ShowNews

DAY 3

AVIATION WEEK & SPACE TECHNOLOGY / AIR TRANSPORT WORLD / SPEEDNEWS

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Farnborough Airshow

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VOLGA-DNEPR: Specialist cargo company Volga-Dnepr Group finalized an agreement for the acquisition of 20 747-8 freighters here yesterday. The aircraft have a list value of US$7.58 billion. Signing the deal were (l to r) David Joyce, president & CEO of GE Aviation; Stanley A. Deal, SVP of Boeing Commercial Aviation Services; Alexey Isaykin, president of Volga-Dnepr Group; Denis Ilin, EVP of Airbridge Cargo Airlines; and Ray Connors, president & CEO of Boeing Commercial. —Page 6

Orders Here Top $54 Billion

Just when you thought the backlog of orders for commercial aircraft could get no larger, a torrent of new deals emerged here yesterday with the ferocity of the cascading water of Monday afternoon.

Orders for a total of 478 firm sales and 38 options for commercial aircraft were announced during the first day of the show, for a total of US$54 billion; we list them all on page 8, along with orders for engines to power the new airliners.

The largest deal was by AirAsia for 100 Airbus A321 neos, worth US$12.44 billion, as he upgrades to larger aircraft. —Page 8

CFM International celebrated the 30,000th production CFM56 engine here yesterday. In the 35 years that the engines have been produced, CFM has delivered more than 9,860 to Airbus and more than 17,300 to Boeing. The company plans to produce 1,700 engines this year.

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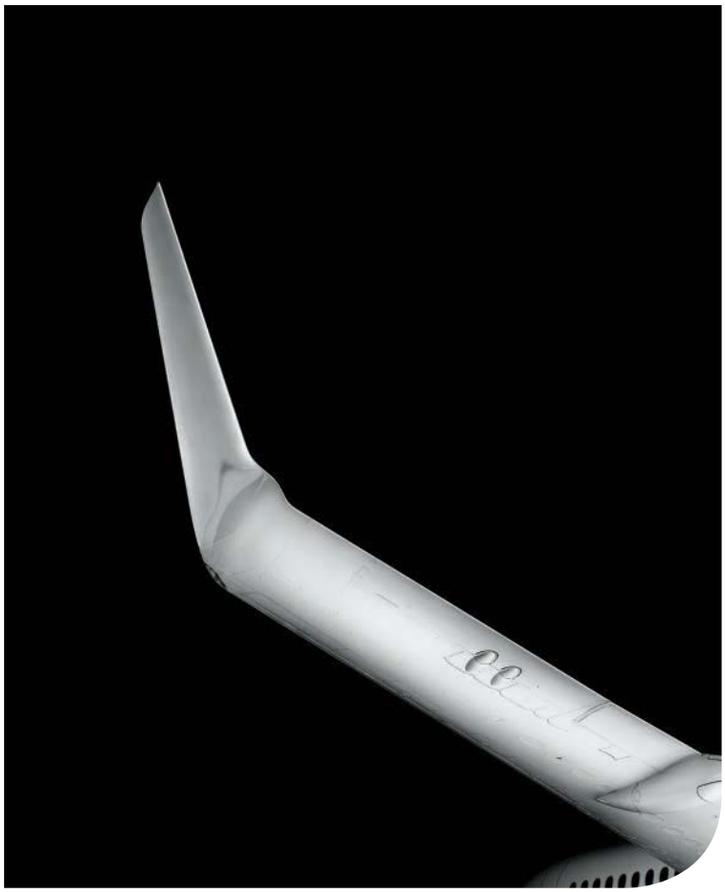

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Boeing Bides Its Time

Boeing chairman and CEO Dennis Muilenberg says the company is getting "a lot of customer feedback" on the so-called middle-of-the-market aircraft but believes the company still has "time to decide."

Boeing chairman and CEO Dennis Muilenberg

After the 777-9... the 777-10? the 777X? the 777-10X?

Muilenberg told reporters at the Farnborough Airshow that Boeing is evaluating three scenarios: continuing to rely on the Boeing 737 MAX and the 787, adding new derivatives of the MAX such as the proposed -10X, or going for an all-new aircraft. If Boeing added an all-new model to its portfolio, the aircraft would be planned to enter service around 2024 or 2025. "We are not stacking up multiple programs on top of each other," Muilenberg said, referring to the ongoing work on the 737 MAX and 777X. He refused to reveal what option he preferred.

While Boeing is still confident about demand for narrowbodies and is still oversold even at the target production rate of 57 aircraft per month, Muilenberg is noticing "some hesitancy in the widebody market" driven by slow trade and cargo weakness. He still expects a book-to-bill ratio of "about one," but orders timing was "sometimes hard to predict." Boeing plans to deliver some 750 aircraft this year. "But building order backlog is not my big worry this year," he said.

Muilenberg conceded that Boeing is still "in the middle of building the bridge" in production from the current version of the 777 to the 777X, "but we still have work to do. We realize that it is a very real risk." Muilenberg pointed out that it is important to align supply with demand while not concretely hinting at potential further production cuts for the 777 line.

Boeing has announced a rate cut for the 777 from the current 8.3 aircraft to seven in 2017. By contrast, Muilenberg pointed out that "the 787 skyline looks healthier" and says a rate of 12 aircraft per month "is sustainable."

The Boeing chairman and CEO confirmed "some customer interest" in a potential 777-10X. "We have full capability" to stretch the aircraft, he said. "The 777X was created with growth in mind, but we don't need to make a decision now." If Boeing was to make the 777 even larger, "it would be a relatively simple stretch," Muilenberg stated.

—Jens Flottau

Aviation Week, Chinese Partners Celebrate

AVIATION WEEK'S MEDIA partners in China helped celebrate the magazine's 100th anniversary here yesterday, while celebrating milestones of their own. *International Aviation,* China's oldest aerospace magazine, was launched 60 years ago, and *China Aviation News* 30 years ago.

Aviation Week and *International Aviation* have been partners since 1987, and the two have also jointly produced the bilingual English-Mandarin *ShowNews* at major aerospace shows in China for nearly 20 years.

Exchanging framed anniversary covers were (l to r) John Morris, editor-in-chief of *ShowNews;* Lance Xie, SVP of China Aviation News; Iain Blackhall, managing director of Aviation Week; Greg Hamilton, president of Aviation Week; and Robert Xiao, chairman of China Aviation Media Group.

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747-8 Lifeline Order From Russia

Specialist cargo company Volga-Dnepr Group has finalized an agreement for the acquisition of 20 747-8 freighters, underpinning the Russian operator's confidence in the future recovery of the air cargo market and providing a much-needed lifeline to Boeing's beleaguered 747 production line.

The carrier, which has already taken four of the aircraft announced in the package, was the first to order the 747-8 freighter in Russia and took delivery of its first aircraft in 2012. Boeing says the newly ordered aircraft will support Volga-Dnepr's long-term strategy to grow the fleet of subsidiary AirBridgeCargo Airlines and replace current 747-400s. The new aircraft will be acquired through a mix of direct purchases and leasing over the next six years.

Boeing also signed an agreement with the AirBridgeCargo and Volga-Dnepr Airlines to provide long-term logistics support for 747-8 and Antonov 124-100 freighters. "Boeing and Volga-Dnepr Group will also enter into an agreement to look at future services opportunities," adds the manufacturer.

The deal at Farnborough is a follow-on to an initial agreement signed at the end of March under which Volga-Dnepr agreed to take four aircraft on lease and order a further 13. These were not listed in the order book at the time, as financing had still to be negotiated. It is not yet known whether any of the Volga-Dnepr aircraft will be 747s previously deferred by other carriers such as Atlas, or unsold aircraft already built.

Boeing, which is in the process of slowing down the 747-8 production rate to 0.5 per month, has at least one 747-8 that was previously unsold in 2016 so far. Until the Volga-Dnepr contract was finalized, Boeing also expected to have another three unsold new 747-8Fs on its hands by the end of 2017, and the revised deal is believed to reflect the sale of these additional aircraft.

Bloodhound, the British land-speed record contender, is seen being unloaded from the cavernous gaping maw of a 747-8F operated by CargoLogicAir, a new UK cargo airline unit of the Volga-Dnepr group.

The decision to reduce production rate from one per month to the new rate reflects the continuing slowness of the cargo market. Boeing plans to accelerate the rate back to one per month again in mid-2019 based on forecasts of a solid market recovery in coming years.

—Guy Norris

Rockton Aviation Signs LoI for Up to 20 MRJ90s

MITSUBISHI IS CLOSING in on its first European order after Swedish regional aircraft leasing specialist Rockton Aviation signed a letter of intent (LoI) to take 10 Mitsubishi MRJ90s and options on a further 10.

Rockton Aviation is a Stockholm-based operating lessor that launched in 1998. It has a fleet of 28 Bombardier and Saab turboprops, placed with UK regional operators Eastern Airways and Loganair, Swedish regional Braathens and Norwegian regional Widerøe.

It started negotiations for the Mitsubishi order last fall and, if firmed, will start receiving the aircraft in 2020.

"We haven't had any in-depth discussions with our customers about the MRJ yet because we didn't have any aircraft on order," Rockton president Niklas Lund said, announcing the LoI at the Farnborough Airshow. He added that, if firmed, the MRJs will most likely be placed with European operators.

Mitsubishi Aircraft Corporation president Hiromichi Morimoto, Rockton Aviation president Niklas Lund, and Mitsubishi Aircraft sales and marketing VP Yugo Fukuhara.

Beyond the MRJs, Lund said Rockton plans to increase its fleet by 10-15 aircraft over the next couple of years. These will be a mix of regional jets and turboprops.

Rockton selected the MRJ90 because of its "clean sheet" design, passenger comfort, modern flight deck and operating efficiency. The lessor has the option to switch to the smaller MRJ70 variant if needed.

Mitsubishi Aircraft Corp. president Hiromichi Morimoto said he hopes to finalize the Rockton order within a couple of months. He added that he is closing in on firming a previously announced letter of intent with Aerolease covering 10 MRJ90 orders and 10 options. "We have almost finalized it, and I think we will be able to announce that soon," he said.

The first MRJ90 is due to be delivered to launch customer All Nippon Airways (ANA), which has 15 aircraft on order and 10 options, in mid-2018.

Mitsubishi has accumulated orders, options and purchase rights for 407 MRJ90s to date, excluding the Aerolease and Rockton LoIs. If firmed, this would take it to a total of 243 orders with 180 options and 24 purchase rights.

—Victoria Moores


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Airliner Orders Roundup

By close of the show Tuesday, announced orders and commitments for airliners totaled 478 firm sales, plus a total of 38 options, letters of intent and memoranda of understanding.

- Air Asia: 100 A321neos, list value US$12.44 billion.
- Air Lease Corporation: Six B737 MAX 8s, list value US$660 million.
- Air Côte d'Ivoire: One A320neo valued at US$107.3 million.
- Arkia Israeli Airlines: Four A330-900neos valued at US$1.15 billion, plus LoI for six E195-E2s, plus four purchase rights, total value US$650 million.
- AWAS: 10 A320ceos, list value US$1.06 billion.
- China Aircraft Leasing: 60 ARJ21-700s, list price US$2.3 billion.
- Donghai Airlines: 25 737 MAX 800s valued at US$2.75 billion, plus five Dreamliners valued at US$1.323 billion.
- Germania Group: 25 A320neos, plus 15 options, total value US$2.7 billion.
- GoAir: 72 Airbus A320neos, list price US$7.65 billion.
- Gulf Air: 10 787-9 Dreamliners firm, plus six options, firm order list value US$2.646 billion.
- Japan Airlines: One E190-E1 valued at US$49.75 million.
- Jetstar Pacific of Vietnam: MoU for 10 A320ceos valued at US$980 million.
- Kalstar Indonesia: Five E190-E2s valued at US$275 million, plus rights for five more.
- Kunming Airlines: MoU for 10 737 MAX 7s, list value US$902 million.
- Nordic Aviation Capital: Four E190-E1s valued at US$199 million.
- Porter Airlines: Three Bombardier Q400s valued at US$93 million.
- Rockton Aviation: LoI for 10 MRJ90s valued at US$473 million.
- Standard Chartered Bank: 10 737-800 NGs for unnamed customer, value US$960 million.
- TUI Group: 10 737 MAX 8s, list value US$1.1 billion, plus one 787-900 Dreamliner, list value US$264.6 million.
- Unnamed Chinese customer: 30 737 MAXs and NGs.
- Virgin Atlantic: 12 A350-1000s, list value US$4.2 billion, plus four leased.
- Volga-wDnepr: 20 B747-8 Freighters, list value US$7.58 billion.
- WOW Air Iceland: Four Airbus A321s, list value US$455 million.
- Xiamen Airlines: MoU for 30 737 MAX 200s, list value US$3.39 billion.

Engine Orders

- Air Lease Corporation: CFM LEAP-1Bs for B737 MAXs, value US$150 million.
- AWAS: CFM56-5Bs for A320ceos, value US$320 million.
- Gulf Air: RR Trent 1000s for B787-9s, value US$900 million.
- TUI CFM International: LEAP-1Bs for B737 MAXs, value US$200 million.

AirAsia Orders 100 Airbus A321neos

AIRASIA ON TUESDAY at the Farnborough Airshow signed a firm order for 100 Airbus A321neos, in a bid to cope with slot scarcity in Asia and at a time when exuberant group CEO Tony Fernandes believes the carrier has weathered a period of uncertainty. Deliveries are scheduled to start in 2019.

"We want to maximize our slots," Fernandes says. He referred to an airport infrastructure problem that is taking place "everywhere in Asia," specifically mentioning China, Indonesia, Hong Kong and Phuket, Thailand. "Low-cost carriers have exploded growth and airports have not kept up," Fernandes asserts. It will take another five to six years, at least, for them to catch up, in his view.

AirAsia expects the 50 additional seats the A321neo provides (over the A320neo) are the solution for now. The company is planning on maintaining a 25-min. turnaround time.

Fernandes predicts his company's annual passenger traffic will grow from 60 million to 100 million "in the not-too-distant future," notably thanks to the type. Each of AirAsia's neos will seat 236 in a single-class configuration. The engine has not been chosen yet, but Fernandes, alluding to the already ordered 300 A320neos, notes he has not picked Pratt & Whitney turbofans.

He praises Airbus executives for having accepted to defer some deliveries in the recent past. "Fabrice [Brégier, Airbus' CEO] believed in us at a time when many people were writing AirAsia off," he says. Since, the load factor has improved. It rose by 8 percentage points to 85% in the first quarter, compared to the same period last year.

Therefore, AirAsia will next year be back to its "usual growth of 15 aircraft per year." Deliveries may be twice as fast, as they will feed both addition and replacement.

In India, Fernandes is hoping a changing regulation will prompt traffic growth and thus a further aircraft order. "We are growing the market; there is a massive potential in connectivity between secondary airports," he says.

The airline is gearing up to start operations in Japan by January.

Overall, it is betting on ASEAN countries gradually moving to open skies policies. Fernandes wants to make the most of that hoped-for trend, "not by flying from Beijing, Shanghai or big metropoles" but rather by developing secondary routes.

—Thierry Dubois

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Quebec Premier: 'Not a Cent of Subsidy' in C Series

A US$1 billion investment in Bombardier's C Series program by the government of Quebec has shored up the program's shaky finances and in turn helped secure crucial C Series orders from Air Canada and Delta Air Lines. But Bombardier's competitors are taking a close look at whether the cash infusion to the Montreal-based company is compliant with World Trade Organization (WTO) rules. Philippe Couillard, the premier of Quebec, sat down at the Farnborough Airshow with Aviation Week editor-in-chief Joe Anselmo.

Aviation Week: The province of Quebec is putting up US$1 billion for a 49% stake in the C Series program. Why?

Couillard: In the market segment that they chose, 100-150 seats, the C Series is a game changer. We just could not afford for it not to succeed.

How do you make this investment and keep it WTO compliant?

There is not a cent of subsidy in this government intervention. It's equity and warrants, similar to what any other investor would have done. I know competitors will not be very happy, but I challenge anyone to find anything [that would indicate this is not a] typical commercial investment.

Will this be a long-term investment?

We're not there for speculation or flipping what we have. We want to make sure it's going to be very successful. Eventually another player could come in, who knows, but we're going to stay as long as is needed to keep the program active. They have 370 firm orders and enough liquidity, with this help and the money they put in the program, to take it to completion and deliver all the airplanes that are on the books now.

Quebec Premier Philippe Couillard (left) with Bomabrdier's Alain Bellemare aboard the SWISS CS100 here Monday.

"The C Series is a game changer," says Quebec Premier Philippe Couillard.

Quebec is buying a stake just in the C Series program, not the entire company.

We are concerned about supporting jobs and innovation in Quebec. We're very happy that Bombardier is making trains in Europe, but at the end of the day what's going to bring added value to our economy is the aerospace industry. The C Series is probably the largest and most promising innovation project in Canada right now – across all sectors.

Will the Quebec government play any role in the management of the C Series program?

We will have people on the board – we will designate two people out of five. Three will be designated by Bombardier, including the chair.

Bombardier is talking with the federal government in Canada about another investment, but you said the C Series is set now financially.

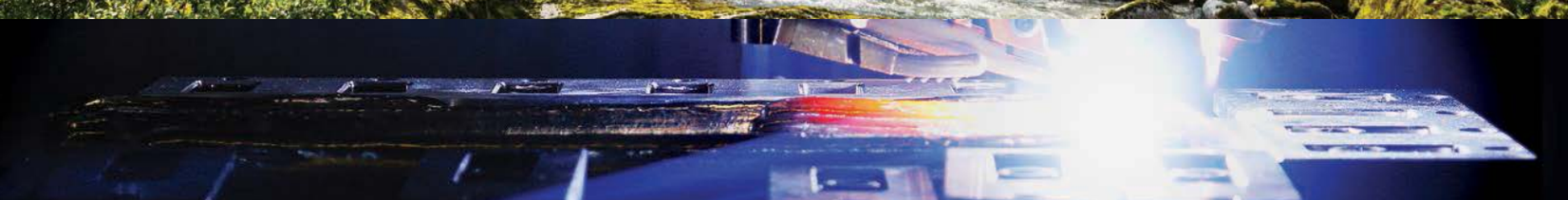
Bombardier is OK in the short- and mid-term. What they need is more flexibility longer term if they want to add more programs, or if they win many more orders. This is why the federal intervention would be helpful. But the survival or the longevity of the program does not depend on federal money now that we have intervened.

Is there an agreement to keep a certain number of jobs in Quebec?

We have an agreement to keep engineering and assembly of the plane in the Montreal region. Also, with the Air Canada order, a center of maintenance will be set up in Quebec. The jobs attached to the C Series program are going to be protected and probably increased with the new orders that they are taking.

The Delta and Air Canada orders were pretty big, but with the Delta order in particular they had to sell some airplanes at a loss to get some market traction.

No other commercial airplane program has done differently. Any commercial airplane that has been developed in the world, including Boeing and Airbus, had to carve a place for themselves in the market. You negotiate hard, but you want to sell planes. As time goes by, my expectation is that we – the Quebec taxpayers – will make a profit out of this investment.



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Ontario: The Other Half of Canadian Aerospace

Two of Canada's provinces have significant involvement in aerospace, but it is Quebec that has made the headlines of late – in no small measure because of its financial bailout of the Bombardier C Series. Restoring the balance, Ontario is well represented at Farnborough this week, through the presence of the Hon. Brad Duguid, minister of economic development and growth.

Bombardier is also significant in Ontarian industry through what was the old de Havilland plant, as well as in the company's land-transport interests. Perhaps less well known is the extent of other companies' involvement, drawn by the fact that, in Duguid's words, "Ontario has the best talent in North America for innovation."

The Hon. Brad Duguid

"We are seeing significant interest internationally," he adds, "and already have 15 of the world's 25 aerospace companies in Ontario. The other 10 better get there quick."

But there is no room for rivalry between the two provinces. "We work closely with Quebec," says the minister, "because of the significant and growing supply chain. For example, Ontario companies contributing to the C Series."

And encouraging the next wave of investors is a ministerial responsibility discharged at air shows. Says Duguid, "Lots of companies have tangible plans to invest in Ontario. There is CA$500 million (US$382 million) in the pipeline before the end of the year."

—Paul Jackson

Turkish Chamber Orders New 328s

Istanbul Chamber of Commerce has signed a letter of intent (LoI) at the Farnborough Airshow to buy 10 TRJ328s, the updated, re-engined version of the former Dornier 328 regional jet that Turkey intends to use as the basis of a commercial aircraft industry.

When it announced the program at last year's Paris Air Show, the Turkish government said it intended to build updated versions of both the turboprop and jet versions of the 32-seat Dornier 328 as stepping-stones toward the creation of a clean-sheet 60- to 70-seater known as the 628. This will also be built in turboprop and turbofan versions.

The Turkish government has ambitious plans for a new TRJ723.

The latter aircraft has recently been renamed the TRJ723, as the design will be finalized by 2023, the centenary of the modern Turkish state.

The Chamber of Commerce intends to use its aircraft, which will be delivered in 2021-22, as "proof of concept" aircraft to encourage existing or new airlines to buy into the 328 project, which envisages a network of routes between secondary and tertiary Turkish cities.

At present, most domestic Turkish flights go via Istanbul, resulting in lengthy, inefficient journeys between city pairs that are relatively close together. The government believes that instituting a network of regional air services will stimulate the economy.

No value for the latest order has been released.

The 328 is designed to be capable of operating from grass or gravel strips and into locations with very limited infrastructure. **—Alan Dron**

Airbus Creates 'Services by Airbus'

With the world's airline fleets due to boom over the next 20 years, Airbus is predicting a similar jump in the requirement for support services.

In its first Global Services Forecast, the European airframer believes that the world commercial aviation aftermarket services market will be worth US$3 trillion over the next two decades. The bulk of that – US$1.8 trillion – will be accounted for by MRO services, growing from US$53 billion in 2015 to US$132 billion by 2035, at an average of 4.6% annually.

The demand for training will also be huge, with an anticipated 562,200 pilots and 540,500 technicians required to operate and maintain the world's growing airline fleets.

Airbus has created a business unit, Services by Airbus, to address customers' needs in the aftermarket arena, based on four pillars – maintenance, training, upgrades and flight operations. Its subsidiary Satair Group will handle the MRO materials sector, providing spare parts to both airlines and MRO operators, while its Flight Hour and Total Support Package services will provide availability and maintenance "by the hour" solutions.

Its upgrade services group will retrofit aircraft with aerodynamic enhancements such as the company's Sharklets wingtip devices, avionics and cabin revamps.

Even the newest aircraft will require maintenance and support.

Its training operation is expanding steadily, said Laurent Martinez, SVP of services for Airbus, at the Farnborough Airshow, with recent or imminent openings in Jakarta, New Delhi and São Paulo. **—Alan Dron**

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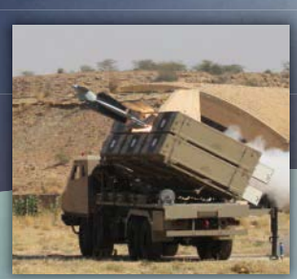

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ATR CEO Proposes Re-Engining, New 100-Seater in Sequence

In an effort to overcome different approaches of the company's shareholders, ATR CEO Patrick de Castelbajac is proposing a sequence of initiatives that includes re-engining of the ATR 72 and ultimately a new 100-seater.

ATR CEO Patrick de Castelbajac

"Leonardo wants a 100-seater and Airbus is favoring a stretched ATR with a new engine," de Castelbajac said at the Farnborough Airshow. "I am trying to get the two to converge." One way to reconcile the differing views and address market needs is to do both things. "We could re-engine the current platform to bridge some years and then launch a 100-seater," de Castelbajac said. "A two-step approach could make sense."

ATR has entered discussions about providing a new engine for a larger version of the ATR with both Pratt & Whitney Canada and General Electric. De Castelbajac said the current PW127M engine was still "doing a good job, but it is old." ATR therefore is hoping a new powerplant could deliver at least a 15% improvement in fuel burn and a 25% reduction in maintenance costs. The fuel burn improvement could even be higher with some aerodynamic changes the company is considering.

"GE is quite eager to get into the regional market," de Castelbajac said. Providing a new engine to ATR could be its opportunity to address the segment. "We have two valid proposals on the table," de Castelbajac said without disclosing further details.

Discussions about the new 100-seater are "still not very advanced" because of the ongoing lack of clarity about ATR's future shareholder structure. The company is 50% each owned by Leonardo and Airbus Group. De Castelbajac does not expect any "significant change in the shareholder structure" over the next few months and is unsure when a decision could be made. Leonardo has made clear that it would take full control of the joint venture, but Airbus Group has not agreed to sell its stake. One of the motivations not to sell could be using the ATR as a platform for hybrid technology later, de Castelbajac said. Its slower speed and range would make it "ideal" as a testing platform for the technology, he pointed out. But there are no discussions about the applications at this stage, the ATR CEO said.

He conceded the start into the year has been "very slow." He stressed that the "volatility of fuel was bad for us," as was the strong U.S. dollar. A key order for 20 aircraft from Iran Air has not yet been finalized because the relevant licenses are still missing. De Castelbajac hopes ATR can achieve a book-to-bill ratio of one this year. The manufacturer plans to deliver some 90 aircraft in 2016. It has a backlog of roughly three years of production, and de Castelbajac "would like to keep that."

—Jens Flottau

Causeway Aero Takes Flight at Farnborough

Northern Ireland Department for the Economy Minister Simon Hamilton has welcomed the launch of Causeway Aero, a new local collaboration in aerospace, during a visit to FIA 2016.

Causeway Aero will bring together BASE, Denroy Plastics, Moyola Precision Engineering, Dontaur Precision Engineering and Hutchinson AeroTech under one brand to offer a full design and manufacturing solution for international aerospace companies.

"Causeway Aero brings together the combined skills, capabilities and experience of a number of our local aerospace businesses to pursue larger and more complex work packages in the global aerospace industry," Minister Hamilton said. "This exciting new venture aligns with the Northern Ireland Aerospace Partnering for Growth Strategy, where local companies are committed to doubling the size of the aerospace sector to GBP2billion [US$2.6 billion] sales annually and increasing employment from 8,000 to 12,000 by 2024."

Marking the launch of Causeway Aero here are (L to R): Mark Hutchinson, Hutchinson AeroTech; Northern Ireland Economy Minister Simon Hamilton; Mark Semple of Moyola Precision Engineering; network facilitator Paul Shields; and John Rainey, of Denroy Plastics.

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GE Pushes Military Engines Technology

GE Aviation's win of a US$1 billion contract to develop a sixth-generation variable-cycle fighter engine is seen as a crucial next step in the future of its US$3.7 billion military engine business.

The Adaptive Engine Transition Program (AETP), awarded by the U.S. Air Force Life Cycle Management Center's Propulsion Directorate to design, develop and test a next-generation, variable-cycle combat engine, will give GE Aviation the opportunity to power sixth-generation Air Force and U.S. Navy fighters as well as to potentially re-engine Lockheed Martin's F-35 Joint Strike Fighter.

Rival Pratt & Whitney won a similar award, but this keeps GE Aviation in the game on future-generation combat aircraft after losing to Pratt to power the F-35 and the Air Force's new B-21 bomber.

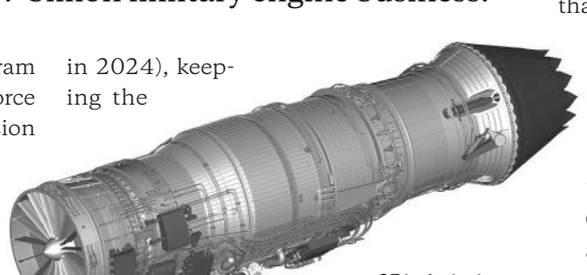
"This is extremely important to us," says Jean Lydon-Rodgers, VP and general manager of GE Aviation's military systems. "We have already demonstrated the highest-ever combination of pressure and temperatures in a jet engine" running up to the award.

The engine will not only bring variable-cycle technology but also a third stream of air that acts as a heat sink. It could solve many of the operational issues in today's F-35 fighter as well as help define future combat aircraft, she says. The 45,000-lb.-thrust-class engine could be ready for flight tests in an F-35 in the 2019 timeframe, should the Air Force decide to do so, she says.

New technologies in the engine include 3-D additive manufacturing and ceramic matrix composites whose manufacturability is being de-risked in GE Aviation's commercial engine business, Lydon-Rodgers says. It is the first engine to contain rotating parts made of ceramic matrix composites.

"Pressures and temperatures are significantly more demanding than commercial," she notes. "We've had a history of developing military technologies and putting them into commercial; now commercial is coming into advanced military, with a more mature design and manufacturing learning curve. We will advance all of this and eventually bring it back to upgrade our commercial engines."

Meanwhile, GE Aviation's fighter engine business is scoring new wins in the international arena with the F404/414 family, for which there is no direct competitor. The engine has been selected to power Korea's 120-aircraft KF-X program (entry into service in 2024), keeping the production line going through 2032.



GE is designing, developing and testing a next-generation, variable-cycle combat engine, to power sixth-generation U.S. Air Force and U.S. Navy aircraft under AETP, the USAF's Adaptive Engine Transition Program.

"Five years ago we were looking at the sunset for this engine," says Lydon-Rodgers. Since then it has also been selected for Saab's Gripen E, and the F404 for India's Light Combat Aircraft Mk.2. Other opportunities include the KAI-Lockheed Martin T-50-based contender for the U.S. Air Force's TX trainer program, and a potential upgrade of the F414 for the F-18 Growler with 3-D aero, a new six-stage compressor and advanced materials to bring 18% more thrust and fuel efficiency and greater durability and reliability.

"The Growler needs more power to enhance the whole weapons system," says Lydon-Rodgers. "This upgrade would [yield] a two-times improvement in power extraction," and could be developed in five years from go-ahead. It has been, she noted, one of the highest-priority programs in the U.S. Navy to remain unfunded.

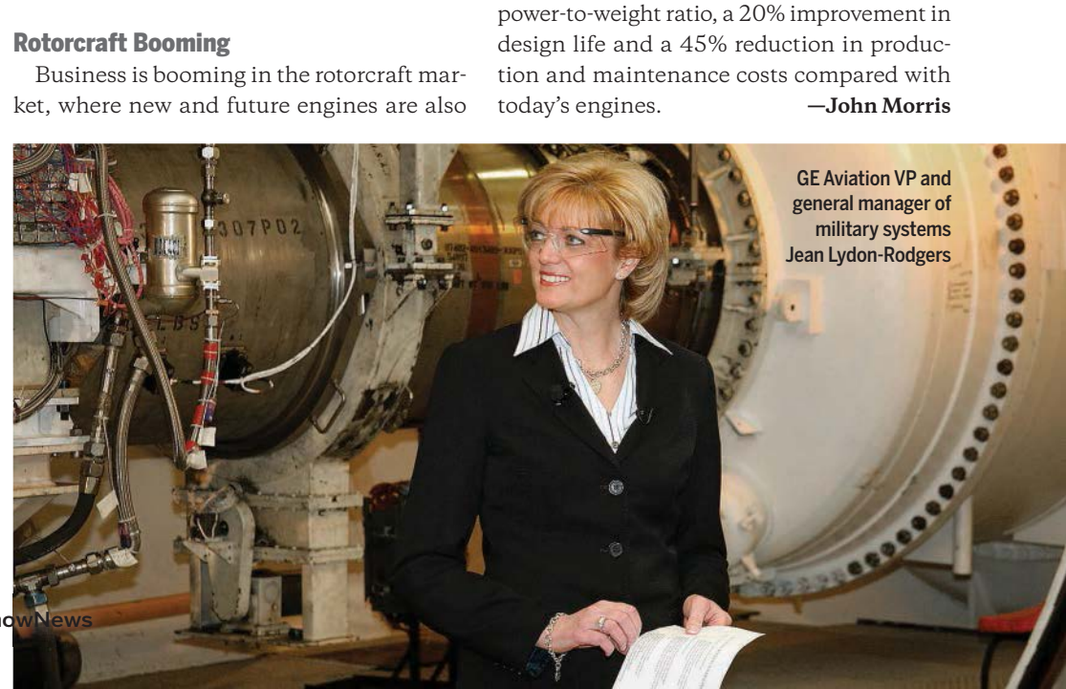
Rotorcraft Booming

Business is booming in the rotorcraft market, where new and future engines are also incorporating the latest technologies and materials, says Lydon-Rodgers. The company is developing a range of turboshaft engines that bracket 3,000 to 10,000 shp to cover almost all future military vertical lift requirements, and potential commercial applications too.

They are:

- T408. Developed as the GE38, this 7,500-shp engine powers the Sikorsky CH-53K. "With over 4,500 hr. of ground and 700 hr. in flight testing, this is one of the best-executed programs I have ever seen," she says. Low-rate initial production (LRIP) has just begun, and entry into service will be 2019.
- ITEP (improved turbine engine program). Also known as the GE3000, this 3,000-shp-class engine is GE's bid to meet the U.S. Army's requirement for a drop-in replacement for the T700 that powers the Black Hawk and Apache helicopters. A winner-takes-all contract is expected to be awarded this fall. "Development is meeting all expectations," says Lydon-Rodgers, with a demonstrator engine completing its second test. The GE3000 will have 25% better fuel economy, 20% longer life and 65% more power than the T700.
- FATE (future affordable turbine engine). The first engine in this 10,000-shp development program will go to test this September. "The technologies are very far reaching," Lydon-Rodgers notes. "This engine has the highest compression ratio on a single-spool design in GE's history, in excess of 27:1, and its technologies can be scaled right back through the GE3000." Goals are a 35% reduction in specific fuel consumption, 80% better power-to-weight ratio, a 20% improvement in design life and a 45% reduction in production and maintenance costs compared with today's engines.

—John Morris



GE Aviation VP and general manager of military systems Jean Lydon-Rodgers

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Scorpion in Line for UK Training

Textron Airland's Scorpion light attack aircraft may be used for ASDOT, the UK defense ministry's Air Support to Defense Operational Training program, following an agreement signed here Monday.

A consortium of QinetiQ and Thales have chosen Textron Airland's Scorpion light attack aircraft as the platform for its bid into a major UK live flying training program.

The companies want to offer the Scorpion the UK defense ministry's Air Support to Defense Operational Training (ASDOT) program.

CEOs from the three companies signed a memorandum of understanding at the Farnborough Airshow on July 11. The ASDOT requirement will see the selected commercial operator deliver red air and electronic warfare (EW) training across the UK armed forces, replacing a number of individual contracts with a single umbrella contract with a single operator.

According to the bidders, the contract is expected to be awarded in September 2018, with a service delivery start in January 2020, and could be worth up to GBP1.2 billion (US$1.5 billion) over 15 years.

Several other companies have also expressed an interest in bidding for the contract, which will replace Cobham Aviation's Falcon 20s and Fleet Requirements and Aircraft Direction Unit BAe Hawks operated by Babcock.

The consortium says the Scorpion was selected after evaluations of 50 different aircraft types.

QinetiQ's role will be the provision of both the fleet and its pilots as well as aircraft maintenance. The company will also get involved in the integration of sensors and jamming pods as well as ensure that the program complies with the complex UK Military Aviation Authority rules. QinetiQ will also ensure the aircraft have provisions for synthetic training and airborne aerial target towing.

Thales will install sensors onboard the aircraft to boost situational awareness, threat replication and targeting training as well as some electronic warfare capability.

Last year, British pilots from both the Royal Air Force and Royal Navy evaluated the Scorpion after the Paris Air Show. As part of that evaluation, they participated in a number of exercises in the close air support and intelligence-gathering missions supporting ground troops. As part of the trials, Thales I-Master synthetic aperture radar was integrated into the aircraft.

The Scorpion also operated with the Royal Navy's Sea King airborne-early warning helicopters.

Victor Chavez, Thales UK CEO, said: "Through this unique partnership with QinetiQ and Textron and the complementary expertise within our respective fields, we have the opportunity to offer all three armed services the most effective, cutting-edge technology coupled with world-leading training and services expertise.

Steve Wadey, QinetiQ CEO, said: "Collaborative working of this nature is vital within the aerospace and defense industries, and I believe this partnership puts us all in a strong position to succeed."

—Tony Osborne

Sweden Declares Meteor in Service

The Swedish Air Force has declared an initial operating capability with the MBDA Meteor air-breathing air-to-air missile on its Gripen fighters, making it the first air arm to introduce the weapon.

The ability to use the Meteor has been introduced through a software upgrade called MS20, which also integrates the GBU-39, the Boeing Small Diameter Bomb, as well as some additional upgrades to electronic warfare, maintenance and logistics systems in the aircraft.

Maj. Gen. Mats Helgesson, chief of the Swedish Air Force, speaking at the Farnborough Airshow on July 11, announced that the MS20 software upgrade had now been installed on all of its Gripens and that the weapon had entered service, but personnel now had to learn about the weapon and squadrons had to develop tactics to use it before a full operational capability could be declared.

"This is the most lethal radar-guided air-to-air missile in the world...and the Swedish Air Force is the first operational user," said Helgesson. "That means a lot to the air defense of a small country."

The Swedish Air Force is to be the first to deploy the MBDA Meteor missile.

Sweden's relationship with Meteor goes back some 16 years, when the Air Force began looking for a more advanced long-range air-to-air weapon. Since then the Gripen has been involved in a number of firing campaigns to develop the weapon.

—Tony Osborne

F-35A Lightning IIs have flown thousands of sorties powered by the F135 propulsion system, developed from the highly successful fifth-generation engine for the F-22 Raptor. Pratt & Whitney partners with customers around the world to provide sustainment solutions that keep the F-35 Lightning II dependable and affordable. We are proud to power today's most advanced fighter aircraft. Now we are advancing engine technology to provide the next generation of fighter engines for tomorrow's defense needs. **Visit us at Pavilion OE3.**

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AirTanker Flies First VIP Mission

AirTanker, the private company established to operate the RAF's fleet of aerial refueling jets, has performed its first VIP mission.

AirTanker's VIP version of the Airbus A330 at Brize Norton.

The AirTanker A330 has 58 "business-class" seats.

As part of its Strategic Defense and Security Review, the British government has spent GBP10 million (US$12.95 million) on a kit of 58 business-class seats ready to be installed on the company's Airbus A330 Voyager multi-role tanker transports (MRTT), allowing them to carry senior government ministers and royal family on overseas jaunts, ending the need to charter aircraft for long-haul trips. Even with the seats installed, the aircraft can still perform their primary mission of aerial refueling. The aircraft took off on its first trip on July 8, transporting Prime Minister David Cameron to the NATO summit in Warsaw, Poland.

According to the UK defense ministry, using the A330s "will be significantly cheaper than using chartered flights."

AirTanker has now taken delivery of 13 of its planned fleet of 14 A330 Voyagers. Of that 14, nine form a core fleet of tankers and transport aircraft for the Royal Air Force, while the remaining five are available for leasing to third parties. One of them is currently operated by Thomas Cook Airlines.

"We are flying 10-15% more than we were the year before and we have reduced the utilization of charter flights," said Phill Blundell, CEO of AirTanker, speaking to Aviation Week at the Royal International Air Tattoo.

Blundell said the armed forces were now utilizing the aircraft more effectively, recognizing the fleet's capability and reliability, but he suggested that the Royal Air Force may need to consider starting to use the surge fleet for military operations because of the high tempo of operations, and there is some consideration about a fleet of narrowbody aircraft because the A330 is too costly for some missions. A small fleet of narrowbodies could allow the RAF to retire its aging Bae 146 fleet.

Blundell says he is also working to push a boom refueling capability to the RAF now that the air arm is investing in more platforms that cannot be refueled using the hose drogue system currently employed on the Voyager. The RAF's fleet of C-17s and RC-135 Rivet Joints requires receptacle refueling using a boom, which the Voyager does not have. The P-8 Poseidon, of which the RAF plans to acquire a fleet of nine, also needs such a system. Several senior RAF officers have told Aviation Week there is now an "active debate" on the need for a boom, although there are concerns about training requirements and the cost.

"Adding a boom would turn the A330 into a military aircraft," said Blundell, suggesting that several of the existing A330s could be replaced by a small number of boom-equipped aircraft, and while this would add cost, it would increase interoperability with allies.

—Tony Osborne

Norsk Breaks Ground on New Oslo Center

In March, Norsk Titanium AS broke ground on a new 9,843-sq.-ft. European final assembly and test center near Oslo, Norway, that is due to be completed in October.

"Customer demand for our additive manufacturing technology is growing to the point where we need significantly more space to assemble and test our Marke IV rapid plasma deposition [RPD] machines prior to worldwide shipment," said SVP of operations Chris Bohlmann. "This new factory will enable us to better serve our manufacturing partners and aerospace customers while expanding our footprint in this innovative region of Norway."

Norsk Titanium also plans to install the world's first end-to-end aerospace Ultra Lean Manufacturing line in the facility. A Merke IV RPD machine, paired with a heat-treating oven and a multi-axis CNC machining center, will convert titanium wire into finished aerospace parts on a 98-ft.-long production line.

"The new Ultra Lean Manufacturing line allows our customers to do hands-on development of new part programs on the same campus as our worldwide technology center," said CEO Warren M. Boley Jr. "Titanium wire comes in one end, the CAD drawing is input, and finished aerospace parts that are fully tested, heat-treated and ready for installation are produced in a matter of days. RPD truly is a game-changer in terms of cost reduction, speed to market and production-line efficiency." Hall 4, Booth A114.

Norsk Titanium's state-of-the-art facility outside Oslo is to be completed in October.

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Bell Unveils Next-Gen V-280 Tiltrotor

Bell's proposed V-280 Valor tiltrotor aircraft would have twice the speed and twice the range of current helicopters, the company says.

As part of an effort to market its new tiltrotor technology to potential foreign customers, Bell Helicopter unveiled a full-size mockup of its V-280 Valor on the first day of the Farnborough Airshow this year.

Bell is partnered with Lockheed Martin on a rotorcraft flight demonstrator for the U.S. Army's Joint Multi-Role (JMR) program, designed to gauge the art of the possible for the next generation of vertical lift capabilities. JMR is the precursor to the Future Vertical Lift (FVL) program, a Pentagon effort to buy a new, state-of-the-art family of helicopters in the 2030s.

The V-280 builds on the tiltrotor technology of the Bell-Boeing V-22, in use by the U.S. Navy and U.S. Air Force, and will fly twice the range at double the speed of existing helicopters, Steve Mathias, Bell's director global business development for advanced tiltrotor systems, told Aviation Week July 11 in front of the full-size mockup here.

Due to the increasingly expeditionary nature of warfare today, Bell is seeing a lot of interest from abroad on the medium-lift FVL, Mathias said.

"Any country with a UH-60 or an H-1 down the road would want this kind of speed and range capability," Mathias said. "Because of the expeditionary [nature of combat], everyone needs the time to react, you need this kind of speed and range, so there will be, I believe, a great deal of interest."

Bell has seen interest from militaries that already fly UH-60 Black Hawks and H-1 attack and utility helicopters, particularly Australia, and NATO allies such as Canada and the UK, Mathias said.

Despite the US$70 million price tag of the V-22, Mathias believes the V-280 will be significantly cheaper than its predecessor because of major advances in tiltrotor technology. For example, the V-280 is equipped with a straight wing, which takes about 50% less time and money to build than the V-22's swept wing.

"If you were a tailor and I came to you and said, 'Build me a suit, here's a big ball of thread, and build me a suit out of that,' or if I came to you and said, 'Here's some cloth,' and said, 'Build me a suit out of that,' it's going to be much quicker and cheaper to build out of cloth," Mathias said.

In another major difference between the two tilt-rotors, the Valor's engines remain in place for transition to forward-flying position, while the rotors and drive shafts tilt. Unlike the Osprey, the V-280 will have a forward-firing capability, and will incorporate an advanced glass cockpit that uses technology similar to the F-35's.

Mathias estimates the Valor will be comparable to a UH-60 in terms of price, or about US$20 million.

The aircraft gets its name from its anticipated cruise speed of 280 kt., and has an estimated 500- to 800-nm combat range, Mathias said. V-280 will be able to self-deploy with internal fuel tanks for a 2,100-nm range with two stops to gas up, and is capable of aerial refueling. This capability makes it much easier for the armed forces to strategically deploy and quickly respond to threats all over the globe, he stressed.

Bell and Lockheed are 60% finished with the build, and the Valor will fly for the first time in September 2017 as part of the JMR tech demonstrator program, Mathias said.

FVL will eventually replace the Army's UH-60 Black Hawk, AH-64 Apache, CH-47 Chinook and OH-58 Kiowa aircraft. The U.S. Navy will likely join as they retire their aging MH-60 Seahawks, as well as the U.S. Marine Corps' UH-1Y utility and AH-1Z attack helicopters.

Boeing and Sikorsky's coaxial helicopter, the SB-1 Defiant, is also competing as part of the JMR program.

—Lara Seligman

Boeing Commercial Airplanes president and CEO Ray Conner (left) exchanges GoldCare documents with Norwegian CEO Bjørn Kjos.

Boeing and Norwegian Agree to Record GoldCare Coverage

AN AGREEMENT ANNOUNCED at the show Monday commits Norwegian airline to a GoldCare support package for its 737 MAX fleet and an extension to the coverage it earlier purchased for its 787 Dreamliner fleet.

Potential value of the complete package is an unprecedented US$3 billion up to 2035.

Norwegian will benefit from Boeing's 737 MAX GoldCare offering of maintenance, engineering and parts when its first airplane is delivered in May 2017.

This is the largest commercial services order in Boeing history.


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RAF to Acquire Certifiable Predator Bs

The UK MoD wants General Atomics' Predator B for future ISTAR requirements.

The UK Ministry of Defense (MoD) has chosen the General Atomics Aeronautical Systems Inc. (GA-ASI) Certifiable Predator B (CPB) remotely piloted aircraft system, with some specific modifications, to fulfill its future armed Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) requirements.

MoD selection of the CPB follows the 2015 Strategic Defense and Security Review and announcement of the UK government's intention to replace the Predator B/MQ-9 Reaper. CPB has been selected as the only viable option capable of meeting the UK Protector program's key user requirements, which include operations in both controlled and uncontrolled airspace. Procurement will be handled through a hybrid Foreign Military Sales/Direct Commercial Sale agreement with the U.S. government.

GA-ASI is undertaking an independent research and development (IRAD) effort to design, develop and produce the CPB, a variant of the Predator B RPA that is fully compliant with NATO's UAV System Airworthiness. Construction has begun, with fuselage integration currently under way, followed by wing and tail integration planned for late summer. Flight testing is scheduled for late 2016.

"GA-ASI is proud to offer CPB, the next-generation Predator B, to the Ministry of Defense to satisfy its emerging requirements for a Reaper replacement certified so that it will be capable, subject to developments in regulatory framework, to operate within unsegregated controlled airspace," said David R. Alexander, president, Aircraft Systems, GA-ASI. "Featuring enhanced safety and reliability systems, CPB will meet European airworthiness certification standards."

Predator C Avenger Gains U.S. FAA Approval

GA-ASI's Predator C Avenger RPA system has passed a significant milestone by receiving a Federal Aviation Administration Experimental Certificate (EC) that allows it to perform routine operations in the U.S. National Airspace System.

Avenger is designed to undertake high-speed, long-endurance missions over land or sea, and has an endurance of 15 hr. It can support a wide range of sensors and weapons loads and has been designed to carry an all-weather GA-ASI Lynx multimode radar, EO/IR sensor, and a 2,000-lb. Joint Direct Attack Munition (JDAM), thus offering Intelligence, Surveillance and Reconnaissance (ISR) and precision-strike capability. GA-ASI plans to start flight testing an extended-range Improved Avenger in September. Increased wingspan of 76 ft. will extend the aircraft's endurance to 20 hr.

The Predator C Avenger UAV has U.S. FAA approval for routine operations in the U.S. National Airspace System.

GA-ASI & NLR Collaborate on RPA Ops in European Airspace

GA-ASI and the Netherlands Aerospace Center (NLR) have signed an agreement to support expanded operational approval for remotely piloted aircraft (RPAs) to fly in non-segregated European airspace. NLR is one of the world's leading experts on the global air traffic management system, with particular experience in Europe.

"NLR's tremendous airspace and air traffic control modeling and simulation capabilities allow us to test and validate civil airspace integration concepts for medium-altitude long-endurance [MALE] unmanned aircraft systems," says GA-ASI CEO Linden Blue, "NLR's contribution to the Predator B's integrated 'Detect and Avoid' system helps further international acceptance of MALE flight in civil airspace worldwide."

While the Predator B is currently operational in segregated airspace in Europe, this collaboration is intended to expand operations into non-segregated airspace.

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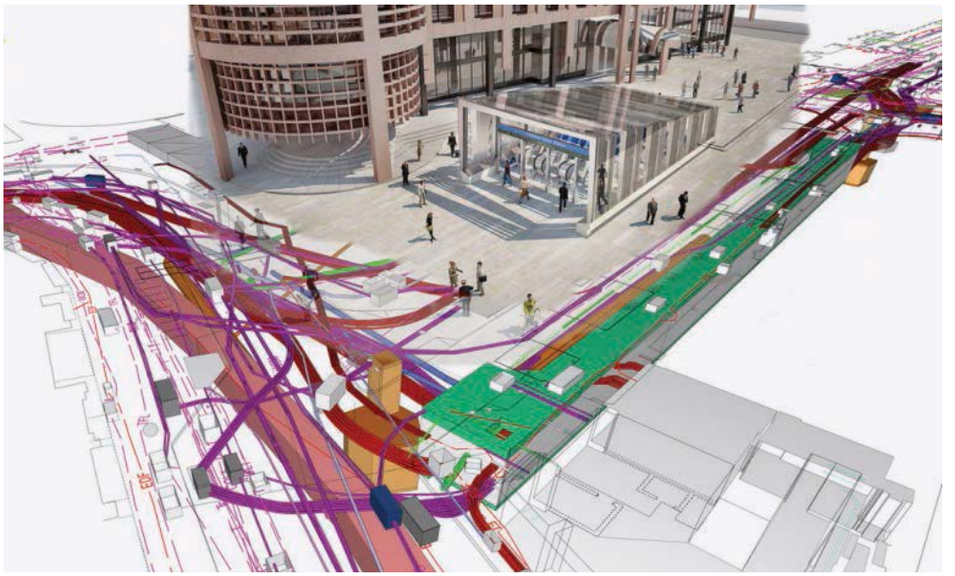
MI5 Warns of Transport Security Threat

Technologies designed to reduce costs of major public building programs may offer terrorists an unprecedented reconnaissance capability, the Security Service (MI5) has warned.



A BIM diagram showing a utility corridor under the Liverpool Street rail station in London.

BIM (building information modeling) systems became mandatory for all centrally procured public construction schemes in the UK from the beginning of April, yet BIM cannot be fully secured, and failure to appropriately restrict access could lead to non-vetted workers obtaining classified building-security data.

The case for using BIM is clear. If different structural, mechanical and electrical plans are superimposed for the first time when building is already underway, delays and cost increases are inevitable. BIM brings all the design data together in a virtual environment, allowing different trades to align plans before construction begins.

> **The trouble is, the resultant model [from BIM] is the most fantastic hostile reconnaissance tool you could look for."**
>
> ***—The head of cross-cutting security knowledge at the MI5-run Center for Protection of National Infrastructure***

"The trouble is, the resultant model is the most fantastic hostile reconnaissance tool you could look for," "Paul" (identities of Security Service staff are not made public), the head of cross-cutting security knowledge at the MI5-run Center for Protection of National Infrastructure (CPNI), told the Counter-Terror Expo in London earlier this year.

"On one project we're advising on at the moment, some 80,000 people have unfettered access to every layer of the model," Paul says. "Not one of them has been security-cleared, and 160 don't even work for the project anymore but haven't been removed from the access privileges of the system. Some of them left under a cloud: and if you left under a cloud you might just have a grievance against your ex-employer to either steal data from the model or inject bad data that could completely compromise the construction."

Configuration of a project's BIM systems can eliminate some of the most worrying problems, but decisions need to be taken early, and by people with a thorough understanding of the security implications. This does not always happen.

"We found one [project] recently where, if I was a lectern supplier, I would be allowed into the BIM model to click on the lectern, see what the spec was, and see if I had one to offer," Paul says. "But with how that BIM model has been set up, because the lectern is touching the stage I can also get the stage details; because the stage is touching the floor I get the floor details; because the floor is touching the wall I get the wall details; and as the wall is touching the locking mechanism on the door I get to see the lock details. Remember: I'm a lectern supplier."

These problems appear to arise because managers may have a limited view of what constitutes a potential security risk. For example, cybersecurity will be part of a robust BIM implementation, but even the best cyber defenses will not, on their own, address all of a project's potential BIM-related security problems.

Major infrastructure programs, such as rail stations or airport terminals, are not classified in the traditional sense, but that does not mean that every aspect of their design is appropriate for public release. The CPNI advises projects on security measures including suitable blast-protection technologies and the projected effectiveness of physical barriers. Making such data public could enable an attacker to circumvent the protection.

"[With] an airport terminal building, the roof is visible on Google Earth, and you can walk past and photograph it – so I'm not that concerned about its security in the BIM model," Paul says. "You can go to Heathrow Terminal 5 and admire the structure – it's beautiful. But the blast counts behind it no-one really should know about, and all the baggage-handling and access to control systems I wouldn't want anyone to know about either."

The answer is to cultivate better understanding and management of security risks, which in turn means reassessing all the security implications when granting wide-ranging BIM access to participants in major infrastructure projects. The CPNI has worked with the British Standards Institute to publish what Paul calls "the fastest ever British Standard," Publicly Available Specification 1192-5, which sets out advice on embedding BIM security-mindedness across different disciplines (physical, digital, human) and throughout the supply chain. Adhering to the standard will require new ways of thinking - even entirely new career fields.

"There is no way of doing BIM securely – you can only do it in a security-minded way," Paul says. "It involves the appointment of a new role, which I think will become a burgeoning profession, called the Built Assets Security Manager, who has got to identify that this plus that is greater than the sum of its parts."

—Angus Batey

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ALIS Arrives in the UK

Getting the F-35 flying in Britain is vitally important to the public image of a program that has endured more than its fair share of negative coverage. Just as critical is the progress of the Autonomic Logistic Information System (ALIS), the jet's next-generation support network.

Just like the jets, ALIS is making its UK debut too. Both air and ground crews have used the system to bring F-35As and Bs to Fairford, albeit not using the same equipment and networking construct that will be in use when F-35Bs are based in the UK.

"Because the deployment is on a short-term basis, the jets are being connected back up through a secure connection to standard operating units [SOUs] in the U.S.," says David Scott, Lockheed Martin Training and Logistic Solutions' VP of business development and strategy. "The SOU is a rack of computer servers that sit at each squadron; they connect into a CPE – a central point of entry – for each country. The CPE in turn connects back to the autonomic logistics operating unit [ALOU], which is in Texas currently, and that's the repository for the information that is uploaded from each of the SOUs, and ultimately from the jets."

The promised gains from ALIS are predicated on this construct. Aircraft data flows up the chain, from the squadron to the nation and into Lockheed's ALOU, where company staff can monitor the global fleet down to the component level. But the plan will only work if users are happy to share what may be quite sensitive information.

"Information uploaded from the countries through their system is contained and controlled by the country," Scott says. "Each country then makes an individual decision about what information they want to upload or share to the ALOU, which looks at fleet health. We can look at who needs spares, what the predictive models are, and we perform failure-trend analysis across the fleet – not just one country's fleet. So there's a benefit to sharing data, but each country makes that decision on their own."

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—David Scott, Lockheed Martin Training and Logistic Solutions' VP of business development and strategy.

Scott notes that as no user outside the U.S. currently has an F-35 based in its own territory, no nation has as yet reached a decision on what level of sharing it will allow. Data shared do not include mission-specific information except where that has a bearing on platform health – aggregated data about "how the airplane is flown aerodynamically" is collected by ALIS, he says, "so we can determine if it is at or is exceeding its design criteria," but operational military data will "never go back" to Lockheed.

The system is likely to require significant bandwidth. Speaking at RIAT, the USAF's Gen. Herbert Carlisle acknowledged that this was a concern but stressed that it was not expected to be a problem.

"Right now, we've been able to operate [ALIS] just about everywhere we've gone," he said. "In a very austere environment? We'll figure it out. Is it perfect? No. Has it got work to do? Yeah. But we can do it. There's some work-arounds to do it. But right now, we've been able to operate just about everywhere we've gotten."

Those work-arounds for bandwidth-constrained environments include an ability to not have to synchronize data back from the SOUs to the ALOU more often than approximately every 30 days. The limiting factor is data storage.

"It depends on the number of flights and operational tempo," Scott says. "The idea is that 30 days will be sufficient for you to conduct deployed operations before you have to connect back up." Continued use beyond 30 days would be possible, but data collected earlier in the deployment would be lost.

The next iteration of ALIS software – 2.0.2 – is running between 60 and 90 days late for release. Also speaking at RIAT, Lockheed's F-35 program manager, Jeff Babione, explained the holdups had involved integrating ALIS with commercial SAP systems used in the purchasing phase of operation, and with one of 2.0.2's four main advances – the integration of what is thus far a standalone system for monitoring the F-35's engine.

"Getting SAP integrated with all our subtiers and also with Pratt & Whitney was probably a little bit more complex than we appreciated," he said. "So we've had to take time and ensure the architecture was appropriate before we could begin the testing. What we're seeing now is that taking that time was important. The testing we're doing is showing that we've got it all linked up right, and now we've just got to make sure the communication is correct and all the ordering functions are working."

—Angus Batey

Lockheed Martin's ALIS operations center in Texas

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Farnborough Builds for the Future

The new conference center will replace the existing Hall 1.

The UK's recent referendum decision to leave the European Union may have caused uncertainty in the currency and stock markets, but the vote has had no impact on the Farnborough Airshow's future plans.

Paul Everitt, chairman of Airshow organizers Farnborough International Ltd., and CEO of the UK's aerospace and defense trade association, ADS, sees no reason to alter course on an ambitious plan to redevelop the Airshow site, while the 2016 edition will see the show consolidating its international position.

"There's been an increase in the number of nations hosting pavilions," Everitt tells *ShowNews*. "I think we're up from 18 in 2014 to 22 this year. We also have the largest-ever U.S., Chinese and African representation at the show. China and Africa may not seem unusual, but the fact that the U.S. – and U.S. businesses - are so interested in the Farnborough Airshow is extremely good news for us. Farnborough has always had strong U.S. presence and representation. The fact we are growing that reflects that we're reaching out beyond our traditional exhibitor base."

More companies are also taking up the option of semi-permanent facilities on the site, following the multi-year model adopted previously by GKN and users of the new permanent infrastructure on Chalet Row A. Everitt says "between 10 and 20" exhibitors have committed to multi-year deals, with the typical contract covering three shows. Some exhibitors are on five-show deals.

The confidence this helps generate is a factor in FIA's broader strategy to redevelop the site. Long-mooted plans to redevelop Hall 1 are now confirmed, with construction set to start after this year's show closes.

"That's very much top of our list," Everitt says. "The creation of a permanent exhibition and conference center is a game-changing development for the Airshow, and for Farnborough International as a business. Our focus is on creating the best facilities for the Airshow, but there are a number of other events in our sectors, both national and international, that might well see this site as a good place to be."

The building will open for the 2018 Airshow, but plans are already in place to expand the site's between-show use. FIA has hired former Dubai World Trade Center commercial director Michael Whatton to the new post of venue director, with a remit to bring new conference and exhibition business to the site.

Meanwhile, Everitt dismisses suggestions that there may be some "airshow envy" between Farnborough and the Royal International Air Tattoo, with last weekend's Gloucestershire show seeing the UK air show debut of the F-35.

"It's a very deliberate arrangement," he says. "The prospect of flying at both shows means it's a much better utilization of resources than might otherwise be the case. I always look on it in much the same way I do Paris: Just as a successful Paris Air Show helps Farnborough be successful the next year, so a successful RIAT helps us to have a successful Farnborough. From our point of view it's definitely a win-win." **—Angus Batey**

Display Rule-Changes Are Prudent, Says FIA

Changes to air show flying display rules introduced by the UK Civil Aviation Authority (CAA) following the deaths of 11 people and injuries to a further 16 outside the Shoreham Air Show in 2015 will not affect Farnborough's ability to stage an "exciting, enthralling, entertaining air display" in 2016, despite the cancellation of the Red Arrows' formation routine, says Paul Everitt.

"I think we must accept that after Shoreham, the public mood has shifted," he says. "We've worked really closely with the CAA post-Shoreham both to input some of their review of the regulations, and in implementing the changes required to ensure that what we do at Farnborough is as safe as it can be."

The regulations make multi-ship fast-jet displays difficult over the Airshow site because of new considerations of risk beyond the airfield perimeter. "That doesn't mean to say that there won't be some multiples," Everitt says, "but the Red Arrows is a big cohort, flying at very high speed in close proximity, spread out over five miles."

Everitt stresses that the flying display is just one part of Farnborough's offering. "We have a mission that is clearly about the next generation," he says. "People seeing exciting air displays is part of that mission, But other parts are we will have people on the ground, and there will be a whole range of activities taking place during the Futures Day and public weekend, which are all about young people getting close to, talking to and being inspired by the people in our industry." **—AB**

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Qatar Takes Stake in LATAM Group

Qatar Airways is to take a stake of up to 10% in South America's LATAM Airlines Group, it was announced at the Farnborough Airshow July 12.

The investment will take place through a capital increase in LATAM, worth US$613 million through the issue of new shares.

The investment is subject to approval by an extraordinary LATAM shareholders' meeting, which is likely to take place "in around one month," said LATAM Airlines Group CEO Enrique Cueto.

Qatar Airways Group CEO Akbar Al Baker said that Qatar had decided to take a stake in the South American group after careful analysis. "This transaction represents an opportunity to support LATAM through a long-term relationship."

It marks the second investment by Qatar Airways in a fellow Oneworld alliance member. It already has a 15.01% stake in International Airlines Group (IAG), parent company of Aer Lingus, British Airways, Iberia and Vueling.

"As a member of Oneworld, we see [the LATAM transaction] as an extension of Qatar Airways' global network alongside our successful investment in IAG," said Al Baker. The agreement, if approved, will lead to code sharing, loyalty program reciprocity and operational efficiencies, among other links.

Al Baker added that Qatar recognized the "short-term local challenges in some of LATAM's markets" – a reference to the recession in Brazil – but the growth potential for Latin America was considerable, he said.

"Qatar Airways is a company I personally admire for its strategy, great brand and deep care for its passengers," said Cueto. "Qatar's investment in our company underscores its belief in the project we are undertaking. We believe this investment will also allow us to explore new possibilities to connect South America with the Middle East and Asia."

—Alan Dron

LATAM Airlines Group CEO Enrique Cueto (left) with Qatar Airways Group CEO Akbar Al Baker at Farnborough 2016.

Qatar Orders Three More G650ER Jets

Qatar Executive on the first day of the Farnborough Airshow announced a firm order for a further three Gulfstream G650ERs, as part of a 2015 memorandum of understanding (MOU) with the airframer. The aircraft will support growing demand for luxury charter flights, notably from private individuals, according to Qatar Airways group chief executive Akbar Al Baker.

As an addition to the three G650ERs already operated, the three newly ordered aircraft will make Qatar Executive the largest operator of the type. The first one will be delivered early in 2017 and the remaining two will follow within months, Al Baker says. They will be based "in different regions," but he does not give any detail on the locations.

Qatar Executive is making the most of the range, which allows nonstop flights from Hong Kong to New York, London to Tokyo or Doha to Los Angeles. "We don't have to worry about payload because Gulfstream specifies the range with maximum payload," Al Baker says. The average passenger load is said to be between four and five. Qatar's G650ERs carry "very rarely" 13 passengers, while 15 is their maximum capacity. They also operate for the country's government, when requested.

The company is disposing of its Bombardier business jets. Three Challenger 605s will be converted to air ambulances.

With three more aircraft, Qatar Executive will become the largest operator of the long-range Gulfstream G650ER.

The final MoU, announced in May last year, is for 30 firm and optional G500s, G600s and G650ERs.

—Thierry Dubois

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PROPELLING THE NEXT CONNECTION

How India's Tejas Fighter Stacks Up

More than three decades in development, India's Tejas light fighter has finally entered service. It is late, it does not meet requirements, but it is affordable, and India plans upgrades that could make the aircraft a capable machine – given a few more years.

More than 30 years in development, India's first two Tejas light fighters entered service on July 1. The Tejas Mk1 is late, and falls short of its requirements, but it has created an industrial ecosystem better positioned to deliver planned upgrades, and future aircraft, than India had three decades ago.

The Tejas is usually compared with regional rival Pakistan's JF-17 Thunder, the product of a Chinese industry now on its fifth generation jet fighter. But technically, perhaps the best benchmark is against others new to building combat aircraft such as Korea Aerospace Industries' (KAI) T-50 and Taiwan's AIDC F-CK-1.

AIDC's experience before the Indigenous Defense Fighter (IDF) program began in 1982 was designing the AT-3 jet trainer (with Northrop). Lockheed Martin (then General Dynamics) provided assistance and the IDF resembles the F-16. KAI's experience before beginning work on a supersonic trainer was license-building the KF-16, and the T-50 was developed with Lockheed, hence its similarity to the U.S. fighter.

India had experience license-building Soviet and Western aircraft when it launched the Light Combat Aircraft (LCA) program in 1983, but its design credentials were limited to Hindustan Aeronautics (HAL, Chalet K7), developing the supersonic HF-24 Marut in the 1960s and improving the Folland Gnat light fighter as the Ajeet in the 1970s.

Aircraft development does not go fast in India, but the Tejas program has been painfully slow. Taiwan's F-CK-1 become operational in 1997, 15 years after formal launch; Korea's T-50 in 2005 after nine years; and Pakistan's JF-17 in 2007 after eight years. The 33 years it has taken India to field the Tejas is extraordinary by comparison. But there is a mitigating factor.

The arms embargo imposed in 1988 in response to India's nuclear tests cut off access to U.S. suppliers, most critically Lockheed for the digital flight controls, forcing India to develop its own fly-by-wire system. Other delays were down to India's failure to develop its own key systems as planned, including the Kaveri afterburning engine and multi-mode radar.

Thus, rather than 70% indigenous as planned, the Tejas is 65% imported. This includes the General Electric F404-IN20 engine and Israeli Elta EL/M-2032 radar, and cockpit displays and flight control actuators originally to be developed in India.

India's Tejas digital fly-by-wire light fighter features Israeli multi-mode radar, a U.S. engine and composite structures.

Aircraft development does not go fast in India, but the Tejas program has been painfully slow.

The bulk of delays came before the first of two LCA technology demonstrators flew in 2001 – 18 years after launch compared with seven years for the IDF, five for the T-50 and four for the Chengdu FC-1/JF-17. But the pace did not pick up much. India flew another 12 prototype and pre-production aircraft before achieving limited initial operational clearance (IOC) in 2013.

How does it compare? The Tejas ticks the boxes for a modern fighter: digital fly-by-wire, multi-mode radar, composite structures. The aircraft has a U.S. engine and Israeli radar, versus Russian and Chinese, respectively, in the JF-17. However, the Tejas is overweight, with a similar empty weight to the JF-17 but for a smaller aircraft. It is underpowered on its 19,000-lb.-thrust F404-IN20, so speed, acceleration and maneuverability fall short of specification. Insufficient internal fuel capacity limits range.

The Tejas Mk1 does not yet have full operational capability (FOC), which adds in-flight refueling and a new radome to increase radar range. FOC is hoped for by 2020, when the full complement of 40 Mk1s is scheduled to be delivered. The IOC Mk1 is armed with Russian R73E short-range air-to-air missiles and laser-guided bombs. FOC adds the Israeli Rafael Derby beyond-visual-range missile, now in flight tests.

India is working on a redesigned Tejas Mk2, powered by a 22,000-lb.-thrust GE F414-INS6, to meet the original requirements, but now the air force plans to buy 80 improved Mk1As as a next step. This will add Elta's EL/M-2052 active electronically scanned array (AESA) radar and an electronic-warfare pod, as there is no room for the planned internal self-protection jammer, as well as reduce weight.

HAL plans to fly the Mk1A prototype in 2018 and complete deliveries by 2025. It also has to ramp up production, from eight a year to 16 – no easy task for the state-owned manufacturer. But, as New Delhi says the Tejas has cost just US$1.1 billion to develop – US$2.1 billion including the carrier-based naval version – it already deserves an A for affordability.

—Graham Warwick

AW189 Certified for Full Ice

The European Aviation Safety Agency has finally certified the full icing protection system (FIPS) of Leonardo Helicopters AW189 super-medium helicopter.

FIPS certification was achieved a week before the Farnborough Airshow, but the company announced it as the show opened on July 11.

The certification was the last hurdle in the long path to introducing the AW189 into the UK's helicopter search-and-rescue network now operated under government contract by Bristow Group.

The AW189 was chosen, along with Sikorsky's S-92, by Bristow as the preferred platform following the UK Department for Transport's decision to select the company in 2013 as the operator for helicopter search-and-rescue services from 10 bases around the UK.

But the lack of FIPS meant that the AW189 has not been introduced to service; instead, the company bought additional Sikorsky S-92s and an interim fleet of AgustaWestland AW139s. The system includes electrically heated main- and tail-rotor blades, heated windscreens and an ice detection system.

The company says the system is fully automatic once switched on by the pilot, allowing the pilot to concentrate on other flying activities. Meanwhile, Italian authorities have released the third prototype of the company's AW609 commercial tiltrotor after it was seized by Italian prosecutors probing the fatal loss of the second prototype last October that claimed the lives of test pilots Herb Moran and Pietro Venanzi.

An interim report, released in late June by the Italian air accident investigation board, suggested that the tiltrotor had entered a condition called divergent Dutch roll during high-speed testing. The condition had not been predicted by any of the company's flight models or simulations.

A company spokesman here at Farnborough confirmed the company will now transfer the third prototype to the U.S. by the end of September, ready to restart flight testing. The first prototype, currently based in Philadelphia, will be transferred back to Italy to support testing there. The company is currently working with the FAA to establish when test flying can be restarted.

The company still plans to achieve certification in 2018. **—Tony Osborne**

Leonardo's AW189 super-medium twin-engine helicopter at Farnborough 2016

F-35 Asymmetric Tests Pave Way for DT-3 Sea-Trials

F-35 test pilots have begun testing the aircraft's ability to carry asymmetric external loads in powered-lift flight. The trials are one of the final hurdles before the aircraft embark on the USS America at the end of October for at-sea developmental testing phase 3 (DT3) – the last of three maritime trials that will give the green light for the Marine Corps F-35Bs to deploy onto amphibious assault ships. The trials will explore the aircraft's ability to operate safely onto decks with a 1,000-lb. asymmetric load as an external store under one of the wings, but not the other.

"In normal high-speed flight we deal with asymmetric loads by adjusting the flight controls," says BAE Systems test pilot Pete Wilson, but this is not as straightforward when the aircraft enters the powered lift stage of flight just before recovering onto the deck. Tests have already begun in no-crosswind conditions, and the team is now beginning to test what may occur when stronger crosswinds are introduced. During most carrier landings, ships will point into the wind and the aircraft will be able to recover safely, but at times the ship may be constrained by geography, forcing aircraft to recover with a crosswind component.

The F-35B's vertical landing crosswind limit is currently 15 kt., although the aircraft can translate at speeds of 20-25 kt. The team wants to confirm computer models and prove how the aircraft will operate in such conditions. The issue was rarely a concern for older generations of STOVL, as they did not often bring back such high-tech munitions.

The DT-3 trials have been timed so that the test team can take advantage of rougher seas several hundred miles off the Pacific West Coast to test the aircraft's ability to operate onto the deck in high-sea states. The plan is to be able to operate in conditions up to sea state six, equivalent to wave heights of 13-20 ft. The DT-3 tests will involve two instrumented aircraft, likely BF-5 and either BF-1 or 4.

The Marines will support the DT-3 trials with a deployable version of Lockheed Martin's Autonomic Logistics Information System (ALIS), marking the deployable system's debut on a naval ship. Previous DT trials on the USS Wasp used a less operationally representative version of the ALIS system normally used at shore bases.

"This is the first opportunity we have had to actually take it [the deployable ALIS]," said Lt. Col. Richard Rusnok, commanding officer of the Marine Corps' VMX-22 operational test and evaluation squadron. "We have used the deployable kit – shore based – and we have an expeditionary environment out to Twentynine Palms, California, and that kind of stuff, but we are going to actually be able to take this deployable kit, load it up and do it like we would for a real deployment."

With Britain wanting to rebuild its carrier strike capability, the UK plans to begin maritime flight trials of the F-35B from the new HMS Queen Elizabeth in late 2018. "This will not be a DT phase," said Wilson. "Testing on the Queen Elizabeth will be like DTs 1, 2 and 3 combined."

"We don't need to use fully instrumented aircraft; we already understand most of the loads on the aircraft systems, as we have tested that during earlier tests," added Wilson. The trials, off the East Coast of the U.S., are expected to take several months.

The ship rolling vertical landing process, developed for the UK to increase bring-back capability, will also be tested during the 2018 trials. In the first quarter of 2017, a major project will be conducted to "produce a body of work to prove whether or not SRVL is fundamentally safe procedurally," Wilson says.

The program will fully occupy BAE Systems' simulator in Warton for between two and three months. Up to 10 STOVL-qualified pilots will be flying simulated SRVLs in combinations of "every load you can fly, day and night, every ambient temperature, pressure, all the wind conditions and ship speeds," Wilson says. Simulated failures – to brakes, nose gear, computers and helmet-mounted display – will also be included.

The developing SRVL conops involves the jet maintaining a speed of 35 kt. relative to the carrier, which permits bringing the aircraft to a halt with the toe brakes inside 200 meters (657 ft.). Wilson expects the difficult parts of the envelope to be aircraft approaching at lower airspeeds in asymmetric configurations. "If we come out of that [simulator trial] looking good, then we know that we're ready," he says. "And if we don't, then we may have more work to do."

—Tony Osborne, Lara Seligman and Angus Batey

F-35 sea trials are becoming far more complicated.

IAI Converts Boeing 737-700BDSF from Passenger to Freighter

Israel Aerospace Industries is developing a supplemental type certificate for a Boeing 737-700BDSF cargo conversion. A first prototype aircraft is under conversion from passenger to full freighter configurations at IAI's facility. The conversion includes the installation of a cargo door on the fuselage, additional structural modification to support full load capacity, and implementation of smoke and fire detection in the cargo bay.

The prototype work is done in Israel, toward the approval of an STC expected during the fourth quarter of 2016. Serial production of the 737-700 conversions will ultimately shift to China and possibly Eastern Europe, where IAI (Chalet A29) is seeking to expand MRO operations. In the past, Bedek had converted 737-400 aircraft; it is now gearing up to offer the stretched, more efficient variant that is beginning to be phased out of service with airlines.

According to Yosi Melamed, corporate executive vice president and general manager of Bedek Aviation Group, the group is expecting the B737-800BDSF conversion STC approval a year from the B737-700BDSF STC approval, with 12 positions and carrying up to 52,000 lb. In the future, IAI plans to introduce more narrowbody airframes, including the 737NG and Airbus 320 and 321. Introduction of a new widebody platform, based on the Boeing 777-200, is also on Bedek's road map.

Through the conversion process, the 737-700 aircraft is fitted with an 84-by-134-in. cargo door on the left side and additional modifications of the main deck to Class E cargo compartment. The converted B737-700BDSF can carry a total of 10 ULDs – eight full 88-by-125-in. AAA, plus one 80-by-43-in. AYK, plus one 88-by-79-in. AYF, providing a total useful volume of 3,673 cu. ft., enabling it to carry up to 45,000 lb. **—Noam Eshel**

IAI's 737-700BDSF cargo conversion includes a fuselage cargo door, structural mods to support full loads, and smoke and fire detection systems in the cargo bay.

A Turning Point in UK Space...

Since 2012, Britain has boosted space spending with new money for telecommunications, Earth observation and propulsion technologies – investments based on the notion that growth in the space sector is outpacing other elements of the nation's economy. Four years later, however, the promise of the industry's dynamism may not be enough to justify a sustained investment in space.

The UK space economy in 2012 saw a turnover of GBP11.8 billion (US$17 billion), with more than 35,000 direct jobs in the industry. At the end of 2013, the space sector was reportedly growing at about 8% per year.

Globally, the UK government and its industry partners targeted a rise in growth in the space economy from 6.5% in 2013 to 10% by 2030, or GBP40 billion in annual turnover.

To this end, the UK Space Agency in 2012 pushed through a large increase in its annual contribution to the European Space Agency (ESA). Beginning in 2013, the five-year plan was to invest GBP240 million over five years in the 22-nation ESA, with the expectation of about a 90% return on investment in the form of industrial workshare.

Already Britain has seen an increase in the number of contracts awarded as a result of its ESA investment; most recent was a 229 million euro (US$260 million) award in April to Airbus Defense and Space UK to build the spacecraft for ESA's carbon-mapping Biomass mission.

The boost in ESA spending has also helped space start-ups, with support from a business incubator affiliated with the new European Center for Space Applications and Telecommunications, ESA's newest facility and its first in the UK. Situated at the Harwell Campus in Oxfordshire – also known as the UK's Space Gateway – the center was relocated from the Netherlands in 2013, bringing jobs to the local economy.

More recently, Britain saw the return of astronaut Tim Peake from the International Space Station (ISS). Although the UK is not a sizable contributor to the orbiting outpost, Peake's mission was expected to stimulate interest in so-called STEM education and inspire a new generation of scientists and engineers.

But a new report from the House of Commons says the government should not rest on the laurels of its astronaut but rather seize on the public enthusiasm for his return to support an expansion of Britain's role in space with a separate national program to address the skills shortage in technical fields.

"It should be a call to arms, not a cause for complacency," the June 7 report says of Peake's Principia mission, from which the

Britain has invested in Skylon, a UK technology that promises a major breakthrough in launch economics and one that could lead to development of a single-stage-to-orbit vehicle.

...But Is It Sustainable?

British astronaut returned to Earth June 18 following a six-month stay aboard the ISS. "Now is also the time to address the missing piece in the UK's space ambitions and establish an expanded national space program alongside our contributions to ESA."

The parliamentary report notes that more than 75% of UK spending on space goes to ESA – with much of it coming back to Britain via industry contract awards. But while the committee admits the return on investment at ESA is good, the nation could do better, thus the call for a homegrown program that would be funded in parallel.

In 2013, the government identified satellites as one of eight "great technologies" that should be pursued for the future, notably in the area of small spacecraft, which has become a burgeoning niche in the UK space sector. That year alone saw 92 satellites weighing 1-50 kg (2-110 lb.) launched globally in a market that is expected to have a value of US$7.4 billion in 2015-19.

With this in mind, the committee says the government should develop an indigenous smallsat launch capability and spaceport to serve as a catalyst for the market. While some companies, notably Glasgow, Scotland-based smallsat maker Clyde Space, are supportive, others suggest that improving the business environment for small-spacecraft manufacturers would prove more beneficial to the satellite sector.

Specifically, a regulatory regime that motivates the manufacturing of small satellites is "more important than having a spaceport," says Inmarsat COO Ruy Pinto.

Whether the UK government would actually fund a new commercial spaceport is a great unknown.

In May, Queen Elizabeth II's speech to Parliament suggested the spaceport would not be built with public funds, although the government could possibly ease regulatory burdens and thereby remove any unnecessary stumbling blocks for potential investors.

Likewise, UK minister for universities and science Jo Johnson said the government's role in supporting the spaceport was more to facilitate it than to fund it.

"We have always made it clear that this is primarily a commercial enterprise," Johnson said. "Government's role is to make sure there is an enabling regulatory environment and that we work through all the complex regulatory and technical issues that having a spaceflight capability involves."

The UK has, however, signaled support for cutting-edge propulsion technologies that could lead to an indigenous launch capability, notably the Sabre powerplant in development at Reaction Engines Ltd. (REL), a UK start-up with a long-term plan to produce a single-stage-to-orbit launch vehicle dubbed Skylon.

Globally, the UK government and its industry partners targeted a rise in growth in the space economy from 6.5% in 2013 to 10% by 2030, or GBP40 billion in annual turnover.

The UK government is investing in the nation's burgeoning small-spacecraft industry and has promised regulatory changes to enable development of a British spaceport.

However, the committee says that as of February, the UK government's GBP60 million promise to invest in REL had not yet materialized.

"This was a bold decision, but it has not been followed by solid action," the report says of the UK investment announced in 2014. "The government seems to have fallen short of the professional standards of investment that we would expect."

The report also chides Britain's lack of appetite for risk. Aside from Richard Branson of Virgin Galactic, the UK lacks the start-up culture of SpaceX and Blue Origin, companies that are pioneering new business models and technological developments in the U.S. space sector.

"Space is one of the areas where, if you are a new entrant or you have an idea that may not have maturity or is very innovative, people are naturally hesitant," says Patrick Wood of Surrey Satellite Technology Ltd., a subsidiary of Airbus Defense and Space that leads the nation's smallsat industry.

Further, the report suggests the government could be doing more to provide financial incentives for space players. UK Finance – the British equivalent of the U.S. Export-Import Bank, France's Coface and Export Development Canada – is not doing as much as it could to foster low-cost loans for satellites.

"Government should provide details of its progress on developing an export promotion plan for space," the report asserts. "This should include information on export finance initiatives that will assist the space sector and how these compare with our international space and satellite competitors."

The government should likewise fund flight demonstrations to attract new investment to unproven technologies; the report cites a lack of flight heritage as a barrier to new entrants in the UK space sector.

"Given the scale of this barrier, we recommend that additional resources are made available to Innovate UK, so that it is able to expand further its In-Orbit Demonstration Program," the committee urges, citing the government agency that competitively fast-tracks funding for new developments.

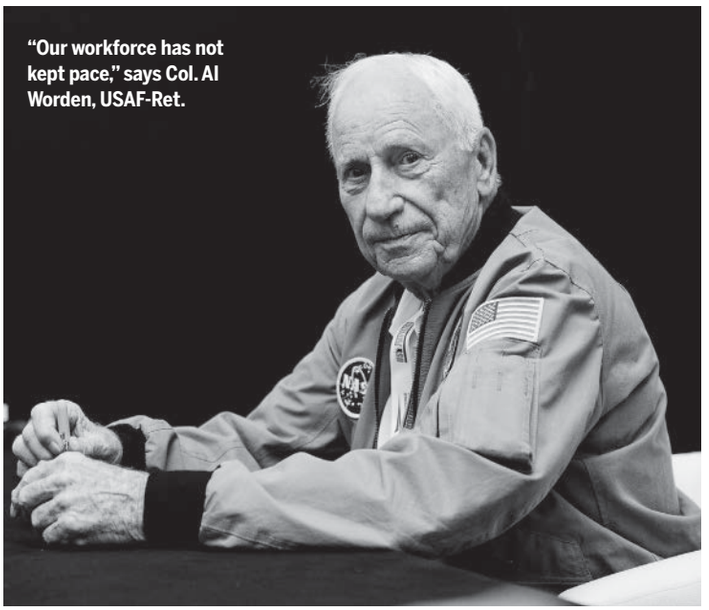
Finally, the report notes that the current licensing and regulatory regime has not kept pace with innovations in the space sector, and that although efforts to evolve the regulatory status quo in the UK are under way, progress has been slow and too narrowly focused on the specific case of cubesats, rather than small satellites more generally.

"It is vital that, while the UK space agency maintains its reputation as a responsible regulator, it also does not adversely impede innovation and growth in the sector," the committee states. "We are concerned that...draft regulatory proposals, as they currently stand, risk complicating the process when the intention is to simplify regulation and make it more proportionate."

—Aviation Week

STEM to Space: Let's Launch More Flight Careers!

If you had told me when I graduated from the United States Military Academy in 1955 that my career would take me via the U.S. Air Force to the Empire Test Pilot School here in Farnborough to the moon on Apollo 15 and back to Farnborough 52 years later – with so many extraordinary experiences and personal connections along the way – I certainly would have laughed it off with a big "No way!"



"Our workforce has not kept pace," says Col. Al Worden, USAF-Ret.

There are probably a lot of you here this week who, similarly, could not have guessed at the start of your careers that you would find such rewarding work in the most exciting industry in the world.

We can't predict where our passions will take us, but we can all agree, no industry enables mankind to reach as far as aerospace. Consider that just over a century ago, the Wright brothers discovered controlled, powered flight, and today, we're orbiting Jupiter!

This industry is chock-full of such historic human accomplishments, achieved by millions of professionals, connected across the continuum of time by the four cornerstones of STEM – science, technology, engineering and math.

Yes, millions. For perspective, consider the manpower it took to fly 23 other astronauts and me to the moon and back between December 1968 and December 1972. By some estimates, the Apollo space program employed half a million people – 34,000 directly at NASA and 375,000 outside contractors.

Since then, our industry's ambitions have only grown, but our workforce has not kept pace. If today's dreams of colonizing Mars and commercializing space are to be realized, the pipeline for STEM talent must be expanded.

Among his many accomplishments in a career that spans some 50 years, Al Worden was command module pilot of the Apollo 15 lunar mission. He is the author of *Falling to Earth.*

The good news is aerospace is at the forefront of STEM education. For example, look at the success of the Team America Rocketry Challenge in the U.S., or the Royal Aeronautical Society's Schools Build-a-Plane program. These industry-supported initiatives excite and inspire thousands of young people to experience the excitement of flight firsthand in collaboration with volunteer industry professionals. Notably, each of these programs will have a presence at Farnborough this week.

Two additional STEM programs will generate interest in STEM among professionals and students during the show. On Thursday morning in the Hub presentation area in Hall 3, Kallman Worldwide, organizer of the U.S. International Pavilion, will host a panel discussion about industry initiatives to attract, train and retain workforce talent. And Friday, Farnborough Futures Day will bring young people ages 11-21 to the show to learn about careers in aerospace and defense.

Aerospace is an industry that never stops giving back. For my part, I chaired for seven years and still represent the Astronaut Scholarship Foundation, a not-for-profit group founded by the Mercury 7 astronauts to help STEM-driven students pursue their college education.

If you also love what you do, take advantage of these initiatives or others to share your passion with young people. Together, let's inspire the next generation of innovation and launch more careers in flight!

—Col. Al Worden, USAF-Ret.

Getting Down to Earth at FIA 2016

HERE AT THE Farnborough International Airshow, British astronaut Maj. Tim Peake will be making his first public appearance in the UK since completing his 186-day mission aboard ISS, the International Space Station. During his time in space, European Space Agency astronaut Peake, a former British Army helicopter pilot and graduate of the Empire Test Pilots' School, made 3,000 orbits of the Earth, and covered a total distance of some 125 million km.

He is scheduled to appear in the Space Zone and on the Airshow Live! stage on Friday, Futures Day, when FIA 2016 opens its doors to the general public. On Saturday, Peake returns to take part in the Airshow Live! stage show, where he will be interviewed and then will launch the flying display.

Maj. Tim Peake

SINGAPORE AIRSHOW 2018 6–11 Feb

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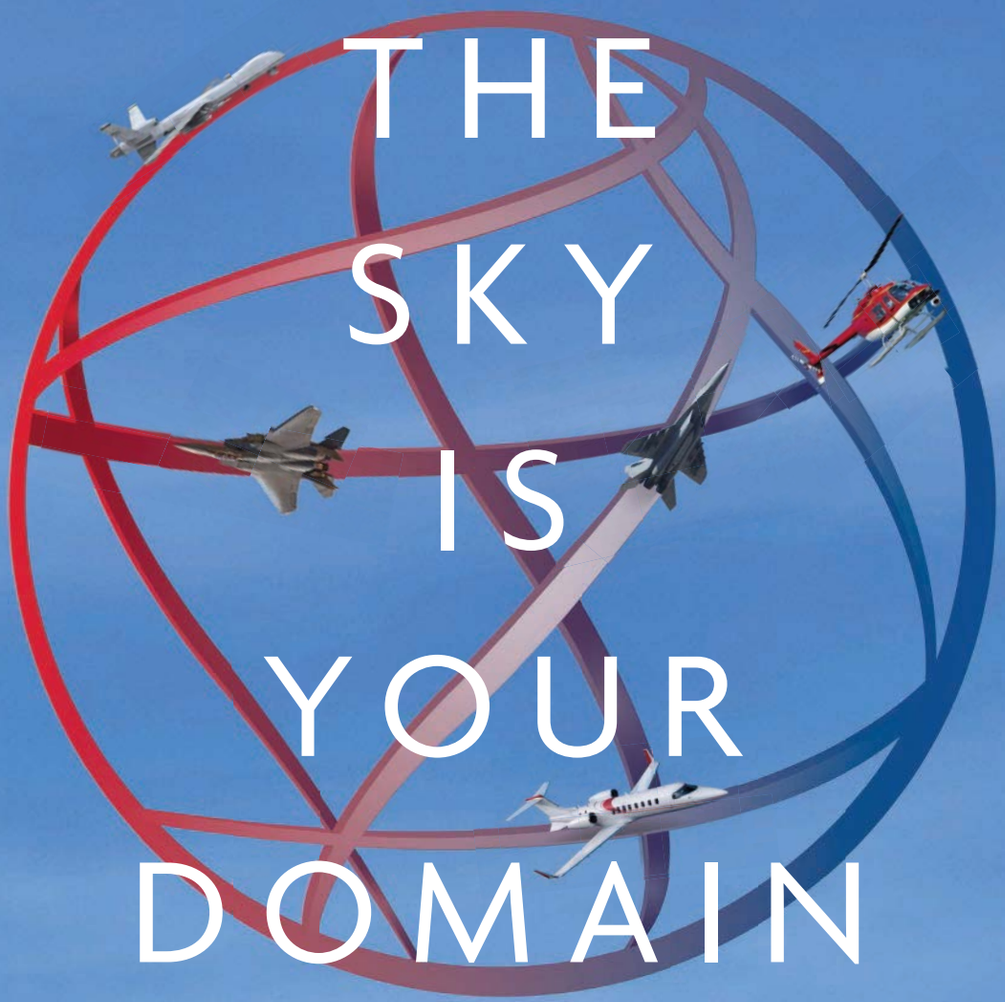

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ATR-72 Maritime Programs Advance

The fourth P-72A maritime patrol aircraft, a derivative of the ATR-72 regional airliner, is to be delivered to the Italian Air Force next year.

The Italian Air Force has begun acceptance trials of a new fleet of maritime patrol aircraft based on the ATR-72 regional airliner.

It has ordered four P-72As from Leonardo-Finmeccanica's aircraft division. Three are currently undergoing acceptance tests and are due to be delivered to 41 Stormo, based in Sigonella, Sicily, in the coming weeks.

The P-72As will carry out maritime patrol, electronic surveillance, and command and control missions, as well as secondary tasks such as search-and-rescue and anti-piracy. They will supplement but not directly replace Italy's aging fleet of Breguet Atlantic anti-submarine warfare aircraft.

Leonardo-Finmeccanica (Booth L1) has fitted out the aircraft with its in-house Airborne Tactical Observation and Surveillance (ATOS) mission system, which links the aircraft's onboard sensors; Star Safire HD electro-optical turret; Seaspray 7300 electronically scanned array search radar; and a self-protection suite based on the Elettronica's ELT800V2 electronic support measures system.

The fourth aircraft will be delivered in mid-2017 in fully operational configuration that also includes Ku- and Ka-band satellite communications and the ability to use Sicral, an Italian military strategic communications system, and Vortex, a line-of-sight video data-link system. The original three aircraft will be retrofitted to this standard later.

The Italian Air Force had ordered the aircraft in 2008 and expected them to enter service in 2012. However, Leonardo officials say the program was redefined and the timing rescheduled after the air force asked for the aircraft's configuration to be changed.

The P-72s will be operated by a standard crew of eight – two pilots, four mission system operators and two observers. Maximum endurance is 10 hr., although a typical mission will last 6-8 hr.

The aircraft have been configured so that an anti-submarine warfare capability could be added in the future. The wing can be fitted with hardpoints for torpedoes, and the rear fuselage has been strengthened to allow fitment of a magnetic anomaly detector. An area in the rear cabin has been earmarked for a sonobuoy launcher.

"The aircraft operates very comfortably at low altitude," said a company source. "As it is designed as a passenger aircraft, it is comfortable for the crew. "In many ways propeller aircraft are better than jets for maritime patrol as they are less susceptible to bird strikes."

At the IDEF defense show in Istanbul in 2013, Alenia Aermacchi and Turkish Aerospace Industries (TAI) signed a memorandum of understanding to offer the ATR-72 as a maritime patrol aircraft, with the Italian company supplying the basic airframe and carrying out the final integration and test work, while TAI made modifications to the aircraft and installed mission equipment. To be known as Meltam-IIIs, they will be operated by the Turkish Navy and the first of six ordered will shortly be transferred to Turin, Italy, after fitting out by TAI in Turkey. The aircraft are fitted with the Thales Airborne Maritime Situation & Control System (AMASCOS) mission system and should be delivered back to Turkey in 2017. Two more ATR-72s have already been supplied to Turkey for utility missions.

—Tony Osborne

nEUROn Makes First Public Flight

The nEUROn flew in public outside Marseille on June 4.

The nEUROn unmanned combat air vehicle demonstrator took flight on June 4 at the Dassault Aviation flight test center at Istres in what is claimed to have been the first time a stealth aircraft controlled from the ground has flown in public.

The 15-min. flight was carried out by teams from Dassault, the French defense procurement agency DGA and l'Armée de l'Air. After takeoff, nEUROn was joined by a Rafale and a Falcon 8X and the three aircraft then flew past in formation along the runway at an altitude of 150 meters in front of thousands of spectators. In March 2014, nEUROn became the world's first unmanned combat air vehicle to fly in formation with other aircraft, then a Rafale and Falcon 7X.

"This flying display, in a limited airspace, represents a real achievement, both technically and in terms of flying skills," says Dassault. "Outside of the U.S., the nEUROn team is the first in the world to have designed, built and flown a stealthy unmanned combat air vehicle demonstrator and the first to have submitted it to a comprehensive test program, including tests involving operational detection systems [radar and infrared], and launch of a weapon from an internal bay at high speed." Chalet J1.

More Grist for the Mil's Mill

A purpose-equipped, quick-change medium helicopter will transform the United Nations' humanitarian activities in underdeveloped countries.

It's a Transformer, but it's not a toy. Ukrainian Helicopters' Skytransformer version of the Mil "Hip" medium rotorcraft is being promoted on Booth 3/E110 and has a presence (and a half) in the static display.

The "add-on" display, comprising a section of fuselage, is necessary to represent the optional passenger interior, because Ukrainian Helicopters is offering a versatile aircraft that can change its interior at short notice to tackle the next task on the list. Transformer is the outcome of the company's more than a decade of experience in numerous stabilization, peacekeeping, humanitarian and relief missions in Europe, Asia, the Middle East, Africa and Latin America.

The white-painted helicopter has its tail rotor on the left side, which means that it is what the East calls an Mi-8M and the West says is an Mi-17. Either way, it's a TV-1 subvariant.

Ukrainian Helicopters' sales pitch is, "Air ambulance: Transformed to anything in 40 minutes." In humanitarian form, the helicopter accommodates two in intensive-care modules, three on stretchers and two attendants.

A SkyTrack communication system allows medical attendants to consult with specialists on the ground during the return flight, the system also transmitting the patients' vital parameters to assist diagnosis.

That medical interior can be swapped for folding bench seating for 21 passengers, plus a luggage compartment for 320 kg (705 lb.); or the Combo configuration, with between five and 10 individual "comfortable" seats, separated by a partition from between 2,000 and 3,000 kg (4,409 and 6,613 lb.) of cargo.

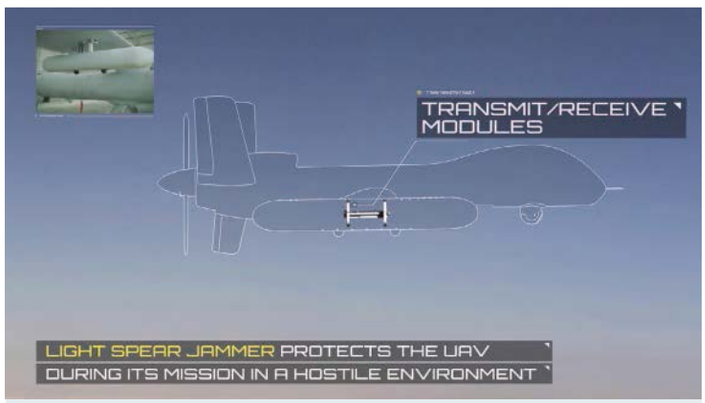
As a pure freighter, the Mi-8M can transport 4,000 kg (8,818 lb.) in the cabin, or 3,000 kg underslung.

For search and rescue, the interior includes one medical module, three stretchers, two attendants' seats, foldable bench seats, a rescue winch and a stock of survival equipment. In all cases, the helicopter is fitted in the chin position with an infrared turret on a Flir Systems Polytech mounting.

The necessity of a Flir sensor is confirmed, says Ukrainian Helicopters, from the company's experience in Somalia, where medical flights on behalf of the UN cannot be flown between 1600 and 0400 hr. Further capability comes from an infrared searchlight coupled to the Flir and pilots' night vision goggles.

Perversely, some factions even object to UN mercy flights, so there is Kevlar armor that protects the helicopter from small-arms fire, and an airborne missile-protection system operating in an automatic mode to defeat surface-to-air missiles.

White-painted Mils have already done much for humanity. Thanks to Ukrainian Helicopters, they can now do more. **—Paul Jackson**



Elbit's operational concept for Light Spear shows the pod mounted on a representative current-generation unmanned aircraft.

Elbit Offers Self-Protection System for UAVs

ELBIT SYSTEMS HAS used the Farnborough Airshow to launch a new platform-protection product aimed at the unmanned market. Light Spear leverages Elbit and sister company Elisra's experience in electronic warfare, signals intelligence and digital systems integration to provide a wide range of capabilities in a small, lightweight, low-power-consumption package.

Light Spear incorporates electronic support measures and electronic countermeasures (ESM and ECM) packages, utilising DRFM (digital radio frequency management) technology. DRFM allows detected RF signals to be recorded, manipulated and retransmitted to jam and defeat threats by fooling receivers in missile countermeasures.

Promotional materials issued by Elbit posit the podded system for carriage on a Reaper-like UAV platform. Current unmanned systems have had little need for advanced countermeasures or jammers, as they have tended to operate in uncontested environments, and the lack of a pilot onboard has meant defensive features have not been high on the agenda for customers. Future unmanned combat aircraft concepts leverage stealth technologies to permit operations in denied airspace. Podded countermeasures could provide a halfway house, protecting the expensive and operationally sensitive equipment onboard while enabling information-gathering – and potentially strike – operations to be conducted in hostile airspace. **—Angus Batey**

No, they didn't build it here. Ukrainian Helicopters brought an extra display fuselage, as the manufacturer is offering a versatile "Skytransformer" aircraft allowing an operator to change its interior at short notice.

White-painted Mils have already done much for humanity. Thanks to Ukrainian Helicopters, they can now do more.

Ex-Im Bank Banks on a Political Solution to Stalled Deals

Inevitably, U.S. aerospace's current dissatisfaction with the Export-Import Bank of the United States (Ex-Im) was high on the list of questions posed to its chairman and president, Fred P. Hochberg, when he addressed a "roundtable" organized by the U.S. Pavilion at Farnborough on Monday.

Fred P. Hochberg

The crux of the problem is that Ex-Im is one board member short of the quorum of three needed to approve any guarantee exceeding US$10 million, so while it is able to provide its much-needed assistance to small firms, the bigger deals remain stalled. In fact, concedes Hochberg, overall activity is merely a third of one year ago.

But the holdup is a political one. The Senate Banking Committee refuses to allow new nominations, so the best that Hochberg can hope for is that the situation will be resolved, "at the end of the year, after the election." Meanwhile, 85 similar agencies in 67 other countries are functioning normally – against U.S. industrial interests.

That's not to say that Ex-Im is impotent. Its role is to support "hard to finance" deals, a definition that applies to a lot of aerospace. In fact, 32% of Ex-Im support is normally of aviation.

Although not a narrow interpretation of American aerospace, noted Hochberg, Brazilian Embraer's assembly plant in Melbourne, Florida, qualifies for support, as does any similar business.

Examples of those needing ongoing assistance, said Hochberg, are the Air Tractor and Thrush companies, both of which export half the agricultural aircraft they build. They and their local communities would suffer grievously if overseas deals were to dry up.

Regrettably, those with larger fish to fly will just have to be patient. **—Paul Jackson**

Ikhana Aims for Twin Otter MTOW Increase

California-based Ikhana Aircraft Services will soon begin flight testing a DHC Twin Otter 300 in pursuit of an FAA Standard Commuter Category Supplemental Type Certificate (STC) raising the aircraft's maximum takeoff weight to 14,000 lb. The original Twin Otter 300 had a 12,500-lb. MTOW. Modifications required for the STC include an upgrade to Pratt & Whitney-Canada PT6A-34 engines, installation of Raisbeck swept four-blade turbofan propellers, and structural, aerodynamic and systems changes. The upgrade will be packaged so that it can be accomplished at a customer's maintenance facility. IKHANA expects to gain STC approval by year-end.

CAE Signs Long-Term Pilot Training Deals

CAE has signed a 10-year agreement with Vietnam Airlines for Airbus A320, A350 and Boeing 787 pilot training, and a seven-year contract renewal with Asiana Airlines for A330 training. In addition, it has renewed for five years an agreement with Jet Airways of India. CAE will also supply one flight simulator each for Airbus A320, A350 and Boeing 787 aircraft to the Asian Aviation Centre of Excellence, and an A320 full-flight simulator and A320 flight-training device to ChongQing Yu Xiang Aviation in China. CAE is at Chalet B38.

Diamond Delivers Flight Inspection DA62 to UK

Diamond Aircraft Industries (OE18) has delivered a DA62 to UK flight inspection service provider Flight Calibration Services Ltd. (FCSL). The aircraft is equipped with 28 EASA-certified antennae. FCSL Director Matt Taiyeb commented, "In combination with our recently developed, state-of-the-art flight inspection system, the DA62 has the performance and payload we require to further optimize the delivery of flight inspection and calibration services to airports worldwide. Add lower fuel burn, reduced emissions and reduced noise, and the DA62 is a great example of how FCSL is working to minimize the impact of its operations on the environment."

U.S. Navy Launches Last MUOS Satellite

On June 24, the U.S. Navy successfully launched its fifth and final Mobile User Objective System (MUOS) satellite on a United Launch Alliance Atlas V rocket. The Navy handles acquisition of the Pentagon's UHF narrowband satellite communications, which keeps the military connected through foul weather and across complicated terrain. The new MUOS satellite will function as a spare. The other four are providing near-global coverage that enables communications even in Polar regions. The next step is upgrading software for thousands of radios across the U.S. military so they can receive signals from the MUOS.

Seastar Windscreen Win for GKN

GKN Aerospace has been awarded a GBP4.8 million contract to design and manufacture the cockpit windscreen for the Dornier Seawings Seastar all-composite, twin turboprop amphibian. The windscreen will use advanced lightweight materials designed to maintain optimum clarity in the rigorous maritime environment. GKN (Chalet G1) will complete design and qualification of the windscreen by December 2016 at its Kings Norton, UK, facility. Flight trials and production will start in 2017 in anticipation of Seastar type certification scheduled for the following year. The windscreen will meet European Aviation Safety Agency and Federal Aviation Administration safety requirements.

CMC Esterline: Antonov & More PC-21s

Esterline CMC Electronics (Hall 1, Booth B60) has been awarded two key contracts to provide its high-performance avionics systems for the AN124 transport aircraft operated by Antonov Airlines, and for the AN148/158/178 series.

Under the terms of the first contract, CMC will supply its CMA9000 flight management system, CMA5024 GPS sensor and MFD2068 multifunction display in a dual configuration for the upgrade of seven AN124s.

For the second contract, the company will provide dual CMA9000 FMSs and five MFD-3068 multifunction displays for 60 new-production AN148/158/178s that are destined for commercial and military customers.

Pilatus Aircraft has awarded CMC contracts to provide avionics for the Royal Australian Air Force's forthcoming fleet of 49 PC-21 turboprop trainers, deliveries of which will start in June 2017, and for eight PC-21s ordered by the Royal Jordanian Air Force. The company will supply four CHDD268 cockpit headdown displays and two smart MFD2068 multifunction displays that are in the PC-21's front and rear cockpits; dual flight management systems; GPS landing system sensors; and head-up displays.

CMC has been selected to carry out a glass cockpit avionics upgrade on a further seven Finnish Air Force BAE Hawk jet trainers. Finland's existing upgraded Hawk fleet provides basic and advanced training at Tikkakoski Air Base for pilots destined for Boeing F/A18C/D-equipped frontline squadrons. This new contract covers the adaptation of CMC's Cockpit 4000 integrated avionics suite for an additional seven Hawk Mk51s currently held in reserve that still have their original analog avionics. Upon completion, the Finnish Air Force will have a fleet of 31 glass cockpit-upgraded Hawk Mk51s and Mk66s.

Esterline's Korry Electronics division has introduced its Quick Switch LED-illuminated 5/8-inch switch. By focusing on streamlining its lean manufacturing processes, Korry has reduced production time of the most popular versions of the switch to just three days after receipt of order.

CMC has made the milestone delivery of its 3,500th high-gain satcom antenna system. The unit has been installed on a Saudi Arabian Airlines Boeing 777. CMC's latest CMA2102SB high-gain satcom antenna system supports Inmarsat AeroH+, Swift64 and SwiftBroadband satellite communications services. CMC has been supplying satcom antenna systems to the aviation industry for more than 25 years, and has delivered electronically steered, phased array, high-gain and intermediate-gain systems for use with the Inmarsat satellite network to some 120 airline customers as well as to OEMs, military, corporate and VIP customers.

The Pilatus PC-21 cockpit will include Esterline CMC flight management system and GPS.

Esterline CMC's CMA9000

Airbus and Boeing: Both Are Bullish

The Airbus A350XWB and Boeing 747-8F freighter are among the high-value widebodies on show at Farnborough 2016.

Both Airbus and Boeing released bullish forecasts for the global commercial aircraft market on the opening day of the Farnborough Airshow, with Boeing projecting slightly stronger demand.

Boeing forecasts demand for 39,620 commercial aircraft over the next 20 years valued at US$5.9 trillion. The number of aircraft, which includes regional aircraft below 90 seats, is 4.1% higher than the 20-year forecast issued by Boeing in 2015.

The Airbus forecast calls for 33,000 new commercial aircraft through 2035 valued at US$5.2 billion. The disparity between the forecasts is smaller than it appears, since Airbus is only including aircraft with more than 100 seats; Boeing's forecast includes 2,380 regional jets.

A more accurate signifier of the narrow split in the manufacturers' views can be seen in their projection of the average annual global commercial passenger air traffic growth rate from 2016 to 2035: Airbus projects growth of 4.5% per year over the forecast period, while Boeing sees annual growth of 4.8%.

Airbus said the world's commercial jet fleet will double from 19,500 today to 40,000 by 2035 as "some 13,000 passenger and freighter aircraft will be replaced with more fuel-efficient types." Boeing projects the world's commercial jet fleet (including regional jets) will grow from 22,510 today to 45,240 by 2035.

Both manufacturers said the single-aisle market will dominate new aircraft deliveries over the next 20 years, with both Airbus and Boeing projecting narrowbodies will account for 71% of new additions to the global commercial fleet during the forecast period.

Though widebodies will make up a decided minority of deliveries, widebody aircraft will account for 54% of the value of commercial jet deliveries from 2016 to 2035, Airbus noted, projecting demand for 9,500 widebody passenger and freighter aircraft over the next 20 years valued at US$2.8 trillion. Boeing sees demand for 9,100 widebody aircraft over the forecast period, "with a large wave of potential [widebody] replacement demand in the 2021-2028 timeframe." Boeing noted that it "projects a continued shift from very large airplanes to small and medium widebodies such as the 787, 777 and 777X."

Both manufacturers dismissed near-term concerns about the global economy in making their forecasts. "Middle classes in emerging markets will double to 3.5 billion people by 2035," Airbus said. "Globally, by 2035, 62% of world population will be city dwellers and the number of aviation megacities will rise from 55 to 93 by 2035. These centers of wealth creation, many of which are already schedule constrained airports, will account for 35% of world GDP. In 20 years, the number of daily, long-haul passengers traveling to, from or via aviation megacities will more than double to 2.5 million."

Boeing projected that the growth of developing markets will drive air traffic growth: "Emerging markets throughout the world have shown that air travel is one of the first discretionary expenditures to be added as consumers join the global middle class. As emerging market demand begins to develop, it may take the form of nonscheduled services to leisure destinations. Later, the same demand may migrate to scheduled services of low-cost carriers or to network airlines."

—Aaron Karp

Engine Alliance Adds New Overhaul Centers

Engine Alliance (EA) is adding two new engine overhaul centers to its GP7200 MRO network: Emirates Engine Maintenance Centre (EEMC) in Dubai, and Pratt & Whitney Eagle Services Asia (ESA) in Singapore. The new facilities will add capacity to accommodate the growing fleet of GP7200 engines as they begin to enter their first shop visits.

"We're thrilled our partnership with EA now includes full overhaul capability in Dubai," said Iain Lachlan, divisional SVP at Emirates Engineering. "The ability to perform maintenance work locally will translate to cost and time savings, allowing us to keep our A380 fleet running at the highest level of efficiency." EEMC has already completed 25 light engine repairs, and its first piece-part overhaul is now under way.

Engine Alliance is adding GP7200 overhaul centers in Dubai and Singapore.

Engine Alliance is also expanding capability in Singapore, where ESA, previously a center of excellence for GP7200 low-pressure compressor (LPC) overhauls, now becomes a full engine overhaul center. "ESA makes perfect sense because of its multi-model flow lines," noted Kevin Kirkpatrick, P&W Eagle Services Asia's executive director of aftermarket operations, Asia. "We don't need a dedicated line for each engine family. Instead, each line can handle multiple engine types. Engine Alliance is at Hall 4, Booth H71.

BAE Stealthily Posits Future UCAV Concept

As well as the current and soon-to-enter-service technologies on view all over the Airshow site, there are a few glimpses of possible futures to be found. One of the most intriguing is buried deep in a submenu on a touchscreen installation on the future unmanned systems stand in BAE Systems' exhibition hall.

In a piece of forward-scanning work that sits at the very low end of the technology readiness level scale, BAE is positing a cranked-kite stealthy UAV that can change shape during flight, deploy retractable fins from internal bays to aid maneuverability and that uses air bled from the engines instead of moving control surfaces.

"These are concepts; we haven't worked out how to engineer some of these ideas yet," cautions Martin Rowe-Willcocks, BAE's future combat air systems (FCAS) business development director. "We're trying to ask, if you want a vehicle that does more for its shape, how does that work? Would a core airplane with disappearing fins, reconfiguration of the shape for different speeds and control regimes, and so on, be something that was worth exploring?"

Perhaps the biggest surprise is that none of these ideas are unprecedented. Aircraft from the Mirage Milan to the T-144 have had retractable control surfaces; airplanes as different as the XB-70 and the B-1 have changed their configuration in flight. And BAE have already demonstrated using bleed air to control flight on an earlier UAV program. Still, the concept raises far more questions than it answers, but, as Rowe-Willcocks points out, that's really the point of the exercise.

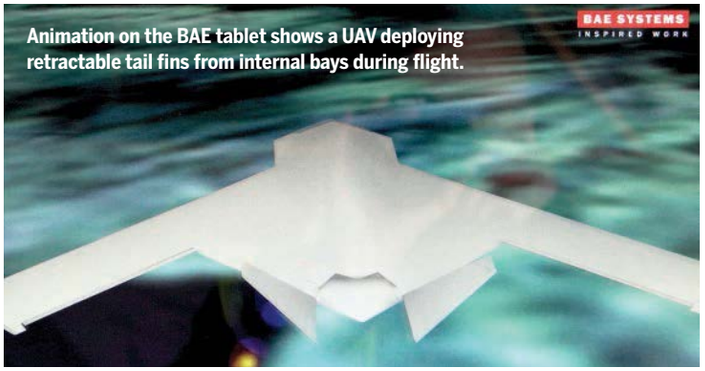
Take, for example, the shape-changing idea. It implies a flexible outer skin on the aircraft, which will not fold or kink as the structure underneath it shifts, if the airframe is to maintain stealthy characteristics.

"That's the challenge. A traditional aircraft that changes its shape like a Tornado or F-111 has some fairly sharp corners and quite big gaps. To us, that's the purpose: to ask, if we wanted to do that, how would we achieve it? I'm not saying we know yet! But what I am saying is, we need to try to test the boundary, so we'd know if we decided we needed to do that whether we'd have to run an individual technology program that explored that piece of the airframe."

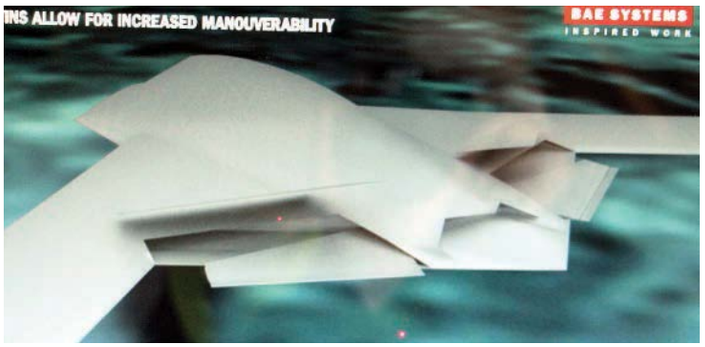
Another obvious challenge the concept poses is software-related. Current aircraft that change configuration in flight do at least have someone onboard to manage the transition. If the system has to do that itself, some new techniques around reconfigurable autopilots are required. Extant work will also inform this discussion, if and when it takes place.

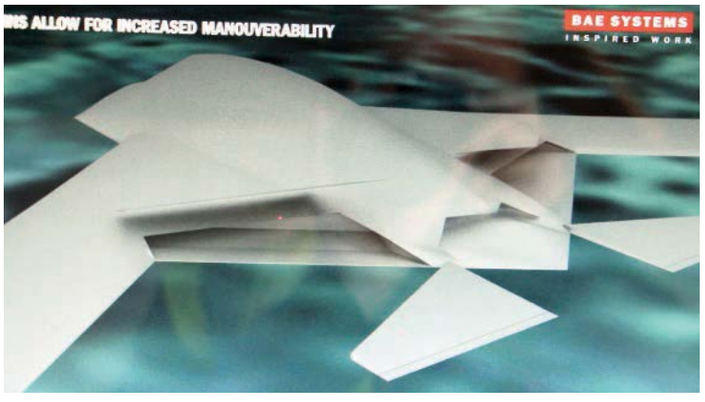
"We've not specifically explored reconfigurability in flight, but we've done reconfigurability between shapes," Rowe-Willcocks says. "If you look at the line of development from Raven to Corax to Taranis, they have slightly different shapes but a common core architecture inside them. And in the very early concept phases we had a single flight-control system that worked across three very different airplanes in Raven, Corax and [still partly classified UAV] Herti, all at the same time, by putting different control laws in there. Of course, you're not changing the shape of the airplane while it's flying. That's the next thing: How would you do that?"

—Angus Batey



Animation on the BAE tablet shows a UAV deploying retractable tail fins from internal bays during flight.





Older Project Demon-strates Surface-Free Control

The Demon program, which culminated in flights on Walney Island in September 2010, has already proven one novel capability. Air bled from the engine is routed to openings along the top and bottom of the wing's trailing edge. Variably controlling the airflow through the four apertures allows the aircraft to be steered. "We sponsored this work inside the university network to build one of these and see if it worked," Rowe-Willcocks says. "As a concept, we found it works quite well, but the big challenge would be engineering it into a full-scale airplane."

Another challenge would be incorporating the concept into a stealthy design. Demon's wing trailing edge had long gaps for the air to flow through, which leave edges that would not be tolerable on a low-observable design.

"So we know flowing air can move the aircraft, but that's not a stealthy trailing edge," Rowe-Willcocks acknowledges. "But if you think of the way the conformal air data [system] works on the nose [of Taranis] – it's a streamlined nose but you've got holes there that you're using for air-data management – could you do the same thing?

"It's about building blocks,. "It's not proven – you're not going to put it in a fighter yet. But it shows it's possible to do these things."**—AB**

New Boeing 777X: Composites From UAE

Boeing will source composite materials for its 777X aircraft from a new joint venture formed by United Arab Emirates-based Mubadala Development and Belgian composite materials and adhesives manufacturer Solvay, Boeing Commercial Airplanes president and CEO Ray Conner said at Farnborough.

Solvay executive committee member Roger Kearns, Boeing Commercial Airplanes supplier management VP Kent Fisher, and Mubadala aerospace & engineering services CEO Homaid Al Shimmari.

The Mubadala-Solvay joint venture will produce primary structure composite material for use in manufacturing the 777X empennage and floor beams. The companies plan the joint venture to become operational by 2021; a new facility will be built in Al Ain, UAE.

"Boeing is pleased to be the first customer for their new joint venture in the UAE," Conner said. "Our commitment to purchase this [carbon-fiber pre-impregnated] pre-preg material for the 777X meets several important goals for Boeing, from further advancing aerospace industry development in the UAE to expanding high-quality materials in our supply chain."

"Boeing has been a key global partner of ours for years," Mubadala aerospace & engineering services CEO Homaid Al Shimmari said. "Together with Solvay, we will further develop our capabilities in advanced composite materials production in order to expand the supply chain and create a materials ecosystem. The creation of a new manufacturing facility at the Nibras Al Ain Aerospace Park supports our efforts of delivering on Abu Dhabi's Economic Vision 2030 by developing a regional aerospace hub for Abu Dhabi."

"First introduced in the 1970s, prepreg composites – a combination of high-strength carbon fiber and toughened epoxy resin – reduce weight and therefore improve fuel efficiency in aircraft," Boeing says. The 777 was one of the first commercial airplanes to contain structurally significant composite parts, and "composites account for 50% of structural weight of the 787 Dreamliner."

"The 777X will have the world's largest composite wing," Boeing says: "Production of the 777X will begin in 2017, with its first delivery in 2020." **—Mark Nensel**

GE and Flydubai Collaborate on Predix Data App

GE AVIATION UNVEILED one of the first digital customer solutions built on its Predix software platform, an application developed through a collaboration with Flydubai.

GE worked with the low-cost carrier on the network operations insights application at its first data analytics center in Dubai, which was opened last year. The airline implemented the platform at the end of June and will use it across its all-737 fleet to minimize aircraft delays, improve pilot operational understanding and manage scheduling and revenues in a real-time setting.

GE Aviation worked with Flydubai to apply its Predix software to a versatile app.

Along with the center in Dubai, the U.S. engine specialist opened its second data collaboration center in Paris in mid-June, which it will run in conjunction with GE Digital. It plans to open two more centers this year; the first in Shanghai next Wednesday (July 20), which will also be operated in conjunction with GE's digital business, and the other in Austin, Texas, later this summer, which GE Aviation will run independently as its digital headquarters for aviation.

Jim Daily, GE's vice president and chief digital officer for engineering and technology, said the engine maker would ideally like to set up another collaboration center in Southeast Asia in 2017, with the exact location still to be decided.

"When looking at the region and where our customers are, it makes sense to put a center there," Daily said. "Ideally, I'd like to identify a specific location this year before setting up sometime in 2017."

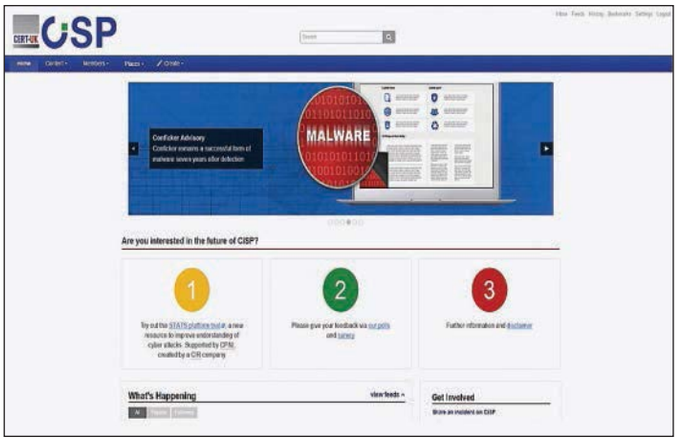
Daily also revealed that GE's aviation arm is exploring ways to further grow its ties with GE Digital with opportunities for crossover collaborations through its Predix platform.

"We're trying to do as much as we can in conjunction with GE Digital. While there are instances unique to aviation, there's also room for a lot of crossover and the Predix platform was designed with this mind," he said.

—James Pozzi

You Are Not Alone, Says Cyber-Defender

One of Britain's most senior cyber warriors has a message for Farnborough's SME community. You've got a problem, but there's help available from the government and from some of the biggest names in the defense industry – and it's free.



The CISP allows companies and individuals to exchange information about network threats via a social media-style interface.

Chris Gibson is the director of CERT-UK – the British government's Computer Emergency Response Team, established to help protect the critical national infrastructure (CNI) from digital attacks. But prevention is always better than cure, so the majority of CERT-UK's efforts are spent building resiliency. The organization conducts awareness-raising outreach, holds exercises and runs an ambitious crowdsourced intelligence network, the CISP (Cyber Information Sharing Partnership).

"Ultimately, we're here to help resolve a national incident that affects the UK. If the prime minister is banging the table in COBRA, that's when I really care – but we're here to help make everyone better, so we don't have a national incident."

—CERT-UK director Chris Gibson

"Ultimately, we're here to help resolve a national incident that affects the UK," Gibson says. "If the prime minister is banging the table in COBRA, that's when I really care – but we're here to help make everyone better, so we don't have a national incident."

The traditional view of what is critical to a nation includes the supply of energy, food, water, communications and financial services, but cyberattacks on other kinds of companies have shown that the definition needs to be more elastic. Worse, a cyberattack on one company can affect others its networks connect with. It is these long supply chains that have become CERT-UK's preoccupation, and where much of Gibson's time and attention is spent.

"There are two things that we try to point out," he says. "If your suppliers get hacked and go out of business, you haven't got a supply chain. And if your suppliers get hacked and they have access to your systems, that's even more worrying. Small companies don't have those big teams of people who can look at threats and vulnerabilities, and can keep on top of making sure their systems are up to date. It's a real problem for them."

The vast majority of digital-security problems – Gibson cites Lancaster University research that puts the figure at over 99% – can be fixed or avoided if companies follow the steps set out in the UK government's Cyber Essentials scheme. Yet many businesses – particularly SMEs – don't seem to realize this.

"This is where the CISP comes in, "Gibson says. "It provides situational awareness to help you understand the risks you're running."

The CISP is, in essence, a private – and very heavily secured – social-media platform where individuals can discuss cybersecurity issues in differently themed chat rooms. There are rooms for different industrial sectors, and others grouped by region, subject or specific cyber vulnerability. Members can post under their real names or anonymously.

To ensure information about an attack in one sector or region does not become stovepiped, the CISP has a Fusion Cell that monitors all conversations in real time, and is able to alert adjacent sectors to problems that may be affecting other businesses. A third of the Fusion Cell's staff is drawn from CERT-UK, other government departments and law-enforcement agencies; the other two-thirds are seconded from industry.

Industry staff typically spend two days per week at the Cell, and are not paid by the government. Companies participating include defense primes BAE Systems, QinetiQ and Babcock, as well as banks, telecom providers and cybersecurity companies.

Membership of CISP is rising – more than 6,200 individuals and 2,200 companies have signed up. Although initially restricted to companies clearly connected to the CNI, the remit has broadened.

"We've got all the CNI, realistically, that we expect and want on there," Gibson says. "That's under a thousand companies. The other 1,500 companies include everyone from the retail sector to academia and charities. We even have a primary school on board."

As that audience has broadened, a need has developed to provide different levels of technical detail.

"Originally it was very bits-and-byte-y, very network-defender kind of stuff," Gibson says. "We still have that high-level stuff, because that helps us protect the CNI as fast as possible. But we also need to help SMEs understand that it's a dangerous world out there, and help them learn how to defend themselves."

The message to the UK's aerospace and defense supply chain is clear.

"The importance of doing the basics cannot be overstressed," Gibson says. "It's about understanding your network, understanding what data you want to protect, and understanding the best way of doing that. Focus your defenses where you need to: Don't try and defend everything. Do Cyber Essentials – that would really solve a lot of your problems, and would mean I could focus on the ones I really care about. And join the CISP – I can't recommend it highly enough."**—Angus Batey**

OPINION

BY **MICHAEL RICHTER**

Supply Chain Will Continue to Consolidate

In an active M&A market for the industry, Michael Richter, managing director and head of Lazard's Aerospace and Defense investment banking group, shares his observations from Farnborough.

The industry has witnessed a robust 12 months as debt markets continue to support private equity participation in aerospace and defense M&A, the latter of which is firmly back in vogue and benefiting from increased investor comfort.

Transactions worth a total US$88.3 billion in defense and commercial aerospace were consummated in 2015, according to DACIS's M&A database Jan. 1 – June 16, 2016. The primary driver of transaction volume (in dollars) in 2015 was the US$37.2 billion acquisition of Precision Castparts by Berkshire Hathaway, he agrees.

Whether or not we see additional large-scale M&A transactions within the aerospace segment, this transaction highlights the relevance of the continuing supply-chain rationalization trend. We continue to see suppliers across the supply base work to deliver value to their OEM and Tier I customers through simplified value streams, integrated capabilities and scaled operations.

Michael Richter is managing director and head of Lazard's Aerospace and Defense investment banking group.

In the defense sector, a stand-out transaction was Lockheed Martin's acquisition of Sikorsky for US$9 billion, and there may be more buying to come, following on the heels of KKR's acquisition of Airbus' defense electronics unit and Marlin Equity Partners' acquisition of Cobham's surveillance business.

For participants within the supply chain, M&A continues to be one of the primary tools for accelerating these types of strategies. More consolidation in U.S. government services and federal services is also anticipated as the segment remains fragmented and EBITDA margins generally hover below 10%.

The need for – and thus likely future spending in – critical capabilities such as communications, power projection, nuclear deterrence and cyber provides a road map for defense contractors in pursuit of growth. The technologies and qualifications necessary to compete for these programs can take years and significant capital expenditures to develop, so M&A can be an attractive alternative. Platform investments and bolt-ons continue to be in focus for private equity firms.

In the commercial aerospace sector, a positive macro environment exists for aerospace suppliers, which continue to benefit from the stability provided by the OEMs' large order backlogs and increasing aircraft production rates on many platforms. M&A is expected to play a prominent role, whether it is ongoing supply-chain consolidation or the emergence of interest in the maintenance, repair and overhaul (MRO) sector. Consolidation can help drive down costs and help OEMs better compete on pricing.

While these dynamics may continue to attract investor interest in the sector, it is the emergence of two new factors that could have the most impact on the pace of acquisitions.

First is the scarcity factor, or the game of musical chairs among suppliers that has largely come to an end. New platforms (including the Boeing 787 and Airbus A350) and derivative updates like the Boeing 737 MAX and Airbus A320neo, have created an unprecedented opportunity for existing and new suppliers to secure large future revenue streams.

These long-term contract opportunities are now committed, so for those suppliers that were unsuccessful in winning a role on these platforms, M&A may offer a second bite at the apple.

The second factor is "scale." As OEM production volumes increase, managing the risk of parts shortages from suppliers has become an important component of ensuring on-time aircraft delivery to customers. However, aggressive OEM pricing campaigns require significant price concessions from the supply chain through programs such as Boeing s Partnering for Success. These competing pressures of significant volume increases and price reductions are benefiting suppliers of scale with significant competitive advantage.

Size enables investments in efficiency tools – such as automation, next generation machinery and tooling, and sourcing – to be funded from a larger capital base and amortized across a larger organization. Here, benefits of improvements in cost structures can be amplified by a larger statement of work. These investments deliver the pricing required by OEMs at levels of profitability that can also satisfy investors.

While consolidation offers the potential for lower prices and reduced going-concern risk associated with larger, more stable suppliers, the OEMs must contend with increased single-point-of-failure risk should a supplier stumble. This raises enhanced opportunities for well-run, well-capitalized Tier 1, 2 and 3 suppliers.

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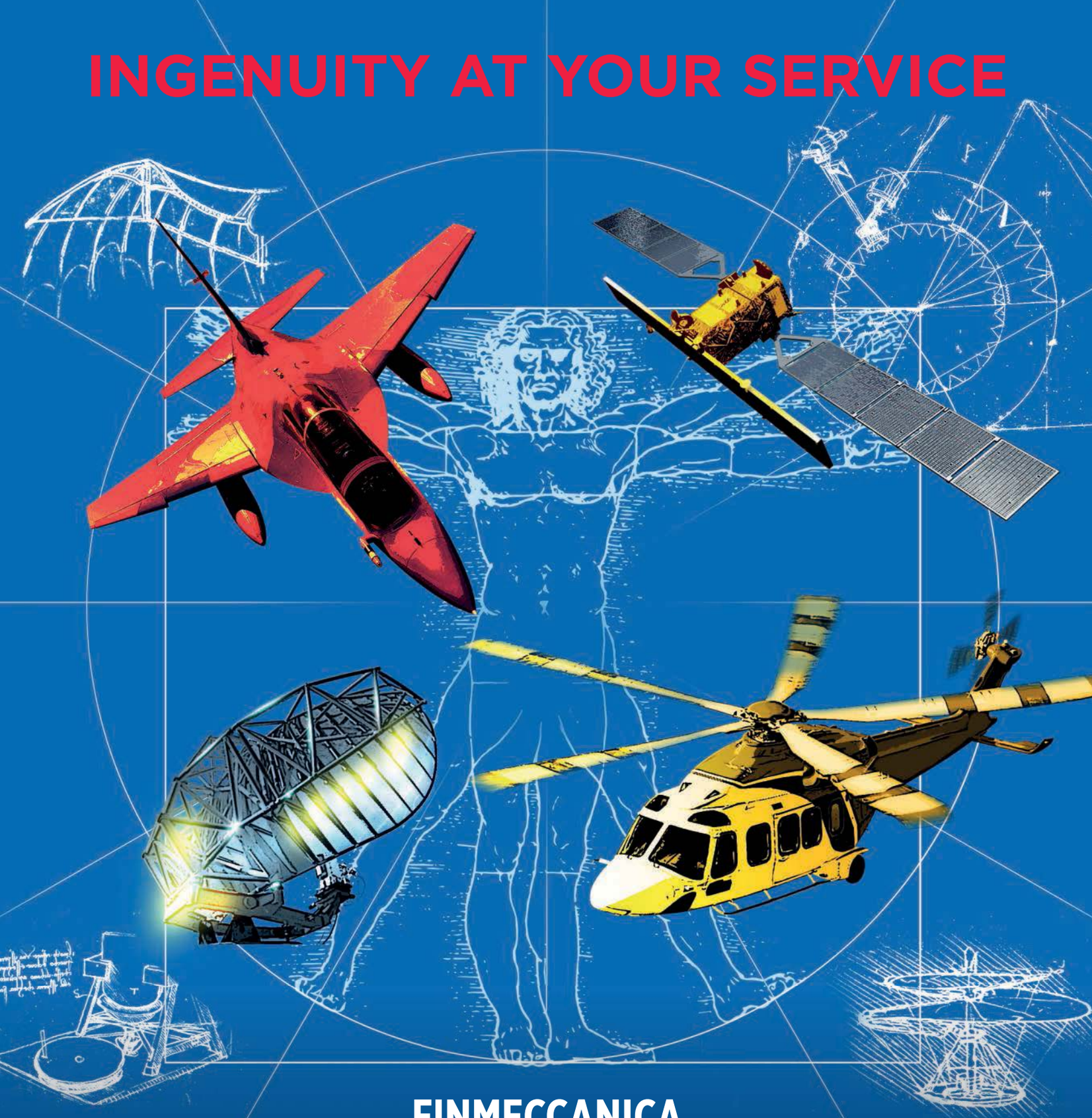

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