begin Jan. 15, will demand the Air Force cull four or five of 19 planned F-35A Joint Strike Fighters, while the Marines and Navy each cut a F-35B and F-35C, respectively. At the annual Association of the U.S. Army conference, the Army chief of staff spoke of damage to about 485 acquisition programs. “Some we will have to cancel,” said Gen. Raymond Odierno. “Ground Combat Vehicle, name your favorite acquisition developmental program, it’ll probably be affected.”

Harrison says historical trends

U.S. DEFENSE DEPARTMENT



Another procurement holiday will mean ‘a lot of broken glass on the floor.’

—TODD HARRISON

Center for Strategic and Budgetary Assessments

point to a low in annual authorized defense procurement of just \$62 billion. As the years go on, and cuts to once-planned procurements mount, it could devastate many programs as they figure out that the new economics of reduced purchases or the subsequent lack of military capability due to smaller numbers—or both—are just not worth pursuing. The Joint Chiefs have warned about the risks a smaller military faces in regards to capabilities, especially compared with existing national security strategy and expectations (*AW&ST* Sept. 30, p. 29). And, Harrison warns, the defense industrial base could go to an arsenal model where there are quasi-state companies providing niche production capabilities, such as for shipbuilding or tactical fighters. Looking forward,

he sees “a lot of broken glass on the floor” unless BCA is changed. ☛

WEATHERING THE STORM

The last-minute Oct. 16 law to restart U.S. government spending and debt authority mentioned few programs specifically, but did aim to protect two weather satellites that are nearing key phases of development. Since Congress could only pass a stopgap measure, which continues funding at fiscal 2013 levels until Jan. 15, 2014, the law does not allow necessary approvals for changes to programs, or new ones to start. That left almost every federal program in a bind, including the National Oceanic and Atmospheric Administration’s Geostationary Operational Environmental Satellite System (GOES-R). Fiscal 2014 plans outlined a \$339 million increase above its 2013 level to meet its launch schedule. In turn, lawmakers made a rare exception, stipulating that GOES-R and the Joint Polar Satellite System (JPSS) should be funded to maintain planned launches—which, considering orbital dynamics, are important. The next GOES launch is planned for October 2015; first launch for JPSS is scheduled for 2017. ☛

LION RESTS

The death Oct. 18 of Rep. C.W. “Bill” Young (R-Fla.) is hitting defense hawks in Congress at a particularly bad time, considering the recent shutdown, continuing resolution and ongoing sequestration threat. Widely respected as one of the staunchest advocates and friends of the military, Young was the chief defense appropriator in the House of Representatives where he served since 1970. “He will be greatly missed for his willingness to work across the aisle and his advocacy for veterans,” says politically opposed Rep. Rosa DeLauro (D-Conn.) “A veteran himself, he was a great champion for our men and women in uniform.” Says House Armed Services Chairman Buck McKeon (R-Calif.), “This is truly a sad day.” In line to succeed is 10-term Rep. Rodney Frelinghuysen (R-N.J.), an Army veteran of the Vietnam War who is considerate, “moderate” and wealthy, according to *Politico*. ☛

New Contender

Seoul is offered another option as it weighs launching an indigenous fighter program

Minseok Kim **Seoul** and Bradley Perrett **Beijing**

Korea Aerospace Industries (KAI) is pushing for South Korea to cut the technical challenges of its proposed KF-X fighter program, offering a single-engine concept that probably has a distant connection with the Lockheed Martin F-16. KAI's KFX-E design should be cheaper to develop and build than the larger proposals put forward by the Agency for Defense Development (ADD), the chief proponent of the KF-X.

Especially in its twin-tail version, the KFX-E resembles ADD's indigenous fighter designs.



KAI executives have long regarded ADD's plan to develop a twin-engine Typhoon-size KF-X as too ambitious. Meanwhile, the South Korean government has repeatedly deferred launching the KF-X. If it goes ahead, it cannot enter service before the mid-2020s. Cutting costs by accepting a smaller size would probably improve the program's chances.

In July, KAI coyly published a picture of a stealthy KF-X concept related to its T-50 supersonic trainer and called KFX-E (or KF-X-E). It gave no details then and did not respond to Aviation Week's request for comment (AW&ST July 22, p. 33). But now the company has stepped up to make its case for the aircraft, arguing at an official seminar that the KFX-E would meet all air force requirements, except for being powered by just one engine.

The KFX-E turns out to be much larger than the T-50, with an empty weight of 9.3 metric tons. It is larger even than the 8.9-ton F-16, from which the T-50 is derived, but remains much smaller than ADD's two proposals, the C103 and C203, each about 11 tons empty (AW&ST April 29, p. 46).

KAI has worked out two versions of the KFX-E, one with a single fin and one with two, the latter presumably demanding more development work but reducing radar reflections. KAI has not provided for a weapons bay in the KFX-E; ADD has reserved space for a bay in its

KF-X Alternatives

	KAI KFX-E	ADD C103
Weight, empty	9.3 metric tons (20,500 lb.)	10.9 metric tons (24,000 lb.)
Weight, max.	20.9 metric tons (46,000 lb.)	24.0 metric tons (53,000 lb.)
Internal fuel	3.6 metric tons (8,000 lb.)	5.4 metric tons (12,000 lb.)
Span	9.8 meters (32 ft.)	10.7 meters (35.2 ft.)
Length	15.2 meters (50 ft.)	15.7 meters (51.3 ft.)
Wing area	37.1 sq. meters (400 sq. ft.)	42.7 sq. meters (460 sq. ft.)
Engine	1 X P&W F100 or GE F110	2 X EJ200 or GE F414
Hardpoints	9	10
Weapons bay	None	Space provided

Sources: Korea Aerospace Industries and Agency for Defense Development

Also much smaller than and more differentiated from the Lockheed Martin F-35, the KFX-E may offer the further advantage of minimizing competition from that U.S. stealth fighter. But it may have Lockheed Martin or other U.S. intellectual property in its design, exposing it to a foreign veto over sales or even development.

Seoul will probably have a foreign alternative to consider, too. Western proposals for KF-X include twin-tail developments of the F-16 and Eurofighter Typhoon, and an advanced version of the Boeing F/A-18E/F Super Hornet. Those offerings were included as technology transfer in bids for the separate F-X Phase 3 program for 60 fighters. F-X Phase 3 has been abandoned, but a successor competi-

tion will be needed, probably reviving foreign KF-X proposals.

KAI has moved from cooperation to competition with ADD. For a decade, the manufacturer was a design contractor in support of the agency. But industry officials say that at least some

designs, though neither the C103 nor C203 would initially have one. Following a 2009 decision to downgrade the stealthiness of the KF-X, the ADD proposed first to field an aircraft whose shape would give it the makings of a low-observable fighter. Later versions

would introduce features to realize that potential.

Especially in the twin-fin version, the KFX-E has many external similarities with the C103, ADD's tail-aft design. (The C203 has horizontal stabilizers forward.) This is because KAI has used the same technical studies. The leading- and trailing-edge sweep angles of the main and tail planes are the same in the KAI and ADD designs, and various edges are similarly aligned. The same inlet duct design, with a boundary layer diverter, appears to have been used. However, fuselage width and volume are noticeably smaller for the KFX-E, reflecting the lower weight of the aircraft and perhaps F-16 design roots—though it takes a keen eye, and maybe some imagination, to see much of the F-16 in KAI's drawings. At 3.63 tons, the KFX-E's internal fuel capacity is only 14% more than that of the U.S. Air Force's current F-16C Block 40.

If the KFX-E carries an external tank on its center under-fuselage hard-point, it cannot use two stations on the corners of the fuselage. Altogether, it has nine hard-points; the C103 has 10. Depending on whether the chosen engine—either the Pratt & Whitney F100 or General Electric F110—can deliver more thrust than it does in the F-16, the KFX-E will accelerate more slowly than the U.S. fighter. The bigger wing will surely generate more drag, too.

The KFX-E borrows from the light-attack version of the T-50, the FA-50 of 8 tons empty. KAI Vice President Seongseop Jang told the Sept. 26 seminar at the Jungwon air force base that the designers proposed "using existing FA-50 parts with minimum modifications for the KFX-E development." So the KFX-E would use or adapt the FA-50's flight control, auxiliary power, electrical, environmental control and oxygen systems, as well as the landing gear.

KAI stresses that the KFX-E is not an adapted FA-50 (or T-50). This is important because South Korea cannot modify the T-50 design without U.S. authorization. At the seminar, KAI did not address legal restrictions on its proposal. But the KFX-E has probably been designed with at least close reference to the T-50 family: A telling point is that a single fin is offered as standard, while the desirable twin-fin configuration is an option. The structure for the single fin could be derived from the T-50's.

Jinsoo Cho, president of the Korean

Society for Aeronautical & Space Sciences, criticizes KAI's proposal, arguing that South Korea needs an indigenously designed aircraft to avoid foreign interference in international sales and upgrades. Cho, an influential figure in South Korean aerospace policy, seems to take for granted that the KFX-E is not entirely South Korean.

The role of foreign partners in the KF-X development is still in question. Indonesia has been working with ADD on the design. Its attitude to KFX-E is unclear. Also uncertain is how South Korea can acquire technology needed for a mainly indigenous KF-X. The F-X Phase 3 bidders instead offered updates of their own aircraft.

Whichever airframe and engine are chosen for KF-X, only one set of South Korean avionics is available. Following initial production with foreign avionics, the KF-X would switch to systems developed mainly by LIG Nex1. That would include an active, electronically scanned (AESA) radar that, according to the company and ADD, will perform about

as well as the Northrop Grumman APG-80. The South Korean radar has around 1,000 transmitting-and-receiving modules. Software for functions including ground-moving-target indication is already developed, while 95% of technologies related to the antenna and 75% of test-related technologies have been acquired. Foreign help will be needed in testing.

LIG Nex1 has revealed plans to develop an electro-optical targeting system similar to Northrop Grumman's Litening II targeting pod. Signal-processing techniques and a high-resolution infrared camera are ready, but the company says it lacks the capability to develop an internally mounted targeting system, such as the F-35's.

The radar warning receiver for the KF-X will be similar to those in established fighters, such as the F-16. Technologies needed for that system are ready. It will be able to detect low-probability-of-intercept radars, says LIG Nex1. But antennas will not be conformal. The electronic warfare

system of the indigenously developed ALQ-200K pod will be adapted for internal installation. A digital radio-frequency memory was developed in 2012. The KF-X will have no towed decoy.

KAI's fighter design has probably not been worked to nearly the level of detail as the C103 and C203, which ADD has produced after more than a decade of study, which ramped up in the past two years. The manufacturer still has plenty of time to refine the KFX-E, however, because the government is clearly in no hurry to launch full-scale development of an indigenous fighter. Parliament is unlikely to allocate more than 10 billion won (\$9.4 million) for work on the KF-X next year.



KAI's standard KFX-E design has a single tail fin.

On the other hand, KAI will surely want government funding for any intensive work on its design. Not much is available, and ADD will presumably want it all. In the end, the finance ministry may not dispense all of the money.

Political opposition to the KF-X remains as strong as ever, always focused on the alternative of importing fighters. Meanwhile, President Park Geun-hye's plans for social welfare spending can only put pressure on the defense budget. In January, ADD said the life-cycle cost of the KF-X would be 23 trillion won. Exports are assumed. ☛

Dassault unveiled the design for its Falcon 5X business jet at last week's NBAA convention.

Growing Up

Dassault's 5X, the biggest and most advanced Falcon, takes aim at the G450 and Global 5000

Fred George Paris and Las Vegas

When Dassault Aviation launched design studies for a new business jet in 2006, it intended to develop a mid-sized aircraft to compete against Bombardier's Challenger 300, Gulfstream's G250 (now G280) and Embraer's Legacy 600. Within two years, world financial markets plummeted, and with them, demand for smaller aircraft.

Last week, the French aircraft builder finally lifted the curtain on the new jet's design, and the result is a product that scarcely resembles its origins.

The Falcon 5X will be the biggest and most advanced Falcon jet ever built, tailored to follow the market's shift toward ever-larger and longer-range aircraft. Unveiled with great fanfare at the 2013 National Business Aviation Association (NBAA) convention in Las Vegas, the 5X will have a cabin cross-section that is slightly larger than that of Gulfstream's G650 uber-jet, but it is considerably shorter. The 5X is designed to fly up to 5,200 nm at Mach 0.80 and has a top speed of Mach 0.90. Construction of the first flight-test aircraft is well underway, with a maiden flight targeted for the first half of 2015 and certification the following year.

With an initial list price of just under \$45 million, the new Falcon will compete head-on with Gulfstream's aging G450 and Bombardier's fuel-thirsty Global 5000. Its considerably lighter empty weight, more advanced aerodynamics and 10-15% more fuel-efficient engines will cut fuel consumption by up to one-third compared with those competitors. Dassault says the 5X will have 30% lower direct operating costs

than the G450's and 35% less than the Global 5000's.

The first clean-sheet Falcon in a decade, the 5X shares little with the 7X, which entered service in 2007. It will sport a new fuselage, new wing, new Safran Snecma Silvercrest 1-D turbofans (see page 27) and advanced digital flight-control system functionality. The jet, says Dassault Chairman and CEO Eric Trappier, is a "game changer—an all-new, ultra-efficient, advanced-technology aircraft."

The 5X also provides a foundation for more large and longer-range Falcon jets to compete directly against new, advanced designs being developed by Bombardier and Gulfstream. Another member of the new Falcon family could be announced as early as next spring or at Ebace, Europe's signature business aviation event.

Dassault's pivot to the upper end is aimed at capitalizing on the sweet spot of the business jet market. While demand for smaller aircraft remains anemic, larger and ever-more-capable jets are resonating with buyers, particularly in emerging markets such as China. Gulfstream has won more than 200 orders for the ultra-high-end G650. And Honeywell is forecasting that large-cabin jets will generate more than 80% of the industry's revenues (see page 30).

Dassault is striving to make the 5X the most reliable business jet that it has ever built. Scheduled maintenance will come at 800-hr. or 12-month intervals. While touted as the most technically advanced civil jet the company has sold, all of its major systems have evolved from other aircraft. Almost

nothing on the aircraft is "bleeding edge" technology that might risk the jet spending excessive time undergoing maintenance or repairs.

The primary airframe is an aluminum structure with composites for the empennage, fairings, nacelles and other secondary structures. The clean-sheet, 779-sq.-ft. wing includes winglets as part of the initial design, a first for Dassault. It features a straight leading edge, a relatively modest 33 deg. of leading-edge sweep and 5-10% better lift/drag ratio than the 7X.

The aircraft's nose has new loft contours, including cockpit windows that are 32% larger than those of the 7X, easing visibility during takeoff, approach and landing. The flight deck is designed to be considerably more comfortable, with increased headroom and space aft of the pilots' seats to recline for short rest breaks.

Dassault's third-generation enhanced avionics system, dubbed EASyIII, will primarily use Honeywell Primus equipment. The layout is similar to EASy cockpits in other Falcon jets, with four flat-panel screens arranged in a T-configuration. A single Elbit head-up display with a wide angle of view will be a standard item, as will a wideband Elbit infrared camera in the nose.

The cabin's many new design features include wraparound seats with hollowed-out armrests. The seatbacks feature plug-in ports for individual monitors, and Wi-Fi will support using iPads or iPhones as inflight entertainment screens. Responding to customers' desires for more ambient light in the cabin, the 5X will be fitted with 28 of the largest cabin windows ever used on a Falcon. The 155-cu.-ft. aft baggage compartment will be accessible during flight with no altitude restrictions because the engine rotor burst plane is behind the aft pressure bulkhead. There will also be an unpressurized baggage compartment in the tail.

Falcons are known for their class-

leading fuel efficiency, and the 5X will be no exception. One reason is its Mach 0.80 cruise speed, which is relatively placid by current industry standards. While other large-cabin business aircraft makers, as well as operators, tout cruise speeds of Mach 0.85-0.90—shaving as much as an hour off of longer trips—Dassault's market research indicates that longtime Falcon customers value cabin comfort, range and price ahead of speed.

The 5X project's workshare is similar to that on the 7X, with Dassault building the forward and aft fuselages and the wings. Daher-Socata is responsible for most center-fuselage hardware, Belgium's Sabca is building the aft, lower-center-fuselage section, and GKN is constructing the wing's aft control surfaces. Snecma will supply the aircraft's nacelles as part of an integrated engine package. Corsica's Corse Composite Aeronautique is building the wing-to-body fairing, while Potez, in southwest France, is supplying the main entry door. ☛

With Joseph C. Anselmo in Las Vegas.

Powerful Beginnings

Tests put new engines on threshold of debuts for light, large and long-range business jets

Guy Norris Las Vegas

While it may have been a quieter, business-as-usual NBAA show for the established players in the corporate jet engine market, it was the relative newcomers that made the headlines.

Snecma's Silvercrest was confirmed as the long-expected powerplant for Dassault's officially unveiled Falcon 5X, while General Electric trumpeted progress on the Passport for Bombardier's Global 7000 and 8000. GE and HF120 partner Honda also revealed that the delayed engine for the HondaJet is finally poised for certification, clearing the way for first deliveries of the Japanese-designed light jet late next year.

Seemingly relieved to be able to finally acknowledge one of the biggest open secrets in business aviation, a

bullish Snecma released more details about the Falcon 5X engine certification plan. Flight tests of the Silvercrest will start in December on a specially modified Gulfstream II flying test-bed in the U.S. before the evaluation campaign moves to Istres, France, in early 2014. Although conversion of the Gulfstream in Texas appears to have taken longer than expected, the overall engine development schedule remains on track, with certification expected in 2015, says the French engine maker. The Silvercrest will be rated at 11,450 lb. thrust to power Dassault's Falcon 5X, as well as at 11,000 lb. thrust for Cessna's Citation Longitude.

"We have had four engines in the test cell as of today," says Laurence Finet, general manager of the Silvercrest

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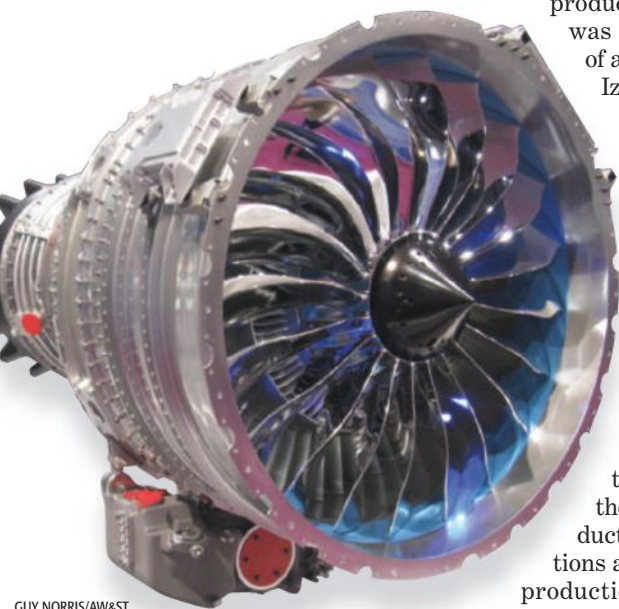
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program. "There were three engines running together from the beginning of October, and now we have removed the one on an open air testbed prior to sending it for installation on the flying testbed," she adds. The unit will be mounted on the right-hand pylon in place of the aircraft's original Rolls-Royce Spey. The Gulfstream was selected over other models due to its high-altitude capability, the similar thrust size of the Spey and because Snecma's parent company, Safran, already owns the aircraft.

"Once we obtain initial flight clearance with the Silvercrest and conduct some altitude and performance tests, we will take it off and replace it with the original engine. The Gulfstream

will fly then to Istres where the Silvercrest will be refitted and complete the remainder of the flight-test campaign," says Finet. The effort, which will take place at Snecma's flight-test unit at the French national evaluation site, is expected to last around five months.



GUY NORRIS/AW&ST

In testing, the engine has performed well to date, says Finet. "We have demonstrated and exceeded our full take-off thrust, and have done performance and operability work. That is not yet complete, but we have good results so far and already know we have a sound engine." Highlights from the early results include snap accelerations in which the engine went from idle to full takeoff thrust in 3.6 sec. "The acceleration is excellent," she adds.

GE Honda Aero Engines expects to achieve its long-awaited FAA certification for the HF120 turbofan by year-end, paving the way for the start of initial production in coming months. "We submitted the final two certification reports to the FAA last week," says GE Honda Aero Engines President Terry Sharp. "On Sept. 3, we held the interim type board meeting at which they [the FAA] endorsed the type certificate plan and granted readiness for engine type inspection approval. So [we're on track] to full type certification by end of year.

"It's been a tough program, but the team came through in the end," adds Sharp. The HF120 will enter limited production in GE's Lynn, Mass., facility. Full-rate production is expected to transfer to Honda Aero's Burlington, N.C., facility in the second half of 2014. A supply chain production readiness review was completed in advance of assembly, says Masahiko Izumi, executive vice president of GE Honda Aero Engines, who adds: "We are approaching the finish line."

Silvercrest, set to power the Dassault Falcon 5X, has a 21-blade, 42.5-in.-dia. wide-chord fan.

The first kits of parts will be delivered to the assembly site at the end of the month. Production assembly workstations are being prepared and production assembly planning has been completed using paperless instructions and data recording. Test cells are also being fitted in Burlington, in advance of the transition next year.

Overall, 13 engines were used in certification, with more than 12,000 cycles and 8,500 test hours accumulated to date. This compares to 7,000 cycles and 5,500 test hours amassed by this time in 2012, and represents the GE-Honda focus on building up endurance time with a dedicated evaluation engine. "There was a quick ramp in cycles and hours last year, primarily because we added an engine to build up cyclic test hours. There is no intention to rest on our laurels and flat-line. We intend to conduct engineering endurance testing ahead of the fleet with another engine, which will run for a further 5,000 cycles," says Sharp.

Initial test results of the Passport

turbofan and its unusual one-piece "blisk" fan are on track in the build-up to next year's fast-paced development and certification phase, according to GE. The 16,500-lb.-thrust engine is targeted at certification in 2015 and entry into service on Bombardier's Global 7000 and 8000 ultra-long range corporate jets in 2016 and 2017, respectively.

Testing of the first engine began at GE's evaluation facility in Peebles, Ohio, on June 24. A second engine joined the test effort in September; a further six are planned for the certification program. "Next year is a big one for us," says Judd Tressler, director of Bombardier programs for GE. The test rate is already building up through the remainder of 2013, he adds. "We will run a third fan blade-out with a rig test coming up, the second engine has run and the first has already gone back for crosswind tests." The program accelerates next year with the start of endurance tests and flight evaluations when Passport becomes the first engine to be tested on GE's newly acquired Boeing 747-400 flying testbed.

"Overall, we'll build up 4,000 hours and 8,000 cycles before entry into service." Four are in build now and two are being tested, says Tressler, who acknowledges the program is not issue-free. "Every day there's a new challenge... things like instrumentation and with clearances and the oil system. However, we haven't had any one big thing that gets you to stop and do anything different. At this point, we are fairly confident we can continue to meet our schedule. That's the reason we test."

First results seem encouraging. "The operability and performance is tracking where we think we should be. Overall, we're very optimistic about what we have," Tressler explains. "We demonstrated a maximum net thrust of 19,200 lb., so we know the capability is there." Compared to its nearest competitor—the Rolls-Royce BR725, which powers Gulfstream's G650—GE says the Passport will have 8% better specific fuel consumption. The engine will also have margin below Stage 4 noise rules and "we'll be able to certify to CAEP/8 emissions regulations with no problems," he adds.

The program follows three years of validation testing on several key technologies, one of the most distinctive features being the 52-in.-dia. blisk fan. The design is made up of a single integrated disk and blades, rather than



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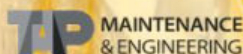
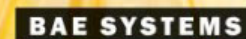
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the conventional arrangement of blades slotted into dovetails in the disk. The feature showed immediate benefits from the start, says Tressler. "With the first engine, right out of the gate we didn't have to adjust anything. In conventional fans, the lube system between the fan blades and disk gets sticky over

time, and eventually noise and vibration goes up. But, [with this design] once the trim is balanced, it is balanced."

One of the most exotic features is the use of an oxide-oxide ceramic matrix composite for the exhaust mixer, centerbody and core cowls. The lightweight, high-temperature-

resistant material is well-suited for lightly-loaded applications, and is the first non-military GE engine with this technology, says principal engineer Bernie Renggli. "It's two-thirds the weight of titanium so we're saving up to 45 pounds per engine, or 90 pounds per shipset." ☼

Hot Spot

China may be business aviation's market of tomorrow, but Brazil is the market of today

Joseph C. Anselmo Las Vegas

As the business jet industry waits for sales to gain critical mass in China, its next major market is already here: Brazil.

Latin America is expected to account for 18% of global demand for business jets during the next five years, well ahead of Europe and the Asia-Pacific region, and second only

Brazil is now the industry's "hot spot," says Rob Wilson, president of Honeywell Business and General Aviation. "It has a substantial fleet base with double-digit growth." The survey results indicate that 57% of the business jets currently operating in Brazil will be replaced or added to with new purchases, compared to 28% in North

While the Greensboro, N.C., company has initially focused on the U.S. and Europe for sales of its new light aircraft, the HondaJet, its next move could be in the Southern Hemisphere. "Brazil is a critical market for HondaJet," says president and CEO Michimasa Fujino. "It is very promising."

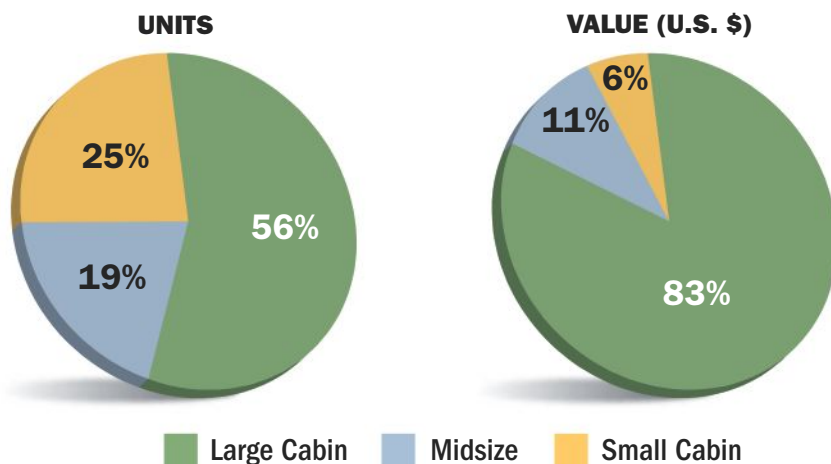
Honeywell's outlook, unveiled Oct. 20 just prior to the National Business Aviation Association event in Las Vegas, projects the industry will deliver 9,250 jets worth nearly \$260 billion through 2023 as it slowly recovers from a bruising downturn that began five years ago. A separate outlook released by Forecast International sees 9,575 business jets worth \$235 billion being built through 2022—a period one year shorter than Honeywell's projects.

North America, with its huge installed base, will continue to dominate the industry. Honeywell projects the region will account for 61% of business jet demand over the next five years. The recovery will favor larger aircraft that deliver high speed and long ranges, such as the Gulfstream G650. Big-cabin jets are expected to account for 56% of the units and 83% of the value of those deliveries. "The trend toward larger-cabin aircraft with ever-increasing range expectations and advanced avionics is seen more strongly than ever in this year's survey," Wilson says.

By contrast, the lower end of the industry continues to struggle.

Cessna Aircraft, which is positioned on that side of the market, is investing in new aircraft with the belief that better days lie ahead. The company's Citation X, which will have a maximum speed of Mach 0.935, is on track to receive final certification by March 2014. And the Citation Latitude, Cessna's answer to Embraer's Legacy 450, is expected to make its inaugural flight in the first quarter of next year. "The market will come back," says Cessna President and CEO Scott Ernest. "It's just a matter of when." ☼

New Business Jet Purchase Plans



Source: Honeywell Business Aviation Outlook

to North America, according to Honeywell's annual Business Aviation Outlook. And that is due in large measure to Brazil, which had the highest purchase plans of any country based on surveys of more than 1,500 operators worldwide. By contrast, the Asia-Pacific market, which includes China and India, is forecast to account for just 5% of demand for business jets during the next half-decade.

America and China.

While much attention has been focused on the growth of business aviation in China, the Brazilian market has a bigger impact on industry sales because it is expanding from a larger base. Honeywell calculates there are about 700 business jets already operating there, more than double the number in China and five times as many as in India.

That is not lost on Honda Aircraft.



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Four-hangar MRO center will accommodate Lion Air's fleet growth and new customers

BUSINESS & OPERATIONS

- MR018 Sensing Success**
Industry broadening automated tracking of key assets

MR04



- MR022 Moving To Mobile**
The technology, regulatory and security developments that will change maintenance documentation management

MARKET ANALYSIS

- MR026 Proven Power**
Venerable GE90 pushes through issues to keep 777s soaring

SAFETY & REGULATORY NEWS

- MR028 Shutdown Shows Delegation's Value**
MR031 EASA Targets Faulty Fasteners
MR032 Corporate Culture

MRO LINKS

- MR038 Environmental Services**
MR039 Software
MR040 Mechanical Components

Reach Higher

Eliminating unplanned aircraft downtime would be a good thing, right? Imagine how operating assets that do not prematurely fail would optimize your operations. The productivity gains and cost savings would be immense.

Perhaps you think I am taking a utopian view of operations, but if your company and employees are not striving for innovation at the highest level, will you ever get there?

GE held its "Minds+Machines" event on Oct. 9, with the philosophy no longer debatable that "a new industrial revolution has been sparked by the convergence of connected machines, advanced analytics and people at work. It's underway and accelerating."

GE Chairman and CEO Jeff Immelt is leading the company through a disciplined build-out of technology, organizational talent and business architecture that, with partners, drives repeatable outcomes around valuable assets.

Immelt says this model requires:

- Interdisciplinary approaches, with the chief information officer intimately involved in core business development activities.
- Analytical and industrial worlds to intertwine.
- New processes and a working knowledge of data science.
- And perhaps the biggest challenge of reaching this level requires open systems and data-sharing. "This can be uncomfortable," Immelt admits.

While most people in the aviation industry would agree that data transparency is a bit uncomfortable, "getting over that and getting to a point where a customer and supplier anchor themselves around [the fact] that truth is in the data and [that they] make a difference based on that," is where the outcomes lie, says Giovanni Spitale, general manager of GE Aviation's Flight Efficiency Services.

Sure, there are technological and regulatory challenges to deliver the right data at the right time and right place, but are those the biggest obstacles—or is it a reluctance to change behaviors?

The question of why our industry is



Does your company have the processes and culture to make new IT ideas flourish?

so traditional and is reluctant to change came up during Aviation Week's MRO IT Roundtable sponsored by Boeing on Sept. 23 in London. People talked about how innovation happens in their organizations, and how they push the best ideas forward. But often, incorporating changes comes slowly. Does your company have the processes and culture in place to make these ideas flourish?

If our industry is going to become more predictive and efficient throughout the supply chain, is it time to take a leap of faith and trust the data—and accept that mobility is coming?

Given that MRO Asia occurs Oct. 29-31, I'll leave you with examples of data and mobility progress happening within the region. Spitale told me EVA Air and Garuda Indonesia are starting to feed flight data to GE for use in its fuel-management program, which is designed to help airlines reduce fuel use and carbon emissions. EVA and Garuda enlisted their whole fleets in the program.

In addition, Hong Kong Aircraft Engineering Co. is developing a safety reporting app for smartphones with Hong Kong Polytechnic University. The app will provide Haeco employees with an easy way to report incidents that did not cause injuries or unsafe conditions. If the pilot program is successful, the MRO will expand the app from Apple to Android- and Window-based platforms.

I hope to see you in Singapore and get your views on leaping to the next level. ☺

—Lee Ann Tegtmeier
Chief Editor MRO

Read Tegtmeier's posts on MRO's
weblog, updated daily:
AviationWeek.com/mro

The next issue of the MRO Edition will be dated Nov. 11.

Keeping Up With Cabins

Lighter seats, advancing mobile technology and custom branding drive interior investments

Heather Baldwin **Phoenix**

Rapid advances in technology and materials, along with intensified competition for passenger loyalty, are driving a wave of innovation and investment in aircraft interiors. The hallmarks of today's newest cabins are improved materials, hardware design and technologies that enable faster, more effective maintenance.

In the past few months alone, major carriers have announced these actions:

- Singapore Airlines debuted new long-haul cabin products, including a redesigned business class seat, improved privacy in first class, a new economy seat with more legroom and a new generation of inflight entertainment (IFE) with touch-screen handsets.
- Qantas says it will unveil new interiors in its Airbus A330s beginning in late 2014, including business suites with flat beds and new (international) or refurbished (domestic) economy-class seats.
- JetBlue plans to debut lie-flat seats in some Airbus A321s in the second quarter of 2014. A new premium section will include an optional, separate single suite with a closable door for privacy.
- Delta Air Lines says it will add flat-bed seats to its BusinessElite cabin on flights between Buenos Aires and Atlanta starting in January.
- KLM, following introduction of Economy Comfort on its Boeing 737s, is planning to add the class on its KLM Cityhopper fleet late this year or in early 2014. Slim, lightweight seats will increase legroom up to 8 cm (3 in.) in business class and 4 cm in economy.

Bolstered by these kinds of investments, today's aircraft interiors market, excluding IFE, is valued at just under \$6.5 billion, according to a report released in September by Frost & Sullivan. The report predicts 3.5% annual growth to \$7.6 billion in 2020.

Qantas plans to introduce business-class seats like these in its Airbus A330s next year.

"Airlines are enhancing first class and business class with pods, but that has a net effect of slowly shrinking space in economy, which is driving economy-class redesigns," says Wayne Plucker, aerospace and defense industry manager at Frost & Sullivan. "This is why seating continues to be the most robust market in interiors."

Still, the most stunning growth is happening in IFE, a sector in which Frost & Sullivan forecast revenue will increase to \$5.3 billion in 2020 from \$1.8 billion in 2011, a compound annual growth rate of 12.8%.

Consumer expectations of 24/7 Internet accessibility and explosive growth in mobile technologies are driv-



Tap the icon in the MRO digital edition to see more interior developments, or go to AviationWeek.com/mrocabins

And watch a time-lapse video of Southwest Airlines installing new interior at ow.ly/q4mtc

ing connectivity growth. Research by Staff.com predicts that mobile phones and tablets will overtake desktop computers for Internet browsing in 2015.

Airlines are already witnessing this trend. Virgin America has seen a 30% increase in Internet uptake during the past 12 months, said Chief Marketing Officer Luanne Calvert at the Airline Passenger Experience Association Expo last month in Anaheim, Calif. A Honeywell Aerospace survey conducted in mid-2013 found nearly 9 in 10 passengers would give up at least one other onboard convenience for reliable Internet connectivity; 25% would give up 6 in. of legroom for it.

Vendors are scrambling to meet this demand. Inflight connectivity provider Gogo last month announced Ground to Orbit (GTO), a hybrid network solution that will potentially deliver 60 Mbps to the aircraft, increasing speeds by more than six times the company's current performance—and more than 20 times the speed of its initial product five years ago. Virgin America will launch GTO in the second half of 2014.

Gary Weissel, vice president and co-managing officer for aviation and aerospace at ICF SH&E, says the merger of improved connectivity with mobile technology is just starting to



QANTAS



JETBLUE

JetBlue is slated to install new lie-flat seats in some Airbus A321s by the second quarter of 2014.

affect cabin design and content delivery. "More and more, you may see airlines taking the approach of providing content and letting passengers bring their own devices." In 3-4 years, "assuming data providers can stream early-release movies, you'll see more and more hardware coming out of the seat with airlines providing the content and relying on passengers to bring the device," Weissel predicts. "I can see in 8-10 years where there is no IFE content on board and airlines are just bringing it in from a satellite."

Neil James, executive director of corporate sales and product management at Panasonic, also says installed IFE will continue to play a role in the cabins of the future. "A few years ago, there was a huge bubble around wireless, and everyone said embedded systems are dead. But we are seeing embedded systems specified in aircraft that are going to be delivered in 6-8 years—and flying for 10 years after that," he says. A case in point: While American Airlines began offering premium passengers branded tablets for IFE in late 2011, its forthcoming fleet-renewal program will feature in-seat IFE, and the airline-provided tablets will be retired.

James says IFE will evolve to embrace personal devices. For instance, Panasonic's newest product, eXO, works with the company's wireless network to provide an environment in which passengers can connect their own devices to an inflight portal for second-screen entertainment, including games and interaction with other passengers.

In addition to improving the passenger experience, technological advances in IFE also improve maintenance. Panasonic receives more than 20,000 records a month, via cellular modem and the Aircraft Communications Addressing and Reporting System,

about the performance of its systems to help diagnose problems and advise on potential solutions. "The next step is to consider the aircraft as a node on the network and for us to further refine the ground-based tools to allow dashboarding so maintenance crews, from their seats, can see everything happening across the fleet in real time and flag anything that requires action," says James.

The visibility is already there. Improved connectivity will provide the next leap in viewing system status in real time. In this way, maintenance will become more about monitoring the health of systems and assessing where potential problems could crop up than simply performing reactive repairs.

CABIN MAINTENANCE

Proactive, data-driven cabin maintenance is becoming increasingly preva-

lent. BAE Systems is working with Emteq to develop IntelliCabin, which will integrate lights, in-seat power systems, seat actuation and control, IFE and smart galleys/lavatories within a single system. Among its prognostic capabilities, IntelliCabin will be able to predict seat actuation failures by using neural, network-based algorithms BAE Systems has implemented in other applications. The system will also off-board fault information to maintenance crews so actions can be initiated prior to the aircraft landing. It is expected to be available at the end of 2014.

IntelliCabin seeks to reduce operating costs by applying intelligence to key areas of the cabin. Dimmable windows will enable flight attendants to darken cabins at a touch of a button, reducing required cooling power. By monitoring potable water usage, airlines can leverage trend data to carry only as much water as needed for a flight, reducing weight. And the in-seat power system intelligently distributes power without the use of under-seat power boxes, eliminating the weight and bulk of those boxes.

"When a device is plugged in, our system recognizes which phones or tablets have the least amount of power in their batteries and powers those," says Faran Siddiqi, business development director for BAE Systems.

GAINS FOR GALLEYS

AIM Aviation has begun building a new factory adjacent to its Galleys Div. in Byfleet, England. The new facility will add 31,000 sq. ft. of production and testing capability, bringing total space to 80,000 sq. ft. Completion is targeted for summer 2014.

The new space will include a full static-test facility—a must-have for Airbus A380- and Boeing 777-approved galley suppliers, which AIM hopes to become. "When Airbus went single-source on its single-aisle aircraft, we had to focus more on widebody galleys," says Richard Bower, AIM's group commercial director. That focus led to expansion in A330 market share to 30% today, up from 12% five years ago. And that growth, combined with potential A380 and 777 business and a spike in retrofit work, spurred construction of the new factory. "We realized we needed a more world-class space to bring the quality of our infrastructure up to the quality of our product," says Bower.

AIM's galley business is retrofit-heavy, with 32 shipsets scheduled for delivery over the next 18 months compared with 30 line-fits in the same time frame. More typically, the company's business is 80/20 line/retrofit. "There is definitely an uptick in the retrofit market, driven by a desire by airlines to fit more seats into their aircraft," Bower says. ☺

“There is a finite amount of power on an aircraft and IntelliCabin budgets and distributes that power.”

Another forthcoming system aiming to improve operational efficiency in the cabin is MAINtag's FLYcheck, a 3-D iPad-based assets management solution for inventory and maintenance of cabin passenger and security equipment. “On a Boeing 777, it takes about eight hours to control all the life jackets and safety equipment,” says MAINtag Vice President Alexis Beurdeley. “FLYcheck decreases that work time to less than three minutes,” about the time it takes a technician to walk down aircraft aisles with a FLYcheck-enabled iPad.

MAINtag provides RFID systems for the aerospace industry, and FLYcheck works by reading RFID tags on equipment ranging from life vests and oxygen generators to medical kits and fire extinguishers at a distance up to 7 meters (23 ft.). It also can monitor IFE. Color-coded results let a technician zero in on the equipment that needs attention. FLYcheck works with 2- and 8-kb-memory tags; MAINtag will soon release 64-kb tags that can store maintenance history data. Beurdeley says MAINtag expects to announce its first FLYcheck customer by year-end.

HAVE A SEAT

As technology makes cabins smarter, advances in materials and design are making seats lighter and slimmer. This is prompting a wave of investment in seating, including widespread modifications in economy classes to maximize every inch of cabin real estate.

For example, in March 2012, Southwest Airlines began retrofitting its Boeing 737-700s with new interiors featuring durable, low-profile seats by B/E Aerospace that save nearly 6 lb. per seat, or 635 lb. per aircraft. Based on 2012 flight activity, the reduced weight saved Southwest nearly 782,000 gal. of fuel, says Chris Woodard, manager of interiors engineering. The new seat covers use E-Leather, a lightweight, scuff-resistant alternative to leather that lasts two years longer than Southwest's previous seat covers.

Southwest anticipates the fuel savings coupled with the increased seat durability will result in more than \$10 million in ongoing annual savings. The seat's low profile enabled Southwest to increase the number of seats on 737-700s to 143 from 137 without sacrificing passenger personal space.



Recaro, which produces these CL3510 seats in Schwabisch Hall, Germany, has rolled out the lighter CL3710 seat this year.

Seat makers are scrambling to keep up with demand by airlines seeking these kinds of savings. Doug Hacking, commercial director at Acro, says the company is sold out through the end of 2013, with additional commitments through fall 2014. “That’s not where we want to be,” says Hacking. “We want to supply lease companies and their operators in 14-16 weeks.” In 2013, the company grew to more than 50 people from fewer than 10; it produces 1,000-1,200 seats per month.

Most recently, KLM Cityhopper chose Acro to replace the seats on its Fokker 70 fleet, boosting legroom through a slimmer seat design that uses composite molding for the seat back and reduces maintenance costs through improved design and reduced part count. Hacking notes that there

are 451 parts in Acro Ultra Recline triple seats—a number he estimates to be half of that in a conventional seat.

In response to soaring demand for economy seats, Recaro earlier this year rolled out the CL3710. The seat weighs less than 12 kg (26 lb.), which Recaro says is the lightest in its class. “New technologies enable a higher structural stability with lower mass within smaller space,” says Rene Dankwerth, vice president of research and development at Recaro Aircraft Seating. “New aluminum alloys and titanium as well as high-temperature plastics lead to higher strength. Furthermore, difficult geometries can be optimized by means of metal injection-molded parts, which also reduce the weight.”

Dankwerth says the future for aircraft seats will be even lighter-weight products; more efficient maintenance due to self-cleaning, self-healing materials and surfaces; and more sleeping comfort due to support features.

Interior maintenance management is evolving, too. For example, responding to operators’ frustration about part replacement availability, Timco Aviation Services’ Cabin LifeCare guarantees spare parts will be where and when they are needed with predictable pricing and no inventory carrying costs, says Leonard Kazmerski, vice president of marketing and business development. ☼

DESIGNING THE FUTURE INTO THE 777X

Evolutions in materials and technology are happening so quickly, one of the big challenges for OEMs is designing a product today that can accommodate unexpected changes tomorrow.

“One of the things that has been a lesson learned is technology is advancing so quickly, yet when we do an interior for an airplane, it doesn’t get updated for 10 to 15 years,” says P.J. Wilcynski, payloads chief architect at Boeing. “How do we design an architecture that allows for updating with new technologies without tearing everything apart?” Engineers are tackling this question as they design the interiors for the forthcoming Boeing 777X.

Today, says Wilcynski, an upgrade from fluorescent lighting to LEDs can require redesign of both the outboard bin buckets and the interface between bins and ceiling—just to change out a light. Aiming to eliminate these kinds of inefficiencies, Boeing is grappling with questions such as: How do we design bins and ceilings to take advantage of future advances in lighting? How do we do a better job of creating an adaptive architecture? How do we design a cabin that allows for easier technology insertion? These kinds of questions are shaping the cabins of the future. ☼

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Ratcheting Up

To meet explosive fleet growth, Asia-Pacific LCCs expand their maintenance capabilities

Elyse Moody **New York**

Skyrocketing numbers of narrowbody aircraft orders have turned attention to Southeast Asia—and its burgeoning low-cost carriers (LCC), in particular. Twenty-seven percent of the world's narrowbody aircraft—half the global fleet—are operated in the Asia-Pacific region, estimated Lufthansa Technik Philippines in the first quarter of fiscal 2013. More than 37% of the total commercial fleet will soon be based there, many of them in service with low-cost carriers (LCC), it also projects.

Such statistics and the aircraft orders supporting them have brought these LCCs prominence on the global stage. *The Wall Street Journal* noted in late August that Indonesia's Lion Air was "little known internationally until it surprised the industry last year with record-setting orders." The airline signed commitments for 230 Boeing 737s in February 2012 and for

234 Airbus A320s in March 2013. But Lion Air is hardly the only carrier in the region making notable additions: AirAsia, the world's largest operator of A320s, ordered 100 more in December 2012, on top of the 200 it secured in 2011. And Jetstar Airways, part of the Qantas Group, will have access to its parent company's order for 110 A320s, including 78 A320neos, in addition to the 14 Boeing 787s it expects to receive soon.

Beyond these carriers, Cebu Pacific Air has more than 50 A320-family aircraft on order and TigerAir has signed for 20 A320s.

This run on the orderbooks reflects projected growth in air travel. The Asia-Pacific region stands to see that demand grow 6.4% annually through 2031, according to Bloomberg News projections. Lion Air CEO Rusdi Kirana says in Indonesia specifically he expects a 20% growth in traffic this year.

Those increases in demand and aircraft numbers mean airlines and independent MRO providers alike must figure out how to absorb them. Where will all those aircraft go? As deliveries roll out, maintenance organizations must propose attractive solutions.

As a Singapore Airlines Engineering Co. (Siae) spokesperson puts it, "The positive outlook for air-traffic demand, especially in the Asia-Pacific region, where the LCC market will continue to grow and fuel the traffic growth, and its buoyant fleet-renewal market, has the attention of most MROs in the region." In other words, a big new fleet is ripe for the capturing.

GROUND WORK

In the past, total outsourcing was the default mode of doing business for Asia-Pacific's LCCs, especially smaller airlines, but some say that model is being replaced.

"The market has shifted," says Brian Hogan, a principal with XSQ Consulting who worked at Philippines-based Cebu Pacific when it established its first joint venture, Aviation Partnership (Philippines) Corp. for line maintenance, with Siae. "All these organizations should do their own line maintenance themselves and



AirAsia, already the world's largest operator of A320s, is leading the Asia-Pacific LCC fleet boom.



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then make a decision on the C checks or the heavy checks, depending on their critical mass, or whether or not they can make an MRO profitable.”

Sticking to the essential core-business approach, some carriers continue to send all of their maintenance to third-party providers. TigerAir, for example, outsources both its line and base maintenance, says Chief Operating Officer Ho Yuen Sang—and he does not anticipate adding in-house capabilities. “Our MRO provider has the capability and capacity to undertake the additional maintenance work for the growing fleet.”

But Ho notes that the increased numbers of aircraft operated by TigerAir and its peers certainly will

line, says Chief Executive Adviser Gary Kingshott, because “the scale of Cebu Pacific’s maintenance profile requires a large proportion of an MRO’s total capacity, and so a joint-venture arrangement with an accredited organization willing to invest remains a viable strategy for Cebu Pacific.”

The region’s largest LCCs, AirAsia and Jetstar Asia, tackle line maintenance in-house or through shareholding partners. AirAsia has received 127 of the 211 A320s and 264 A320neos it has on order and it has grown accustomed to adding a minimum of 24 new aircraft annually. Performing its own line maintenance is a matter of reputation as well as economy of scale.

“Wherever we go, wherever our

nance, and SAE plans to nearly double its workforce and add new hangars, including ones for A330 maintenance, this year in hopes of drawing more business from its biggest partner.

But Tajuddin emphasizes that flexibility remains vital; he looks for agreements of only 2-3 years. “When you have long-term [contracts], you do not have the ability to go out to the market, especially in the airframe business,” in which he says maintenance unit costs may be volatile when man-hours drop.

When asked if AirAsia might consider adding capabilities beyond line maintenance via a partnership or an independent investment, Tajuddin says, “We are actively looking, because our base load with the number of aircraft sometimes justifies our having our own maintenance infrastructure.”

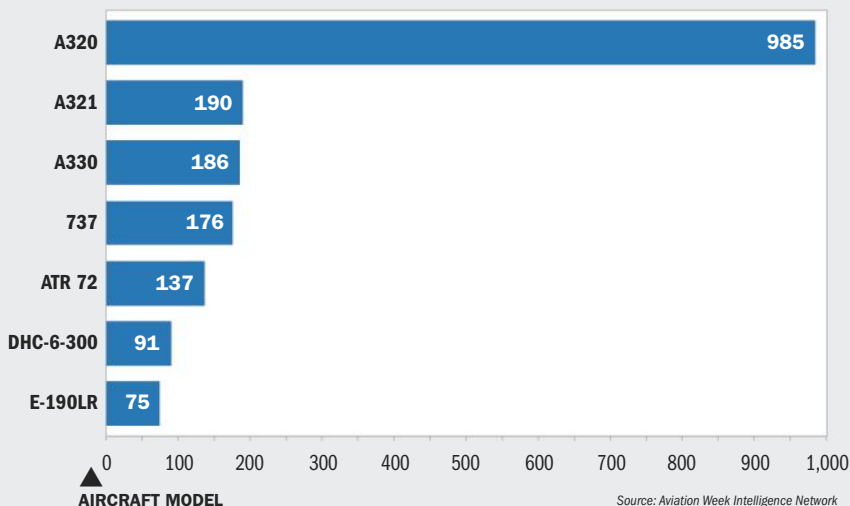
Given that AirAsia took delivery of its first aircraft in 2005, landing gear overhauls will soon start to come due in volume. “We have asked ourselves, ‘Should we invest in a landing gear shop?’” he says. “We do not have any firm idea yet, but we are actively looking.” He notes that he would rather pair up with an independent provider than an airline-affiliated MRO to ensure his fleet has priority.

Jetstar Airways applies a common approved maintenance program across its two main branches, in Australia and New Zealand, as well as its low-cost offshoots in Singapore, Vietnam and Japan. A new affiliate is anticipated to kick off operations soon in Hong Kong, subject to regulatory approval.

In launching Jetstar Japan, which started receiving A320s in April 2012, the group has stuck to that common maintenance philosophy. “Where appropriate, we develop amendments to satisfy local national airworthiness authority regulatory requirements,” says Chris Snook, Jetstar executive manager for group engineering. “This allows for common fleet technical management and configuration control across the fleet. It also maximizes our opportunities to apply insights gained from across the organization to improve safety, reliability and direct maintenance costs.”

But, like AirAsia, Jetstar considers line-maintenance control particularly important. Jetstar Japan performs its own line maintenance in partner-

Dominant Aircraft Types In Service, Asia-Pacific Region



have an impact on the region’s MROs. “[The] higher volume of work could translate to higher productivity and lower unit cost of maintenance,” he says. This would benefit airlines like his that depend on the total-outsourcing strategy.

Cebu Pacific continues the joint-venture approach that Hogan helped establish. The airline added a second joint venture with Siaec, a base maintenance facility at Clark International Airport in the Philippines, although Cebu Pacific also has partnered with Vaeco in Vietnam for its ATR aircraft; with Haeco in Hong Kong for its A330s; and with General Electric, Rolls-Royce and SR Technics for engine maintenance.

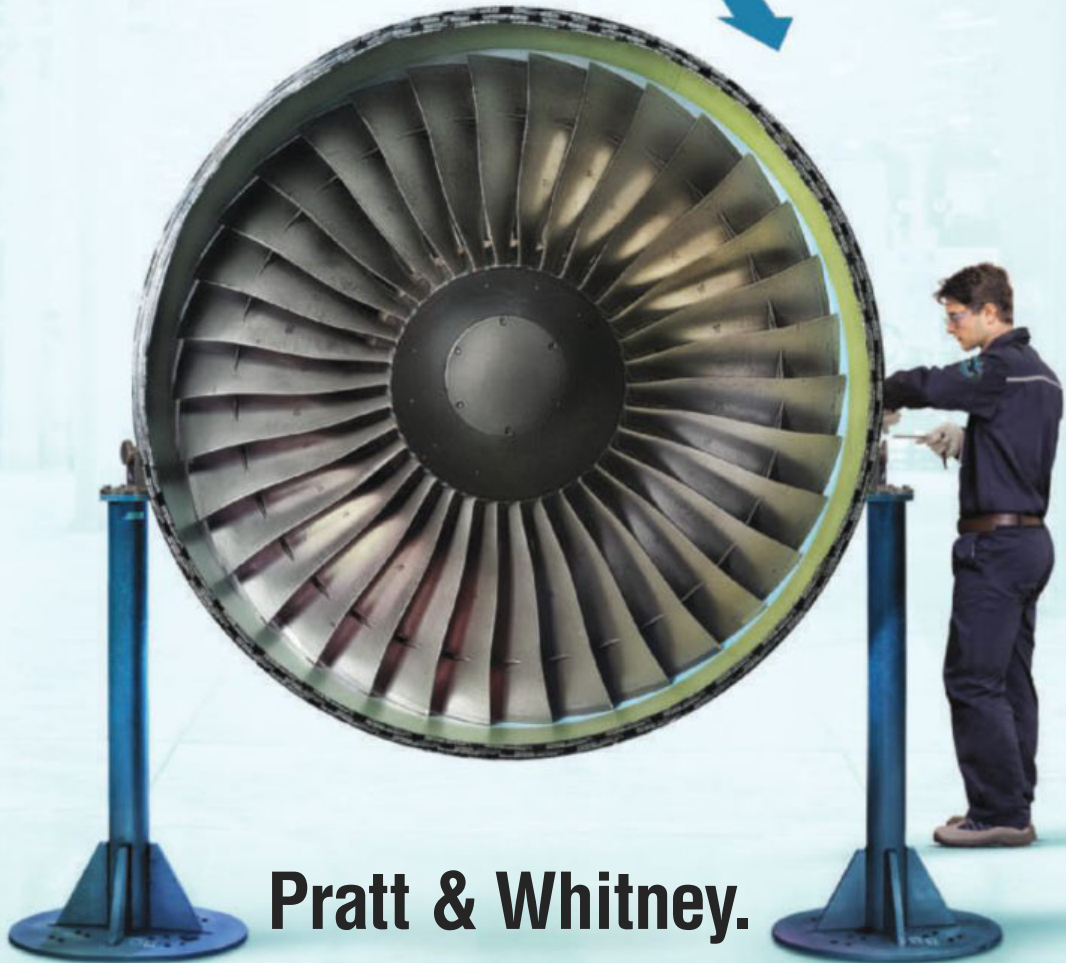
The joint-venture arrangement continues to make sense for the air-

new [air operator’s certificates]—AirAsia India or AirAsia Malaysia, Thailand, Indonesia—we have our own team carry out all of the line maintenance requirements,” says group engineering head Anaz Ahmad Tajuddin. “We would rather have that in-house. Then we have full control, because the AirAsia brand is important to us. We need to have full control of the brand, especially in line maintenance, where daily activities more or less interface with the customers.”

AirAsia sends the bulk of its base maintenance work to a neighbor, Sepang Aircraft Engineering (SAE), a company part-owned by EADS, but it also patronizes Siaec, Garuda Indonesia and Thai Airways, Tajuddin says.

More than 85% of the carrier’s A320s go to SAE for base mainte-

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ship with Japan Airlines Engineering Co.; along with Mitsubishi Corp. and Century Tokyo Leasing Corp. JAL Engineering conducts A checks for Jetstar Japan at Narita International Airport.

The Hong Kong business will be a joint venture between China Eastern Airlines, Shun Tak Holdings and the Qantas Group. Snook says line maintenance for it will be conducted by its MRO partner in Hong Kong. "Heavy maintenance requirements will be

combined with other group activity to leverage economies of scale," he says.

For their part, the region's independent MROs are making plays to accommodate the new work volume, too. The joint venture with Cebu Pacific is only one of 25 that Siaec operates in nine countries, with the aim of offering better cost efficiencies to low-cost carriers, says a Siaec spokesperson. And Lufthansa Technik Philippines recently underwent an organizational restructuring with the aim of capturing

more of the Airbus base maintenance work in which it specializes.

SPACE JAM

Tons of new aircraft and no place to put them? MROs and airlines have been adding maintenance capacity to house new deliveries as work comes due. Perhaps the biggest news is Lion Air's late-August announcement of its intention to build a \$250 million maintenance hub on the Indonesian island of Batam, angled to rival the established MRO hotbed of Singapore. Lion Air CEO Rusdi Kirana has designs for his own airline's Lion Technics MRO arm to handle internal needs as well as those of other carriers only a 45-min. ferry ride from Singapore's busy Changi International Airport (see page MRO14).

The campus reportedly will consist of four hangars, each able to accommodate three narrowbody aircraft at once. Two hangars are set for completion by year-end and the remaining two will follow by next summer. The site would complement a smaller one it is building in Manado, Indonesia, as well as its existing facilities at Surabaya.

Partners Cebu Pacific and Siaec are completing a long-planned second hangar at their maintenance campus at the former Clark AFB in the Philippines, which will be able to house aircraft as large as the Boeing 777. And while maintenance activity in Australia tends to be cost-prohibitive, Jetstar is leasing a widebody hangar at Melbourne Airport to undertake Boeing 787 and A320/A321 line maintenance, including A checks and triage, Snook says. About 35 technical and support staff initially will be employed there, he adds.

But new investments seem likely. "It's not going to be easy for the market to absorb a thousand planes in the next 10 years," says XSQ Consulting's Hogan. He points to the possibility of new hangars being built by either independent investors or joint ventures in underdeveloped regions such as Malaysia, the Philippines and Indonesia—or even Myanmar, Bangladesh and Vietnam. He notes that this growth will be extended once China opens up further.

Snook concurs that these countries are "all establishing credible MRO options."

As Hogan puts it, "it's a huge problem, but it's a huge opportunity." ☛

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Growth Capacity

Four-hangar MRO center will accommodate Lion's fleet growth as well as new customers

Adrian Schofield

Indonesia's Lion Air is moving closer to completing the first phase of its new maintenance, repair and overhaul facility in Batam, which will help it handle the massive number of aircraft deliveries the carrier has scheduled and make it a player in the third-party MRO market.

The first two of the planned four hangars are scheduled to open by the end of the year on Batam, an Indonesian island just south of Singapore. These two larger hangars will quadruple Lion Air's MRO capacity, which is currently provided by its single-hangar operation in Surabaya, Indonesia's second-largest city.

Lion Technic President Romdani

four of the hangars are due to be finished by the end of June next year. Engine and component repair facilities are also planned for the site. The total cost is estimated at \$250 million.

When all these facilities are fully established, they will require an additional 2,000 workers, of which 1,400 will be involved with the engine and component shops. These new Batam employees would almost double Lion Technic's current workforce, which now stands at 2,500.

Lion also intends to open a third MRO facility in Manado, in the eastern part of Indonesia. This would be a single-hangar operation, able to handle turboprops and narrowbodies.

Batam, when there would be certain parts and components that would be sent to the relevant original equipment manufacturer's MRO operation in Singapore.

With the planned capacity increase, Lion intends to conduct more third-party maintenance work, says Romdani. The carrier currently does a very limited amount of third-party work, mostly on behalf of the owners of some leased aircraft that it operates.

The construction of the Batam facility means Lion could potentially allocate 30% of its heavy maintenance capacity to third-party work, Romdani says. However, the carrier is emphatic that this does not mean 30% of the capacity will always be set aside—the amount of outside work will depend on demand and Lion's own maintenance needs.

Lion also may still send its aircraft to Singapore MRO providers or to Garuda's GMF AeroAsia if its own facilities are full. But this will obviously happen to a lesser extent when all four hangars are open.



The first two hangars at Lion's new Batam site were at this stage of construction in July.

LION TECHNIC

Adali Adang tells Aviation Week that without this new facility, the rate of aircraft deliveries would overwhelm the current capacity by next year. So far, Lion has been able to boost the use of the Surabaya facility through shift increases and efficiency improvements, but this will soon not be enough. The carrier has taken delivery of 19 Boeing 737s this year, and is due to receive another five by year-end. It has outstanding orders for almost 550 narrowbodies from Boeing and Airbus.

The new hangars will each be able to accommodate three 737s or one 747-400, compared to the two-narrowbody capacity of the Surabaya hangar. All

Construction is due to begin next year.

The location of the Batam site offers some significant advantages over Surabaya, says Romdani. The existing facility is situated within a naval base, making employee access somewhat complicated. The Batam facility will not be faced with this issue, and also has more land available for growth.

Batam is just 35 min. by sea from Singapore, which will make it easier to obtain parts via the extensive logistics network there. Lion plans to establish its own ferry service to Singapore for transporting spare parts. This would be useful in situations such as the disassembly and overhaul of an engine at

The engine and component repair facilities at Batam are expected to open by the end of 2016 or the first quarter of 2017. Lion is in discussion with several companies about potential partnerships, Romdani says. On the engine side, Lion is talking with both Pratt & Whitney and CFM.

As Lion builds its expertise in this area it will handle a wider range of engine and component work. However, it will still make sense to send some parts to OEMs and specialist companies.

While the Batam operation will be controlled by Lion Technic, it will be branded as Batam Aero Technic. The different name will underline the in-

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creased emphasis on third-party work.

Gaining European Aviation Safety Agency (EASA) certification for Batam and its other maintenance facilities is a major objective for Lion. The carrier is beginning this process with its line maintenance operations at Jakarta Soekarno-Hatta International Airport. This will allow Lion to conduct line maintenance for airlines flying into Jakarta that may have policies against working with companies that do not have the EASA stamp of approval.

Batam is just 35 min. by sea from Singapore, which will make it easier to obtain parts via the extensive logistics network there

Lion Technic intends to employ eight EASA-certified maintenance personnel from Europe, and they will work with Lion staff in Jakarta to help

them ensure they are meeting EASA standards.

After the Jakarta base is certified, Lion will concentrate on getting its other line maintenance stations approved. Then it will

seek EASA certification for heavy maintenance of airframes, engines and components.

This process should be smoother with the new Batam facility, as it is being designed and built with EASA standards in mind, Romdani says. The carrier has even arranged for EASA officials to travel to Batam to look at the project and make sure it is in line with their standards. Lion believes it is important to involve EASA in the process, and develop an early relationship.

Lion's fleet is currently dominated by Boeing 737s, most of which are the -900ER variant. It also has two leased 747-400s.

The carrier is due to receive its 100th 737 on Nov. 4, and has one of the largest narrowbody orderbooks in the industry. Last year it struck a deal with Boeing for 230 737 family aircraft, primarily from the MAX range. Then in March of this year Lion ordered 234 Airbus A320s, mostly from the Neo range.

Many of the new narrowbodies will go to Lion's Indonesian-based core operation, but aircraft will also be allocated to its affiliate joint ventures in other Asian countries. So far, these include Malindo Air in Malaysia, and Thai Lion Air.

Lion also has a regional subsidiary named Wings Air. It has a fleet of 30 aircraft, mainly ATR 72-500s. It is taking delivery of new ATR 72-600s, and has about 30 still on order.

Despite the massive backlog, Lion has indicated that more orders are in the pipeline. The carrier has confirmed it is considering a "double-digit" purchase of Bombardier CS300 aircraft, and could make a decision by the end of the year. These would fill the size gap in its fleet between the ATRs and its narrowbodies.

If a CSeries fleet reached critical mass, Lion would look to perform heavy maintenance at the Batam facility, an airline spokesman says. He notes that this would align with the carrier's intention to keep heavy maintenance in Indonesia whenever practical. ✎

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Sensing Success

Aftermarket industry broadens its automated tracking of key assets

Sean Broderick **Washington**

A scan of recent supply chain- and logistics-related product announcements underscores that aviation is placing a premium on keeping real-time tabs on high-value goods.

On the production line, manufacturers are marking parts with tags designed to help everyone from line mechanics to vendors. In the after-

“Permanent RFID part-marking is an answer to the growing need for efficient and error-proof identification of aircraft components throughout their life,” says Tom Williams, Airbus executive vice president for programs.

Boeing, meanwhile, introduced an aftermarket RFID system for rotatables and repairables last year. Developed in partnership with Fujitsu and

dividual items, where necessary, with passive RFID tags, revealing a product's status at the wave of a handheld scanner.

Responding to customer Germanwings's request for a simple, low-cost way to track expiration dates on life jackets, LHTL also developed an aftermarket RFID tracking system for emergency equipment. Dubbed Aviocheck, the system puts passive tags on components, easing mechanics' determination of which must be swapped out. Because checks can be completed more quickly, inspections can be conducted more frequently, which in turn enables operators to maximize the useful life of each component.

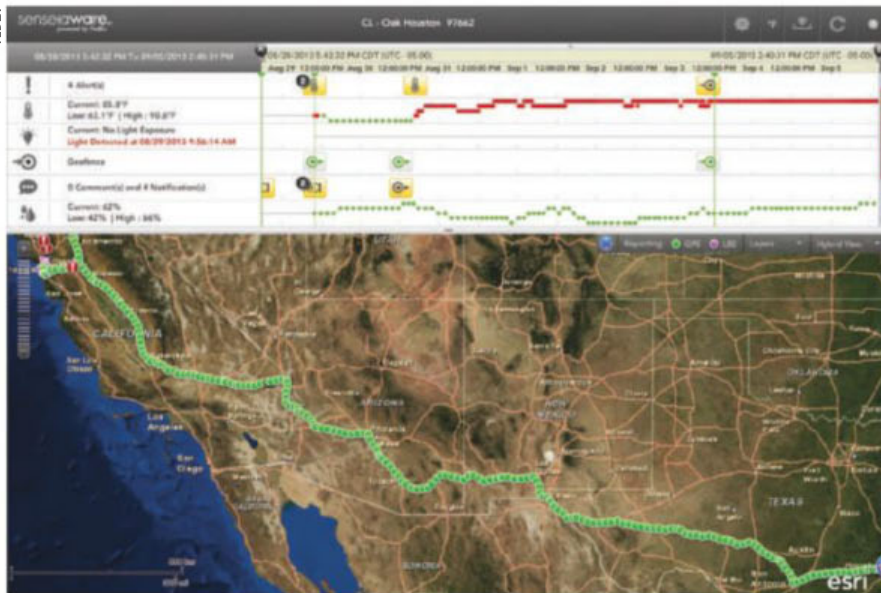
However, RFID's usefulness can be limited in uncontrolled environments, such as when an item being tracked leaves the tracking organization's control perhaps to be shipped via a commercial freight carrier, for example. This is where sensor-based logistics can help, combining coaster-sized

SenseAware software displays a tracked item's path as a breadcrumb trail. Sensors can be programmed to check in as often as every few minutes.

sensors with Web-based software that relays location—through GPS or cellular networks—as well as temperature, barometric pressure and light exposure, and vibration. While some parameters are unnecessary for aircraft spare parts, they are critical in tracking priceless, hypersensitive items such as organs heading to a transplant recipients.

Airlines have been quick to see the benefits, both as providers and users of the services. In the past year, American Airlines and Southwest Airlines have teamed up with sensor-based logistics specialist OnAsset Intelligence to offer sensor-based tracking to cargo customers.

United Airlines is using another sensor-based offering, SenseAware, to solve a nagging logistics problem of its own. Last year, the carrier's Houston maintenance base dispatched a team and set of tools to solve an aircraft-on-ground (AOG) issue in a Latin American country, says Mark Green, tooling supervisor at United's Houston Technical Operations center. Both the



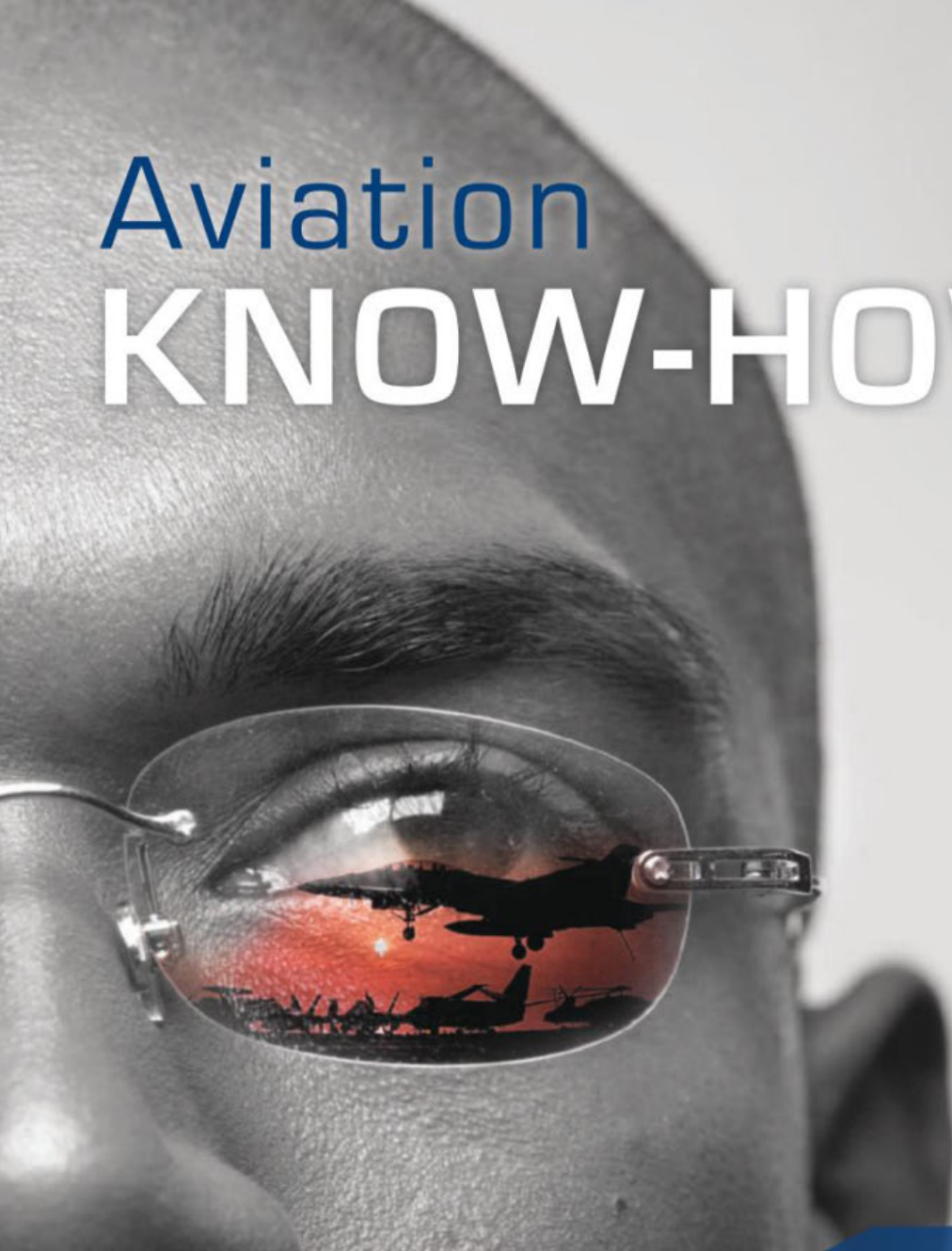
market, using sophisticated sensors to monitor parts and key shipments—from components sent to bail out a grounded aircraft to the tooling needed to do the job—is becoming bigger business.

Airbus is using its A350 program to raise the stakes on radio frequency identification (RFID) parts-tracking for new airliners by tagging about 3,000 parts, and it is broadening the effort to other aircraft. The expansion's first step: permanent tags on life vests and seats on models in production. Besides increasing inventory visibility, permanent tags will help mechanics pull data such as maintenance history and expiration dates on a cabin's worth of seats within minutes, eliminating the time-consuming task of manually reading each tag.

field-tested with Alaska Airlines, the Component Optimization Program is adaptable to any type of aircraft. It uses low- and high-memory RFID tags and contact memory buttons to store everything from simple serial numbers to complete maintenance records and even re-writable notes and images.

Lufthansa Technik's early involvement in permanent parts-marking research is paying benefits for the Lufthansa Group. The group's Logistik Services (LHTL) has taken RFID's benefits to consumables and expendables. Typically, ensuring that bins of adhesives or individual cans of sealer or grease are still usable means manually checking each one for an expiration date. LHTL streamlined the effort by developing a system called Avio.store, which tags consumables bins and in-

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aircraft and personnel returned home shortly after the job was done. But the tooling—including some proprietary, Boeing-supplied equipment—was held up by customs agents.

"After three months, they were still telling us they couldn't find it," recalls Green, who manages some 20,000 tools worth about \$15 million. "That was the proverbial straw that broke

the camel's back. I had to do something."

Green and United tapped SenseAware, which FedEx developed to try to obtain real-time information about every item in its supply chain, "down to our envelopes," says Chris Swearingen, FedEx global marketing manager. "This is an information business. It's about having that 24/7 visibility

through the supply chain, and using data to make decisions," he adds.

Like RFID, sensor-based programs are scalable. SenseAware customers can choose from several payment options, including a monthly subscription that starts with a handful of tracking devices, the smallest of which weighs about 6 oz. The sensors can be attached to objects such as engine stands or shipped in cases containing high-value goods, like tooling dispatched to fix a grounded aircraft.

SenseAware software allows each device to be tracked in real-time. Geofences, or virtual perimeters, can be set up to track when a sensor enters or exits a certain area. This is useful to confirm arrival of an inbound shipment, such as on an aircraft that has parked at a geofenced gate, or transport of a high-value piece of equipment.

While most customers use SenseAware to track their own goods, some companies use it to track their vendor shipments in order to gain more visibility of their inbound supply chain, Swearingen says.

Brought online at United in April, the service is paying dividends at the carrier. In August, a United 737-800 enroute from Seattle to Houston had engine trouble shortly into its flight and diverted to Idaho's Pocatello Regional Airport. A replacement aircraft arrived within hours, but fixing the stranded airframe required an engine change—and a team of United technicians equipped with the proper tooling.

Green dispatched some tools via truck out of Denver, but other equipment and the team had to take a commercial flight out of Houston. The only air service to Pocatello is via Salt Lake City on a rival carrier, further complicating the logistical challenge.

But each package sent to Idaho carried a SenseAware sensor, allowing Green's team to monitor the equipment on its way from two facilities on two transportation modes outside of United's system. In the end, the fix was made without a hitch, and all of Green's tools arrived home safely.

Green says he has not lost a SenseAware-tracked item yet and sees more potential for the system at United for high-value, hard-to-find parts, such as an integrated drive generator sent to an AOG or a maintenance facility. "It's amazing what gets lost out there, and what we had to write off," says Green. ☒

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Moving To Mobile

Technology, regulatory and security developments that will change maintenance documentation management are progressing

Paul Seidenman and David J. Spanovich **San Francisco**

The proliferation of mobile devices and software that enables increasingly more complex data distribution and handling could lead to the most significant evolution in maintenance documents management since the transition from paper to electronic formats.

Airlines and MROs are, in fact, jumping on the new technologies, and pushing back the boundaries in documents management. Chuck Cook, manager of fleet programs and technology for Jet-Blue Airways, reports that this year, the carrier selected MyMobile365—an iPad application from Comply365, an air carrier-focused software company—to distribute flight-manual updates. However, he adds, there are plans to expand the application to flight attendant and maintenance documentation, with the on-aircraft “carbon-copy based” technical logbooks, which use “pen-and-ink inputs,” a prime candidate.

Using a mobile device, the technician can sign off electronically and transmit the information directly from the aircraft to the airline’s maintenance computer system, rather than entering it manually from the carbon copy.

“The paper duplicate is the critical piece for which an e-Tech log would be beneficial,” says Cook, who predicts “the industry will migrate toward digital technical logbooks within the next five years.”

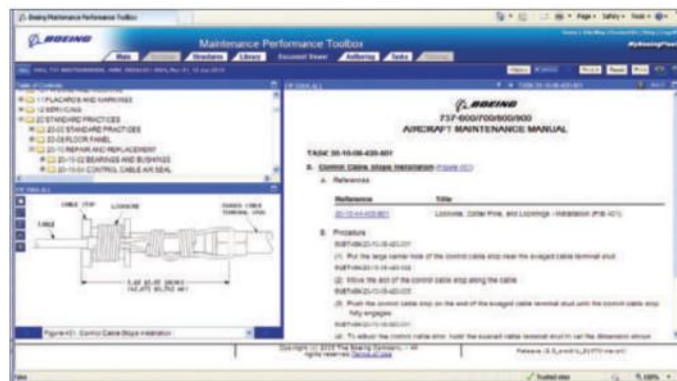
But he cautions that if mobile devices will play an increasing role in documents management, planners must consider how to make updates—and how to audit who has and has not acknowledged receiving the updates. “That is why we went to a cloud-based system for our pilot manuals,” Cook



BOEING

says. “Whenever there are changes, our technical department uploads them to Comply365. When the receiver enters a security code, it verifies the update’s receipt.”

For the past five years, mechanics at Southwest Airlines have accessed technical documents online, using computer terminals linked to the air-



SOUTHWEST AIRLINES

line’s server. According to Amy Oonk, director of aircraft programs, the next step will be to extend access to the libraries to the mobile environment.

“We are considering an iPad app from Boeing, on which the maintenance library would be downloaded so the mechanic can call up a technical document, wherever the airplane is located,” says Oonk. While no final decision has been made, Oonk says the airline is evaluating the iPad acquisition and related infrastructure costs for possible

inclusion in its 2014 budget.

Greater use of mobile devices will take place, as more maintenance events happen away from major maintenance facilities.

“Airlines today are maximizing their ability to use an aircraft. If it is more efficient to carry out maintenance in a line environment, they will do it,” says Lynne Thompson, vice president of

customer service for Boeing Commercial Airplanes. “This will be driven by a combination of the capability to access the maintenance data from

Boeing has launched a line maintenance applications suite for mobile devices, giving mechanics instant access to technical information.

any place, along with the ability to store parts at predetermined locations. Today’s com-

puting tools will allow us to do this.”

But Thompson stresses that the key to digital distribution of technical data lies with advancements in interconnectivity. “At Boeing, we are very rapidly making progress with digital distribution of technical data via the MyBoeingFleet web portal,” she says.

Boeing has created a suite of mobile line maintenance applications, which work together to give mechanics access to the information they need to resolve maintenance issues

Southwest Airlines mechanics view technical documents online, using computer terminals linked to the airline’s server. An app for accessing document libraries is being evaluated.

airplane-side or on-the-go, in close collaboration with maintenance and engineering teams based elsewhere. Branded the Boeing Mobile Line Applications Suite, it includes Toolbox Mobile Library, Toolbox Mobile Parts and Maintenance Turn Time. Each is a subscription service, which includes mobile apps available through Apple’s iTunes. Web-friendly versions, compatible with any modern browser, are also available, she says.

Guo Peihong, general manager of technical services for Taeco (Taikoo [Xiamen] Aircraft Engineering Co., Ltd.) a heavy maintenance MRO in

China, agrees that more technical document management access will transition to mobile devices.

"We have carried out a trial run of document access by iPads in one of our hangars, and we plan to phase that in to all our hangars in the near future," Peihong says. "But one challenge is to develop a system which can provide technical manuals/documents available to the technical team in whatever manner they need—online, off-line or wireless—as well as to minimize the time required for searching and organizing the technical data, and thus focusing on the actual job of planning and executing aircraft maintenance."

However, Peihong cautions that while digital document management helps "secure data integrity and government regulatory compliance," it has its challenges.

"Because digital distribution relies on IT [information technology] systems, how you protect the organization from data interruption and downtime—when losing connectivity—is the most serious challenge for digital distribution. That is why implementing an effective business continuity plan is very important," he explains.

Don Carter, director of engineering for Sabreliner, whose MRO services business jets and small military aircraft, predicts the trend toward mobile devices in documents management will accelerate as they become more capable, and able to store more data.

As the 3G and 4G networks expand, there will be faster data downloads, Carter says. "And, as with all technology, the cost of the devices will come down, making it easier for MROs to provide them to the technicians."

Although interconnectivity with mobile devices is a cutting-edge trend, developments in documents management within the hangars are also taking place. One example is electronic work sign-off, according to Timothy Cormier, chief of operations of Pratt & Whitney Eagle Services Asia in Singapore. The company specializes in the PW4000 family and the GE90—and with entry into service, the PW1500G.

"This is an electronic method of replacing the hard copies of 'travelers'—the work orders that accompany the hardware in the shop—and work instructions," says Cormier.

The work instruction form contains the specific steps that need to be followed to complete the task, along

with a section for the technician to certify the repair was completed in conformance with those instructions. The electronic sign-off is specifically facilitated using a software program accessible via a computer terminal at the technician's work station.

"Because it is self-auditing, it assures that every task has been signed off, prior to closing out a sales order. It also improves the time efficiency involved with auditing the electronic paperwork. This is what we have been moving toward . . .

throughout the entire Pratt & Whitney global MRO network," he says.

"While most of the documentation we receive from our customers today is in digital form, the documents still have to be converted into consistent work orders, using a standardized and easily understandable set of instructions for shop employees to follow when performing the repair. With e-documentation, it is easier for our employees to reference the original technical data furnished by the individual customers." ☛

'CLOUD' CONTROL

Cloud computing is considered to be the next major trend in electronic-documents management, but still to be decided is how much data will be controlled by airlines, and how much by original equipment manufacturers. Best practices devised to keep engines on-wing longer is one of the issues, says Paul Mingler, GE Aviation's chief consulting engineer of product safety.

"An airline may want to follow our recommended best practices, or their own, based on their experience—especially where older aircraft are involved," he notes. "If an airline uses its own best practices, it might want to keep its manuals under its own control, but for OEM best practices, it could prefer to access manuals hosted on the OEM website."

Mingler reports that GE is developing "Regional Best Practices," based on an airline's geographical locations. "Cloud-computing technology gives us the ability to offer regional best practices through GE's industrial Internet. We are in a tryout phase on that with some of our customers."

For Chuck Horning, chairman of the aviation maintenance science department at Embry Riddle Aeronautical University, it makes sense for OEMs to control the documentation, for distribution via their websites by subscription. "Updating the manuals is much easier, since it eliminates the middle man in an airline's technical services department who would receive the updates from the OEMs for uploading onto the airline's local server."

However, JetBlue Airways' Chuck Cook, manager of fleet programs and technology, says that the carrier is "still comfortable" controlling and hosting its own manuals.

"Our biggest concern is that crews understand the manuals, which is why our manual layout is consistent across our different aircraft types—both Airbus and Embraer. When pilots and technicians use the manuals, they will be nearly identical in terms of their organization and layout."

Southwest Airlines' Amy Oonk, director of aircraft programs, explains that although cloud-based systems are viewed as "the wave of the future," there are concerns.

"The big issue is how secure would the information be?" she asks. Southwest needs to answer that first before determining how to use cloud computing for maintenance document management, she says.

For Oonk, another issue with OEM-resident manuals is that, in order to carry out repairs, a mechanic might have to go to multiple websites. "We have one central server—with a secure log-in system—that mechanics access for all the information they need."

Kerry Frank, cofounder and CEO of Comply365, reports that one of the biggest challenges for aviation is that the OEMs are moving to an XML format, in the absence of an industry standard. That could impact cloud-based document access. "For carriers managing multiple fleet types, a lack of connectivity standardization is disruptive and unmanageable. Aviation, as a whole, [should] work together toward a solution, but it must be done quickly given the rate of change with technology."

The A4A airline association has working groups dedicated to this matter. ☛

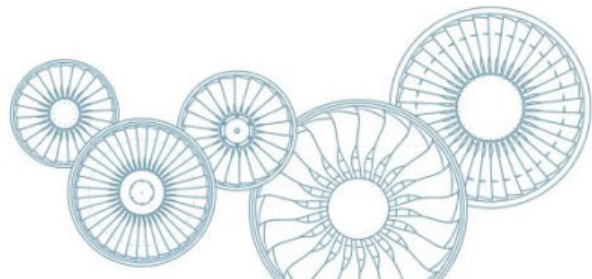


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Proven Power

Increase in yearly overhauls projected as venerable engine keeps Boeing 777s soaring

Sean Broderick **Washington**

As the only all-new engine developed for one of the most ambitious aircraft models built in the jet age, General Electric's GE90 family has more than held its own. Nearly three out of every four Boeing 777s delivered are powered by GE90s, and the percentage will only grow—every undelivered current-generation 777 listed in Boeing's backlog is slated to have GE power as well.

Boeing figures show 991 777s delivered through Sept. 30, including 730 powered by GE90s. Another 328 777s—a mix of -200LRs, -300ERs and freighters—remain on order.

The GE90 entered service in November 1995 on a British Airways 777-200. The baseline GE90 family includes six variants certified at thrust ranges of 76,000-94,000 lb.

The engines competed with Rolls-Royce Trent 800s and Pratt & Whitney PW4000s for spots on 777-200s, -200ERs and -300s. The larger "Growth" variants, rated at 110,000 lb. and 115,000 lb., are the sole engines on Boeing's 777-300ER, -200LR and 777 Freighter.

The 777 bridged the gap between twin-engine efficiency and ultra-long range, and the GE90's consistent growth played a significant role. The engine family's maturation is evident in its aggregate statistics. The GE90-94B's departure reliability is 99.98, its engine removal rate is 0.030 and inflight shutdown rate is 0.0001 for the 12 months ended Aug. 31, GE reports. The original GE90 engine design has racked up more than 18 million flight hours and 3.1 million cycles. The average time be-

tween engine removals is 13,300 hr.

The GE90-115B checks in with a 99.983 departure reliability, a 0.032 removal rate and 0.0002 shutdown rate for the 12 months ended Aug. 31. The family has accumulated over 20 million hours and 2.6 million cycles, and an engine's average time between removals is 16,200 hr.

Aviation Week's MRO Prospector (MROP) projects a steady uptick in annual overhauls in the near future, driven by a maturing fleet and continued deliveries. The projected 2013 total of 212 overhauls is expected to climb slightly in 2014 and jump to 308 overhauls in 2015.

Opportunities in the Growth variants will surge as more aircraft powered by the newer GE90s are delivered, MROP shows. Engine overhaul costs for 2013 were expected to be about even at just more than \$600 million for each family. By 2018, the growth models are expected to generate nearly \$1.8 billion in annual overhaul revenue, rising to about \$2.4 billion in a decade. The smaller models, by contrast, will see annual overhaul costs dip to \$400 million in five years and below \$390 million in a decade.

The GE90's aftermarket support network is growing to meet demand. The primary overhaul center is GE's shop in Cardiff, Wales, which handles about 200 overhauls per year and is also home to the primary GE90 MRO fulfillment site, with more than 200



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GE AIRCRAFT

The 1,000th GE90-115B for the Boeing 777 long-range models was delivered from GE's Peebles, Ohio, site in March 2012.

term GE OnPoint service agreements.

Despite GE's solid share of GE90 aftermarket work, the sheer size of the market means there is plenty left for an independent or two. MTU Aero Engines has its eyes on the growing demand for GE90 work driven by both the maturing in-service fleet and the 650-plus engines on backlog. The German engine specialist, which holds risk-sharing status on the GENx, began supporting the Growth engines in 2011 and offers a spares pool to support its GE90 overhaul customers. Earlier this year, it projected a 13% average annual jump in GE90 shop visits through 2019.

A significant service issue that affected a set of -115Bs has been resolved, GE reports. Operators and the OEM had to remove from service and/or rework 177 transfer gear boxes following three inflight shutdowns in five months earlier this year. The problem, radial-gear cracking and separation, was traced to a manufacturing anomaly. ☛

shop visits completed per year. Tai-koo Engine Services (Xiamen) Co. Ltd. supports -115Bs through a GE-branded service agreement.

GE also is working closely with

Emirates on a new facility slated to open in 2014 and support the -115B as well as the GP7200. The GE-backed facilities will help the OEM support the 70% of engines that are on long-




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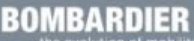
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Washington

Shutdown Shows Delegation's Value

FAA officials have spent considerable energy this year warning industry that shrinking resources tied to federal budget cuts would put the squeeze on myriad airworthiness approvals, new product certifications and related tasks that keep aviation going—and innovating. One way to ensure your projects are moving, the officials says, is to take on more of the FAA's work by creating an Organization Designation Authorization (ODA).

The FAA's motivation in pushing ODA was sequestration-related cuts, but the partial FAA shutdown provided an unintended testimonial on the value of self-sufficiency.

When the government went into essential-services-only mode on Oct. 1, FAA's Aviation Safety Office (AVS) saw its staff shrink to 300 from 7,000 overnight. Recalls soon brought back key personnel—mostly Part 121 inspectors

at the outset—but the engineers and support staff that keep general airworthiness approvals going stayed home.

For most of the industry, this spelled potential trouble in the form of added delays on top of an already slowed certification approval process left short-handed by a sequestration-related hiring freeze. But for the companies with ODA approvals and other authority granted by the FAA, it meant—for the most part—business as usual.

“There should be a bang-up business going on for persons with delegated authority—designated airworthiness representatives, designated engineering representatives and the like,” said Sarah MacLeod, executive director of the Aeronautical Repair Station Association (ARSA), a week into the shutdown. “While the process for obtaining a delegation is slow and painful, when granted within the proper parameters the ability to issue approvals and authorizations without the direct involvement of an FAA employee is essential to the continued operation of a business.”

ODAs are not uncommon, but both the raw figures and one FAA executive close to the program suggest they are under-used. At the beginning of September, for instance, there were just 26 active major repair, alteration and airworthiness (MRA) ODAs, 33 parts manufacturer approval (PMA) ODAs, and 43 supplemental type certificate (STC) ODAs. Many organizations hold multiple ODA approvals and may have separate ODAs for different groups, which artificially inflate the figures. For instance, Boeing's five ODAs include MRA and STC approvals in Wichita and MRA, production certificate and type certificate ODAs in Seattle.

Most of the MRA designees are large organizations—companies such as American Airlines, UPS, Cessna, Pratt & Whitney and Hamilton Sundstrand. Considering there are approximately 4,700 certificated FAA repair stations, opportunities seem to abound—especially with smaller shops.

“In the MRA arena, if you are a small repair station and you do the same kind of business over and over, whether it is altering airplanes, doing repairs, or [working on] replacement parts,” ODA is worth considering, explains David Hempe, manager of the FAA's Aircraft Engineering Div. “Everybody wants to think about the ODA as [a mechanism] for big guys, but it is really something that can be set up for small businesses as well.”

Hempe, who spoke with Aviation Week well before the shutdown, notes that the same general criteria apply for PMA producers.

While beneficial, ODAs do not completely shield their holders from a widespread FAA work stoppage. While an ODA shifts much of the day-to-day approval work in-house, agency involvement is required to verify that projects are meeting established goals along the way to certification.

Still, notes ARSA's MacLeod, when it comes to depending on the federal government, any independence is better than complete reliance.

“Anyone needing the intervention of a government employee to ensure the continued operation of a business must seriously consider the alternatives available from the regulations,” she says. ☐

—Sean Broderick



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Europe

EASA Targets Faulty Fasteners

The European Aviation Safety Agency (EASA), concerned about the number of reports of defective fasteners, is developing a certification memorandum that will advise product developers to take steps to ensure the quality of so-called standards nuts and bolts (see photo).

EASA based the certification memorandum (CM), which would be neither binding nor considered formal guidance, in part on a 2012 Safety Information Bulletin (No. 2012-06) that warned of faulty self-locking nuts. "Several manufacturers . . . have received numerous reports of defective standard hardware installed on different areas of their products," EASA noted. In particular, many self-locking nuts have been found cracked, parallel to the nut axis, in some instances only

a short time after installation. Broken bolts have also been reported.

The bulletin was prompted in part by the probe of the February 2011 crash of a Robinson R44 in Australia, which investigators determined was caused by the separation of a flight-control fastener.



ACORN BEARINGS

Another instance of faulty fasteners led Israeli regulators to issue a July 2010 airworthiness directive against certain Israel Aircraft Industries Galaxy and Gulfstream 200s that may contain cracked nuts.

"Within the last few years an accumulation of failed standard fasteners

(nuts and bolts) in aviation has been observed," EASA notes in the certification memorandum. "The eventual improvement of the quality and conformance of standard fasteners by responsible parties does not address . . . existing defective parts in the supply chain."

A draft of the CM urges design approval holders to conduct a design review to help mitigate the risk of installing defective fasteners. The review should include defining how fasteners are qualified, making sure maintenance instructions specify replacing qualified fasteners with other qualified fasteners, and devising a parts numbering system for the fasteners.

The CM was posted for public comment through October. EASA states that it plans to issue a Continued Airworthiness Review Item to type certificate holders that would address "the potential hazard for existing designs." ❖

—Sean Broderick




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By Heather Baldwin

Heather Baldwin covers MRO, training and human factors. She can be reached at: O&M@aviationweek.com

Corporate Culture

Understanding Malaysian culture is a key part of SR Technics training

The global nature of aviation maintenance means technicians from different countries and cultures can suddenly find themselves working side by side. When this occurs, maintenance organizations face an added layer of complexity in the area of human factors.

That's why SR Technics is placing so much emphasis on cultural education as it prepares to open a component repair facility in Kuala Lumpur, Malaysia. Set to be operational by year-end, SR Technics Malaysia will complement the company's repair network in Switzerland, Spain and Abu Dhabi. The company is training the first of 75 technicians who will work there.

An important component of the ramp-up program for Malaysian workers is on-the-job training in Zurich with Swiss technicians. While the arrangement is valuable and es-

sent," explains Jimmy Khaw, quality manager at SR Technics Malaysia. Such a simple, unconsidered gesture by a Swiss technician could cause discomfort or offense, straining the working relationship. Training Swiss technicians prior to the arrival of Malaysian workers therefore included this mandate: "Never point, especially at a person, using an individual finger other than the thumb. Make a fist or take the entire hand."

Even the initial greeting can be tricky. While a handshake is normal for the Malaysians, who are familiar with Western ways, the Swiss were

"Never point, especially at a person, using an individual finger other than the thumb. Make a fist or take the entire hand."

sential, SR Technics realized it could also be a human factors minefield without thorough intercultural training on both sides. For instance, while everyone on the shop floor is familiar with the problems that can arise from excessive fatigue or distraction during a critical repair procedure, what about a Swiss technician pointing at corrosion on a part—and causing offense by doing so?

In the Malaysian culture, it is "very impolite to point to something with a finger, particularly to an individual, but also to something within a docu-

ment," advised that a foreign man should always wait for a Malaysian woman to extend her hand. Similarly, foreign women should wait for a Malaysian man to extend his hand. A one-page summary of the most important intercultural "rules" further advised: "Initial greetings should be formal and denote proper respect. If you are unsure how to address somebody, just ask politely."

Peter Hotz, one of the Swiss trainers who worked with the Malaysian technicians, observes, "The intercultural training was great as it has

shown me how to behave respectfully toward our Malaysian colleagues. I've traveled a lot in Asia, but [the training was] a good reminder, for example, not to point at people or things with a finger. If you have the respect of your colleagues, you naturally work more effectively and safely together—an essential in the aviation business."

Striving for this kind of mutual respect is a long-term endeavor that goes beyond words and gestures to encompass a broader understanding of cultural differences—sometimes with the goal of closing those gaps rather than simply understanding them. For example, "Asians are often softly spoken and . . . if a superior requests something, the employee tends to do it," Khaw says.

While he notes this trait is easing with Generation Y workers, who tend to be more willing to question why something is done a specific way, there is still quite a breach between the Malaysians and Swiss when it comes to hierarchy. "At SR Technics and in Switzerland, the culture is to be self-driven and responsible for your own actions," Khaw explains.

Understanding the safety ramifications of both approaches, SR Technics is consciously steering the Malaysians toward a Swiss mindset when it comes to speaking up. "We want to foster a culture whereby our employees are motivated and allowed to give feedback or complaints," says Heinz Freimann, general manager of the Malaysia facility.

To get there, the company is not only relying on verbal comments but also asking Malaysian workers for written ones following training sessions. In writing, "we have found the new technicians to be very open and willing to share critical feedback with the management team," adds Freimann. Simply spending time at SR Technics in Switzerland is also giving Malaysian technicians confidence about what is culturally acceptable. They see firsthand that if there is any doubt about what they are being asked to do, they should question it. 

MRO IT: Fostering Support for IT Innovation

Helen S. Kang • London, UK • September 23, 2013

The data-intensive environment of the aviation MRO (maintenance, repair, overhaul) industry is now a reality. Extracting useful information from the exponentially-increasing amounts of data collected from varying sources and formats has become more challenging, yet also more and more critical. The urgency of a demand-driven aviation MRO network is stressed by the delay in implementing innovations and technologies to quickly process and send integral facts to the right places at the right time.

As new technologies continue to emerge and evolve rapidly, maintenance operations are challenged in getting IT investments or upgrades to support this new data-concentrated MRO ecosystem. The rationale for technology investment must clearly reflect cost-value benefits, except not all the benefits are quantifiable, such as quality, cost of disruption, reliability and safety. Due to difficulties in quickly getting IT investment approvals, MRO operations have turned to innovating existing processes, technologies and systems to meet the demands for faster intelligence.

Determining approaches to justify IT initiatives and sharing innovating measures were the foci of a September 23 Aviation Week Executive Roundtable held at the ExCeL Centre in London, UK. The goal of the roundtable was to assess innovations and successes from current IT projects, and create benchmarking IT business case approaches based on lessons learned.

The roundtable was hosted by Gary Smith, Head of Powerplant & Fleet Transition at easyJet, and Lee Ann Tegtmeier, Aviation Week's Chief Editor MRO. The meeting was sponsored by The Boeing Company.

This was the fifth MRO IT roundtable and the third for the European region*. Previous meetings determined that mobility has become the catalyst for moving technology projects forward. The successes from these implementations and integrations may provide a benchmarking template for IT business cases and justifications for investment. However, short-term goals and key performance indicators must be clearly outlined for rationalization on business investment and transformation.

Organizations participating in the September 23 roundtable were ATA e-Business Program; AAR Corp.; AerData; Air Livery Ltd/Air Works; Air Supply Consulting; airberlin technik GmbH; Airbus; AJ Walter Aviation; American Airlines; Atlantic Airways Maintenance Department; Avmax Aircraft Leasing Inc.; BAE Systems Regional Aircraft; Bombardier; easyJet; EgyptAir Maintenance and Engineering; FL Technics; Flatirons Solutions; Flybe; GE Aviation; HEICO; IATA; IBM; kuehne+nagel management AG; Lufthansa Technik AG; Mxi Technologies; Nayak Aircraft Services; Panasonic System Communications Europe (PSCEU); PIA Engineering; Safran Corporate Strategy; Sanad; SenseAware; Sikorsky Aircraft; Snecma; StandardAero; TAP Maintenance & Engineering; TAP Maintenance and Engineering Brazil; TeamSAI; Technology Solutions; Thales Avionics; Turkish Technic; TWI; United Airlines; and Virgin Atlantic Airways.

Roundtable participants divided into six work groups that were challenged to respond to a set of questions that focused on following topics:

- Benchmarks on MRO IT projects' innovations, successes and challenges, and how innovation is fostered within companies.
- Goals for the next 12-18 months, and expectations on their IT systems.
- Determine approaches to justify IT initiatives. Based on best practices/approaches for justifying efficiency projects, create a template for IT business cases and justifications for technology investment.

The 2013 Aviation Week MRO IT (Europe) Executive Roundtable participants acquiesced that in order to have a successful IT business case, business and IT objectives must be aligned, and there must be engagement from all stakeholders from the beginning. In justifying IT investments, it was determined that leading with the outcome of efficiency improvements first is key to success. It was emphasized that innovation is not just about solving current problems, but also finding solutions to unpredicted problems in the future. Participants were encouraged to use the information from the Roundtable as inspiration for implementing projects successfully within their organization.

MRO IT: Fostering Support for IT Innovation

KEY FINDINGS:

- Business strategies and IT initiatives MUST be aligned from the very beginning, with engagement from multiple disciplines.
- Lead with the story, not with the numbers. Provide examples that resonate with people and align with their real-life experiences. If you move forward with the anecdote, the numbers will follow. Focus on improving people's efficiency with the tool, rather than having the tool as the driving force (e.g. mobility). The numbers are needed for finance, but "selling the story" will bring projects success. These are going to drive innovation.
- The most important necessity of an IT system is the ability to distill data into "trusted" actionable advice and intelligence, in real-time and with predictive analytics.
- What is the cost of NOT doing it? (How do you quantify delays and compliance?) This is a significant business case variable that must be included.
- Innovation = Creativity x Execution + Optimism

Details of topical conversations in the work groups follow.

APPROACHES AND BENCHMARKS FOR INNOVATION

- Innovation = Creativity x Execution + Optimism.
- Phased approach to Innovation:
 1. Awareness.
 - "Islands" of problems - habit of protecting ideas rather than sharing, sometimes even within companies. Stop waste of "silo" innovation – connect people, share ideas/risks. Do not do it yourself!
 2. Inspiration – how to create awareness and get inspiration to solve problems.
 - Connect people via community platforms, voting systems and internal innovation showcases.
 - Feedbacks from the shop floor – employees start prototyping ideas on their own, and if it works, then show the manager.
 - Outside ideas - collaborate with research institutes for 'outside-the-box' thinking.
 - As much as inspiration is encouraged, be mindful of governance and compliance from IT, HR, regulators.
 3. Realization - how you facilitate innovation (idea to reality)?
 - The process of screening ideas and moving them into projects has to move faster. If ideas take 6-8 months to decide, then the momentum of something new is lost and everyone gives up.
 - Money, speed, technology, manpower – how to raise the money? How to quickly develop it quickly and then get the manpower to support that?
- Line of business vs. R&D - needs to be done outside the day-to-day procedures.
- Collaborative network – being able to connect.
 - o "Do you have the privilege to innovate or can anyone have a great idea?" (e.g. incoming Gen Y personnel need to feel connected at the workplace).
- Customization IS innovation.
 - o Much of MRO innovations are driven by OEMs. We are changing our systems to support the products they're developing.
 - o Innovation falls back on necessity or need. There is a diverse spectrum of IT platforms, and the main challenge is getting them to talk to one another without additional resources.
- Through CRM (customer relationship management) – problem solving, innovation, cost, flow of information for buying decisions, campaigns, web access (web portals).
 - o Continued interaction of customer voice in development process – build strategic teams consisting of the customer, competition and technology.
- Partnership between business and IT - consumer technology impacting and transforming business.
- Allow cannibalization (impact on existing processes) - be willing to sacrifice things to move forward.
- Improve data support and exchange (via standardization). Data is the currency to make the industry move faster.
- Forget competitive advantage – ask "What do you want to do in 5 years?" Even if it is something new

MRO IT: Fostering Support for IT Innovation

presently, it could be replicated by others in a few years.

- Learn from other industries ahead of the game.
- Forget legislation/company policy/aviation regulation, safety in development process.
- Stop talking about IP – can we find ways to get over the barriers? Common data sets approach.
- Challenges to Innovation - reliability, scalability, security, IT naysayers, risk minimizers, momentum during innovation projects, legacy, mergers.

ASPIRATIONS FOR THE NEXT 12-18 MONTHS / REQUIREMENTS FOR AN OPTIMAL IT SYSTEM

What do you want to achieve in the 12-18 months?

- Data integration with zero disruptions, leading to less AOG.
 - So much data coming from myriad of sources with isolated data syncs (maintenance, environment, passenger, engine, finance, crew, flightlogs, etc.)
- Turn an Excel database into software.
- Convert legacy ERP systems to web-based and more.
- Paperless.
- Respond to regulatory requirements quickly.
- Internal process improvements.
- Capture more data for more value (useful decisions).
- A “plan for IT” that is integrated, focused, cost-effective, and generational.

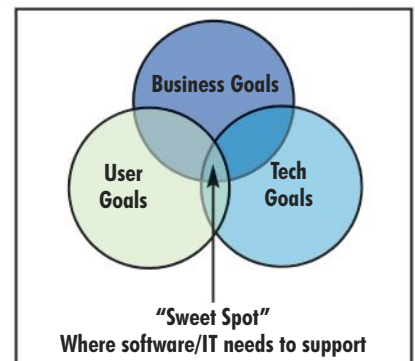
What you want out of your IT systems?

- Cheaper, Faster, Better!
 - Ultimately, greater efficiency, more safety with lowered costs.
- “Limitless” access – better connectivity and better data.
- Simplicity – getting data in a workable format.
- Traceability.
- Training.
- Usability – UI (User Interface) / UX (User Experience)
- Consumerization.
- Mobility.
- Distill data into intelligence – analytics, real-time, predictive.
 - With next-gen aircraft supplying too much data, IT has become the processing machine that is churning out “trusted” advice and intelligence. With super high-tech vehicles, all that data has to be analyzed and given right advice to the right people.



TEMPLATE FOR IT BUSINESS CASES AND JUSTIFICATIONS FOR TECHNOLOGY INVESTMENT

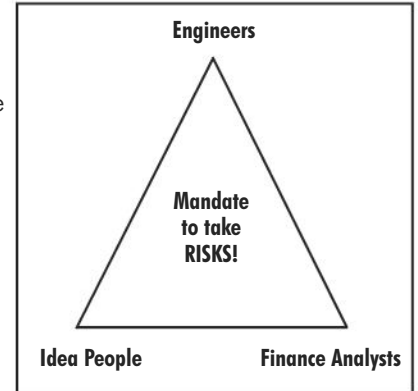
- Business Strategies + IT Aligned → CRITICAL!
 - Must be together from the beginning of the process.
 - Diversity is important! Engagement of multi-disciplines (culture, ages, profiles, etc.).
- Tangible vs. intangible benefits.
 - Measure efficiency, reduction of cost, anything that is creditive of advantage. How we can quantify “cheaper, faster, better”?
 - Come up with a solution before conceiving it.
 - Monitor outcome of initiatives. How successful is the project coming along?
- Challenge what is (im)possible.
- Take a lot of risks. It is hard to do this in our industry, so needs a mandate or



MRO IT: Fostering Support for IT Innovation

at least management support.

- Lead with the story, not with the numbers. Improve efficiency of the people with the tool (Ex. mobile devices). These are going to drive innovation.
- Because IT investments are not easily approved, incremental solutions ease the way to justify the projects.
- The end goal has to be a balance of innovation (What if?) vs. respond to requirements (What do YOU want?)
- Question - We employ people who we trust to make multimillion-dollar decisions daily on engines and aircraft, but why are the same considerations not given to them to make technology decisions? Instead they are asked to make near-impossible IT justifications and business cases.
- Business Case Variables:
 1. Cost of NOT doing the initiative.
 2. Champion.
 - Business/operations leader has to justify the investment (ROI). Does it make business sense? The business leader enables the champion/imitative to move forward.
 3. Culture supports the idea/innovation.
 4. Consumerization of IT/social.
- Anti-variables
 5. Did you consider and include ALL the stakeholders?
 6. Unions (legacy mindset).
 7. Quality, safety, regulatory, brand, customer – variables that cannot be measured.
 - These help drive the project, but 1-5 need to be there.
 8. Linked to company goals.
- Compelling anecdotes are key to justifying IT investments – going beyond the spreadsheet.
 - o Lead with the anecdote and the numbers will follow.
 - o Numbers are tangible and solidify the business case, but how much are true? Intangible elements, such as people-ware, have to be taken into account.
 - o True cost across the organization is used to determine feasibility.



* For findings and reports on past meetings, please go to <http://mediakit.aviationweek.com/ExecutiveRoundtable/>

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LINKS

Reuse, Recycle, Reclaim

The aviation aftermarket has become more sophisticated about how it repurposes aircraft, engines and material no longer needed in operation. Some aircraft still get parked, but the number that remain inactive in deserts or on tarmacs is dwindling because aircraft financiers, lessors and parts providers employ asset-valuation strategies earlier in the game. Today, many mature aircraft

are worth more as parts than as a whole.

The Aircraft Fleet Recycling Association (AFRA), formed in 2006 to promote sustainable management of end-of-life airframes and engines, also has augured environmental practices by promoting Best Management Practice Guides for dismantling, recycling and use. Here are a few of its members' environmental services. ☛

1. Disassembly & Recycling

Supplier: Aircraft End-of-Life Solutions (AELS)

Offering: AELS primarily disassembles and dismantles at Woensdrecht Airport in the Netherlands. It has provided end-of-life solutions for more than 40 aircraft from 10 countries—including a Boeing 737-500 that it recently disassembled in South Africa. It holds AFRA dismantling and recycling certification.

www.aels.nl

Link 600

2. Component Resale

Supplier: Orange Aero

Offering: Orange Aero supplies gas turbine engine components that have been overhauled at maintenance facilities approved by the FAA,

the European Aviation Safety Agency and the Civil Aviation Administration of China. Its specialty is Rolls-Royce RB211 components. Sited near London Gatwick, Heathrow and Glasgow airports, Orange Aero is an AFRA accredited disassembler.

www.orange.aero

Link 601

3. Asset Management

Supplier: Gecas Asset Management

Offering: Gecas stocks 100,000 certified aviation parts to provide airlines with rotatable and repairable components. Its asset management services division is AFRA accredited for disassembly.

www.gecas.com

Link 602

4. Metal Recycling

Supplier: ELG Haniel Metals

Offering: ELG has nine recycling operations throughout the U.K. and has been an AFRA-accredited recycler since 2012.

www.elg.co.uk

Link 603

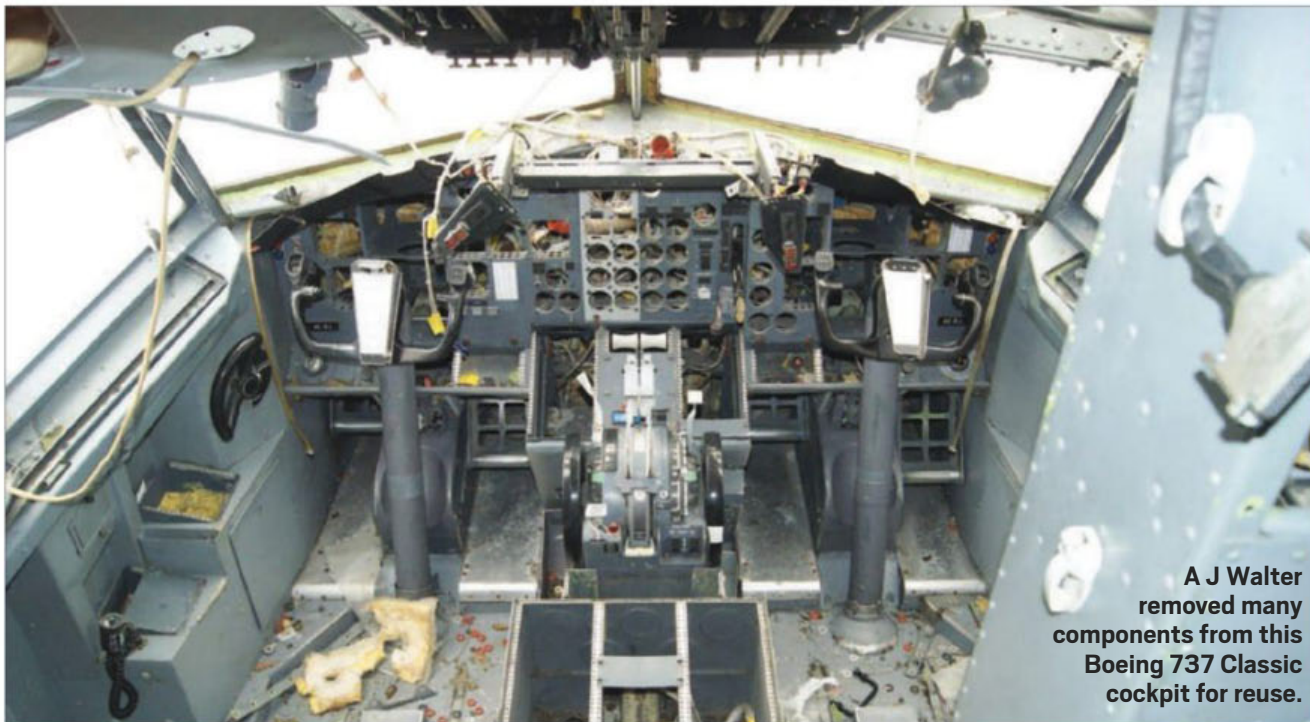
5. Metal and Plastic Recycling

Supplier: Wiederkehr Recycling

Offering: The Wiederkehr Recycling Group is headquartered in Buelisacker, Switzerland, and specializes in the recovery of recyclable metals and plastics. It received AFRA recycling accreditation in 2013.

www.wierec.com

Link 604



A J WALTER AVIATION

A J Walter removed many components from this Boeing 737 Classic cockpit for reuse.

Enter Link # at www.AviationWeek.com/MROLinks for more information

Software

Sean Broderick

Integrating process management software into an MRO operation is no longer cutting-edge—it is core to an efficient operation's success. MRO providers benefit from a range of choices, from products developed by providers that want to solve their own problems to technology companies that look at aircraft maintenance management challenges and see endless opportunities to help a surging part of the aviation industry.

1. Wings Aloft

Supplier: Applied Database Technology

Offering: ADT's Wings suite is used by airlines, including Onur Air, and large repair stations. Wings includes nine modules that integrate line, hangar and back-shop tasks, and connect key functions such as employee training records and finance. The company backs its products with stellar support; it says it has never lost an account in its 20-year history.

www.adbtech.com

Link 605



ONUR AIR



EMBRAER



AIR MAURITIUS



EUROCOPTER



SWISS INTERNATIONAL AIR LINES

2. From Line To Cloud

Supplier: EmpowerMX

Offering: EmpowerMX offers a suite of software focused on one task: lowering the cost of airworthiness. Its newest offerings include a line maintenance tool, FleetCycle Line Manager; and FleetCycle Cloud, a software-as-a-service option that eliminates the need to invest in hardware. American Eagle, already an EmpowerMX customer, also has adopted the cloud-based option.

www.empowermx.com

Link 606

3. Flexibility Matters

Supplier: Mxi

Offering: Mxi's Maintenix software provides advanced capabilities, including automated workflow, electronic signatures and support for portable wireless devices. Maintenix Version 8, released earlier this year, boosts key functions such

as enhanced search and consolidated views of an asset's past and predicted life cycle. Customer Air Mauritius demonstrates the product's flexibility, using the entire suite for its entire fleet, ranging from ATR 72s to Airbus A340-300s.

www.mxi.com

Link 607

4. End To End

Supplier: Ramco

Offering: Ramco's Series 5 software is an end-to-end business process-oriented web-centric solution covering the full spectrum of MRO operations. The suite offers software tailored for airlines, business aircraft operators and MROs of all sizes. Earlier this year, the company signed a partnership agreement with Eurocopter, which will both help customers with their maintenance planning and offer OEM-aggregated fleet data to help support its global customer base.

www.ramco.com/industries/aviation

Link 608

5. 120 And Growing

Supplier: Swiss Aviation Software

Offering: Swiss Aviation Software, a Swiss International Air Lines subsidiary, has 120 customers for its AMOS maintenance suite, including MROs and large and small airlines. In 2012, AMOS achieved a major milestone when it launched with its first customer—Portugalia Airlines—running the software on an Oracle database. AMOS, which has won contracts from several carriers in 2013—including SAS, AviancaTaca and Vanilla Air—also can be paired with Sybase.

www.swiss-as.com

Link 609

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Mechanical Components

Sean Broderick

Like many MRO industry verticals, the mechanical component market has its share of top-tier suppliers entering the aftermarket, either through organic growth or acquisition. Major roles in new aircraft programs give manufacturers such as Moog inside tracks to lucrative aftermarket opportunities. But, as companies like Avtron Aerospace and Heico prove, there is still plenty of room for innovative independent suppliers.

1. Focused On Motion

Supplier: Moog

Offering: Born five decades ago as an aircraft and missile component supplier, Moog now specializes in supplying and repairing a wide array of motion-control activation technology, serving customers ranging from aircraft manufacturers to Formula 1 race teams. Moog supplies design, integration and certification support for the primary flight control actuation on the A350, providing 27 actuators and associated control electronics for the newest Airbus widebody program. Moog also is the system integrator for the Boeing 787 primary flight control actuation system and high-lift system.

www.moog.com

[Link 610](#)

2. State-of-the-Art

Supplier: Avtron Aerospace

Offering: Avtron has been developing aviation equipment and component test technology since before the Jet Age. Unlike many existing test benches, Avtron's equipment provides the pressure ratings and capability required to support newer aircraft platforms such as the Airbus A380 and Boeing 787. Korean Air recently selected Avtron's next generation of universal test systems to upgrade its component repair capabilities to support the aircraft platforms of the future, including the carrier's A380s.

www.avtronaero.com

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3. United Units

Supplier: Heico

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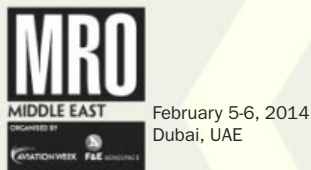
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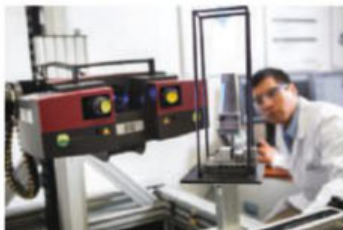
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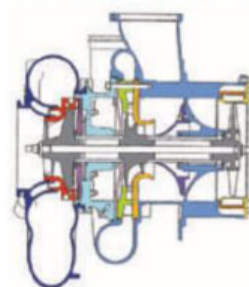
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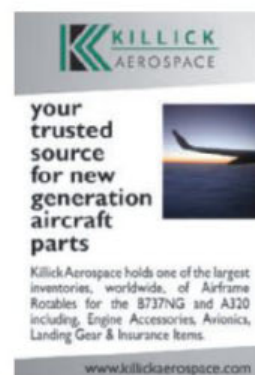
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imagination at work



Hamburger Hill

Upcoming fights in Congress will look a lot like old ones

Michael Bruno **Washington**

Republicans and Democrats on Capitol Hill have ordered another potentially fruitless “super committee” showdown by Dec. 13. It will be followed Jan. 15, 2014, with another ad hoc deadline to keep the government open, and then again Feb. 7 to have the congressionally-mandated debt ceiling raised once more.

The new dates were established by the Oct. 16 law to re-open the U.S. government and avoid defaulting on the country’s debt to date. The last-minute law resolved none of the entrenched budget disagreements, however, which means the new deadlines renew the promise and peril of readdressing widespread, automatic cuts known as sequestration, as well as ratcheting up the budget anxiety already infecting the Pentagon, NASA, FAA and their industrial bases.

Officials and contractors continue to guess whether they face a year-long stopgap continuing resolution (CR) of appropriations, which freezes all spending authority for fiscal 2014 at prior-year levels—2011 in the case of NASA, for instance—and whether another round of sequestration, or worse, kicks in during the next calendar year. The uncertainty is compounded by an unprecedented degree of vagueness over what Congress will appropriate for fiscal 2015 and beyond, the timeframe for which planners are now struggling to craft budgets to meet the ostensible Feb. 3 deadline.

At the Pentagon, which bears half of the annual sequestration cuts under the 2011 Budget Control Act that triggers them, the next round of slicing and dicing, scheduled for Jan. 15, would lop off more than \$20 billion from the 2013 level, that was itself lowered by \$37 billion when the first round of sequestration took effect last March. None of it was planned for because the on-deadline political deals that introduced and allowed sequestration occurred outside of the regular budget planning cycle for the whole government.

“Congress did not remove the shadow of uncertainty that has been cast over this department and our government much of this year,” notes Defense Secretary Chuck Hagel.

The former Republican senator openly doubts whether lawmakers can reach a compromise and provide more assurance on budget planning soon. Many analysts agree. “There is nothing in the July 2011 debt-ceiling crisis, the [original] super committee deadline of November 2011, the ‘fiscal cliff’ resolution at the end of 2012, and now the latest debt ceiling/CR donnybrook to suggest that a clear picture emerges on what this new committee will do until Dec. 11-13,” says Capital Alpha Partners analyst Byron Callan.

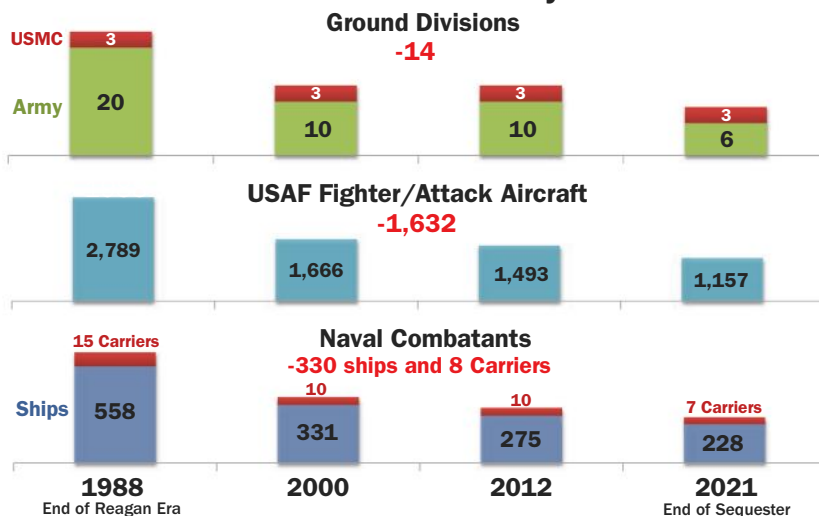
Counterparts at RBC Capital Markets echo the sentiment and predict, at best, a full-year CR and subsequent sequestration cut. What is more, “there will be plenty of further

opportunities to play this high-stakes game of chicken in the run-up to the midterm [congressional] elections in November 2014,” RBC adds.

The analysts have good reason to doubt, as even the two senators who were relied upon to craft the Oct. 16 deal quickly made comments reaffirming their polar differences. Senate Minority Leader Mitch McConnell (R-Ky.) had previously joined tea party legislators in declaring sequestration a victory for the Republican Party that must be maintained. During negotiations for the Oct. 16 law, he tried to further cement sequestration as a mechanism by allowing federal agencies more flexibility in applying what appropriations they do receive.

Senate Majority Leader Harry Reid (D-Nev.) rejected the move because he and most elected Democrats do not want sequestration made easier to accept. Moreover, they hope to lean on hawkish Republicans like those on the armed services and defense appropriations committees—some of whom from the Senate sit on the new bicameral committee, albeit none from the House—who want to relieve the Pentagon of sequestration as they make a case for increasing federal revenue and shielding Social Security, Medicare and Medicaid.

More of Less in Military Power



Sources: Fiscal 2014 Greenbook, Shipbuilding History, Defense Department Service Budget documents and Bipartisan Policy Center

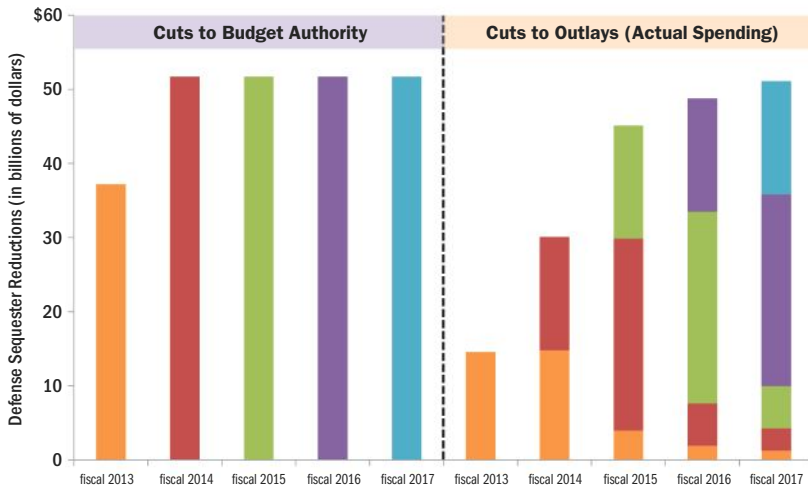
Furthermore, some analysts fear worse-than-sequestration defense budget cuts could be enacted. “Even if the two sides work out a deal, any plan to replace the sequester will involve additional defense budget cuts,” laments Mackenzie Eaglen of the rightward American Enterprise Institute.

On the other hand, if they cannot agree, as was the case in October, the government could shut down again early next year. “Without a budget and a long-term agreement, we will be right back here in a few months,” notes TechAmerica CEO Shawn Osborne. “How are companies to plan and invest?”

Then there is the fact that CRs, such as the one running until Jan. 15, do not allow for changes to programs or for new ones to begin. For most Pentagon accounts, like Air Force aircraft procurement, annual budgeting works broadly with one large lump sum provided, which allows planners some flexibility in how individual programs are funded—even under a CR. Navy shipbuilding is more restrictive. Each ship program is allotted a proscribed amount of money for a year.

A Pentagon press officer says one Major Defense Ac-

How Sequester Cuts Become Spending Decreases



Note: Analysis includes sequestration cuts to budget authority of fiscal 2013-17 appropriated accounts and unobligated balances, assuming cuts to unobligated balances have the same effect on outlays. Sources: Defense Department, Bipartisan Policy Center calculations

means that up to \$147 billion in regular, non-emergency investments for new weapons, that were once expected, will not occur.

Compared with peak investment spending around 2011, the trough will be about 40% below, according to AIA, RBC and others.

If another round (or more) of sequestration

The Budget Control Act mandates sequester cuts to budget authority each year, as listed on the left. But how the lack of spending of that money is felt—i.e., the missing outlays over the years—is illustrated on the right-hand chart.

occurs in fiscal 2014, analysts, officials and officers believe it will feel twice as bad and inflict actual institutional damage in agencies and their missions. One reason is that fiscal 2013 cuts in March purposefully were more superficial than structural in the hopes that they would be undone by a grand bargain.

quisition Program that will be delayed is the Navy's Afloat Forward Staging Base, a planned waypoint for patrol and auxiliary boats, helicopters and Special Operations Forces at sea. Smaller programs, such as R&D projects, equipment modifications and minor equipment purchases all over the Defense Department, will also be delayed under the CR, he notes.

Callan says the SSBN(X) nuclear-armed replacement submarine for the current Ohio-class also could be near the top of the list of plagued programs.

Beyond a CR, of course, are ongoing fears of the long-term effects of annual sequestrations in the decade covered by the 2011 budget law. According to a recent report by the Aerospace Industries Association (AIA), in fiscal 2013-17, the Pentagon could spend 15-20% less on R&D and procurement—what proponents call “investments”—than was projected in President Barack Obama's budget request—and for which industry planned. That

used tricks like furloughing employees or tapping unobligated and leftover funds from earlier years to pay back some of what was demanded. But those funds are dwindling and furloughs will have to become layoffs, and agencies will have to make profound operational and programmatic changes in order to catch up and meet future sequestration mandates. That is particularly true if Congress continues to ban cost-saving requests from the administration, such as military pay and health-care reforms, as well as denies another round of base closures and realignment.

“The combination of sequester cuts and unaddressed cost increases will erode force readiness, stall modernization and reduce the fighting forces by at least 50% by 2021,” predicts a new Bipartisan Policy Center report.

“Many people haven't seen the economic impact because most of the economic impact is still to come,” the report states. “More pain is coming and it will be more intense.”

Hurry Up and Wait

Army's Scout helo waffling raises questions about EADS' long-term viability in the U.S.

Amy Butler and Graham Warwick **Washington**

The U.S. Army appears poised once again to either delay or outright terminate its latest effort to replace the 1970s-era Bell OH-58D Kiowa Warrior, with budget cuts threatening its long-gestating plans for the Armed Aerial Scout (AAS) program.

If either happens, the effect will be felt by a rotorcraft industry starving for new military programs after a decade of contracts to keep existing

platforms flying for the wars in Iraq and Afghanistan. And it could mar the relationship between the Pentagon and industry, which continues to spend company funds on research and development following cues from the Defense Department, but with diminishing hope of seeing a financial return anytime soon.

The uncertainty surrounding AAS ramped up substantially last week at

the Association of the U.S. Army convention in Washington, when Army Secretary John McHugh failed to list the program among the service's top priorities as it prepares for life under the constrained funding of a continuing resolution and further deep budget cuts sure to come (see page 31). Acquisition chief Heidi Shyu added to the worry when she said AAS would be nice to have, but acknowledged there are other priorities.

“We wanted an Armed Aerial Scout as a replacement,” Shyu said at the show. “But in this fiscal environment creating a brand-new program is very tough.” When establishing one for a particular mission area, the funding “goes to zero” for sustaining and upgrading the existing system, she notes.



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This could be justification enough for the Army to continue upgrading the Kiowas piecemeal to avoid a dearth of funding in the near term to keep the scout fleet flying.

Europe's EADS has the most skin in the game. The company has spent more than \$100 million developing three AAS-72X demonstrators aimed at the Armed Aerial Scout requirement. But the company is facing a shutdown of its U.S. line assembling the Army's UH-72A Lakota utility helicopter—the basis of its AAS design—without a near-term commitment to continue procurement, starting an AAS competition or finding other customers to continue production.

The company is hoping to entice the U.S. Air Force to buy some UH-72s for its long-desired Bell UH-1N replacement, a long shot given the financial pressure on the Pentagon and the service's decade-plus on-again, off-again approach toward its Common Vertical Lift Support Program. In a Sept. 11 letter to acting Air Force Secretary Eric Fanning, EADS North America CEO Sean O'Keefe argues that the service should opt for the Lakota as a "cost-neutral" alternative to extending the life of its 62 UH-1Ns by only 12 years.

A lull in Lakota procurement could lead to a premature closure of the assembly line in Columbus, Miss., as well as a death knell for the European company's hopes of being a major player in the world's largest defense market. The company lost its bid to sell Airbus A330-based aerial refuelers to the Air Force after a long campaign and its only other major platform that might have potential for the U.S. is the unproven Airbus Military A400M. The four-engine transport faces an uphill battle to garner congressional support as Lockheed Martin's powerful lobbying apparatus is protecting its twin-engine C-130 tactical airlifter.

At the beginning of the AAS voluntary flight demonstration conducted last year, the Army challenged industry to offer a new aircraft with improved high/hot hover performance at the same or less cost than extending the service life of the Kiowa Warrior—no more than roughly \$15 million per aircraft. EADS officials believe they invested in the Lakota improvements in good faith and offered at least a 90% solution to the AAS requirements, but may ultimately end up with yet another failed attempt to sell hardware to the Pentagon.

By contrast, a delay of two or three years in starting an AAS program and staging a procurement competition would fit well with Sikorsky's plans. The company and its industry partners are investing around \$200 million in building two prototypes of its S-97 Raider coaxial-rotor light tactical helicopter. The first of these is to fly at the end of 2014. A year-long envelope expansion program is scheduled to follow and Steve Engbreton, director of advanced military programs at Sikorsky, says the company will be able to demonstrate the Raider's capabilities to the Army at the end of 2015, and be ready with an off-the-shelf mission equipment package installed on the prototype for the 2016 AAS competition.

Among the other contenders, Boeing with the AH-6i appears to be moving on to different priorities, and AgustaWestland with the AW169AAS was a late entrant that was always considered a long shot. Termination of the AAS program, meanwhile, would leave Bell in a relatively good place, as it is likely to receive continued, incremental funding to upgrade the Kiowa Warrior fleet. The company has backed off on internal funding for

Collateral Damage

Sequestration cuts keep Hawaiian Airlines' turboprop plans in limbo

Adrian Schofield

While the U.S. government shutdown may be over, Washington budget squabbles are continuing to disrupt airline business plans. Hawaiian Airlines is a prime example, with the FAA saying it does not have the resources to perform the certification work needed for the airline to launch its new turboprop subsidiary.



HAWAIIAN AIRLINES CONCEPT

The U.S. Army is already upgrading the cockpit and sensor of the OH-58D to produce the OH-58F.



BELL HELICOPTER CONCEPT

its Block II upgrade to the OH-58D, which it has proposed for AAS, electing not to fly an uprated version of the current Rolls-Royce engine after testing the alternative Honeywell HTS900 turboshaft in flight. The company may be hoping the Army will fund those ef-

forts if it, indeed, is looking to fill a gap with today's fleet.

Underscoring the Army's uncertainty on how to move forward with the scout mission, the service has even proposed converting some of its Boeing AH-64 attack helicopters into

more lightly armed "Apache Lites" as a gap-filler until it can pursue a proper program. But AAS contenders argue the Apache would be unsuited to some aspects of the scout mission and more costly to operate than the OH-58D or a new aircraft. ☒

Hawaiian has purchased three ATR 42s for its Ohana inter-island operation, but they are sitting idle as the airline waits for the FAA to act. The delay dates back about six months to the budget cuts related to the sequestration process. Hawaiian intended to launch Ohana during the 2013 summer season, but has been unable to do so.

This situation is "incredibly frustrating for us," Hawaiian CEO Mark Dunkerley tells Aviation Week. "The strategic development of our business is being held hostage to the budget battles that are taking place."

He went further during an earnings call with analysts, describing the delay as "completely unacceptable" and "woeful in every dimension." So far, it is not costing Hawaiian much to keep Ohana in mothballs, although the airline is not able to recoup the investment it has made in the subsidiary. The FAA cannot even provide an estimate of when certification work may occur.

Dunkerley, in the Aviation Week interview, says that in planning the new

subsidiary, Hawaiian sought the "most expeditious, least impactful" path from a regulatory perspective. "Considering the enormous contribution that airlines and our customers make to funding the provision of [government] services that we use, it's especially galling that we're in this situation."

The carrier is "paying close attention to see if the strategic initiatives of other competitor airlines are likewise being held up, and if they are not, we will have some questions," asserts Dunkerley. Up to now, Hawaiian has not seen any indication that other carriers are receiving more attention from the FAA, although he adds that "we will not hesitate to raise [this issue] if we do."

Ohana is intended to fill a gap in Hawaiian's inter-island network by offering flights from Molokai and Lanai to Honolulu. The airline currently has no other turboprops in its fleet, and its smallest aircraft are its Boeing 717s.

The ATRs are owned by Hawaiian, although they will be operated under contract by Empire Airlines, which is

primarily a cargo carrier. Since the ATRs will be operated under Empire's certificate, that carrier has to conduct proving runs for the FAA in Hawaii. Currently, the aircraft are at Empire's main base in Coeur d'Alene, Idaho. The first few ATRs were previously owned by Czech Airlines.

The FAA has said that once it gets a budget approved it can complete the certification, but it is impossible to gauge when that will be, says Hawaiian's Senior Vice President of Operations Charles Nardello. Once the carrier has a certification date, it will be able to spool up marketing for the service. But the uncertainty means it cannot sell tickets yet.

Hawaiian has indicated that it may build its turboprop fleet to as many as six aircraft. Nardello says the carrier will be assessing what other inter-island markets it might use these aircraft in. Due to the scope clause in the carrier's contract with its pilots, the ATRs essentially cannot be flown on the trunk routes between the islands that are flown by mainline aircraft. ☒

Defense Maneuvers



ANTHONY PECCHIA/EUROCOPTER

European A&D companies seek common platform development

Amy Svitak Paris

One year after the failed mega-merger of EADS and BAE Systems, the question of defense-industry consolidation in Europe looms. But with most governments paring back defense spending and no large national or pan-European programs on the horizon, the urge to merge is waning among top aerospace and defense companies as they redouble efforts to stay competitive in an increasingly global market.

"In the 1990s and early 2000s, when defense spending was more stable, you had the promise of consolidation that could lead to more business, with the idea that pan-European programs would succeed national ones," says Jean-Pierre Maulny, director of the Institut Relations Internationales et Stratégiques (IRIS) here. "That promise is now gone, and the question for the future is not so much consolidation but the competitiveness of industry."

On the heels of the unsuccessful merger attempt last year, EADS overhauled its governance structure to reduce interference from government shareholders and put itself on more equal footing with global competitors, notably Boeing. In July, the company changed its name to the Airbus Group and combined three of its weaker

units—Airbus Military, Astrium and Cassidian—in response to shrinking defense spending in Europe.

"The page was turned with EADS 2.0," says Luc Boureau, director general of Cassidian, which comprises a €14 billion (\$19 billion) enterprise with 45,000 employees and more than 600 legal entities, many of which he says will be eliminated in the reorganization. "We'll be more competitive because we'll be able to reduce internal costs," Boureau adds.

He notes that such savings may help in the short term, but with few new defense programs in Europe's future, some companies are collaborating on their own. In June, after France announced plans to buy U.S. Predator UAVs to meet short-term gaps in its intelligence, surveillance and reconnaissance (ISR) capabilities, EADS proposed a collaborative program with rivals Finmeccanica of Italy and Dassault Aviation of France to develop a new European reconnaissance drone.

"I am pleased to announce we are just now submitting a report about this call to the French government," Boureau says. Although the project is unfunded, he says the companies are hopeful the proposal will find its way into France's new €190 billion military program law (LPM), a six-year budget plan to finance defense programs in 2014-19 that is working its

Eurocopter produces 20 versions of the NH90 military transport helicopter to meet varying customer requirements.

way through the French parliament.

While the budget trims French defense spending through the end of the decade, companies that rely on both civil and defense aerospace programs for revenue say they expect to remain largely unscathed if the financial plan is carried out. "If the LPM is executed to the letter, the impact on Safran will be acceptable, with a reduction in business of €150 million a year expected," says Michel Dechelotte, director of institutional affairs at the company, which has €15 billion in annual revenue split 80/20 between civil and defense, respectively.

In the meantime, Dechelotte says France and other defense powerhouses in Europe should focus their investments on a pan-European program capable of sustaining design expertise and production lines.

"You cannot forever solve the problem of a lack of government financing through consolidation or industrial monopoly," Dechelotte says. What Europe needs is "a common program with a minimum number of different iterations," he notes, one that pulls expertise from multiple countries into a single platform that can sus-

tain the defense industrial base here.

"Defense industry jobs in Europe don't really depend on consolidation but on the length of production runs of a given product," he says. Examples not to follow, he said, include Airbus Military's multiple versions of the A400M tactical airlifter and 20 distinct variants of Eurocopter's NH90 helicopter developed to meet a multitude of customer requirements.

"The cost of European equipment is no higher than anywhere else, but if you have short production runs, you can't get the per-unit cost down," he notes. "This means we work in a fragmented way and cannot make our investments profitable."

Helene Masson of the Fondation pour la Recherche Strategique here says the absence of a concerted effort to develop a common multinational defense platform has ramifications for Europe's ability to stay competitive through technology innovation as European capitals pressure companies to sell defense products abroad.

"It used to be just manufacturing that had to go international when looking for export contracts," Masson says. "But with no new big programs coming in, companies have to find ways to sustain research and technology programs. So now the entire thing, including design, has to become internationally competitive."

Masson says the dilemma for governments is the need to favor defense exports necessary for the survival of the industrial base while ensuring that Europe retains critical technologies.

"By 2020, the risk that we will lose technologies deemed critical for the industrial base here is relatively high, because you'll have an aging technology base that is not renewed by new programs," notes Masson, who is coordinating the French contribution to a December European Union Council summit on defense that will set priorities and time lines for R&D in areas where capabilities are most needed. For example, Masson says governments could ring-fence key capabili-

ties for export only among European nations while reviving mechanisms for cooperation in support of pan-European and trans-European programs.

"Nations should be able to use defense offsets to strike new partnerships and joint ventures, or develop local subsidiaries that might produce material at lower cost," she says.

These and other collaborative pooling and sharing concepts will be addressed at the December summit. The outcome—a portion of which is to be funded through the European Commission's €1 trillion multiyear budget—is expected to harmonize defense commerce in Europe, and could enable the EU's executive arm to develop common military certification and standards, fund dual-use R&D and ultimately purchase and operate its own military hardware, including UAVs.

"EADS is giving strong support to this EU Council, especially for any decisions it might make for funding drones," Boureau says. ☛



The advertisement features a collage of images at the top showing four different types of lithium ion batteries: a black rectangular unit, a white open case with internal components, a yellow cylindrical unit, and a black rectangular unit with red and blue terminals. Below these images is a large blue banner with the text "High Power Lithium Ion Batteries for Aircraft" in white and green. The background of the banner shows a white commercial airplane and a black helicopter flying in a blue sky with white clouds. In the bottom right corner, there is a QR code. At the bottom left, a dark blue box contains the text "Where SAFETY and QUALITY come first." The EaglePicher Technologies, LLC logo is in the bottom right, with the tagline "An OMC Company" and the website "WWW.EAGLEPICHER.COM".

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Offshore Alert

Operators look to default use of cockpit automation in over-water helo operations

Tony Osborne London

Helicopter operator CHC Scotia is encouraging greater use of automation in its flights in the wake of the Aug. 23 crash of a Super Puma as it approached a Shetland Islands airport.

CHC is urging crews to “default” to the use of onboard automated systems after U.K. air-accident investigators reported a loss of airspeed during the approach of a Eurocopter AS332L2 Super Puma, G-WNSB, was “unobserved” by the pilot and co-pilot moments before it crashed into the North Sea.

Four oil workers died when the Super Puma ditched while on approach to Sumburgh Airport after a flight from

Airbus A330 over the Atlantic Ocean, where it has been suggested that pilots had become overreliant on automation in the cockpit. CHC’s thinking is in line with that of helicopter manufacturers, who are advocating the increased use of automation into the cockpit.

Eurocopter points to operations of its EC225, which, despite its recent grounding due to the bevel-gear vertical-shaft issues that forced two aircraft to ditch into the North Sea in 2012, now include wide use of automation with a TCAS II (traffic-alert and collision-avoidance system) linked to the aircraft’s autopilot.

All AS332L2 Super Pumas operating over the North Sea returned to flight a week after an Aug. 23 ditching.



the Borgsten Dolphin drilling platform on behalf of oil company Total.

Eurocopter’s analysis of the aircraft’s flight data recorder found that the aircraft’s nose-high attitude, low airspeed, high rate of descent and high power levels had placed the AS332L2 into vortexing conditions. Using that data, modeling demonstrated that with reduced helicopter performance and limited height available, the “impact with the sea was unavoidable,” said the U.K. Air Accidents Investigation Branch (AAIB) in a special bulletin published on Oct. 18.

Such a recommendation to favor automation, however, appears to fly in the face of recent accidents such as the crashes of an Asiana Boeing 777-200 in San Francisco, or an Air France

Sikorsky also has been working to enhance automation in the cockpit, having earlier this year introduced an application into the avionics of the S-92 to reduce the workload of pilots approaching oil platforms. The system has been under development since 1997 but was only approved by the FAA last May. While the rig-approach app flies the route automatically, the crew can spend more time looking outside for visual clues, particularly during bad weather.

The subject of automation will also be studied in a joint safety review announced by CHC and the other two major North Sea operators: Avinicis, the parent of Bond Offshore Helicopters; and Bristow Group.

The helicopter in the Aug. 23 crash

had been flying an approach into Sumburgh’s Runway 09. The aircraft’s commander had prepared for a non-precision approach with the co-pilot monitoring the vertical-descent profile, referencing the airport approach chart. Visibility was 4,000 meters (2.1 nm) but in haze with an 18-kt. surface wind.

At 2.3 nm from the airport, the Super Puma’s airspeed fell below 80 kt. and “continued to reduce, unobserved by the crew,” says the AAIB report.

The aircraft was also below the altitude expected along the approach. The report states that the cockpit issued two “check height” automated warnings to the crew. The second warning was followed by a “100 feet” automated call, 2 sec. before the aircraft hit the water. “At some point the commander saw the sea, but he was unable to arrest the helicopter’s descent and it struck the surface shortly thereafter, at 1717 hr.,” investigators note.

The report says CHC’s standard procedures state that the pilot not flying is required to monitor the approach and look outside to acquire visual references for landing, while the other pilot flies the approach on instruments. If a visual reference is not acquired, then a missed-approach profile should be flown.

Moments before the Super Puma ditched, the co-pilot realized the helicopter was about to enter the water and activated the flotation system. Once in the water, the helicopter rapidly inverted, but remained afloat, for 14 of the 18 passengers to escape along with the pilot and co-pilot.

The AAIB says the survivability aspects of the crash are subject to ongoing inquiries, but that investigators have recommended the airport owner, Highlands & Islands Airports Ltd., provide a water rescue capability that can be used in all tidal conditions.

The accident, the fifth in four years in the North Sea, sparked an outcry over safety, including a Facebook page—“Destroy the Super Pumas”—although much of this furor has died down since the AAIB report stated the cause was not a technical issue with the aircraft.

Nonetheless, the accident has prompted a total of at least five inquiries and reviews from the Oil and Gas U.K. trade association, U.K. and Norwegian aviation regulators, the U.K. government’s transport committee, the Helicopter Safety Steering Group—an offshore safety committee—as well as the North Sea operators. ☒

TONY OSBORNE/AAIW&ST

Growth Mode

Demand for larger twins has Airbus planning more production capacity and perhaps a bigger A350 version



The second A350 test aircraft, MSN003, took off for its first flight on Oct. 14.

Jens Flottau *Toulouse*

Airbus seems to have one ambitious goal for its A350 program: two-prong growth. First, by expanding production capacity to better cope with the strong demand. And second, by expanding the aircraft itself to a 400-seat version.

With 756 firm orders in hand nearly a year ahead of the aircraft's likely entry into service, Airbus knows the marketplace is interested. And following a several-year weak phase caused by the redesign of the A350-1000, sales for the stretched version are also picking up, underlining what can be described as a more general trend toward larger twins.

On one hand, there is shrinking demand for the smallest version of the family, the A350-800, as indicated by Aeroflot's partial move away from the jet (see p. 40). On the other hand, the production split between the -900 and the -1000 could turn out far differently than originally anticipated, with the larger variant selling stronger than planned. "There is a good piece of the cake to grab," Didier Evrard, A350 program chief, says. He points out that the market for A350-1000s has grown by 29% since the launch of the A350 program more than 20 years ago. Nearly 2,100 units are in operation.

Indeed, the capacity of the final assembly line in Toulouse is being expanded to handle a 50/50 split between the two versions. Also, Airbus appears to be coming to the realization that the 350-seater (in standard three-class configuration) may not be big enough in the long term if airlines, as expected, decide to opt for the stretched Boeing 777-9X, which will have around 400 seats.

As part of the assembly line expansion, Airbus is adding a third Station 50, where the current Station 59 has been. That station, which is used for sections

preparation ahead of the actual final assembly process, will move to the other side of the line. Currently, two of the four Station 40s are used for wing assembly and two for testing. But when the second part of the final assembly line is completed and line production is launched, all four stations will handle wing assembly while further integration and outfitting work take place in the four Station 30 bays. These are anticipated to be ready for use in late 2014. A fifth Station 30 is scheduled to be in place by late 2015.

Evrard says that the setup will be sufficient for the planned rate of 10 aircraft per month, or more, if market demand is strong. He does not say how many more. At a rate of 10 per month, the A350 would be among the highest-output widebody programs Airbus has ever had, matching the A330 rate. Airbus will build one aircraft per month by year-end—around 10 months ahead of first delivery, and will be building three per month by the end of 2014.

The -1000 is now "entering the industrial phase of the program" as Airbus has begun disseminating data to the tooling manufacturers. Final assembly is to start by the end of 2015, followed by first flight in the second half of 2016 and entry into service by mid-2017. Evrard notes that the challenge will involve phasing it into a production line that is already running at high speed building the -900.

But the advent of the -1000 does not necessarily mean the end of the line for

the A350. Airbus is weighing the potential of further stretching the smaller aircraft. Current studies center around how much additional engineering would have to be put into the aircraft's struc-

ture and systems to allow for an additional extension to the fuselage.

Airbus's chief operating officer for customers, John Leahy, confirmed for the first time at the International Society of Transport Aircraft Trading (Istat) conference in Barcelona earlier this month that Airbus is studying the idea, however, he later downplayed his comments. Evrard says: "We are not in a hurry to define another product, but if the market needs it, we will do it."

The current studies are primarily technical. Making the A350 longer would mean a double stretch of the baseline A350-900. Evrard explains that the landing gear for the -1000 is already different and strengthened compared to the -900, and has an upward weight potential in the tens of tons, so that system would not be a limiting factor. He indicates that no serious technical showstoppers have emerged. He points out that: "Others did it, we can certainly do it, too." This is a reference to Boeing's launch of the 787-10, a double stretch of the 787-8.

The amount of engineering work required hinges on the extent of the stretch and the kind of missions it would have to fly. A stretched aircraft without significant upgrades is likely to lose range. But to be competitive with the 777-9X in terms of range, substantial investment would likely be needed.

Airbus's stance is that the -1000 will be superior even to the -9X. It argues that the Boeing aircraft will be 35 tons heavier (operating empty weight) and will use 15% more fuel than the -1000 while only providing 10% more capacity. And even the smaller -900 reaches the same unit-cost level per seat that Boeing targets for the -9X, says Sophie Pendaries, who heads product marketing for Airbus. Boeing's figures, of course, are much different.

The 777-9X is expected to be formally launched at the Dubai Airshow in November, backed by orders from Emirates, and possibly, Etihad Airways. Lufthansa signed a preliminary agreement for the aircraft last month.

Following the technical studies, Airbus plans to take a close look at the market potential of a larger A350, which would likely take the aircraft into a similar size category as the 400-seat -9X. The A350-1000 is defined as a 350-seat aircraft in three classes—nearly identical in size to the 777-300ER. But the A350-1000 can seat nine additional passengers because it will have only four exit doors on each side rather than five for the -300ER, Airbus says.

Any decision on a formal launch for a further A350 stretch is a long way off and service entry is unlikely before the end of this decade. Following the -900, Airbus plans to deliver the first -1000 around mid-2017, and the future of the -800 is still up in the air. While Evrard says the shrink would not be difficult to do, it could still be a distraction for engineering resources if Airbus opts to build a larger version at the same time.

But for now, Airbus needs to complete flight-testing and certification regimes for the A350-900. Early September 2014 is projected to be the type certification date. That would be followed by first delivery to Qatar Airways soon after. Evrard notes these targets are based on the assumption that the flight-test program and production ramp-up run according to schedule.

Airbus has not specified a date when the aircraft is to be delivered to its first operator beyond stating the second half of 2014. But the target for certification is more defined, indicating the company is comfortable with the results of its flight-test program. "It was important to fly rather early to have some flexibility in the program," Evrard says. The -900 took off for its first flight on June 14, days ahead of this year's Paris air show.

MSN001 had accumulated 77 flights and 378 flight hours as of Oct. 21 and MSN003, the second flight-test aircraft, had completed three flights and 25 flight hours. Following the completion of minimum unstuck speed tests (VMU, the slowest speed at which the aircraft will still take off), Airbus is preparing for flutter testing with MSN001 and icing trials with natural ice before year-end, weather permitting.

Airbus is also progressing with final assembly of MSN002, the third flight-test aircraft and the first that will have a passenger cabin installed. It has begun integrating some cabin elements such as galleys and flight crew rest compartments. MSN002 is planned to be ready for painting before year-end, and final preparations before first flight in February 2014. It is crucial for Airbus to maintain that schedule in order to conduct the six months of testing needed for cabin certification. A February first flight would therefore take certification into the August timeframe. Early long flights simulating long-haul air-

line operations are scheduled for next spring.

MSN004, which is planned to fly at roughly the same time as MSN002 in February, will have a much shorter lead time because it does not bear a complex cabin or the extensive flight-test instrumentation of MSN001 and MSN003.

MSN005 is to enter final assembly in October and will likely fly in May. It is the second aircraft with a cabin installed and is the first certification-standard aircraft. MSN006 (the first aircraft for Qatar Airways), will follow in November and fly in August 2014. ☛

NEAR NOWHERE

Jens Flottau **Frankfurt** and Maxim Pyadushkin **Moscow**

Airbus has been openly reluctant to actually build the shorter A350-800. But it still holds 79 firm orders for the type, and some customers are proving hard to convince to trade upward.

Russia's largest airline, Aeroflot, last week opted to convert 10 orders for the -800 into commitments for the larger -900 version, but still wants eight of its original call for 22 aircraft to be the smallest A350 family member. The backlog for the -800 has already been cut by more than half in previous years.

Airbus has been encouraging its customers to give up their -800 commitments in favor of the larger -900 and -1000, but has had mixed success. A number of airlines continue to insist on the 250-seat aircraft (in three classes), because they believe they are unable to fill the larger variants. The future of the type could very well rest on the decision of the planned merger of US Airways and American Airlines. With an order for 18 aircraft, US Airways is now by far the largest -800 customer, following by lessor Aircraft Purchase Fleet (12) and Yemen Airways (10). Hawaiian Airlines has bought six of the type and several other airlines have single-digit commitments.

But if "New American" decided that the -800 no longer fits its requirement for the long-haul fleet, that might very well be a turning point for the program.

A350 program chief Didier Evrard said last week that "as long as the airlines show an interest, the aircraft will be built. It is not complicated for us to do it." He said timing for first delivery was still "a moving target" because of the ongoing talks with airlines.

Aeroflot shareholders approved the change to the makeup of its order for 22 A350s. As part of the original deal signed in summer 2007, the airline planned to take 18 A350-800s and four A350-900s. Now Aeroflot wants to have more of the larger -900s, bringing their number to 14 while the -800 order is reduced from 18 to eight. According to an Aeroflot report, the deal is valued at \$3.1 million, not counting custom duties.

The aircraft are expected to begin entering the airline's fleet in 2018, but the order conversion extends the delivery period to 2023. If deliveries are delayed, Airbus will grant a \$25 million discount for another Aeroflot order for five Airbus A321-200s, according to the airline's report. Leasing agent GTLK took the \$291.5 million order on behalf of the airline, and will lease the -200s to Aeroflot for 12 years. The carrier already has two of the CFM56-5B3/3-powered A321s in operation; the others are expected to be delivered by the end of the year. ☛

From Voice to Text

Harris Corp. says it has a critical mass of airlines needed to prove datacomm benefit

John Croft Washington

Harris Corp. has agreements in place with five major carriers, including United Airlines, to equip more than 1,500 aircraft over the next six years with digital communications gear that will accelerate ground operations at 57 airports by mid-2019 and remove most voice communications with air traffic control in the en route environment beyond 2019.

The FAA estimates that the tally represents 80% of the “tipping point” number of aircraft needed to make con-

element in the transformation of the air traffic control system (ATC) from voice to automated air traffic management. Harris is the prime contractor.

Digital tower departure clearances (DCL) are the first step along the FAA’s datacomm growth path, which ultimately will replace most voice messages with secure text messages and, in the 2025 time frame, extend to negotiations of 4-D trajectories between ATC and the flight deck. Europe’s command set for 2015 is much broad-

To participate, an aircraft must be equipped with the Future Air Navigation System (FANS) 1/A architecture and a VDL Mode 2 radio. FANS 1/A has traditionally been used for air traffic services and Aircraft Communications Addressing and Reporting System (Acars) capability on oceanic routes. O’Sullivan says carriers must install the required equipment before receiving the rebate, which is computed based on the upgrades needed to participate. Airlines can use the rebates for new or existing aircraft. In many cases, the aircraft already have the needed systems but require a “service code” to enable the additional functionality. Upgrade costs can range from \$30,000 to \$500,000, and airlines choose the avionics vendors.

In its agreement with Harris, announced Oct. 21, United Airlines said it will equip 397 aircraft, mostly older Boeing 737s and 757s, with datacomm over the next six years. O’Sullivan was not able to identify the other carriers, but one is likely to be American Airlines, a partner with Harris on the DCIS contract, along with Thales, General Electric and Arinc.

United, which had earlier upgraded 35 aircraft, is taking part in DCL testing at Newark, N.J., where UPS, FedEx, British Airways, Lufthansa and Scandinavian Airlines are also participating. The FAA is operating a datacomm DCL testing site at Memphis, Tenn., with FedEx as well. The two airports are using a Thales automation platform for the trials, although all airports offering DCL will eventually use a new FAA-built tower data-link system under development.

O’Sullivan says lessons learned to date include some FMS interface issues and “loads and drops,” where the FMS rejects a routing. In some cases, the rejection was due to controllers using FAA-standard three-letter identifiers for airports rather than the international-standard four-letter identifiers.

By mid-2015, the so-called first-key sites— Salt Lake City, Houston Intercontinental and Houston Hobby airports—will begin offering datacomm DCL, and by 2019, the FAA plans for it to be in operation at 57 U.S. airports.

O’Sullivan says there will be “solid metrics” on the benefits of using datacomm for DCL in 2-3 years. In the meantime, the rebate fund helped the early adopters to “close the business case,” he says. ☐



GEORGE HAMLIN

troller-pilot data-link communications (datacomm) practical in terms of capacity increases that will provide a return on investment for airlines and the FAA.

John O’Sullivan, Harris’s vice president of NextGen initiatives for civil programs, tells Aviation Week he is confident enough airlines will sign up by the end of October to reach the 1,900-aircraft goal and commit most of an \$80 million “rebate” fund the FAA set aside to encourage operators to equip. Unlike Europe, which has a 2015 deadline for airlines to equip for datacomm to operate above 28,500 ft., the FAA has no mandates. The FAA plans to have the command-and-control infrastructure in place at 57 airports by 2019 and in the en route environment thereafter.

The project is part of the U.S. agency’s broader data communications integrated services (DCIS) program, a key

er than the FAA’s initial application, with approximately 100 uplink and downlink messages available, most of which are predefined text messages for “noncritical” communications.

While it is not unusual for aircraft to receive an initial clearance digitally over a VHF Data Link (VDL) Mode 2 radio, changes to that initial clearance, often required by weather issues, must be made by voice and manually keyed into the aircraft’s flight management system (FMS). With datacomm, ATC sends a digital message to the aircraft as well as the airline operations center. The pilots use bezel keys on the communications management unit in the cockpit to accept or deny the amended clearance, or ask for more time. Once the pilots accept the clearance, another key automatically transfers the route into the FMS.



CFM

A set of 18 black resin-transfer-molded blades and a larger bypass ratio distinguish the Leap-1A from earlier CFM56s.

2009, is scheduled to enter service in 2017, although CFM is maintaining its original engine development schedule, which calls for the -1C to be certificated in mid-2015. The Leap-1B is on track to enter service on the MAX in 2017.

"The engine is running fantastically," says Ted Ingling, engineering lead for the Leap-1A/C. Initial work is focused on aero-mechanical engineering tests to look at the high-order attributes of the engine and establish that the "fundamental architecture is working as expected," Ingling says. "We are making sure the thrust in the rotor architecture is where we want it to be, and to make sure we understand the fundamentals of the engine. We do those kind of tests while we're developing initial software loads for follow-on runs. We use the first engine to tune that software," he adds.

Staying on track will be critical to the success of the busy test effort that quickly ramps-up before the end of this year and into 2014 when, at one point, up to 15 development engines will be running in parallel. "That is unprecedented and that's only part of the overall test plan," says CFM Executive Vice President Chaker Chahrour. The overall test and certification program will eventually include 60 engines. Some 28 will be development engines for the Neo, MAX and C919, while the balance is made up of compliance engines which will power the three new airliners during their certification campaigns.

From a schedule perspective, the monumental effort got off to a good start when the first engine entered testing three days earlier than the target date established when the program was laid out in 2010. "We also got combustor light-off first time, and the first day we did mechanical check out," says Ingling. Full power was achieved five days later with a run up to 33,100 lb. thrust to cover the highest rating required for the A321. The first engine was then pushed further, demonstrating more than 35,000 lb. thrust and with it the availability of fundamental growth margin, should it be required, adds Ingling.

"In early testing, we're looking at the initial performance of the engine, vibration and the aero-mechanics," he says. "We do runs to check the fan and

Pressure Testing

Initial CFM Leap engine runs start the clock on huge development/certification plan

Guy Norris **Peebles, Ohio**

It is ironic that when the first CFM56 fired into life in 1974, barely anyone outside of General Electric or its French partner Snecma noticed or even seemed to care.

It was a low-key debut for an engine that would become an industry game-changer; yet 39 years later the contrast could not be greater for the first run of its 21st-century successor, the all-new Leap. The reason is simple. Compared to the first CFM56, which at the time was an unproven orphan with no applications or orders, the Leap is already a pivotal component of the plans of Airbus, Boeing and Comac. Remarkably, more than 5,000 Leap engines were on order before a drop of fuel was ignited.

The pressure on CFM is therefore intense. Not only does the Leap inherit the vast medium-thrust, high-bypass market dynasty created by the CFM56, it must also maintain from Day 1 the CFM56's mature reliability rate while concurrently improving fuel burn by a step-changing 15%. Just as challenging to GE and Snecma, the large backlog means production is set to start at re-

cord rates from the get-go. Delivery rates are set to exceed 1,700 Leap engines per year within just three years.

For the first time since its formation in 1974, CFM is also facing a competitor from the start: Pratt & Whitney's PW1000G geared turbofan. This powerplant not only challenges across a broader thrust range than the International Aero Engines V2500 which it succeeds, but will enter service on the Airbus A320neo ahead of the Leap. Although the Leap and PW1000G only compete head-to-head for the Neo, the engine contest is as cutthroat as ever.

The air of expectancy is therefore almost palpable at GE's test site here in rural Ohio where the first Leap-1A engine is in the early phases of evaluation following its start-up on Sept. 4. The Leap-1A is destined for the A320neo, slated to enter service in 2016, and will be followed by the aero-mechanically identical Leap-1C for the Comac C919, as well as the architecturally common Leap-1B for Boeing's 737 MAX. The C919, the Chinese airliner project that officially launched the Leap in late

compressor blades, the engine dynamics and the bearings. There's also a lot of starting to map out the start envelope, figure out the fuel schedules and see how the starter interacts with the engine."

The Leap's basic architecture is based on a scaled version of the same eCore design at the heart of the GENx, with an advanced low-pressure (LP) system from Snecma. However, while the Leap core is designed to operate at a higher pressure ratio than the latest CFM56, it is deliberately tuned to lower pressures than the bigger GE engine that powers Boeing's 787 and 747-8. "We're well inside GE's experience for these kind of pressure ratios," says Ingling. "The GENx is the high watermark in terms of pressure ratio and temperature and, although we had the option to mimic or even exceed the GENx, we didn't because we wanted durability for this marketplace. We want it to be a copy of the CFM56 in terms of time on wing."

Assembly of the early development Leap engines includes installing test sensors to record up to 1,500 parameters.

The third version of the eCore ran earlier this year in the build-up to Leap testing. "Using this, we have done aerodynamic, stall, performance-mapping and so on, but what we don't get effectively is interaction with the LP system and we don't get transients [rapid changes between thrust demand]," says Leap program manager Gareth Richards. The full-up engine is also therefore the first to check the full operability characteristics of the integrated LP and high-pressure (HP) systems. Testing includes "bodies"—or throttle bursts and chops—that check the related response of the compressor.

The engine is also fully configured with standard systems such as the eductor-based surface oil-cooling mechanism that, like the same system on the GENx, consists of surface coolers mounted around the inner lining of the fan duct. The eductor device produces a venturi effect, which ensures a positive pressure to keep oil in the lower internal sump.

Engineers are also verifying the performance and behavior of the composite fan using "clearance-ometers" developed by Snecma to sense the exact motion and vibration of individual

blades. The sensors are mounted in the fan case at the leading-edge, mid-chord and trailing-edge positions to measure variations in the local magnetic field as each blade passes by. Using careful "per-rev" calculations, engineers can deduce from the measurements whether the blades—and specific parts of each blade—are passing the sensors early, late or on time. The results indicate whether the flexible blade, made by Snecma using a resin transfer molding (RTM) process, is untwisting to the correct degree with increasing rotational speed.

"The untwist we're looking for is right on the prediction," says Richards. "That calibrates the engine models, which say as the engine speed goes up, forces act on the fan, and we use those sensors to be witness to the fan

phase of testing, the first engine will go through a second build cycle in readiness for early icing tests at GE's dedicated facility in Winnipeg, Manitoba.

"This will include a full demonstration of the certification test profile [a year before the actual certification test], plus an engineering test for icing. It is another risk burn-down, and we have taken lessons learned from GENx icing and then some," says Richards, referring to the ongoing development work at GE to tackle the core icing issues encountered particularly on the GENx-2B. The engine will undergo a third and final rebuild in readiness for use in the destructive blade-off test scheduled to take place in Villaroche, near Paris, next September.

The start of engine tests comes as CFM continues to rack-up record orders for the current CFM56-5/7 as well as the Leap models. The GE-Snecma joint venture has taken orders for 2,196 engines this year, outpacing the 1,972 booked over the whole of 2012. The 2013 orderbook is split almost evenly between current and next-generation engines, with booking taken for 1,094 CFM56s and 1,102 Leap units so far.

"The two CFM product lines are doing very well so far," says CFM president Jean-Paul Ebanga. "At this stage of the Leap program, we have more than 5,000 engines already on order. In terms of backlog, we are in good shape, and on the CFM56, our backlog is also above 5,000."

The sales success continues to put greater onus on preparations for meeting delivery demands and ensuring a smooth production ramp-up. Cedric Goubet, CFM executive vice president, says the goal is to achieve an accelerated delivery curve that will see Leap production rise from zero to 1,700 engines "within less than three years." Overall, the plan calls for "1,700 Leaps by the end of 2018 and start of 2019, and maybe going up to 1,800 by the end of the decade," he says. All these exceed the recently achieved historic maximum annual delivery rate of 1,500 engines for the CFM56. ☼



CFM

mechanical characteristics. All of this is confirmation of our analysis. We are validating what we expect the engine to be doing."

In the case of the fan, CFM also continues to run parallel validation tests of the final blade configuration in a demonstrator, even as the first Leap engine starts to run. The final phase of the Mascot 2 program, which involves testing an RTM fan on a CM56-5C, is now underway with a series of cross-wind evaluations at Peebles. "This is building confidence ahead of further runs," adds Ingling.

The first engine, designated 598-001, is festooned with 1,300 pieces of instrumentation. These include thermocouples in rotor cavities "to understand the secondary systems, feed and purge cavities, loads and temperatures of the bearings," says Richards. "We also have performance rakes to understand how the fan is pumping and how the core is pumping," he adds. Following its first

Carrier Nation

Building, fixing carrier fleet remains U.S. priority

Michael Fabey **Washington**

With sequestration putting a crimp on most of the Pentagon's major military programs, the U.S. Navy continues to whittle away at the costs of building its next-generation aircraft carriers.

Scrutiny is being focused on the CVN-78 Gerald Ford, the lead ship of a class of new carriers that includes a set of major technologies such as an electromagnetic aircraft launch system (Emals), dual-band radar (DBR) and advanced aircraft landing arresting gear.

Emals is tested and proven, says Rear Adm. Thomas Moore, program

due in part to discovery that the "water twister," a component that helps absorb the energy of a landing aircraft, was initially "under-designed," Moore says. He adds that it is "the one system we haven't had a chance to fully test out," but that the Navy has developed a plan to catch up on the testing.

The Ford is scheduled to be christened Nov. 9. The class is highly dependent on electric automated systems meant to cut down on crew size and, therefore, the life-cycle costs of the ship.

That electric-ship design, Moore says, will mean the Ford will have to

heydays of the 1970s and '80s, when the service enjoyed what amounted to a five-carrier production line.

The Navy and builder—Huntington Ingalls Industries' Newport News Shipbuilding—have a better starting point with 79 than they had with 78, Moore says, with a complete design, more complete materials set and Ford's lessons learned. But they will need more. "The shipbuilder and I looked at other yards to see how we could build 79 differently. Other shipyards did more work earlier in the process—and they could do it faster."

Moore acknowledges that carriers are not assembly-line projects. "But clearly there are big pieces of the ship that are similar, almost like an assembly line," he says.

Newport News can fashion worker units similar to those in an assembly-line plant, he suggests, and points out how successful Bath Iron Works was in employing a "vertical-build" concept for the DDG-1000 destroyer.

No longer building Nimitz-class carriers such as CVN-72, now being overhauled, the U.S. Navy must cut costs to produce the new Ford-class ships.



MICHAEL FABEY/AW&ST

executive officer for aircraft carriers. DBR components have undergone some trials, and more tests are scheduled for the whole radar system.

Moore tells Aviation Week that Emals was his "No. 1 technology concern" two years ago. Constant ground-based testing has shown the technology is sound and reliable, he says.

The Navy is now resuming DBR testing. "We have arrays at Wallops Island [Va.]," Moore says. "They should ring out any problems there."

The Ford-class carriers cannot afford to have any operational issues with the radar. "It's integral for ship defense. It also takes the place of the air traffic control radar," Moore notes. "I have to have it." He adds that the arresting gear "now has most of my attention."

The gear testing is behind schedule

undergo "the most challenging test program" for a Navy ship, slated to last about 28 months.

The new systems are meant to make the ship more efficient and, over the long-term, more cost-effective, but they are expensive to buy. The Navy expects Congress to approve a new Ford construction cap this year of nearly \$12.9 billion, according to Moore.

"The Ford is in the yard and in the testers' hands," Moore says. "The principal focus now is: What can I do to get the 79 under contract? We've got to drive affordability into that ship. We've got to change the way we do business. We can't just build 79 the way we built 78 and expect to get cost out."

One of the best ways to cut costs is to ramp up production, but Navy officials know there is no returning to the

"They leave a whole side open," Moore says. Workers have easier access to larger ship areas. When the work is done, he says, the yard just "slides over and mates" the remaining ship section.

"In some areas on the carrier, especially in the bow sections, we can do vertical-build strategies," he says.

By looking to compete some carrier work that is common to other ships in the Navy, such as the command-and-control systems, Moore says he also is trying to create "islands of competition." Still, one of the most effective ways is drive down costs is to offer financial rewards for the contractor. "The best way," Moore says, "is to put them on share line that rewards them."

Despite the high prices for constructing and maintaining these ships, the cost to build or overhaul the carrier fleet is worth it, he says. "We are a carrier nation." ☐

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Volume Not The Issue

Technology, preparation and quality are major supply chain challenges

Henry Canaday **Washington**

Boeing and Airbus are headed up the production curve, and new aircraft from Bombardier, Embraer and Mitsubishi will be entering the market soon. About 70% of the supply chain for all airframe manufacturers consists of the same companies. Will these common aerospace suppliers be pressed so hard by simultaneous demand surges that the supply chain is threatened?

Quite possibly, but not for the traditional reason—high volumes. Aircraft production usually peaks along with, or a little after, economic and industrial production high points. Those hundreds of aerospace suppliers also make products for other sectors. When every sector is booming, shortages can occur in both crucial raw materials and specialized manufacturing capacity.

The aircraft boom this time coincides with a still sluggish world economy, with plenty of spare capacity. Below the top

airframe tier, suppliers and raw-product markets will likely have plenty of slack.

This surge is largely to replace older aircraft with more fuel-efficient jets. And there's the rub. In an effort to cut weight and improve efficiency of engines and cut weight and drag from airframes, OEMs are pushing new designs and materials forward rapidly. That could be where problems develop.

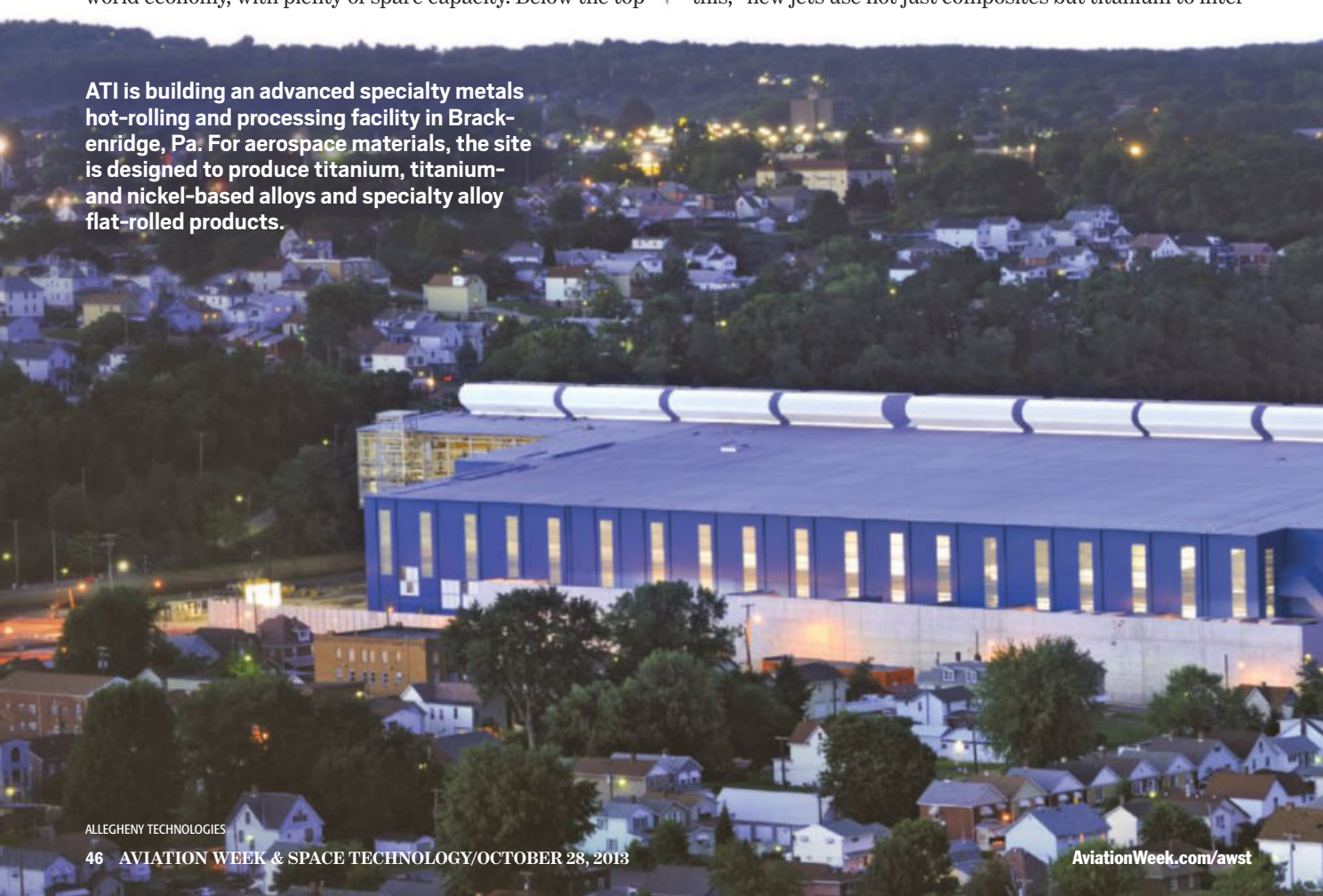
In 2012, Boeing and Airbus ramped up production of aircraft by 29%, measured by value. "That is a pretty steep angle, they can do that," summarizes Richard Aboulafia, vice president for analysis at the Teal Group. "Also, remember military capacity is coming off-line, so that will be available."

Aboulafia argues that the real challenge is learning to build new kinds of jets and engines and to manage mass production of thousands of new subsystems and structures. "Boeing can build 40 or 50 787s a year, but can they do 10 or more a month?" Beyond the long-range 787, there are the Airbus A350, Bombardier's CSeries, the Mitsubishi Regional Jet and Embraer's EJets 2, plus geared turbofan and Leap engines (see page 42).

Moreover, some OEMs may be out of shape when it comes to commercial engine runs. "Pratt hasn't built its own new commercial engines in 20 years, since the JT8D," Aboulafia says.

The obvious change in airframes is a much more extensive use of composites. Aboulafia says the broad industrial base for composite production vanished when the Cold War ended and military orders for composites shrank. Compounding this, "new jets use not just composites but titanium to inter-

ATI is building an advanced specialty metals hot-rolling and processing facility in Brackenridge, Pa. For aerospace materials, the site is designed to produce titanium, titanium- and nickel-based alloys and specialty alloy flat-rolled products.



face with aluminum, and you have to ramp up fasteners too. That has been a problem in the past."

Fasteners are hardly simple commodities. They must be produced in different shapes, sizes and materials to do the specific jobs assigned to each.

The 787 uses plenty of carbon for composite production, but also more titanium than any other jet so far. "And it's getting the biggest production run of any widebody in history," Aboulafia observes. If availability is not a problem, pricing on titanium, nickel and nickel alloys might be.

"Can airframe OEMs get these metals at the prices they expect?" Aboulafia asks. He believes even Boeing may have a tough time getting the rate it wants from major suppliers like Precision Castparts. "One challenge might be to ramp up at the price you want."

Interestingly, the Teal analyst sees no challenge in what is arguably the most complex part of any aircraft, avionics: "Once you write the software, you just replicate it."

Still, crucial Tier 1 companies seem confident. Spirit AeroSystems has endured financial stress, layoffs and management changes, but thanks to its importance to the A350 supply chain, Airbus may acquire one of the supplier's French facilities.

But Spirit is still worth \$3.5 billion on the market. And it has a solid plan to support increases across all of its customers, especially on the 737, 787 and A320 programs, according to Don Harris, director of the Wichita-based operation's supply chain management. "We have an established cadence that integrates our internal operations and our external supply chain, ensuring we are all aligned on production rate increases," he emphasizes. Spirit is watching raw material and hardware production as build rates increase and new

aircraft transition from development to assembly.

Harris says the company has a strong logistics plan and is working with customers to continue providing quality products, on time.

So Spirit does not foresee any systemic problems in its portion of the supply chain. It focuses on sustaining product quality throughout its supply base and identifying any issues quickly. "We've been increasing production rates for quite some time and . . . have a good understanding of what it takes to support the increasing demand for our products," Harris says.

Similar confidence is felt in newly important specialty metals. "We have had this vision since 2006 and 2007, that there would be this ramp up in titanium, nickel alloys and super alloys," stresses Dan Greenberg, spokesman for Allegheny Technologies. "We feel we are prepared."

Allegheny has built facilities for a secure supply chain and is eager to reach high build rates. It has built a facility in Utah near the magnesium resources of the Great Salt Lake to ensure supplies of this ingredient in titanium processing. Greenberg says his company has done all it has been asked to do to prepare for the 787, A350, Rolls-Royce's Trent XWB series and the new engines for single-aisle jets.

On pricing, the Allegheny official says titanium costs were so high in 2007—the peak of global economic growth—that the company acted to stabilize prices. It integrated backward to titanium sponge, the porous titanium that is the first stage in processing the metal. "We have closed the loop on melt, remelt and reversion," Greenberg stresses.

Allegheny also integrated forward so it produces not just titanium ingots, but near-net shapes, very close to final part shapes and even finished titanium components.



Moreover, Greenberg says Allegheny Titanium Alloy 425, approved for aviation in 2010, will reduce the cost of making titanium parts. For the future, the company seeks only stable prices and a strong level of demand, which he points out are in everyone's interest. "We do not want peaks and valleys."

The market does not seem worried about supplies, at least now. In fall 2013, titanium-ingot prices were 25% below their late-2011 peak, and nickel prices were half their 2010 level.

Michael Lentini is distribution sales manager at Spirol International, which makes spring pins and shims. Lentini does not anticipate any supply chain problems for these fasteners as long as OEMs call for standard items. But problems might arise if OEMs go outside these standards.

One reason is that certification for military and aerospace fasteners is often extremely rigorous—demanding examination of the ore from which the metal was obtained, where it was smelted, the chemicals and oil used and an extensive paperwork trail. The paperwork can take longer and cost more than the actual making of the fasteners.

The fastener industry is moving toward more environ-

dramatically improving the initial engine build. The British company has set up a preproduction facility to handle all preparatory work, experiments and tooling for the XWB.

GE has taken a different approach than Pratt to improving engine efficiency. GE's Leap will actually ease pressure on markets for expensive metals such as titanium by replacing some metal parts with ceramic matrix composites (CMC). This novel technology has its own challenges, but GE will fabricate CMC in its own new plant.

There may be fewer composite manufacturers now than at the end of the Cold War, but survivors such as Spirit, GKN and Hexcel are high-tech enterprises and want to be high-volume. To be economical, the new capital-intensive composite-manufacturing techniques such as automated lay-down need big orders. So, as with Allegheny, this is a production surge suppliers have been panting for, not fearing. That does not mean everything will go right. Aircraft production is always complex and characterized by long lead times. Ali Bahrami, vice president for civil aviation at the Aerospace Industries Association, says extensive assessments are undertaken to

ensure all suppliers have the capacity and resources to match demand.

Assessments start with long-lead items, complex parts and those subject to tight tolerances. "Availability of certain raw materials may be an issue," Bahrami acknowledges. But he argues that OEMs and suppliers usually manage this material challenge.

An Airbus A350 composite fuselage panel is under construction at Spirit AeroSystems' facility in Kinston, N.C.

When pressed on where problems may crop up, Bahrami cites not a supply sector, but a process affecting many sectors. "Critical steps in quality-control checks and statistical analyses need to be evaluated and monitored to make sure quality is not sacrificed in favor of quantity," he says. "The cost of fixing a quality-escape or rework could be very expensive if the right checks and balances are not in place."

So the real challenge for the supply chain is producing a massive number of newly designed parts made of innovative materials on budget, on time and at the very high-quality levels demanded by commercial aviation. And this challenge can have a knock-on effect on aftermarket parts.

In the past, when production cycles hit their peak, suppliers favored production for new-aircraft manufacture, notes Richard Levin, managing director of A.J. Levin, a value-added distributor of specialty hardware and consumables for Airbus and ATR aircraft. At first, prices rise in the aftermarket and then "it becomes a capacity problem," he says. "Some OEMs tell us they can't supply us, we do not buy sufficient volumes."

Levin says the potential problem is most significant in fasteners. He sees no sign of it now, and is sanguine about the future. He notes that lead times can vary from 16-18 weeks at the trough to 52 weeks at the peak of a production cycle.

As far as remedies go, one is expensive. Levin can buy "deep," or stock bigger inventories. But he also tries to partner as much as possible with his suppliers, helping out when they run short of an item and hoping they will return the favor when he is short. "We try to be a partner, not just a customer." ☐



SPIRIT AEROSYSTEMS

mentally sensitive processes as standards, but aerospace and military customers sometimes require methods outside these standards, which creates special challenges and costs. Moreover, Lentini says, some aerospace orders require an extra 90 hr. of fastener preparation, adding to potential delays.

All of these difficulties can be handled with good planning. But Lentini observes, "[Fasteners] are always the last thing on the list [OEMs] think about." When everything else is ready, OEMs call for fasteners. A little more forethought would help.

But if supply chains problems do arise on the new jets, it will be despite the fact that, this time, major OEMs have probably prepared more thoroughly than ever for production increases. Airbus has centralized all procurement in one unit and built an electronic hub for collaborating with suppliers. Boeing has set up an organization dedicated to development of new aircraft.

Pratt may not have made new commercial engines in large volumes in a while, but it has been active in the aftermarket where supply chains can be tricky. To prepare for its ambitious geared-turbofan program, the company has been scrutinizing suppliers and reviewing their systems thoroughly. Scorecards and remedial clinics are used extensively.

And Rolls-Royce designed a virtual XWB on computers,

Additive, Action!

Jugs of metal powder are key parts of GE's future supply chain

Lee Ann Tegtmeier Cincinnati

If GE Aviation's use of direct metal laser melting is any indication of how additive manufacturing could radically change parts production and supply chains, the industry should be on alert.

GE has used additive manufacturing technologies over the years, but its purchase of Morris Technologies and Rapid Quality Manufacturing (RQM) in November 2012 provided a quantum leap into direct metal laser melting (DMLM), which it views as a disruptive manufacturing technology.

This technology, which builds up 3-D parts by depositing thin layers of metal powder over a grid—where

Direct metal laser melting precisely melts thin layers of metal powders to build up GE Aviation engine blades.

a computer-guided laser traces each part—melting and rapidly solidifying the powder into metal so the next 20-micron layer can be applied.

This may be a disruptive manufacturing technology—but the supply chain and aftermarket should take note because of the radical changes it could produce.

To understand why, consider how DMLM works from a rapid prototyping and manufacturing perspective.

First, the new product introduction process is faster because engineers test iterative designs quickly. "In the same six weeks that we can make one fuel nozzle, we can make a dozen or two dozen different nozzles with minimal additional efforts," which means engineers collect data on various designs simultaneously and test the envelope within the design space they are exploring, says Eli Liechty, manager of GE Aviation's Additive Development Center (ADC) and Additive Lean Lab.

The rapid prototyping process has allowed design cycle times—from producing a functional concept to advancing that part to a test cell—to plummet to six weeks from six months.

Besides being faster, this process does not require expensive tooling

because the test parts are literally being built in the same machines used to manufacture them.

Additive could radically expand the breadth and scope of repair, too. "We are looking at ways to further enhance our component repair business because additive gives us intrinsic benefits we can't get with conventional repair processes," says Liechty. "This additive process allows for more complex geometries with tighter tolerances and



finer detail resolution," so "we envision capturing a wide variety of parts that today we'd love to repair but don't have the technology to repair them," says Liechty.

The supply chain and aftermarket knows that the more that parts become complex, the more demanding the repair processes.

Besides the rapid prototyping and repair benefits that direct metal laser melting provides, part simplification is another major benefit. If you're looking to simplify a complicated part to manufacture, the fuel nozzle is a quintessential place to start, asserts Liechty.

For the CFM Leap-1A fuel nozzle, "we took what would have been a 20-piece design and reduced it to one," he says. "A 20-piece design would have been a combination of castings, forgings, machined-components that have to be brazed.

Those parts traditionally would come from multiple vendors that used various manufacturing processes—all with different lead times. Then there's



Tap the icon in the digital edition of *AW&ST* for more on GE's direct metal laser melting process, or go to AviationWeek.com/dmlm

the cost of bringing the material together—and storing it. That 20-piece part breeds a complex supply chain.

"Our inventory is a jug of powder," which certainly "leans" the supply chain.

With the additive technology GE has developed to control porosity, surface finish and density of parts, the additive material is stronger than cast parts in tensile, fatigue and cycle properties, says Liechty. And coupled with the inherent design benefits from additive, you simply get a more intelligent design.

The single piece that replaces those 20 contains multiple fuel and air passages. "With additive, because we don't have the same design constraints, we can manage the formation of those features in a more efficient way so we can better manage thermal stresses and mechanical loads," he says.

This translates to the Leap fuel nozzles that are

five times more durable than the conventional counterpart in the GENx, according to the manufacturer. And keep in mind the GENx is the company's first application of TAPS (twin annular pre-swirl technology) to better control emissions; Leap evolves from that.

"When you look at the requirements of the Leap program and expectation that this is the narrowbody platform of the future," says Liechty, "we couldn't have met the requirements with conventional means." To produce the long on-wing time requirements, additive was the only option.

Weight of the additive fuel nozzle is about 33% less than if GE built it with conventional methods. Liechty points out that there are 19 of these per engine in the Leap-1A, the Airbus version, and 18 in the -1B Boeing version.

Additionally, the spray pattern consistency has improved with this design, which increases the fuel efficiency in the combustor and the downstream turbine hardware behind it.

Liechty says the ADC is focused on

inventing additive parts and new applications. While he would not disclose the specifics, he says GE is experimenting with different engine parts and has proven that additive can reduce weight by 50-80%, “so that will be one of the long-term plays and benefits of additive as we leverage it across other components.”

Liechty predicts a huge demand for new super alloys that can sustain higher temperatures and components that will be larger.

Given that GE can't buy plug-and-play DMLM machines for what it is creating—it rebuilds and refines what it purchases from Electro Optical Systems—creating bigger components

is not a simple task. The chamber in which the metal disposition and laser melting occurs could be bigger, but the laser optics and related machine software need to evolve.

The additive revolution is not limited to machines—it also requires that engineers think outside of the box in their design approaches because the

Power Player

Intertrade's growth helps Rockwell Collins gain from aftermarket trends

Sean Broderick **Washington**

Intertrade, which facilitated the establishment of the airliner surplus parts supplier business four decades ago, has added engine parts to its portfolio, completing its evolution from a one-product specialist to a full-service used-components supplier.

Born in 1969 as a two-man shop refurbishing and selling Collins avionics, Intertrade has charted an increasingly familiar course in the surplus parts market. It spent 25 years focusing on avionics before delving into airframe parts, starting with Boeing 737 Classics. In 1999, Rockwell Collins snapped up Intertrade, joining the increasing pool of manufacturers recognizing the value of the aftermarket beyond supporting their own products.

Earlier this year, Intertrade quietly began offering engine parts to customers, breaking the news in a late April tweet offering CFM56-7B parts. Steady buying and stocking has created a sizable inventory, setting Intertrade up to formally announce its latest expansion by Nov. 1.

“We’ve grown our business significantly on the non-Rockwell Collins side, buying whole aircraft for teardown,” said Chris Rauch, Intertrade’s director. “We saw [engine parts] as just a natural extension of our strategy to continue along that growth path.”

The company’s airframe parts focus has been on current-generation narrowbodies, which are projected to play significant roles in the world fleet even after their replacements begin rolling off assembly lines. Intertrade’s engine strategy will follow suit, targeting Boeing 737NG and Airbus A320-family operators. Recent acquisitions include an ex-Meridiana Fly CFM56-5B, an ex-GOL CFM56-7B, an ex-Japan Airlines V2500-A5, and two V2500-A5s last operated by Spanair.

Intertrade has offered engine-related components, such as thrust reversers and cowls, for some time as part of its broader growth strategy. The company’s revenue mix now features 70% non-Collins products. While Rockwell Collins does not break out Intertrade’s financial figures, company executives had the subsidiary pegged to grow about 10% in 2013 based on figures compiled through three quarters of its fiscal year, which ended Sept. 30.

Adding engine parts should aid short-term growth, and

could help offset inevitable softness on the airframe side.

While there’s little doubt that the air transport serviceable parts market is booming, not all product lines ascend at the same rate. Surplus material made up about 10% of the \$11 billion parts market in 2001, according to consultancy ICF SH&E. Today, surplus parts account for 18% of a \$15 billion market, and the share could climb to 20% by 2015.

Engines, at 65%, claim the biggest slice of the surplus pie, largely because of the opportunity. Engine work takes up about 40% of the global maintenance, repair and overhaul (MRO) market, Aviation Week’s MRO Prospector shows, nearly twice as much as the next-largest category.

Components, which at 21% of the global MRO market rank second to engines in total spending, account for 30% of the surplus business, SH&E figures show.



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design and manufacturing rules are intertwined.

So while GE and Morris had worked together since the mid-1990s, being under the same corporate umbrella has allowed the former Morris businesses to evolve into new alloys, machines, processes and applications. It also provides the Additive Lean Lab with

more resources to focus on producing the Leap-1A fuel nozzles and working on its scalability to ensure a smooth entry into service.

The additive development work has been so successful that in less than one year after GE acquired the Morris businesses, their proven capabilities are propelling them, in essence, to

“becoming the hub of additive for all of GE, not just aviation,” Leichy says.

GE plans to make 30,000 Leap fuel nozzles by 2017, and 100,000 by 2020, so the ramp-up is steep. Expect more rapid additive development, and expect GE to announce in the next six months a new dedicated facility in the U.S. to manufacture the nozzles. ☛

Airframe parts—typically motor-driven systems like flaps—round out the balance. They also are the easiest to stockpile, because they typically last the longest. For surplus parts dealers, this point underscores the value of tapping the engine market.

One real-world example is Air Salvage International (ASI), which has parted out eight 737-600s and -700s in the past two years. The earliest jobs, which naturally came when fewer models had been parted out, yielded about 2,000 marketable parts per aircraft, says Bradley Gregory, ASI's commercial director. But as warehouses filled and some of the low-demand, low-wear parts were readily available, that figure declined. The latest jobs yielded about 750 parts that ASI expects to resell, Gregory says. In each case, the expected return-on-investment window is 12-24 months.



“On the first couple of NGs we parted out, the thrust reversers were fetching more than market value for a new part,” Gregory says. The long lead time for a new reverser drove the demand for serviceable used units, which often were spoken for before the retiring aircraft landed. Today, used 737NG reversers fetch about 25% of the new list price.

A steady high demand for engine parts helps insulate them somewhat from such volatility—as long as sellers can acquire inventory at reasonable prices.

In 2007, half of the surplus parts on the market came from airline or broker inventory, while the other half were harvested directly from aircraft, SH&E calculates. Now, the share of surplus parts being sourced directly from part-outs is about 82%. If you are dealing in used parts, “You have to get your hands on the aircraft themselves,” says Richard Brown, SH&E principal. Otherwise, “you are further down the food chain.”

Rockwell Collins is carving out a place high up the food chain, getting into every aspect of the surplus parts business except the physical parting out of the assets, which it continues to subcontract. Its engine division set up shop in a Boca Raton, Fla., industrial park. While part-outs will be the primary focus, Rauch says the company will not pass up an opportunity to lease out a flyable high-demand engine it acquires. “We’re looking at all different scenarios now.”

Intertrade's evolution has helped Rockwell Collins mitigate the negative impact of the surge in surplus parts demand.

Intertrade's support of current-generation narrowbodies, long focused on avionics and airframe components, now includes engine parts.

The company posted a 13% jump in commercial aftermarket revenue, to \$235 million from \$208 million, in its fiscal year 2013 third quarter that ended June 30. The air transport segment grew 17%, to \$128 million from \$109 million on the strength of higher spares sales and retrofits, such as cockpit display upgrades.

The company's aftermarket business is roughly split between “non-discretionary” spending, or traditional MRO work needed to keep aircraft in service, and “discretionary” spending, such as retrofits. Clay Jones, the company's former CEO who remains on its board of directors, said just before his July retirement that demand on the “traditional MRO” side of the air transport aftermarket is lagging as more—and newer—aircraft are scrapped. Jones added that the situation is expected to continue “for some time into the future.”

With an expanding Intertrade in its portfolio, Rockwell Collins is poised to gain from it all. ☛

Asset Manager

ILFC to sell minority stake in AeroTurbine to Lufthansa Technik

Lee Ann Tegtmeier **Chicago**

International Lease Finance Corp.'s (ILFC) purchase of AeroTurbine two years ago signaled a new sophistication in managing its assets. Lufthansa Technik noticed and is understood to be purchasing a 15% stake in AeroTurbine. Sources involved in the deal say the partnership will be announced this week.

The agreement, pending regulatory approval and typical closing requirements, includes AeroTurbine supplying a certain amount of material to Lufthansa Technik, Lufthansa

And because ILFC's fleet will continue to evolve, this pipeline will not shut down. Material will consistently flow into AeroTurbine's system.

This allows companies to buy used, serviceable parts, which often are a fraction of the price of new ones, in a very predictive way that satisfies operational requirements.

Lufthansa Technik's investment bolsters its fill rates of that serviceable material for its group of companies, and underscores its interest in developing a strategic alignment with ILFC, which

renewal to keep up with airlines' demands for more efficient aircraft, given the spiking costs of fuel. It regained access to substantial liquidity and started placing sizable aircraft orders.

As it planned for a younger fleet and identified the 250 aircraft for retirement, ILFC's executives came to the realization that to extract more value from the remaining life of the assets and be smarter about life-cycle management, they needed to implement a cradle-to-grave approach.

Enter the AeroTurbine acquisition from AerCap Holdings for \$228 million in August 2011. This launched ILFC, which is Airbus's largest customer and Boeing's biggest leasing company customer, into the part-out business and resultant inventory solutions, supply-chain and engine-leasing businesses.

The link-up has allowed ILFC and AeroTurbine to make joint sales calls



AEROTURBINE

Technik consigning surplus material to AeroTurbine, and AeroTurbine purchasing maintenance services from the German-based MRO, according to industry sources.

Expect the companies to take advantage of these reciprocal business opportunities immediately after closing.

The catalyst for ILFC purchasing AeroTurbine is really the same one that impelled Lufthansa Technik to invest in the company—the pipeline of about 250 aircraft that the leasing company has identified for retirement—and the resulting stream of material.

This pipeline helps to render the unpredictable surplus market predictable. Instead of procuring parts in the open market or on consignment, this flow of material provides AeroTurbine with the ability to chart which aircraft and engine serial numbers will be available—and when.

AeroTurbine benefits from the predictable pipeline of aircraft and engine parts coming from aircraft that ILFC retires.

is one of the largest leasing companies in the world, boasting more than 1,000 aircraft in its portfolio.

Prior to this agreement, Lufthansa Technik was a tactical customer of AeroTurbine products and services, but it did not have a contractual arrangement.

In a statement that will be released this week, ILFC CEO Henri Courpron says, "This new partnership is a first step in developing a broader relationship between Lufthansa Technik and ILFC" and "will further advance ILFC's strategy to provide complete aircraft life-cycle solutions to its customers."

Five years ago, ILFC was emerging from the 2008 financial crisis with a veritable financing and leasing services business—but a fleet that needed

for putting in and taking out aircraft—from initial spares provisioning for new aircraft to exit strategies for aircraft and spare inventories that operators no longer require.

And now add Lufthansa Technik, one of the largest, technologically savvy maintenance, repair and overhaul operations in the world, to its list of partners.

Courpron's vision of complete aircraft life-cycle solutions is becoming more clear—and Lufthansa Technik's investment is a sign that the strategy laid out two years ago with AeroTurbine is working.

If the forthcoming partnership meets certain performance targets, Lufthansa Technik will have the option to increase its investment to 19.9%. ☛

Touch and Go

Touchscreen, voice control, virtual co-pilots in future flight deck

John Croft Washington

Honeywell engineers and human-factors experts are investigating a range of new human-machine interface technologies including touchscreen displays, voice recognition systems and “assisted interaction,” a virtual co-pilot. Part government contract and part Honeywell internal research and development, the work is designed to lower workload and increase safety for pilots of next-generation transport and business aviation aircraft.

“We’re taking what we learn from these studies and putting it into a comprehensive approach to a next-generation flight deck,” says Andy Drexler, Honeywell’s director of marketing and product management for the cockpit systems group. “Our focus is on the pilot flying the aircraft, rather

design decisions,” says Drexler of the study, set to be completed in July 2014.

Early results from the study reveal that digital-resistive touchscreens placed on the center pedestal are optimal. “If you’re in a large flight deck of a high-end business jet or air transport aircraft, you’re used to interacting with your systems on the pedestal,” says Drexler. “From a pilot workload perspective, if you put touch there, that’s the best place for it.”

Honeywell came to that conclusion in part using pilots and a full-motion simulator fitted with a selection of 8-in. and 15-in. displays mounted at inboard, outboard, forward and overhead cockpit positions. The input method for the displays was either projected-capacitive (used on the iPad and other consumer devices) or digital-resistive. Along with qualitative assessments of the pilots’ workload, researchers used electromyogram measurements of muscle activity to gauge the pros and cons of mounting locations and touch technologies.

Although touch technologies such as infrared and projective-capacitive are popular in the consumer electronics market, Drexler says both are too risky for aviation in the near term due to concerns over “inadvertent touch” or difficulties caused by cold hands or pilots wearing gloves. Resistive touch requires pilots to physically push the screen and limits functions like pinch and zoom or swiping. “You’re going to have a pressure that has to be applied, more so than for a consumer device,” says Drexler.

A logical forward-fit application for touchscreens in the air transport sector would be as part of Embraer’s E2 upgrade for the E170/E190 regional jet, a 2018 time-frame refresh with a new Honeywell Primus Epic 2 integrated avionics and next-generation flight management system. Drexler will not confirm that Embraer has selected touchscreens for the E2, but he does say there are several unannounced platforms that will use the technology. In business aviation, a Honeywell touchscreen is a relative latecomer to the market. Garmin already has an infrared touchscreen controller available, and Rockwell Collins aims to certify digital-resistive touchscreen pilot displays for the Beechcraft King Air next year.

Beyond 2020, man-machine interfaces could include voice control and assisted interaction.

Drexler says voice control might be appropriate for high workload situations, for example calling up an approach plate rather than scrolling through menus to find it. To date, however, experience from the consumer world shows that voice commands are often misunderstood and recovery from an error can be difficult. Honeywell is researching vocabulary sets and building early prototypes of the technology, which it will demonstrate to customers on iPads or tablets. “We’ll go back and forth with customers, improving voice control until it falls out of the technology funnel or the customers say they’d like to have it,” says Drexler.

Research is also underway to bring artificial intelligence to the flight deck in a form Honeywell calls assisted interaction. “We’re not taking control from the pilot. But if there are abnormal situations that they’re not used to dealing with, the system could help guide them through the right set of procedures in the right sequence so that they’re able to respond safely,” says Drexler. “We might be able to get to the situation where the system becomes like a co-pilot.”



Due to safety concerns, Honeywell touchscreens initially will not use the projected capacitive technologies so familiar on consumer devices such as Apple’s iPad.

than managing automation. Ultimately, nobody went to flight school to become a programmer.”

The first technology to transition from the lab to the flight deck will be touchscreen displays, though specific avionics components or customers have not been announced. Honeywell has been testing a variety of display types and mounting locations in its crew interface motion simulation (CIMS) lab, in part for a two-year FAA contract aimed at “usability” assessments of certified cursor control devices and touchscreen controls. Usability in this case means determining whether certain combinations of display location and size, when combined with turbulence and touch technology, would cause pilots to make more input errors and take longer to perform tasks compared to traditional manual man-machine interfaces.

“The [FAA] will take the results into consideration for regulatory guidelines, and we’ll use it to inform our product

Raburn Returns



TITAN AEROSPACE

Self-described 'serial entrepreneur' takes on his next challenge: ultra-long-endurance unmanned aircraft

Graham Warwick **Washington**

He made a bold but flawed bid to create a new sector of aviation, and now very-light-jet pioneer (VLJ) Vern Raburn is returning to aerospace, assuming the reins of another start-up taking aim at a market that does not exist—yet.

Raburn, who founded VLJ maker Eclipse Aviation in 1998 and saw the company set a production record before he was ousted in 2008 as the company headed into bankruptcy, has been named CEO and chairman of Titan Aerospace, a New Mexico-based start-up developing solar-powered, high-altitude, ultra-long-endurance unmanned aircraft.

Titan is developing the Solara series of “atmospheric satellites,” aiming to fill the gap between conventional aircraft and satellites with solar-powered UAVs that could stay aloft at 65,000 ft. for up to five years.

The former Microsoft executive is taking over as CEO as the Moriarty, N.M.-based company is preparing to fly its first production-size prototype and embark on a major financing round aimed at venture capitalists. “This is what I do—start-ups with lots of risk and no markets,” says Raburn,

who describes himself as a “serial entrepreneur.” Titan was started four years ago in a loft in New York, “and now it’s time to get serious,” he says.

After a career involving leadership roles at software companies Microsoft, Lotus and Symantec, Raburn founded Eclipse to develop and manufacture the Eclipse 500, initially offering the twin-turboprop VLJ at just under \$1 million. After development delays caused by a change of engine supplier, deliveries began in January 2007. The company shipped 260 aircraft in just 17 months but, facing supplier and financial problems, Raburn resigned in July 2008 and the company later filed for bankruptcy protection.

The failure of on-demand air-taxi operator and Eclipse customer DayJet accelerated the manufacturer’s demise. But Eclipse’s assets were purchased out of liquidation and a new company, Eclipse Aerospace, began operations in September 2009, restarting production of the VLJ this year.

Raburn, meanwhile, says he became aware of Titan because the start-up is located “two hangars down” from where his sailplanes are based at Moriarty. The idea of atmospheric satellites

Raburn has been involved in more than 30 start-ups over the past 40 years.

is not new, having been pursued by AeroVironment with the hydrogen-fueled Global Observer and Qinetiq with the solar-powered Zephyr, but Raburn says Titan’s approach is based on combining off-the-shelf technologies.

“We don’t have to invent anything. It’s in how we integrate and operate it,” he says, citing lightweight carbon-fiber structures, high-efficiency solar cells, high-power-density batteries and miniaturized payloads. “This combination of technologies gives us a very lightweight aircraft with a really big span,” Raburn says, adding that this provides the area needed for solar energy collection and span loading required to withstand turbulence enroute to 65,000 ft.

Titan’s 50-meter-span (164-ft.) Solar 50 will carry a payload of around 50 lb., increasing to 250 lb. for the 60-meter-span Solara 60. Endurance will start at weeks, “and we will build up to months,” Raburn says. “We don’t know yet if it will go for years.” He cites uncertainty about how long components such as bearings will operate before breaking, or how many charge/discharge cycles that batteries will withstand. “We are learning a lot from the satellite industry,” he says.

The aircraft are being designed so new generations of higher-efficiency solar cells and higher-power-density batteries can be plugged in, extending endurance and increasing payload. “They are designed to be easily upgradable,” he says.

First flight of the Solara 50 is expected in late spring, and Titan plans a year-long test program while it works with the FAA on certification and prepares for production and operation. Certification is a major hurdle to be overcome. The FAA is only beginning to allow commercial operations by civil UAVs and is starting with systems already operated by the Pentagon. “The FAA is an issue, but we hope they will be ready,” says Raburn. “I am cautiously optimistic.”

Whether Titan’s business model will be selling UAVs or providing services, “we don’t yet—it could be either or both,” he says. “There is not a market there today, but we think there is going to be and that we fit into a slot that cannot be done with UAVs today.” ☛

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Aviation Week & Space Technology
October 28, 2013 VOL. 175, NO. 37 (ISSN 0005-2175)
Two Penn Plaza, New York, N.Y. 10121-2298

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- Nov. 26-28**—Autonomous, Unmanned Systems & Robotics conference, exhibition and demonstration. Rishon Lezion, Israel. See ausrexpo.com
- Dec. 5-6**—ACI International Aviation Issues Seminar. Washington. See www.aci-na.org/event/2421
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FAA Stalling on Small UAS Rules



It is rare that industries come to Washington begging for more regulation. But that is how we in the unmanned systems business find ourselves with respect to small unmanned aerial systems (SUAS). A notice of proposed rulemaking (NPRM) has been on the shelf for years. We need to move forward before a serious accident occurs.

The issue of how to safely integrate the myriad sizes and classes of UAS into the national airspace is complex. But it is clear that in at least one category, small UAS (under 55 lb.), we have a good idea how to start. The FAA convened a SUAS Aviation Rulemaking Committee, which had broad participation from many communities and completed its work in 2009. Many of us expected an expedited release of draft regulations. We are still waiting.

These regulations would impact three distinct communities. First are hobbyists, whose interests are represented by the Academy of Model Aeronautics. Since

“ We in the business are in a paradoxical situation: An airplane we operate in our jobs is essentially illegal but perfectly fine to fly in a schoolyard for fun ”

1936, the AMA has set voluntary safety standards for models under which hundreds of thousands of enthusiasts have flown millions of flight hours with an admirable safety record. The AMA takes the not unreasonable position that voluntary standards have worked so far, so modelers should be exempted from FAA regulations. They convinced Congress to include language to this effect in the FAA's 2012 reauthorization bill.

The second category is the “do-it-yourself drone” community, which comes more from computer and robotics enthusiasts than traditional aeromodelers. Chris Anderson, a former editor at *Wired*, estimates there are thousands of do-it-yourself drones in operation. Unlike traditional models, which are either free-flight or controlled by radio within the pilot's line of sight, these computer-driven aircraft literally have minds of their own. The third category comprises aerospace and defense companies, which includes everything from the industrial giants to garage startups.

Models fly under the FAA's Advisory Circular 91-57, issued in 1981. Everyone else needs either a special airworthiness certificate (experimental ticket), or a

certificate of authorization (available only to public entities), or must fly in restricted airspace. The effect of this is that commercial UAS users—and by commercial, we basically mean anyone in the private sector who is being paid to do this—are prohibited from operating UAS in the National Airspace. This covers everything from aerial photography and surveying to news reporting to communications relay to cargo delivery. The effect is that professional aerospace companies—which arguably have the most to lose from lax standards, and who are mostly likely to have established safety procedures, to follow the rules and to carry good insurance—are being punished, while amateurs operating on the fringes are allowed to operate more or less with impunity. The public, of course, cannot tell the difference.

This is a recipe for disaster. The current situation effectively encourages people to fly in quasi-legal activities, without uniform standards and with little or no enforcement. This is not the way aviation has achieved its enviable safety record.

Furthermore, the absence of FAA rulemaking encourages others to fill the vacuum and preempt the FAA. Dozens of states are either considering or have already promulgated rules impacting SUAS—a morass that the FAA will have to untangle when it finally steps up to its leadership role.

Many of us in the business find ourselves in the paradoxical situation: An airplane we operate in our day jobs is essentially illegal, but is perfectly fine if we head off to the local schoolyard as modelers and fly for fun. Activities should be judged on objective standards of safety, not on whether someone is being paid to do it.

The issue of privacy has muddled the drive for UAS safety regulation. My own belief is that many of the things that most concern privacy advocates, such as flying low enough to look in someone's window, may also be unsafe, and that effective safety regulations will go a long way toward addressing the privacy concerns. But the FAA must not allow such misgivings to stand in the way of implementing its primary charter. Its mandate is safety.

The history of aviation safety regulations is, sadly, one where rules are promulgated largely in response to accidents. We cannot, should not and must not follow this path on SUAS. Rules will evolve based on experience and practice, but we must start somewhere. The FAA should release the SUAS NPRM immediately so we can all get started. ☺

John Langford is a longtime aeromodeler and the founder and CEO of Aurora Flight Sciences Corp.

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