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18 July 2014

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Flexibility of airpower

The giant F-35 programme has endured its fair share of flak from many quarters. Its ‘affordable’ tag now seems like a cruel joke to some potential customers and questions still remain about the readiness of its software as it counts down to initial operating capability. Only time will truly tell if it performs as well as the glossy brochure says. Two articles this month (one from a F-35 test pilot), however, hint that its true capabilities may prove a big leap once in service.

Though much criticised, the UK’s switch from CV to STOVL variant, there may, perhaps, be one big advantage going for the F-35B that arguably outweighs its payload and range drawbacks. That is flexibility in its ability to operate from airbases, ships and shorter, more austere airstrips. Though its complex systems and stealth coatings mean that it would be perhaps unlikely to operate from rough ‘Harrier hide’ inside German forests, the ability to quickly disperse to a wider set of airfields or operating bases than other combat aircraft brings its own advantages and complicates enemy targeting. With a new Cold War brewing, the amalgamation of air force assets into a few giant superbases would present in the time of conflict, an irresistible target to enemy attacks. As the attack on Bastion in 2012 demonstrated — even supposedly impregnable, well-defended superbases can be vulnerable to determined attackers on foot — let alone the proliferation of lower-cost precision weapons and missiles that can target hangars and parking spots easily found on Google Earth.

While taking F-35s ‘off-piste’ in this way may be difficult, crucially it may not be impossible — especially in improvising a defence against a surprise attack. The F-35, then, scores extremely highly in one of the key tenants of air power — flexibility and versatility.

Indeed, there are already signs that this vulnerability is a concern in Washington. Under the ‘Rapid Raptor’ concept, the US Air Force plans to disperse fleets of 30-40 F-22s across the Pacific, complicating any temptation by adversaries to shut down its operations by attacking key superbases.

As the ultimate in a flexible based fighter, could then, the F-35B find itself being exactly the right aircraft, at the right time for the new geopolitical realities?

Tim Robinson

tim.robinson@aerosociety.com
Flight plan
The 2015 round-the-world flight will see the Solar Impulse take off from the Gulf, before heading east over India and China, crossing the Pacific, over the US, across the Atlantic, Europe and North Africa. The entire trip, split into five-to-six day legs, will take five months.

Lightweight construction
Despite a 72m wingspan, Solar Impulse 2 only weighs 5,000lb, thanks to advanced composite and carbon fibre materials — that are lighter in weight than ever.

Concept of operations
The two pilots will take turns to fly the aircraft in five or six-day legs. During the day the aircraft will cruise at 28,000ft. At night it will slowly descend to 5,000ft before climbing again when the sun comes up.
Round-the-world — without a drop of fuel

Revealed in Payerne, Switzerland, on 9 April by adventurer Bertrand Piccard and André Borschberg was Solar Impulse 2, a solar-powered aircraft that they aim to fly in a round-the-world flight in 2015. The lightweight Solar Impulse 2 is a bigger and more sophisticated version of the first Solar Impulse HB-SIA demonstrator, which performed a number of successful solar flights including a transAmerican crossing last year. Flight tests of Solar Impulse 2 will begin this month.

Solar panels
The top surface of the aircraft contains 17,248 solar panels which drive four electric motors and top-up lithium-polymer batteries for flight during the night.

Cockpit
The unpressurised, unheated 3·8m³ single-pilot cockpit features a reclining seat and toilet. A ‘virtual co-pilot’ will allow the human pilot to sleep and alert him if the autopilot strays off course.

Engine power
Solar panels supply four electric motors (17·5 CV each) with power — giving a top speed of 105mph during the day. The brushless electric motors are 94% efficient.
**GENERAL AVIATION**

**Learjet 85 makes first flight**

Bombardier has flown its new Learjet 85 business jet for the first time. The test aircraft took off from Wichita Mid-Continent Airport on 10 April for a flight lasting two hours 15 minutes, during which it reached an altitude of 30,000ft and a speed of 250kL. The maiden flight of the all-composite Learjet 85, the biggest Learjet model yet, had been delayed for about a year, with Bombardier not yet announcing a new entry into service schedule.

**DEFENCE**

**Qatar goes on £23bn spending spree**

The Gulf state of Qatar has announced defence deals worth some £23bn – including attack helicopters, missiles and aerial tankers.

Among the purchases are two Airbus Defence and Space A330 MRTT tankers, 22 NH90 military helicopters, a Patriot missile system, along with 24 AH-64E Apache attack helicopters and three Boeing 737 AEW&C aircraft.

**NEWS IN BRIEF**

The European Parliament has voted to back proposals that non-EU airlines should be exempt from reinstated payments for carbon emissions. The change was demanded by China, Russia, India and the US.

Singaporean budget carrier Tiger Airways has placed a $3.8bn order for up to 50 A320neo single-aisle airliners from Airbus. The order breaks down into 37 firm A320neos and 13 options. The airline will now cancel an earlier order for nine A320s – which were set for delivery this year.

Four RAF Typhoons have been offered by the UK to bolster the Baltic Air Policing mission next month. Other NATO countries, including France, Denmark and Germany have also offered fighters.

India has successfully launched IRNSS-1B, the second of seven Indian Regional Navigation Satellite System (IRNSS) satellites. The satellite was put into orbit on 4 April by a Polar Satellite Launch Vehicle (PSLV) launched from Satish Dhawan Space Centre.

**AEROSPACE**

**Underwater pings narrow search for MH370**

As AEROSPACE went to press, a total of 15 aircraft and 13 ships were engaged in the continuing search for the missing Malaysian flight MH370 777 after ‘pings’ were detected by several search ships in the southern Indian Ocean, including Australian naval vessel Ocean Shield which is operating a US Navy towed pinger locator. A statement from the Australian Prime Minister Tony Abbott said that authorities were now confident that the signals were coming from the black box flight recorders from the missing airliner and that their location was now known to within a few kilometres at a depth of 2-6 miles beneath the ocean. However, there have not yet been any confirmed sightings of wreckage from the aircraft.

Bombardier has unveiled plans for how Heathrow airport could be redeveloped into a new residential district, if the decision was made to move airline operations and Lufthansa’s Germanwings low-cost subsidiary. Lufthansa is now to hold further talks with the Vereinigung Cockpit pilots’ union, which represents most of the airlines’ 5,400 pilots.

On 2 April, Lufthansa pilots began a three-day strike in a dispute over retirement contracts. The strike caused the German flag carrier to cancel 3,800 flights. The industrial action also affected cargo operations and Lufthansa’s Germanwings low-cost subsidiary.

**AIR TRANSPORT**

**Strikes ground Lufthansa**

**Japan**

Japanese carrier ANA has ordered 70 new Boeing and Airbus aircraft. The order comprises 14 Boeing 787s, six 777-300ERs, 20 777Xs and 30 Airbus A320 and A321neos.
Turkey has taken delivery of the first of an eventual ten Airbus Defence and Space A400M transport aircraft, making it the second country to receive the A400M after France.

US commercial space company Sierra Nevada Corporation and Lockheed Martin have announced that work has begun on manufacturing the first Dream Chaser orbital vehicle.

Piper Aircraft has achieved the milestone of the delivery of the 550th Meridian turboprop. The 550th Meridian, which first entered service in 2000, went to a Swedish customer.

China has signed a deal to buy 70 airliners worth up to $10bn with European aircraft manufacturer Airbus. The order was originally put on hold over a dispute over the emissions tax for aircraft flying over Europe. The deal will involve 43 A320-family aircraft and 27 Airbus A330 aircraft.

Lebanese air traffic controllers staged a two-hour strike on 1 April in protest over pay. The temporary stoppage delayed 13 incoming and outgoing flights.

Saab has announced it has flown a Selex ES IRST (Infra Red Search and Track) sensor on a Gripen fighter for the first time. The Selex ES Skyward-G IRST is a passive sensor set to be incorporated on the Gripen E.

NASA has cut all space project co-operation with Russia with the exception of the International Space Station (ISS) in protest over the Russian intervention in Ukraine.

Beijing-based 999 Emergency Rescue Center, a subsidiary of the Beijing Red Cross Foundation, has signed an order for an Airbus Helicopter light twin EC135 P2e plus one option. The aircraft is due for delivery before the end of this year.

Engine manufacturer GE has announced it is to build a new $100m factory for the CFM LEAP turbofan engine in Lafayette, Indiana. It is expected to create up to 200 jobs by 2020.
AEROSPACE

Hawaii’s Island Air has placed an order for up to six Q400 NextGen turboprop airliners from Bombardier. The deal breaks down into firm orders for two, with options for an additional four.

DEFENCE

Turkish F-16 shoots down Syrian MiG

On 23 March, a F-16 from the Turkish Air Force engaged and shot down a Syrian AF MiG-23BN Floggers that had intruded into its airspace. The MiG was reported to be one of two that was attacking Syrian rebels on the ground in one of the border towns in the Lakatia province when it crossed over into Turkish airspace and was shot down by a TuAF F-16 from 181 Filo. The Syrian AF pilot was reported to have ejected safely.

AEROSPACE

StratoBus concept promises five-year eye-in-the-sky

Thales Alenia Space has revealed this concept for a high-altitude geostationary airship — the StratoBus. Described as ‘halfway between a drone and a satellite’ the solar-powered, StratoBus would operate at 65,000ft, using small electric engines to keep it on station for up to five years. Uses could include communication relays, surveillance and GPS augmentation.

AIR TRANSPORT

Skymark’s first A380 flies

The first Airbus A380 for Japan’s Skymark Airlines made its first flight on 8 April in Toulouse, France. The aircraft will now be flown to Hamburg for cabin outfitting and painting. Skymark is the first Japanese A380 customer and has six on order. It will operate its A380s on Japanese-US routes.

GENERAL AVIATION

300th Phenom 100 delivered

Brazil’s Embraer has reported the milestone of the 300th Phenom 100 light business jet delivered to a customer. The seven-seat aircraft was delivered to Laticínios Bela Vista, an agribusiness in central Brazil which already operates one Phenom 100. The first Phenom 100 was delivered in 2008.

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NORTH AMERICAN AVIATION

On the ground in one of the border towns in the Lakatia province when it crossed over into Turkish airspace and was shot down by a TuAF F-16 from 181 Filo. The Syrian AF pilot was reported to have ejected safely.

NEWS IN BRIEF

Hawaii’s Island Air has placed an order for up to six Q400 NextGen turboprop airliners from Bombardier. The deal breaks down into firm orders for two, with options for an additional four.

The UK and France have signed a contract with MBDA, worth more £500m to develop a new helicopter-launched anti-ship missile for their navies. The FASGW/ANL missile will equip Royal Navy Fleet Air Arm (FAA) Wildcat helicopters as well as French Navy NH90s and Panthers.

NASA has delayed the first uncrewed test flight of the Orion spacecraft to December this year. The slippage of Exploration Flight Test - 1 (EFT-1) is due to a higher priority for the mission’s launcher — a Delta IV rocket — which will launch a USAF military satellite first.

Private helicopter operator Columbia Helicopters has acquired five Boeing CH-47D Chinook helicopters from the US Army. The ex-military aircraft will be refurbished and used for construction, oil and gas and fire-fighting missions.

The US Federal Aviation Administration (FAA) has given the go-ahead for Boeing subsidiary Insitu to operate three ScanEagle UAVs over northern Alaska.

Lufthansa has ordered CFM LEAP-1A engines to power 15 Airbus A320neos and 25 A321neos. The order is valued at over $1bn.

Lockheed Martin has delivered the first two Republic of Korea Air Force C-130Js to the US on 27 March. The first two South Korean Hercules form part of an order placed for four C-130Js in 2010 by Seoul.

On 22 March an Ariane 5 ECA rocket successfully launched two satellites into orbit from the ESA spaceport in Kourou, French Guiana. The payload was telecommunications satellites Astra 5B and Amazonas 4A.
DEFENCE

Indian C-130J crashes

On 28 March, an Indian Air Force Lockheed Martin C-130J crashed in India with the loss of five personnel on the aircraft, including two Wing Commanders.

The incident happened some 72 miles from the Gwalior airbase while it was on a training mission. The C-130J had only entered IAF service some three years ago.

SPACELIGHT

Sentinel-1a launched

Europe has launched the first satellite in its flagship £6-2bn Copernicus Earth observation project, when ESA’s Sentinel-1a was launched from French Guiana by a Soyuz rocket. The Sentinel launched on 3 April, is a radar satellite, and once linked with other Earth monitoring satellites in the Copernicus network by 2019, will generate some eight terabytes of data each day.

AIR TRANSPORT

INFOGRAPHIC: 60 seconds in aviation

ON THE MOVE

Heathrow Airport CEO Colin Matthews is to step down from the company later this year.

The new Chairman of the National Aeronautic Association is Jim Albaugh.

David Loso has been elected as Chairman for the Aircraft Electronics Association.

AEROSPACE

VTOL X-planes selection

US defence research agency DARPA has downselected four companies for Phase 1 of a project to develop an unmanned VTOL X-plane for a next gen tiltrotor-style capability. The four companies are Aurora Flight Sciences (middle, right), Boeing (top, right), Karem Aircraft (not shown) and Sikorsky (bottom, right).

Shell unveils ACE programme

Aviation fuel and lubricant providers Shell Aviation has launched its Aviation Centre of Excellence (ACE) programme — aimed at FBOs and small to medium-size airports. The ACE covers marketing support, supply security, dedicated technical support and inspection and safety operations management.
UK steps up F-35 preparations

With the UK MoD close to confirming orders for the first 14 F-35B STOVL Lightning II aircraft planned as part of the Joint Royal Air Force and Royal Navy-operated future carrier force, interesting winds of change are blowing across the air power community. Just as it is in the US, air power remains the essential core competency for future UK defence. The Joint Combat Aircraft, as it was originally known in UK military parlance, will form an intrinsic part of Britain’s future combat air capability. Training of UK pilots, together with the engineers that will be responsible for maintaining the UK’s F-35 fleet, is a massive task and it is one that has been meticulously planned. To achieve the F-35 training goals, RAF and RN staff have embedded with the 33rd Fighter Wing, a graduate flying and maintenance training wing located at Eglin Air Force Base, Florida. This is the centre of excellence of F-35 training capability, including pilots, maintainers, air battle managers and intelligence personnel. The plan is that, by 2018, the facility will have an annual capacity to train 100 pilots and 2,100 maintainers. For Britain, which is a Tier One partner on the F-35 programme, the ability of our pilots and engineers to train alongside US military personnel is another example of how the UK pools and share assets and expertise with its largest ally.

Last month I saw for myself the superb F-35 training facilities at Eglin Air Base and got to talk with a number of RAF and RN personnel engaged in the F-35 Lightning II programme. The facilities and particularly the Academic Training Centre are, to say the least, remarkable. UK military embedded at Eglin are highly motivated professionals who are clearly dedicated to the job in hand. In a relatively short period of time, have come a very long way in developing the relationship with the new F-35. In turn, they will become trainers themselves, ensuring that, by the time the jets to be acquired by the UK are fully operational, all the required support is available.

A 3,000+ aircraft programme

While the original UK planning assumption was that a total 140 F-35s would be acquired, the Secretary of State for Defence has subsequently confirmed that the UK will acquire 48 F-35B STOVL variants on top of the four development aircraft already acquired and of which three have so far been delivered. By any standards imaginable and not withstanding concerns over defence cuts, timing and maybe the potential for lowering of aircraft acquisition numbers by some nations, the F-35 is a 3,000 plus aircraft programme. Eight international partners including the UK, Australia, Italy, Netherlands, Canada, Denmark, Norway and Turkey are joined at the hip on the F-35 programme. But for Britain, as a full Level One partner and having invested $2bn in the F-35 development project, the importance and success of the F-35 programme is far greater than that. Level One partner status meant that, right from the start, our F-35 programme requirements have been formally incorporated into the Joint Operational Requirements Document. In practice this means that, ever since F-35 programme inception back in 2001, Britain has enjoyed significant influence on the aircraft development. It has also meant that, led by BAE Systems, hundreds of UK companies are and will continue to be permanently engaged in the F-35 manufacturing programme.

Two-year upgrade cycle

Following the well reasoned change back to the original decision that the UK would acquire the F-35B STOVL version of the aircraft (this followed realisation of potentially very high cost and large scale risk involved in fitting a system of electronic ‘cats and traps’ to the new Queen Elizabeth class aircraft carrier) it seems to me that the principle remaining area of debate around the UK purchase of F-35s is centred on future aircraft upgrades. Back in 2006, the UK and US signed the ‘Production Sustainment and Follow-on Development (PSFD) agreement. This is the MoU governing how follow-on development and all future upgrades will work. It also includes scope and the full cost-sharing arrangements across the international partnership. The F-35 upgrade strategy has, in fact, been designed to field capability and sustainability improvements on the aircraft every two years with the scope of upgrades being jointly agreed by the international partnership. The UK Government can rightly claim that the PSFD MoU provides the UK with full visibility of cost and it in part explains too why UK personnel are embedded
not only at Eglin AFB but in Washington DC as well.

Over an anticipated 30-year programme life, Lockheed Martin expects to produce well over 3,000 F-35s, of which up to a half will likely be exported. The intention is that Fort Worth will eventually produce 100 F-35s annually and, while it is true that the programme is behind the original schedule and that there are some issues left to resolve, such as recently-found cracking on the STOVL version of the aircraft, the programme is progressing very well. Considered a dream for pilots to fly and operate in a denied environment the F-35 relies on no fewer than 8.4m separate lines of code that allow it to do the job effectively. In today’s world of military aviation it is the capability as opposed to the airframe that matters. While the vast majority of required work on F-35 coding lines is now complete, some work remains to be done. Having seen the aircraft fly and the STOVL version in hover at Eglin Air Base and having had the opportunity to speak to two of our fully trained F-35 pilots, I am hugely impressed with how the whole F-35 programme is now progressing.

In July Her Majesty the Queen will officially launch the first of Britain’s two new ‘Queen Elizabeth’ class carriers currently under construction in Glasgow and Rosyth and from which the UK’s Lightning II aircraft will eventually operate. Sea trials for the first carrier, HMS Queen Elizabeth, are due to begin in 2016 and two years later, in 2018, the trials will be further enhanced when the first F-35s are expected to join the ship. As mentioned, the UK has already received three of the four F-35Bs, as part of a well planned and co-ordinated pre-operational build up and training process. The UK aircraft, numbered BK1, BK2 and BK3, had, at the time of my recent visit to Eglin, already notched up 144, 158 and 98 hours, respectively. Three RAF and RN pilots have so far completed Lightning II training and a fourth pilot is expected to complete the course shortly. In total, 44 UK military personnel are now embedded at Eglin. More UK military support engineers have begun the F-35 maintainer course and, on completion, some will be posted either to Edwards or the Marine Corp Air Station (MCAS) Beaufort, South Carolina.

Clichés are, of course, easy to come by but, when an experienced military pilot emphasises that this an aircraft that will not only keep you out of harm’s way but also one that makes us very relevant, I find such a view compelling. There is no doubt that from a pilot’s perspective the F-35 is different from anything that has gone before, Stealth is built-in as an inherent part of the design but the real point behind F-35 for me is that the aircraft offers a giant leap forward in systems management capability within a denied battlespace environment. The bottom line is that an F-35 pilot is far better able not only to make relevant weapons based decisions but also to act on them. The UK’s first squadron of Lightning IIs is planned to stand up at RAF Marham as the revived 617 Squadron some time during 2018 when initial operational capability in a land based role has been completed. When not engaged in carrier strike operation all the UK’s F-35Bs will be based at RAF Marham. In the meantime the RN has resurrected 809 Naval Air Squadron as being the first formation to fly the aircraft.

Lightning Academy

UK involvement in the programme is growing and the F-35B variants already purchased and that will remain in the US as part of our training capability are all fully engaged in both the testing assessment and training programmes. The three UK pilots that fly the aircraft together with 13 maintenance engineers that support the UK’s Eglin-based aircraft do so under a partnership agreement with the USMC. The Lightning Academic Training Centre facility at Eglin currently supports all F-35 training activities. Designed and built for purely in connection with F-35 training, the impressive centre at Eglin currently houses six of an intended ten full mission simulators. Maintainers and engineers will spend a full five months at in the Lightning Academy being taught in classes of about 12. A further 12 UK engineers recently arrived at Eglin to begin the five month process of F-35 training and the numbers are likely to increase over the coming months.

The UK’s third F-35B, ZM137, made its first flight in April 2013.
There are some issues identified in press releases which start to give more reasonableness to scenarios 4 & 5: 1. The woman who called on the non-contract cell phone (burner phone) 2. The visual sighting by Mike McKay of the burning about the same time radio and radar contact was lost (most likely due to the operation of the aircraft’s anti-missile system — chaff) 3. The access of the aircraft by two individuals via false identification 4. The practicing by the pilot on his own private flight simulator 5. The disconnection of ACARS 6. The visual sightings of the aircraft on a Westerly heading over the Maldives 7. The avoidance of radar contact. All of these start to add up to covert activity which is most likely related to smuggled cargo that may well be linked to the indications of military grade weapons systems gone missing from two Ukraine military bases. It would be my assumption that specific state players would not want key weapons systems to fall into the wrong hands. It could be reasonably surmised that MH370 was forced into the deepest depths of the ocean in order to keep its cargo from falling into the wrong hands. The P-8 Poseidon being part of the task force aligns with this thought (deter unwanted submarine access or guide friendly submarines to key target areas).

**Jeffery Sikes**

What is the possible reason why anyone should be allowed to switch off a transponder on an aircraft, especially a large commercial airliner?

**José Martins**

I am a 64-year old Captain, I flew seven years for Varig Brazilian Airlines and retired as a MD-11 Master Captain. The same occured with a Boeing 707 Cargo (reg PP-VLU) that vanished in the air when flying from TYO to LAX. Never found, not even traces. Nothing.

**Ney Langsch Senandes**

One scenario not covered is engine explosion. I have in mind the Qantas A380 turbine disc disintegration when the biggest chunk of it did not hit the aircraft and smaller pieces did not cause decompression. Large pieces hitting the fuselage could cause damage to electrics, electronics and sudden and chaotic decompression. The Qantas immediate cause was rectified but turbine discs can be subject to failure from other causes.

**David Ferry**

What happened to Flight MH 370?

Excellent summary of the most likely causes of the disappearance of MH370 and a very good initiative to ask the experts at the FOG conference for their views.

**Clare Walker CRAeS**

Thank you for the summary. I would agree with points 4 and 5 with some other explanation that the reason for pirating was due to the cargo being carried, which to date has never been disclosed entirely (other than some laptop batteries). I hold great doubts about explanations 1, 2 and 3, as the flight diverted and continued for far too long for these to be reasonable.

**Nicholas J E Kurth FRAeS**

Speculation continues over the fate of the missing Malaysian Boeing 777.

**Black Swan events**

Perhaps the RAeS would like to pave the way and demand Public Transport Regulatory change to negate ‘losing’ aircraft in future through continuous ADS-B type tracking utilising current satellite technology. Low power/size requirements would allow a new unit to be sited with few design complications — remote from pax/aircrew both physically and electronically. Let the discussion commence!

**Mike Wood**

**Hans N.** [on What happened to Flight MH 370?] Just a theory: if there was a cockpit fire in the avionics, the pilot would take all circuit breakers, and try to pull out the fire, that would also close down the ability to use tracking of any kind. the following is the pilots’ reactions, aviate, navigate, communicate. I’m sure he did it in that way, no matter the trouble he had.

**Johnny S.** It is hard to believe that with so much in the way of comm. equipment on board, that both pilots were not able to send off some sort of MAYDAY call if there was a fire in the avionics. It takes very little time for a MAYDAY to go out — one pilot could have done it while the other dealt with the circuit breakers (CB). Flying an airliner and transmitting at the same time is usual for an airline pilot. This is particularly important when the aircraft changed its course and could possibly cause a collision hazard to other air traffic. Pulling out CBs is only used to isolate the fire. When that is done CBs are reactivated to see which ones affected the fire. The pilots would have been on oxygen and would probably have carried out an emergency descent. They may have turned back to look for a suitable landing field. In this scenario the fact that the plane continued to fly for hours does not fit. Nor does the fact that an ‘unidentified’ aeroplane flew over the Malaysian airspace unchallenged. What were the military
radars doing? There are too many unexplained factors in this accident that will only (possibly) be resolved when the wreck and the flight and voice recorders are found.

**Hans K** [on MH370 – implications of a Black Swan aviation event][5]. Am I missing something. Inmarsat could support accurate flight tracking on helicopters. Is it a matter of coincidence that the US Patent Office published two patents two years ago. I pioneered and commercialised satcom ADS protocols 20 years ago. I established in 2001-2003 (GE had a representative on that committee as well as RR and P&W) further developed the ETOPS or LROPS rules. It's unclear if four-engine passenger aircraft are history but clearly the thrust capability and reliability of the latest engines and those coming in the next few years suggest that four-engine aircraft may be hard to justify economically as well as from a safety viewpoint.

**Balachandran P. Assistant Director Airworthiness CAD (Retd)** [On Twilight of the Tri-jets][3]. Except for the FOD problems, turbofan engines with wide intakes have established that two of these can deliver the same performance as that of four turboshift engines. Hence, we can conclude that four-engine aircraft will become a part of history. Moreover, introduction of composite material for construction of aircraft has also reduced the need for four engines.

**James J. engineering & aerospace consultant** I believe it is. The old saying of ‘four engines for long haul’ really isn’t the case anymore. Twins can fly further and faster, and are more importantly for the operators — cheaper to operate.

**Graham L. Director at Glowe Services Ltd** Interesting. Do you think the next generation of Jumbos would cope with two engines? I’m thinking of the upgrade/replacement for the A380.

**Ioan E. Aircraft Engineer at GE Aviation** ETOPS was established seven years ago. Today’s engines are very reliable. There is every likelihood that the value/cost equation in the future will favour two engines over four.

**Thomas M, Technical Director and System Safety Consultant** ETOPS has been in place far longer than seven years. The 777 was the first aircraft to formalise ETOPS requirements. Then, an ARAC committee in 2001-2003 (GE had a representative on that committee as well as RR and P&W) further developed the ETOPS or LROPS rules. It’s unclear if four-engine passenger aircraft are history but clearly the thrust capability and reliability of the latest engines and those coming in the next few years suggest that four-engine aircraft may be hard to justify economically as well as from a safety viewpoint.

**@Lara_Small** Great intro to the latest AEROSPACE magazine — cost shouldn’t be the driving force on aircraft connectivity.

**@DMVanderhoof** [On RAF MPA options] would the Dash 8 or 295 be a downgrade?

**@Jollycurator** [On RAF fighter through the ages picture — see below] Sept 1960, prior to Coltishall’s ‘At Home’ day, 20th Battle of Britain anniversary. I have a lovely colour version of this.

**@thrustvector** Nice! Interesting that neither Javelin nor Lightning look to be at particularly high AOA; Spit and Hurri must have gone flat out!


**@J缉rhanDefence** Very good stuff, and way better than all put out by the cranks calling themselves TV news channels like Fox and CNN.

**@angusbatey** [On What happened to MH370 blog post][2] Cogent, un-sensationalised expert insight into #MH370 from @AeroSociety

**@CBrenchley** Great summary

**@pietro_nurra** I note it but there is a natural enthusiasm in Test Pilots for their project plane I’d like to see Red Flag reports

**RAF fighter formation at RAF Coltishall on the 20th anniversary of the Battle of Britain, Sept 1960.**

1. From Aden to UK — by Hunter, AEROSPACE, April 2014, p 36.

Additional features and content are available to view online at http://media.aerosociety.com/aerospace-insight
In October 2013 the Assembly of ICAO member states adopted the new, fourth edition of the Global Air Navigation Plan (GANP). The new GANP, part of a system of regional performance dashboards and global performance reporting, provides the strategic direction for ATM change programmes worldwide.

The GANP’s Aviation System Block Upgrades (ASBU) planning and integration framework is one of the keys to achieving global interoperability. It was formulated in 2010/2011 reflecting the SESAR, CARATS and NextGen plans and architecture and the ICAO Global ATM Operational Concept (GATMOC).

The ASBU framework contains 51 modules, each representing a specific improvement in a capability in one of the Performance Improvement Areas (PIAs). The modules are organised into time blocks (0 to 3) with milestone dates of 2013, 2018, 2023 and 2028 respectively. These are the availability dates of the technologies and global standards and procedures for the modules in each block. Work will then be completed at Regional and State level to prepare for operation. Implementation, in line with local requirements and priorities, will follow; for example, Block 1 modules will generally be implemented, where required, between 2018 and 2023.

The development of a capability forms a thread of modules across the blocks. Not all modules are required in all States, and not all threads have modules in all blocks (see table on next page).

The short term priority is implementation of Performance-Based Navigation (PBN), the foundation of Block 0. For Block 1, modules have been categorised as essential, desirable, specific or optional, to aid planning.

The Block Upgrades are supplemented by technology roadmaps for the Communication, Surveillance, Navigation, Information Management and Avionics areas. An ATM logical architecture is being developed, to describe the linkages between ASBU modules, GATMOC components and the operational environment.

ICAO is working with ARINC, RTCA and EUROCAE, standardisation bodies who are developing technical standards. CANSO (the ANSP association) actively supports and promotes the ASBU system.

World air traffic is expected to double between 2012 and 2030. ATM modernisation programmes have made major advances towards the goal of a safe and efficient global air navigation system to meet future needs. The agreement of the new ICAO Global Air Navigation Plan is a significant milestone. John Pluquet reports.
USA: NextGen and the FAA

The NextGen programme was launched in 2003 to improve the safety, security, efficiency, quality and affordability of the US airspace system.

In addition to their research and development work, recent progress includes:

- Deployment of key capabilities, including near-term improvements to ATM at congested airports in major cities.
- Deployment of key NextGen foundation projects: (i) En-route automation (ERAM) — a new computer system for the 20 US en-route control centres — implementation expected to be complete by March 2015 (ii) ADS-B — to extend aircraft surveillance coverage — deployment to be completed by end 2014
- Investment decisions for DataComm, SWIM and the NAS Voice System.
- Senior appointments to strengthen programme management.

The FAA NextGen Implementation Plan (2013) details the development and delivery of NextGen Operational Improvements (OIs), in time segments from 2012 to 2016+, grouped into portfolios:

- Improved surface operations
- Improved approaches and low-visibility operations
- Improved multiple runway operations
- Performance based navigation
- Time based flow management
- Collaborative air traffic management
- Separation management
- On-demand NAS Information
- Environment and energy
- System safety management
- NextGen infrastructure

The FAA has established an Operational Incentives programme to encourage aircraft operators to invest in the required equipment and training, and demonstrating the benefits is high on the FAA’s agenda.

The Single European Sky (SES)

The political Single European Sky initiative was launched in 1999, to drive cost and capacity improvements in European ATM. Functional Airspace Blocks (FABs) and the ANSP Performance Scheme are cornerstones of SES. The nine FABs (where ATM is harmonised across borders) are in operation, and have begun to achieve positive results. For example, the UK-Ireland FAB expects cumulative savings to customers to exceed €300m by 2020. As FABs mature and collaboration develops, benefits delivery will accelerate. The Performance Scheme was introduced in 2012. Targets for 2015-2019 have recently been agreed. They include a 3.3% annual ATM cost reduction. SES2+, controversial new legislation to accelerate SES, was launched in 2013. SES2+ consolidates the SES2 legislation of 2009, contains powers for the European Commission and introduces changes and new provisions.

ANSP Alliances such as A6 (SESAR ANSPs) and Borealis offer a strong co-operative network alongside the formal FAB system. The strategic role of National Supervisory Authorities (NSAs) will be crucial. SES2+ recognises the importance of extra-FAB collaboration and aims to strengthen NSA independence and promote inter-NSA collaboration.
SESAR 2+ contains a framework for SESAR Common Projects (see below), proposals for unbundling non-core ATM support services and a clearer division of responsibilities between the EC (economic), EASA (technical) and Eurocontrol (operational e.g. network management). EASA will be renamed the European Aviation Authority.

The European Parliament made a number of amendments, including removal of a reference to high seas North Atlantic airspace. SESAR 2+ now requires approval by the Council of the EU, which is expected to make further changes. Other European developments and proposals include:

- Centralised Services (CS) — the Eurocontrol initiative for centralisation of selected support services currently provided by individual ANSPs
- Network Manager — Eurocontrol will continue in this role, until end 2019 when re-appointment will be sought; in SESAR 2+, consideration is given to making the Network Manager a free-standing industrial partnership
- Standardised European Rules of the Air (SERA) — implementation of a single set of operational rules, based on existing ICAO requirements, is in progress.

SESAR

The SESAR programme is the technology pillar of SES. Under the annual ‘release’ system, flight trials and simulations verify and validate SESAR solutions. 68 exercises took place in 2011-2013, and a further 20 are planned for Release 4 (2014). Solutions validated so far, or planned for 2014, include:

- Point merge in complex TMA (exploiting flight management systems to reduce vectoring and traditional holding)
- Free routing (allowing airspace users to plan their routes freely between specified entry and exit points)
- Initial 4D trajectory (i4D) and flying to a time in en-route and TMA airspace — the first i4D flight was in February 2012
- Remote tower services and infrastructure.

There is growing emphasis on SESAR deployment planning. In 2015, the Interim Deployment Programme will hand over to the Deployment Manager (to be appointed). The latter will manage the Common Projects to deploy functionality essential to the future ATM system. The first has been defined. The Pilot Common Project covers four functional areas, initially:

- Extended AMAN and PBN in high density TMAs
- Airport integration and throughput
- Flexible airspace management and free Route
- Network collaborative management.

Incentives will support the Common Projects, and EU funding is expected.

SESAR, NextGen and the ASBU Framework

The ASBU modules are the hub of interoperability. The modules can be used as a template for defining a new programme, or for checking the coverage of a defined plan. They facilitate the planning and management of collaboration by aiding identification of common elements and activities, and by providing shared terminology.

The SESAR programme has mapped its OIs to ASBU modules, and the results are summarised below. SESAR’s plans effectively address all ASBU modules. For Blocks 0 and 1, available information confirms that NextGen presents a similar picture.

SESAR/NextGen collaboration is facilitated by the 2011 Memorandum of Understanding between the FAA and the EC. Key areas include:

- Transversal activities e.g. concept of operations, separation provision, road-mapping, investment
Feedback on progress is positive, with regular reporting being instituted. Recent discussions have envisaged exploration of opportunities for demonstrations, and further refinement of coordination plans.

Florian Guillermet, Executive Director of the SESAR Joint Undertaking (SJU), stresses the importance of interoperability and collaboration, and SESAR’s commitment to interoperability, “Since the outset, the SESAR Programme — with the European ATM Master Plan — has been committed to and focused on global interoperability and harmonisation, recognising these as prerequisites for a smooth and seamless transition towards a global air traffic management (ATM) system. We therefore actively support the ICAO Global Air Navigation Plan with the ASBUs together with International partners. On the same note, we work closely with industry standardisation bodies both at European and global level to advance relevant common industry standards and procedures.”

The SJU have in place, or are discussing, demonstration activities and co-operative agreements with Japan, Singapore, Canada, Mexico, Brazil, the Gulf States, China, Australia and the Ukraine, and the FAA’s co-operative links include those with Canada, China, Japan and other Asia Pacific countries. The Japanese (CARATS), Brazilian (SIRIUS), Chinese and Canadian programmes are examples of the many other ATM improvement initiatives across the globe.

## RPAS integration

The challenge of integrating remotely-piloted aircraft (RPA) into the air navigation system is being addressed at state, regional and global levels.

ICAO is working on the development of the required standards and procedures and ASBU modules have been defined:

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<th>Acronym</th>
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<td>APTA</td>
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<td>Wake Turbulence Separation</td>
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<td>RSEQ</td>
<td>Sequencing AMAN/DMAN/SMAN</td>
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<td>Airborne Separation/Sit Awareness</td>
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<td>Trajectory-based Operations</td>
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<td>CCO</td>
<td>Continuous Climbing Operations</td>
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*ICAO’s timetable for the introduction of remotely piloted aircraft systems (RPAS) into the air navigation system:*

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
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<tbody>
<tr>
<td>2018</td>
<td>Basic RPAS operation</td>
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<tr>
<td>2023</td>
<td>Wider access to airspace</td>
</tr>
<tr>
<td>2028</td>
<td>Safe operation in all classes of airspace</td>
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</tbody>
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**Conclusion**

Approval of the new GANP and the ASBU framework is much more than a formal milestone. It provides an agreed framework for planning and coordinating the delivery of both interoperability and programme-specific goals, and for making informed investment decisions.

Using the framework, SESAR and NextGen are progressing towards their goals, and have links with many of the other programmes world-wide which are aiming for alignment with the framework; ANSPs are forming alliances and other groupings to increase efficiency; ICAO is working closely with technical standardisation bodies to ensure that global standards and procedures will be ready when needed.

At national, regional and global levels, partnership and collaboration will be the keys to success.
As we count down to the start of operational test for the Lockheed Martin F-35 Lightning II, UK Lightning Requirements Manager and F-35 test pilot Wing Commander JIM SCHOFIELD, RAF talks to AEROSPACE about the generational leap he believes the fighter will bring to air forces.

AEROSPACE: What is your background. How did you get to become an F-35 test pilot?

JS: I joined the Royal Air Force in 1996 and after flying training, started to fly the Harrier in the night attack role. It was a fantastic experience with the full range of combat and operations in the desert, arctic and maritime environments. So a great operational background to get my teeth into. I was then lucky enough to be selected for the Empire Test Pilots’ School in 2004. After which I went on to test the Harrier and help introduce the GR9 to front-line service. After that, I went back to ETPS to become the principal tutor fixed-wing, which was a busy couple of years. Then I went to HQ 1 Group to be the Joint Combat Aircraft (JCA) desk officer. Then out to Patuxent River to test F-35s for two and a half years.

Q: Describe a typical day at Pax River in F-35 testing.

JS: In common with most flights of any aircraft, you start off by checking the weather. There is then a pre-flight brief which, in this case, was normally and hour and a half long. With 40 flight test engineers in the room, it was quite different to the test flying I was used to in the UK, just the scale of it. Then I got dressed, walked to the aircraft, went flying, executed the mission, landed, and had a debrief that could be anywhere from half an hour to an hour. Then came the exciting bit — writing the report on the flight which could take up to three hours. The differences there with the front line are the content of the mission, which varied every day. There was never a dull moment, it could be testing the mission systems one day and then flying a flutter mission the next day, which would look at the aircraft’s response to disturbances. The other difference was the ancillary...
test pilot duties, reviewing test cards for missions or future sorties and make sure the test points on those cards are all safe to fly.

Q: And you flew the F-35B STOVL and F-35C carrier variants out at Pax, as well as the chase-plane F-18 Hornet?

JS: That's right. And the B and the C variants were very difficult to tell apart when they were flying. The cockpit is identical. There are slight differences in the handling but really the two aircraft fly very similarly.

Q: We're about half way through the flight test programme. How is it evolving? What test points are upcoming?

A: Most of the envelope has been cleared now. So we've also carried out the airstart testing out at Edwards, which was turning the engine off and on again. The high angle-of-attack flying has been finished on the 'A' now, is underway on the 'C' and has just started on the 'B' variant. We've taken two jets to the Marine Corps carriers twice now and a lot of the STOVL clean envelope expansion has been done. Really we are looking ahead to events such as expanding the envelope with external weapons, testing with the ski-jump at Pax River. There's also a lot of mission systems testing to come — finishing the Block 2 software testing and starting off on Block 3.

Q: The helmet has had some issues — is that now behind us now? Is it difficult adjusting to a fighter without a traditional head-up display (HUD)?

A: Personally I never had any problems with the Gen II helmet but I know problems were identified with it. Happily they've developed a Gen III helmet which was designed to overcome the deficiencies of the Gen II. We'll start testing with that fairly shortly. It was very easy adjusting to a fighter without a HUD because there is a 'virtual HUD' where the HUD would have been. In addition you get a lot of other information when you look away from the 'virtual HUD'. So really the difficulty for me was adjusting to a fighter with a HUD, whenever I flew the F-18. The Distributed Aperture System (DAS) is fully functional. The pilot can project that image in his helmet and wherever he looks, he'll get an infrared image of the world around him, which is jaw-dropping really, the first time you use it and see everything below you.

Q: Can you say something about the UK and joint RAF/RN input to the F-35 flight test programme?

A: As a Level 1 Partner the UK gets a big vote in how the jet is developed. We've got service personnel and UK industry representation within the F-35 Integrated Test Force at Naval Air Station Patuxent River, Maryland, and Edwards AFB, California. These include an RN Commander in charge of the UK contingent, a test pilot, a mission systems specialist, flight test specialists and around eight RAF and RN maintainers. So we've got very good representation in all of the key areas we would wish to gain early exposure to the aircraft. In addition, we've also got a few personnel at Edwards in anticipation of the start of UK operational testing (OT) later this year. We're also putting people through the 'schoolhouse' through training down at Eglin in Florida. They will feed into Edwards to...
support operational test. The UK has three aircraft at the moment. We’ve signed on the line for a fourth. Two of the current three will be going to Edwards for operational testing, as will the fourth. The third will remain at Eglin AFB being flown by UK and US pilots in a pooling agreement with the US Marine Corps. 17 (R) Sqn will be the unit carrying out the operational test while the USMC Squadron at Eglin is VMFAT-501, which is their training squadron. VMFAT-501 will move to Beaufort, Carolina sometime in the next year. 617 Squadron meanwhile will stand up in 2016 at Beaufort and return to the UK in 2018.

Q: Given the complex software and mission systems — does that mean that flight testing today is more difficult in spotting software ‘bugs’ — rather than assessing the performance/handling of a combat aircraft?

JS: I think at its most basic, the testing is no more difficult, because you are generally just concentrating on one thing at a time. When the baseline capabilities have been proven, however you throw it all together in a more operationally representative manner. The jet can do an awful lot of things; with that great range of capabilities and complexity, you could argue it’s more difficult for the pilot to spot one given bug in the systems. But, the mission systems have undergone an awful lot of rig testing before they even get on the aircraft. Then they are flown in quite a wide-ranging test programme. These bugs we wouldn’t expect to get at the front line. In addition, the automatics, the autopilot and the great flying qualities of the aircraft mean the pilot can dedicate all their attention to testing, whereas previously you’d be concentrating much more on flying the aircraft.

Q: The true capabilities of the jet are obviously highly classified — but could as a test pilot could you give us a clue in perhaps comparing it to a previous leap in fighter capability — such as from the Gladiator to the Spitfire or the Me109 to the Me262?

JS: I think we are talking about a bigger step than any of those really. No-one has ever put all the things this aircraft can do into one package. I liken it to a combination of the introduction of the Harrier, so you can do STOVL now. Not only that, but also it’s a stealthy aircraft, so akin to the introduction of F-117. It also has impressive performance and unparalleled handling — which neither of those aircraft had. You’ve then got a platform with all of the sensors and all that information fused and presented to the pilot in an easy-to-comprehend manner. Really those systems have no parallel in any past aircraft. That would be the closest I could come to describing it in those terms.

Q: Since the end of the Cold War, we’ve moved away from the idea of dispersing our air forces to complicate an attacker’s targeting (although the US is now looking at this with F-22s in the Pacific). The F-35B is obviously much more complex than the Harrier but could it bring back some of that operational flexibility?

JS: Yes I think so. We’ve really missed the Harrier’s capabilities. Being able to have the jet at a deployed operating base with, for example, a shorter runway or potentially in the woods, as you allude to. That’s a fantastic capability to have, in addition to all the other things the aircraft brings.

Q: As a single seat jet — what steps have been taken to reduce information overload to the pilot?
Are you happy that the cockpit designers have done a good job?

JS: I am. I’ve talked about the flying qualities and the autopilot before. I should add that you can engage the autopilot with a button on the stick and then you can steer the aircraft with your feet. That enables you to concentrate more on the screens in front of you. With the range of sensors it has, the aircraft does a great job of presenting the information that all those sensors generate into an easy-to-understand picture for the pilot. There’s no traditional radar screen as pilots would be used to — instead there’s a tactical situational display which tells you what is going on all around you. It’s much easier to assimilate that information than it was in previous fighters where you had one screen per sensor system.

Q: Any issues with the touch sensitive displays in using gloves or during turbulence?

JS: The screen is designed to operate with flying gloves on. It works perfectly well like that. There is a red cross that appears under your finger. You put your finger on the screen, then drag it to where you need it. It works even in turbulence.

Q: One report from pilots who had flown the F-35 criticised the rear canopy visibility in a close-in dogfight. Is that a valid concern?

JS: No it’s not. In the unlikely event that the fighter manages to track you on radar and gets within visual range of you, not only can you see through the cockpit transparency as you could in legacy aircraft, you can see through the aircraft’s structure with DAS. In many ways you are well ahead of where we used to be with conventional fighters.

Q: In terms of pure performance the F-35 has plenty of power but is heavily wing-loaded — which legacy aircraft do you think comes closest?

JS: It’s a difficult one to answer. I flew F-18 concurrently with F-35. In terms of handling, it flies like a F-18 but a generation on — it’s much nicer in every respect. In performance terms, those figures are classified, so I can’t really comment.

Q: All ‘beloved’ aircraft get a nickname — has the F-35 got one yet?

JS: It hasn’t got one yet — but I am convinced it will become a beloved aircraft — assuming it isn’t already — which it may well be. There’s certain to be one in the pipeline.

Q: For pilots on the front line — what do you think will be the biggest surprise (welcome or otherwise) for them when transitioning to the F-35?

JS: I think the biggest surprise, (and they’ll probably be aware of it from having read about it), but until you’re flying this aircraft does it really hit home, that you can do so much with one aircraft. You can get airborne from a short strip. You can fly a mission that includes going supersonic. It’s stealthy, so you can operate in areas that were previously denied to you with unbelievable situational awareness. Then you can come back and land vertically on a pad. So they are going to be very pleasantly surprised by that.
Since the disappearance of Malaysian flight MH370, there have been many theories put forward as to what might have happened aboard the aircraft. At a recent high level-RAeS Flight Operations Group conference, Bill Read polled a selection of the experts with some of the most vital technical and operational questions still outstanding.

On 8 March, a Malaysian Boeing 777-200, 9M-MRO, on an overnight flight from Kuala Lumpur to Beijing lost contact with air traffic controllers less than an hour after take-off. No distress call was made. The aircraft was initially thought to have crashed into the Indian Ocean but evidence subsequently emerged that suggested the aircraft’s transponder and ACARS system had both been deliberately switched off while the aircraft changed direction but continued flying.

Investigators now believe that the aircraft eventually crashed into the Southern Indian Ocean where satellite images of wreckage have been seen and sonar ‘pings’ have been detected which may have come from the aircraft’s black boxes. As Aerospace goes to press, search efforts are continuing to locate any trace of the missing aircraft but nothing has yet been found.

A gathering of experts

Since the disappearance of flight MH370, there have been many theories put forward as to what might have happened aboard the aircraft. On 25-26 March the RAeS Flight Operations Group (FOG) held a two-day conference at No.4 Hamilton Place on the subject of the role of the Aircraft Commander in the 21st Century* which included speakers representing pilots, airlines, manufacturers and regulators. Aerospace took the opportunity of the event to ask a selection of these highly experienced and extremely knowledgeable speakers some questions as to what might have happened aboard the missing Malaysian 777. A summary of their amalgamated answers appears below:

What are your views on these alternative theories?

1. The aircraft depressurised but continued to fly
It's possible. This would explain the initial change in altitude and heading, as well as subsequent lack of communication but not why the ACARS and transponder were turned off.

2. The aircraft was overcome by toxic fumes
Unlikely. The pilots should have been able to send out a distress call and, again, it does not explain why the ACARS and transponder were turned off.

3. There was an onboard fire which damaged the communications systems
Again unlikely. This would explain the lack of communication but it is unlikely that the aircraft would have then continued to fly as long as it did if the fire continued to burn.
4. The aircraft was hijacked
A possible theory but the aircraft was not flown to another destination nor was it used as a weapon for a suicide terrorist attack. If it was an individual hijacker, then no one person or motive has been established and, if it was a group, no organisation has claimed responsibility.

5. The aircraft was deliberately diverted by the pilot/co-pilot
Possible again but no reason for this has been identified. If it was a suicide attempt then why did the aircraft continue to fly for so long?

Technical questions:

1. How easy is it to turn off ACARS and the transponder?
Turning off the transponder can be done from the cockpit and is done routinely whenever aircraft have landed. Turning off ACARS is more complicated and would need someone with systems knowledge having to go into the aircraft's avionics bay.

2. Could the aircraft's communication systems have been disabled by any other means – such as fire/birdstrike/power failure/sabotage by third party from the avionics bay?
Birdstrike is unlikely to have caused such damage but the other explanations are all possible. It is possible to disconnect the communication systems from the avionics bay but this should have been prevented if security was adequate.

3. The IFE moving map would have shown that the aircraft was going off course. So why were there no mobile phone calls sent from passengers or cabin crew aboard the flight?
The IFE map may have been turned off. Most of the passengers may have been asleep and not realised anything was wrong until it was too late to do anything. If they tried to phone later in the flight, the aircraft would have been in a remote area over the ocean where there was no signal. Alternatively, the passengers and cabin crew may have been incapacitated in some way, such as by hypoxia due to cabin depressurisation.

4. How long could the aircraft be flown if depressurised?
The aircraft could continue to fly automatically until the fuel ran out. The effect on the people on board would vary depending on the altitude of the aircraft. If the aircraft was above 35,000ft, it would take about one minute before everyone was incapacitated. However, if the aircraft had depressurised, oxygen masks for the passengers would have descended automatically which would work for around 15 minutes. The flight crew could have lasted longer using oxygen masks depending on whether they used pure oxygen or an oxygen mix.

5. Could either the data or the homing beacon on the ‘black boxes’ be tampered with during flight?
No. The cockpit voice recorder (CVR) and flight data recorder (FDR) cannot be tampered with.

6. Could data from the aircraft still be sent to a satellite if aircraft had landed/crashed in the sea?
No.

7. The RAeS Flight Operations Group has written a report about dangers of lithium-ion batteries as cargo. Could they be responsible for a fire?
Possible but unlikely. It has been reported that lithium batteries were being carried in the rear hold of the aircraft but the aircraft is unlikely to have continued flying for so long if a fire had broken out. It also does not explain why the communication systems were turned off.

8. What happens when an aircraft flying on autopilot comes to the end of a FMS waypoint? Carry straight on, circle etc?
There are options for the aircraft to either continue on its current heading or to begin circling.

9. Is live (or triggered) streaming of black-box data feasible?
Yes it can be done but it would be very expensive for an airline to fit such systems to every aircraft in its fleet.

10. What do you think will be the implications of this incident for the aviation industry?
— A change in ATC procedures as to when an aircraft must make contact.
— Improved communications between different international civil and military organisations.
— All airlines need to have a ‘crisis cell’ which is activated for aircraft accidents.
— Aircraft positions and status could be transmitted regularly to airline and manufacturers — but systems would be expensive to install.

Simultaneous failures?
One technical expert highlighted the fact that, for every plausible scenario suggested so far as to what might have happened to MH370, there is at least one contradictory statement. “If it was hypoxia, then who turned the aircraft?” he asked. “If it was a fire, then how did it continue flying?” “If it was the flight crew, then why did the cabin crew not intervene?” He suggested that, perhaps, more than one scenario occurred simultaneously — such as a wiring fire and depressurisation.

But, until more evidence is found, nothing can be proved.

* A full report on the RAeS Aircraft Commander in the 21st Century conference will be published in an upcoming issue.
With the publication of its new 20-year road map for the future of remotely piloted aerospace systems (RPAS) and other robotic platforms, the US Department of Defense has underlined its commitment to RPAS development. Combined with moves by the Federal Aviation Administration (FAA) to test concepts that will bring closer more ambitious civil uses of RPAS, the US has staked out a claim to dominate the RPAS market into the next decade and beyond.

Europe on the other hand, despite some innovative developments, is still far from getting its collective act together. There is a risk that a nascent European RPAS industry could fall still further behind the US and Israel, as well as other new entrants with ambitions to establish a foothold in a new aerospace arena.

The DoD Road Map

US forward planning for new RPAS development has been outlined in the Department of Defense (DoD) RPAS Road Map out to 2038. The Congressionally sanctioned road map describes the challenges of logistics and sustainment, training and international co-operation while providing insight on the strategic planning and policy, capability needs, technology development and operational environments relevant to the spectrum of unmanned systems, aerial, terrestrial and maritime.

The road map recognises the need to be prepared for more technologically advanced potential adversaries. This will entail modified systems or upgrades, including electronic warfare technology, in order to operate. In practice, this may entail manned and unmanned aircraft working in tandem with long range strike assets, jamming and electronic warfare gear in order to access contested areas.

There is considerable emphasis on affordability over the full platform life-cycle and the need to reduce the costs of development, deployment, and training. This will require greater standardisation among the various US military users, more modular development of equipment and a reduction in the costs of satellite communications links between platform and control centres. With unmanned capabilities holding much promise for domestic commercial applications and personal consumer use, this could reduce the costs of future systems for the military. However, growing on-board processing needs, combined
with demands for increased duration will require substantial improvements in power generation, implying a new range of miniaturised equipment and advanced propulsion systems. Again, converging civil-military markets could help to spread the cost of developing this technology, but some requirements, such as stealth, defensive aides and specialised weapons are defence specific.

**Autonomous control**

Expanding both civil and military RPAS operations will require development of full autonomous control, not just automatic flight. Autonomy will imply decision-making capabilities for all but the most sensitive aspects of a mission, such as weapons release. Autonomous platforms will be the only realistic way of overcoming control bandwidth congestion that is becoming a major problem in crowded operational theatres. Increased civil use will also bring similar problems as well as spectrum interference with other communications users.

However, highly automated operations in controlled airspace will demand highly sophisticated ‘see and avoid’ capabilities and rigorous fail-safe procedures. However, a minimum level of control authority expected of the remote pilot has still to be agreed. The DoD is also increasingly aware of the ethical and legal sensitivities surrounding ‘drone’ use as a weapon. The Road map states explicitly that a specific commitment to anything like a fully autonomous RPAS will require high-level political authorisation.

Although budget cuts will impact on US RPAS acquisition — overall, the fiscal year 2014 budget requests $4·1bn for all unmanned systems, citing $3·7bn for unmanned air systems, $13m for ground systems and $330m for maritime systems, respectively. This is a 34% reduction over the previous year’s budget. However, this is substantially higher than any other national investment in RPAS technology and procurement.

Despite the impending cuts to the RPAS budget, a new, large, classified unmanned aircraft developed by Northrop Grumman is now flying — demonstrating a major advance in combining stealth and aerodynamic efficiency. The new RPAS is designed for intelligence, surveillance and reconnaissance (ISR) missions and could be operational by 2015.

**FAA test sites**

The FAA has selected six research sites to help it test and map out the best way to safely bring unmanned aircraft into the heavily used US airspace. This will take the US a long way towards opening up a potentially lucrative market for RPAS applications and services based on RPAS use. The FAA’s programme follows a Congressional mandate to develop a plan safely to integrate privately operated unmanned aircraft by 2015. This will enable much more sophisticated commercial RPAS operations.

The six FAA-sponsored sites are well distributed across the US: the University of Alaska, the state of Nevada, Griffiss International Airport in Rome, New York, the North Dakota Department of Commerce, Texas A&M University, Corpus Christi and Virginia Tech. Virginia Tech’s research will also involve collaboration with Rutgers University in New Jersey.

Criterion for selection included differences in climate and geography, available infrastructure, aviation experience, aviation traffic volume and specific research proposals. The projects will cover safety and logistical concerns, including detection and avoidance of other aircraft, and that the aircraft can operate safely if links to the ground are lost. Other aspects to be investigated include environmental impacts and the development of pilot training and standardised regulatory requirements.

The speed at which states develop an effective regime for RPAS operations in civil airspace will help to determine the winners and losers in the civil RPAS market. The US RPAS trade association (AUVSI) predicts an impact of $13·6bn on the US economy in the first three years of RPAS operation in civil airspace, creating 70,000 new jobs. Similar values are likely to be earned in other world markets. This includes not only the hardware suppliers, many of whom are likely to be from outside the traditional...
aerospace industrial community, but providers of a wide range of services centred on a RPAS platform. As in the space sector, increasing platform availability and capability will generate a new wave of ‘downstream’ applications where the platform hardware comprises a relatively small element in the total value chain.

European moves

For its part, the EU has set out a Road Map for a phased approach over the next 15 years to achieve full RPAS integration with European air traffic management. In the first instance this will be directed at harmonising the current regulations adopted by over 15 individual European states, and to bring these in line with work undertaken by the European Aviation Safety Agency (EASA), which will be expected to take the lead in certifying future pan-European rules. Each of the national approaches differs in several key respects and if left un-co-ordinated, would constrain cross-border operations. The aim of the Road Map is to create a true European Single Market for RPAS based on common rules. This will be a necessary step to encourage the development of a European RPAS industry. However, if the harmonised rules turn out to be more restrictive than those currently adopted, for example in the UK, then European commercial RPAS activity would be seriously hampered.

In the UK, the $90m ASTRAEA (Autonomous Systems Technology Related Airborne Evaluation & Assessment) technology demonstration programme focused on the technologies, systems, facilities, procedures and regulations required to allow autonomous vehicles to operate safely and routinely in civil airspace. The aim of this government-industry programme was to enable the routine use of RPAS in all classes of airspace without the need for restrictive or specialised conditions of operation. A third initial phase of ASTRAEA, 3A, is now underway and the consortium is in the process of bidding for funding for a larger 3B phase.

Throughout the EU, small companies and research institutes are working on a range of innovative small RPAS platforms to operate in dangerous and challenging environments such as nuclear accident clean-up, as well as more routine commercial applications in security, agriculture and resource management. Movement on the regulatory front would help European RPAS innovators to win a share of future commercial markets, as well as facilitate the evolution of full turn-key service packages exploiting fully the unique characteristics of RPAS platforms.

Military manoeuvres

In the military arena, Europe is still bogged down in national versus bilateral, versus multilateral approaches. European aerospace companies are pressing hard for a $1-35bn, pan-European commitment to RPAS R&D in order to fill the gap in European provision for a medium altitude long-endurance (MALE). The December 2013 EU defence summit in Brussels failed to produce specific actions to develop a European RPAS programme, although the 28 heads of government did agree to move forward, albeit slowly, on the joint development of common roadmaps and requirements in several key areas including a next-generation RPAS.

The January 2014 Brize Norton meeting between President Hollande and Prime Minister Cameron had mixed results; while they agreed to shelve work on a MALE aircraft, they committed £120m to a feasibility study of an advanced combat RPAS. As if to underline the urgency for further action, BAE Systems announced successful flights of its Taranis technology demonstrator in February. The Dassault-led Neuron international team is also making progress. Although the Brize Norton agreement did not specify which companies would partner in a bilateral UCAV project, BAE and Dassault were already teaming on preliminary studies. A bilateral memorandum of understanding is expected to be signed at the Farnborough Air Show in July. The two heads of government also agreed to sponsor a European Predator users group.

Italy is also moving ahead independently to develop RPAS hardware and to market ‘turnkey’ services based on an unmanned platform. Germany remains in something of an RPAS no-mans land, still reeling from the embarrassment of the Global Hawk fiasco and still an onlooker to the Anglo-French moves (although Paris would prefer an early German involvement).
The European Defence Agency (EDA) has been active in promoting work on RPAS. In November 2013, a group-of-seven European defence ministers (including France, Germany and Italy) signed a ‘letter of intent’ which required the EDA to draw up a study on joint production of a MALE RPAS, which could be used to strike military targets or for surveillance of migrant boats in the Mediterranean Sea. The EDA is also working on integrating civilian airspace. The EDA and the European Space Agency are working together to test RPAS command and control via satellite in the $3·4m DeSIRE programme. But collectively there is still much to be done to produce an effective European RPAS capability that could meet future civil and military requirements.

**Foreign imports**

Meanwhile, current military exigencies are leading inexorably to more US imports, with the Dutch joining France, Italy and Britain as Reaper RPAS customers. And Israel has embarked on an export push for its family of RPAS goods and services abroad, second only to the US.

In any event, Europe has to think beyond reinventing Reaper and focus R&D on more fundamental technology acquisition that will underpin the next generation of small and medium-sized RPAS. The European Defence Agency and Commission are making an effort to unite disparate RPAS research and to invest in dual-use technology, but resources are limited and could be affected by political divisions over the future generally of European security.

**Conclusions**

The RPAS world is expanding: currently, over 40 states have some form of unmanned programme, although a significant number are proposals. Equally, the number of platform makers is also widespread (over 20 countries have at least one RPAS platform manufacturer), and many of these are not drawn from the established ranks of aerospace companies.

Similarly, with so much of the UAS capability dependent on communications equipment and sensor packages, the avionics and software community may have as much right to claim systems integrator status as the traditional prime contractor. This means that established aerospace companies will have to share the market with a number of ambitious and highly innovative newcomers; existing aerospace centres will have new entrants snapping at their heels.

Making a success of the European RPAS industry also demands looking beyond the interests of conventional aerospace systems integrators with a desperate need to protect existing capabilities. Admittedly, this is an important goal, but not to the exclusion of encouraging other potential players in what is becoming a much more complex and fragmented RPAS market. There is plenty of innovative European RPAS activity in the small, line-of-sight arena. But the US (and for that matter Israel) already has a big lead in developing and deploying RPAS for military and security uses; with the benefit of a single approach to solving problems and a clear political mandate, the US appears better positioned to make the break through into wider commercial applications.

**THE RPAS WORLD IS EXPANDING: CURRENTLY, OVER 40 STATES HAVE SOME FORM OF UNMANNED PROGRAMME, ALTHOUGH A SIGNIFICANT NUMBER ARE PROPOSALS RATHER THAN FLYING VEHICLES**
In early 2014, Rolls-Royce revealed details of two next generation aeroengine designs which are being developed to power aircraft of the 2020s and beyond. BILL READ reports from Derby.
Rolls-Royce is not a company which rests on its laurels. As well as producing the hugely successful Trent family of aero engines, including powerplants for both the new Airbus A350 XWB and Boeing 787, the UK-based engine manufacturer is also working on new designs which will be available to power the aircraft of the future. "Innovators don’t stand still and we want to maintain our position in the market," says Simon Carlisle, EVP — Strategy & Future Technology — Civil Engines. "The demands from industry are getting much greater and we invest around £1bn a year into our aerospace and non-aerospace businesses."

As part of this investment, Rolls-Royce has announced details of two new engine designs that it is currently developing which will be available to power aircraft in the 2020s: the Advance and the UltraFan (a name trademarked by Rolls-Royce). The names for the new engines refer only to the development versions; the production versions will be given ‘family names in line with Rolls-Royce tradition’. According to Rolls-Royce, the Advance will offer a 20% better fuel burn and lower CO2 emissions than the Trent 700 first generation of Trent engines while the UltraFan will offer a 25% improvement. The Advance will also be 5% more efficient than Rolls’ current most efficient engine — the Trent XWB — while the UltraFan will be 10% more efficient.

Both new engine designs will feature a number of architecture and technology improvements, including:

- A new engine core architecture designed to increase fuel burn efficiency and reduce emissions.
- Carbon/titanium (CTi) fan blades and composite casing that will reduce engine weight by up to 1,500lb per aircraft.
- Advanced heat-resistant ceramic matrix composites that can operate more effectively in high turbine temperatures.
- The engines will incorporate many more composite components than previous Trent engines, including third generation CTi fan blades, composite radial drive shaft, composite containment casing and composite rear casing. By using more lightweight materials, Rolls estimates that it will reduce weight by 750lb per engine for just the CTi fan system alone.

**All change**

"These new engines have been made possible by developments in new technology," explains Alan Newby, Chief Engineer Future Programmes. "We are building around the things that have made Trent successful. The Trent XWB has a single stage high pressure (HP) turbine and a two-stage intermediate (IP) turbine. These drive an HP and IP compressor, respectively, with the majority of the pressure rise (work) done by the IP compressor. However, the Advance engine will have a different core architecture. We have changed the work split at the heart of the engine by having a two-stage HP and a one-stage IP turbine, thus the majority of the pressure rise is now done by the HP compressor. By using new material and aerodynamic capabilities, together with more efficient components, we can increase the pressure ratio and have a more efficient engine which uses fewer systems and components with reduced cooling air flows and a lighter core.

"Flying is now routine and is no longer a special event," says Simon Carlisle. "This has increased the importance of the reliability of the product. Another recent trend has been the increase in fuel prices and, therefore, the need for airlines to keep operating economics down. In addition, there are also environmental considerations which need engines to be fuel efficient and quiet. These trends are driving the design of new engines. To increase the bypass ratio fans are getting bigger while the core of the engine is getting smaller — to improve thermal efficiency. Therefore, to improve efficiency and reduce noise, the engine fan will be bigger. A bigger fan means more weight, so we replace the titanium fan blades with carbon titanium (CTi). We will also be using composites for the fan casing. A bigger fan also means that the low pressure (LP) turbine has to do more work, therefore, the LP system is larger and needs to be more lightweight. Meanwhile, the engine core is getting smaller. The harder you run the engine — the more efficient it is. However, this drives up temperatures and the overall pressure ratio (OPR), so new materials are needed that can cope with such conditions, including next
UltraFan

The UltraFan will feature two further innovations — a variable pitch fan system and a gearbox. “As the name implies, the UltraFan has an even bigger fan,” explains Alan Newby. “However, this poses a significant challenge in the size and weight of the LP (lower pressure) turbine that would conventionally drive it. So the UltraFan deletes the LP turbine and uses an enhanced multi-stage IP turbine to drive the fan via a power gearbox. The HP spool and IP compressor remains the same as that on the Advance, we have merely swapped the LP turbine for a gearbox. We can also change the pitch of the fan and, in so doing saving additional weight by doing away with the thrust reverser in the nacelle.” “The UltraFan builds on the Advance,” adds Carlisle. “We are taking the Advance core and wrapping a geared system around it. We have a long heritage of gear design capability from turboshaft, turboprop, LiftFan and Open Rotor gearbox designs and will use that knowledge and capability to develop technology for the very high bypass ratio designs of future engines.” The UltraFan will have increased operating pressure and a bypass ratio of over 15 and will also feature a fully integrated slimline nacelle, low-speed fan system, integrated health management system, multi-stage intermediate pressure (IP) turbine system and an integrated oil system.

Demonstrators

Much of the new engine technology is already being demonstrated through testing on a series of engine demonstrators. These include EFE (Environmentally Friendly Engine three-shaft core technology demonstrator) which was based on a Trent 1000 core; ALECSYS lean burn combustion system, LEMCOTEC (Low emissions core technologies) and ALPS (Advanced Low Pressure System) engine. The ALPS demonstrator is currently being used to test the new generation of carbon titanium fan blades which will be used on the new engines (see panel below). “We have gained a lot of knowledge from core rigs and demonstrators which we can use to verify our computer modelling of how the engines

Scaling the ALPS

Rolls-Royce is currently using its Advanced Low Pressure System (ALPS) demonstrator engine to test composite components for the new Advance engine. In 2013 ALPS was run using composites dressings on the externals of the fan case. At the end of January, ALPS was put on the test bed again, this time fitted with composite fan blades, dressings and annulus fillers. The tests took just over a week and achieved ten hours of running.

“That may not sound much but we got a lot of data from running the engine for that time,” comments Mark Pacey, Chief Project Engineer — ALPS. “We ran the fan system at just under maximum speed and achieved all the test points that we set out to reach. The next stage is to take the engine into one of the calibrative beds where we’ll be doing flutter work and performance work. We’re mapping out the full capability of the fan and taking that data to validate the computational models to ensure that the fan is behaving as we predicted. The plan is then to take the engine to our outdoor test facility in Stennis, in the US where we’ll be exploring ground plane effects, vortex congestion and crosswind effects in which we distort the air flow in front of the engine and see how the fan behaves under those conditions. Later in the year we’ll be taking a separate engine which we’ve already started building to put under the wing of our 747 flying test bed at Tucson. We’ll take the engine up to altitude and make sure that all the preparatory modelling we’ve done on the ground is achieved in the air when the engine is subjected to more extreme conditions.”

Based on the Trent 1000, the ALPS demonstrator is an ex-flight development engine which is now used to test advanced LP system technologies (fan and turbine). “Other than the technology, we’ve made no changes to the engine,” says Pacey. “The whole fan rotor is different, it’s got 18 new blades instead of 20 and blade protection features. The blades are more swept, it’s more open and there’s more space between the blades. The only part that is still standard Trent 1000 is the cone on the front. The performance efficiency of this matches the Trent 1000 very well. In a year we’ll do a further build of this engine with a composite fan case as well.”
Blade runner

The new composite blades for the ALPS demonstrator were constructed by Composite Technology and Applications (CTAL), a former Rolls-Royce/GKN joint venture which was bought out entirely by R-R in February. CTAL specialises in the manufacturing and process development of composite materials.

“When you talk of composites as a technology, you’ve got to see it holistically,” explains CTAL’s Managing Director, Andy Webb. “Unlike a metallic component, where you take a large piece and then reduce it into the shape you want, with carbon fibre you make a composite structure by additive methods. The phrase we use is ‘fly to buy ratio’ — with a carbon composite you’ll find around 90% of the starting material ends up in flying material, compared to around 20% for a large metal forging. There is also the environmental benefit that the processes we use in making carbon tend to be much less energy intensive than metals. There are many different factors involved in making a composite structure, there’s a huge interaction between the manufacturing process, the materials that you use and the performance and behaviour of the material. To get an optimum design sometimes we end up producing a part which is also partially metallic.”

Carbon advantage

Andy Webb can see many advantages for using carbon fibre in engine components. “Weight is the biggest driver,” he states. “Carbon fibre is a third of the density of titanium so, for the same volume, you can have a third of the weight. Reduced weight then offers our customers a variety of benefits. Airlines can use the weight benefit in a variety of ways: reduced fuel burn, reduced emissions, longer range or more passengers. In addition, if you take carbon fibre in tension, it’s stronger than steel. The key is the precise engineering of the structure and how you use the carbon fibre to build up a structure that will enable you to get the benefit of those structural properties and to get that weight benefit. The other thing you get from composites is an outstanding fatigue life. It’s wear resistant, durable and highly repairable.”

Making blades

Webb admits that making a better fan blade has been a challenge. “The Trent generation of engines have hollow titanium fan blades,” he explains. “These were very efficient and it’s been difficult to make one of carbon which can compete. However, the past decade has brought on some tremendous materials development, computational methods and computational capability. When we started this programme we didn’t just want to take a standard resin carbon off-the-shelf, so we brought together our best materials engineers and the best chemists from our suppliers and we’ve invented our own bespoke resin with a very high fracture resistance. We’ve got about 20-25 individual processes from start to completion of a blade and we looked at how we could use automation techniques to make things consistently and reliably. We build a blade up from single pre-precursor strips of carbon fibre layer after layer and we tailor their direction to get different properties, stiffness, strength and impact capability. Unlike titanium blades, there is no void in the composite blade, it’s a solid laminate structure. We also have material running in a third dimension to reduce the effect of cracks, like a knot in wood. Once it’s ready, the blade shape is hot pressed in a steel in the autoclave and then we trim it with water jets and add surface protection to avoid erosion. Then we add leading edges using technology already learned from titanium blades.”

Chicken or egg?

The Advance is scheduled to be ready for service in 2020 with the UltraFan to follow in 2025. At present, neither engine has an aircraft to go on. The size of aircraft that the new engines might be suitable for is not yet determined but Rolls is confident that there will be a demand once manufacturers know the engine is available. “It depends on the requirements of airframers,” commented Carlisle. “Our ambition is to cover the whole spectrum of aerospace applications. We are looking mostly at widebodies but the design is scalable and could be adapted for other platforms.”

Much of the technology being developed and tested for the UltraFan could also be used to support the development of an open rotor engine concept. “We are positioned to mature open rotor technology should there be clear market demand for such a product,” adds Carlisle.
RICHARD GARDNER reports on how Australia recently celebrated its first 100 years of military aviation.

On 1 March 1914, Lt Eric Harrison, an aviation instructor with the Central Flying School at Point Cook, Victoria, made an inaugural flight in a Bristol Boxkite. This is recognised as the birth of military aviation in Australia and, exactly one hundred years later, to the exact minute, another Boxkite took off from exactly the same location at Point Cook. This was the highlight of a weekend of celebrations reflecting a proud and globally accomplished air nation which has made a powerful contribution to two world wars, as well as the Korean and Vietnam wars and, subsequently as a significant coalition partner in a succession of post-Cold War conflicts, right up to today.

The Australian Military Board of Defence had considered a plan for the formation of an Australian Aviation Corps as early as 1910 but, at the time, the British Army had not selected an approved aircraft for military purposes so, in 1911, the Commonwealth Gazette advertised for two ‘mechanists and aviators’ who would be paid a salary of £400 per annum, adding: ‘The Commonwealth Government will accept no liability for accidents.’ An Australian motor mechanic, Eric Harrison, had gone to Great Britain to learn to fly and Henry Petre, a former London barrister, both received their aviator’s certificates from the Royal Aero Club in 1911 and were later appointed as commissioned flying instructors by the Australian government. In October 1912, approval was granted for the formation of an Australian Flying Corps and orders were placed for the first aeroplanes. In 1913 Harrison and Petre arrived back at Point Cook with two Royal Aircraft Factory BE2a biplanes and two Type A Deperdussin monoplanes. A Bristol Boxkite was also ordered and Point Cook became the home of the first flying training school. Today it houses a number of Royal Australian Air Force units and is the location for the RAAF Museum.

Into battle

WW1 erupted only a year after the first military pilots and aircraft had arrived in Australia. Flying training was undertaken in the frail flying machines as volunteers rushed to learn to fly and soon aerial military operations were being flown in British-supplied aircraft in Mesopotamia against the Turks and in Egypt. Four new Australian Flying Corps squadrons were formed and served with distinction alongside the Royal Flying Corps in Palestine and in France. After the war the squadrons were all disbanded but, following the establishment in March 1921 of the Australian Air Force, the ‘Royal’ prefix was granted in August of that year and the RAAF was born. The British Government made an Imperial Gift of 128 aircraft, plus engines and spare parts, to establish the new air service on a stronger basis. Initial types included DH9s, DH9As and SE5s. Additional aircraft included Avro 504K trainers, Sopwith Pups and Fairey IIID seaplanes. Examples of many of these types have been preserved and are now displayed at the RAAF Museum.

The Museum’s celebrations in March of this year were considerably enhanced by the...
The RAAF today — a potent air arm

Today, the RAAF ranks as a leading world-class military air power in its own right, with one of the most powerful and far-reaching air forces in the Asia-Pacific region, challenged in size only by China, India and Japan but, arguably, the most effective by far in terms of overall and specialist capabilities, with significant naval and army aviation strengths, as well as air force power projection. The RAAF has embarked on a very ambitious defence modernisation programme, across all three services but, as a reflection of its key strategic position in the Southern hemisphere, it is continuing to invest in a broad range of air platforms and advanced systems that give it world-class status in terms of ISTAR and global reach.

A recent example is the Air 7000 programme to replace its 19-strong fleet of AP-3C Orion maritime patrol aircraft with a mixed force of up to 12 Boeing P-8A Poseidon jets (Phase 2B) and also high-altitude, long-endurance MQ-4C Triton maritime surveillance UAVs (Phase 1B). This will dovetail well with the similar mix of platforms in the US Navy’s Broad Area Maritime Surveillance programme that is coming into operation in the Pacific region. The massive air search for the missing Malaysian 777 in the South Indian Ocean has seen RAAF P-3s and USN P-8s operating side-by-side out of Perth.

The RAAF has also procured new C-17 heavy-lift transports, C-130J tactical transports and is in the process of acquiring ten C-27J Spartan medium-size battlefield transports. Together with Chinook and NH-90 helicopters, this gives Australian forces a very flexible air mobility force. The fleet of Boeing 737-based Wedgetail AEW&C radar patrol platforms enhance the network capabilities and will, in due course, work alongside the RAAF’s next generation combat platform, the F-35A multi-role stealth aircraft. The long-serving F/A-18As are being retained and have been supplemented by additional advanced F/A-18F Super Hornets, some of which are capable of conversion into the ‘Growler’ electronic warfare role. Another major investment has been the purchase of Airbus KC-30A MRTT (A330) tanker/transports, fitted with both boom and hose and drogue AAR systems.

The RAAF is now recognised by the US as a major partner in ‘Oceana’, so the celebration of one hundred years of Australian military aviation is a highly topical reminder that, in the 21st century, air power has no geographical limits.
The Russian helicopter industry is steadily developing, amid ever-growing demand for rotary-wing products both in the domestic and global market. EUGENE GERDEN assesses Russia’s helicopter sector.

Last year was successful for the Russian helicopter industry, as the total of production of Russia Helicopters, Russia's monopoly for the production of helicopters, (part of Russian State Technologies Corporation), reached 303 helicopters, while its revenue exceeded 140bn rubles ($3.9bn), which is a record figure for the past few years.

The firm order book in 2013 totalled 772 helicopters worth more than 370bn rubles ($10.28bn). For future orders in 2014 and 2015 its portfolio of commercial orders is fully formed, while for 2016 it is currently formed by 25%. In the past the majority of production was accounted for by civil helicopters, which were mostly supplied to foreign customers, now Russia has significantly increased the production and supplies of military helicopters to its national army.

In addition to the domestic market, the volume of foreign sales of Russian helicopters has also increased. In 2013 Russia's share in the global helicopter market reached 16.3%, mainly due to the growth of sales of military helicopters.
Sales success

Analysts believe that this is a great success for the Russian helicopter industry compared to its small share of the global market in the early 2000s which did not exceed 2%-3%.

Denis Manturov, Russia's Minister of Industry and Trade, who is in charge of the development of helicopter industry for the Russian government, commented:

“The Russian helicopter industry has achieved good results during the last several years. If at the beginning of 2000s the country's share in the global helicopter industry was only 3%, then by 2013 this figure reached 16%. Such an increase was mainly due to the integration of individual companies which specialise in the development and sales of helicopters into a single holding company, which is known as Russian Helicopters.”

The same position is shared by Ivan Andrievskii, the first Vice President of the Russian Union of Engineers. According to him, Russia is currently one of the leaders in terms of global sales of helicopters and this trend will continue during the next few years.

He also added that currently Russian helicopters are supplied throughout the world, while the biggest contracts are signed with India and China. There are also large contracts with the US for the rearmament of the Afghan armed forces, as well as some CIS states, and in particular Azerbaijan.

New models

Despite the impressive results achieved in 2013, Russian Helicopters has no plans to rest on its laurels and is planning to accelerate its activities in the design and development of new helicopters of different classes in 2014.

According to the company, the biggest hopes are put on the development and bringing to market of new multi-purpose helicopters such as Ka-62, Mi-38 and Mi-171A2, as well as some new attack models. It is expected that Mil and Kamov design teams, Russia's leading design bureaus, will be responsible for the implementation of these plans.

Boris Slusar, general director of Rostvertol, Russia's leading manufacturer of heavy transport and attack helicopters, which is part of Russian Helicopters, commented:

“Last year Russia introduced some of its latest developments to the global helicopter market, among which were the Mi-171A2 and Ka-62 civil helicopters, as well as the transport and passenger Mi-38. At the same time, this year there are plans for the increased production of the Mi-26T, which is the world's heaviest helicopter, and its military variant — the Mi-26.6

Enter the Ka-62

In the case of the Ka-62, production is expected to take place at the facilities of several plants of Russian Helicopters.

The Ka-62 is designed to carry 12-15 people and, due to its large cabin, is suitable for corporate and passenger transportation as well as cargo transportation, emergency medical services, aerial work and surveillance.

The helicopter is equipped with two Ardiden 3G turboshaft engines of 1,680hp, which are supplied by Turbomeca. Meanwhile, the Ka-62's transmission is supplied by the Austrian Zoerkler.

Russian Helicopters says that serial production of the Ka-62 will start in 2015. By this time the company plans to receive all the necessary permissions for its exports abroad.

The Ka-62 is primarily aimed at the global market, according to earlier statements by Dmitry Petrov, a former CEO of the company who expects it to be in high demand abroad.

In the meantime, the first export contract for the supply of Ka-62 helicopters has already been signed by Russian Helicopters and the Brazilian company Atlas Taxi Aereo. Under the terms of the contract, delivery of the first batch will be started in the first quarter of 2015. Overall, by 2017, up to 14 helicopters will be supplied. In addition, the contract also involves the establishment of a service centre for after-sales service of helicopters in Brazil.

Foreign assembly?

In addition to exports, Russian Helicopters has not ruled out the possibility of the start of local assembly of its helicopters in Brazil and some other foreign countries.

In case of Brazil, there is a possibility that Russian Helicopters may launch its production in partnership with the local firm Odebrecht. In addition to production, the partners also plan to establish maintenance and repair facilities.

Brazil is expected to be not the only foreign country, where the production of Russian helicopters may be established. There is a possibility that production of the Ka-32A11VS will soon be launched in Beijing. The project is expected to be implemented by Russian Helicopters in co-operation with one of its Chinese partners, while total cost of the programme will reach ¥4bn yuan. In the case of the successful implementation of the project, China plans to launch its own design and production of these types.

New production of Chinese-built Ka-32s will be officially launched in 2015. At the initial stage its production rate will amount to 30 units per year, while later will be significantly increased.
At the same time there is also an ever-growing demand for Mi-26T helicopters, which is the only helicopter in the world capable of carrying cargo of up to 20 tons. Like all Russian helicopters, the Mi-26T is extremely reliable and can even be stored in the open air. The Mi-26T is equipped with D-136 engines, which provide high-speed and good performance in hot and rarefied mountain air. These helicopters also come into their own during disaster recovery.

Military helicopters

In addition to civil helicopters, big hopes are also put on the promotion and increased sales of Russian military helicopters abroad.

Currently Russian Helicopters is looking for customers for the recently presented Ka-52 Alligator which is an all-weather day/night combat helicopter, designed for surveillance missions and control of a group of attack helicopters.

It is equipped with signature reduction devices, counter-countermeasures, anti-missile defences and powerful offensive armament. Alligator provides high crew safety and has modern automated systems which facilitate its piloting.

At the same time, the company also offers the Mi-28N Night Hunter attack helicopter able to carry out combat tasks in any weather. It is efficient against tanks, vehicles, armoured personnel carriers, self-propelled guns, artillery and field air defences. In addition, its weapon system allows it to hit low-flying helicopters and slow flying aircraft.

This helicopter has proven of interest to foreign armies. In October 2012, it was reported that Russia and Iraq would sign a $4.2-$5.0bn weapons contract, including 30 Mi-28N helicopters. The deal was confirmed on 9 October but was reportedly cancelled due to Iraqi concerns of corruption.

However, those issues were resolved and all parts of the $4.2bn contract were signed, and are being executed. The first ten Mi-28N helicopters for Iraq were delivered in September 2013, with another batch of 13 Mi-28Ns delivered in January 2014.

By the middle of 2014, the Russian army will have about 40 such helicopters. In addition to Russia, the helicopter is supplied to South America, in particular to Venezuela, Brazil, as well as CIS states. In the latter case, the biggest customer for this type of helicopter remains Azerbaijan which

India, too, has expressed an interest in a modified Night Hunter fitted with French and Belgian avionics. Demand for the Mi-28N Night Hunter is estimated at 400 units by 2020.

21st century Hind

Meanwhile there is a new version of the multi-purpose attack helicopter, Mi-35M, which is developed from the well-known Mi-24 ‘Hind’. The helicopter is currently produced both for exports and the Russian army. It is designed to destroy armoured vehicles, fire support of ground troops, landing and evacuation, as well as transportation of goods in the cabin and on the external sling load.

The helicopter is equipped with a double-barrelled GSH-23L 23mm calibre gun and ‘Storm’ anti-tank guided missiles. One of the main design features of Mi-35M is the use of shortened wings and lightweight fixed landing gear, which allowed a significant reduction in the final mass of the helicopter. The new version of the Mi-35M also received an X-shaped anti-torque rotor which provides better controllability and reduces noise levels. The new model has also more powerful engines which allowed an increase in its flight altitude.

By the middle of 2014, the Russian army will have about 40 such helicopters. In addition to Russia, the helicopter is supplied to South America, in particular to Venezuela, Brazil, as well as CIS states. In the latter case, the biggest customer for this type of helicopter remains Azerbaijan which

The Ka-62 is Russia’s new civil helicopter hope.
recently signed an order for the supply of up to 24 helicopters during the next few years.

Analysts at the Russian Ministry of Transport believe that the domestic helicopter industry will continue its active development during the next few years, being mainly driven by the existing state plans for the expansion of the civil helicopter fleet, with the aim of the improvement of transport accessibility in remote areas, as well as the large-scale rearmament programme of the Russian Army until 2020.

According to state plans, by 2020 the Russian share in the global helicopter market should increase up to 20%. By this time the annual volume of production is expected to reach 470 helicopters.

Losing the competitive advantage?

However, despite the current stable growth, the industry's prospects after 2020 remain clouded. In recent years, Russian Helicopters has lost one of its main competitive advantages — the affordable prices for its products which have nearly tripled since 2005. For example, at present a Mi-17, Russia's multipurpose helicopter, is priced at $16-18m, compared to $6m about seven years ago.

The situation is aggravated by a recent loss of a lucrative $345m contract for the supply of Mi-17s for the needs of the US Government in Afghanistan due to political issues and Russia's support of the Assad regime in Syria.

The first contract between Rosoboronexport, the major shareholder of Russian Helicopters and the US Department of Defense for the supply of 21 modernised Mi-17s, valued at $367.5m, was signed in May 2011. Total cost of the contract, taking into account the supply of spare parts and training of technicians, was estimated at $900m.

Export goals

According to Dmitry Rogozin, Russia's Deputy Prime Minister, one of the main goals of the Russian helicopter industry for the next few years is to increase its presence in Western Europe and the US. Says Rogozin:

"Currently the global demand for Russian helicopters is slightly higher than the volume of its supplies. In this regard, we are considering increasing our production capacities. We are planning to increase exports of both helicopters already equipped with weapons as well as models, which do not have any equipment, so that our customers will be able to equip them in accordance with their needs. A significant number of our helicopters will be sold to Western countries."

According to Rosoboronexport (the sole state intermediary agency for Russia's exports/imports of defence-related and dual-use products), in 2012 exports of Russian helicopters increased by 40%, valued at more than $1.5bn. In the view of state predictions, this year exports will also grow by a further 30%.

Says Grigory Kozlov, Rosoboronexport's head of department of exports of helicopters and services: "We are increasing exports both by strengthening co-operation with traditional partners, as well as through the increase of geographical expansion of our business."

According to Kozlov, due to the reduction of military budgets in recent years, many countries have significantly cut back spendings on R&D and the development of helicopters. He also added that even NATO countries are becoming more open to co-operation with Russia in the field of helicopters' production and supply. In addition, most of the countries of the former Warsaw Pact, including the Czech Republic and Poland, still actively use Russian helicopters.

In the meantime, recent events in Crimea may negatively affect the export plans of Russian Helicopters and may result in the termination of contracts. However, according to the company, so far, none of its customers have announced the termination of earlier signed contracts.

"Currently the global demand for Russian helicopters is slightly higher than the volume of its supplies. In this regard, we are considering increasing our production capacities.

Dmitry Rogozin
Deputy Prime Minister of Russia
Gesture controls and augmented reality are making the leap from consumer electronic devices and video gaming to the aerospace factory in a pioneering project in the UK. TIM ROBINSON reports.

P erhaps the most memorable scene in the 2002 science-fiction film ‘Minority Report’ was in its depiction of a future gesture-controlled computer interface — with Tom Cruise using his hands to perform a criminal data search, waving his hands like a orchestra conductor in front of a giant display to find information.

Twelve years later in 2014, gesture controls are now becoming mainstream, with smart phones and televisions that can be controlled by ‘swiping’ or pointing your hands. Perhaps the biggest application has been in consumer video games, where the Nintendo Wii, Microsoft Xbox Kinect and Playstation Eye have all brought movement or gesture-controlled games to the living room. By tracking the position of a controller precisely in 3D space (or in the Kinect’s case the person itself by tracking the position of the body and limbs) the game can use the input of this to replicate it in a virtual environment — allowing players to play golf, tennis or bowling for example, by using the same movements they would in the real game.

So far, so fun — but outside gesture controls for passenger IFE — is there any real relevance for this kind of technology for aerospace?

"Sometimes you can apply something from gaming at a very low cost that gets very good results"

Simon Astwood
Research team leader — Digital Factory
Airbus Group Innovations, Filton
Into the factory

Surprisingly there is — and it is not inside the flight deck — but on the factory floor. Under a project that partners Airbus Group and Cranfield University with Spanish engineering and aviation infrastructure consultancy AERTEC Solutions, researchers are investigating whether low-cost gaming technology can be used to pass on aerospace manufacturing knowledge and skills. The Digitising Expressions for Manufacturing Optimisation (DEMO) is a 30 month project that started in October 2012 which ‘seeks to leverage commercial gaming interface technology (Microsoft Kinect) to capture and re-use human knowledge of complex manufacturing processes that use deformable materials.’ As its first focus, DEMO is examining laminate lay-up processes in composites manufacturing and is set to run until the middle of next year. Says the Director of AERTEC’s new Bristol office, Pedro de Melo: “It’s about finding novel ways to apply gaming technology to an industrial context”.

Simon Astwood, Research Team Leader — Digital Factory, Airbus Group Innovations (formerly EADS Innovation Works) explains more about DEMO: “The philosophy behind the project was to take this low-cost but quite advanced technology available in the gaming industry and see if we can apply it in quite complex tasks in industrial manufacturing.” He went on: “The gaming world has invested heavily in the infrastructure, the software and the technology to make these kind of games happen. In the Airbus Group we end up spending a lot of money developing very expensive bespoke solutions. Sometimes there is a crossover between the two technologies — and sometimes you can apply something from gaming at a very low cost that gets very good results.”

Motion or gesture controllers, it turns out can be a way of passing on key worker skills. The problem is that many skills, acquired though years of experience are difficult or impossible to write down. The result is then, for global companies like Airbus and others that much time and money is expended in attempting to train and pass on these skills — especially to newer companies of the supply chain in emerging economies. That can necessitate a lot of travel to teach and pass on these ‘unwritten’ skills to less experienced workers. For example, experienced workers hand-laying up composites will work from the centre of the material first, then work towards the edges in one design, yet work from left to right in another to get the best finish.

Astwood elaborates: “The real value comes when you take something that is very highly skilled labour. If you take the ‘black art’ of composite lay-up although Airbus is moving towards mass automation, a lot of components are still made by hand. With a move towards using low-cost production in places like China, there is a need to transfer some skills from typically highly skilled plants to these new plants, that don’t have the 20-years of laminating experience of Spanish workers’. Enter gesture-control technology — or, more specifically, Microsoft’s Kinect. By ‘recording’ the positions and actions of experienced workers doing skilled manufactured tasks (for example deformable composite layup) these can be stored and transmitted to a factory on the other side of the world. The Kinect software which, as well as recording the positions of limbs and body, also allows easy sharing — allowing players to dance or play tennis against each other in real time — also allows with broadband internet these ‘moves’ to be shared with others with the device. “What we are able to do with the Kinect”, says Astwood: “is watch somebody in Spain carrying out that task and then relay that to somebody in China, either as a training tool or actually watching them in their workspace”.

Playing the DEMO

Says Astwood: “Our first demonstration involved performing some composite repairs and we used a normal low-cost desktop projector. We mounted the projector above the workbench and every time they moved their hands around on the job, depending on where they moved their hands, it projected additional information — such as what orientation the material needs to be lined up in. There was also a notes page at the side that gave helpful tips”.

Thus, in the factory of the future, a new worker with TV screen and a Kinect device may not only ‘see’ the correct movements of arms and limbs but also when working the computer may tell them whether they are matching the original ‘recording’ of the highly skilled worker.
Like a video gamer playing a ‘rhythm dance’ game step-by-step, the technician, over time would be able to build up muscle memory in learning a new skill. Says Astwood, “What we are trying to do is to build ways of augmenting the workspace of one of the Chinese workers with lots of additional information captured by the Spanish workers”.

Astwood explains: “Our first step was to use a projector to throw in some additional information using the Kinect. Now we are looking to going into a gaming platform, to take the knowledge and learning from that initial experience and looking at building a computer game simulator — so someone could actually go through the motions of carrying out a task in front of a projector, using hand gestures to select parts and bring them into the workspace.”

The benefits of this are - as well as saving money through travel — as a non-verbal mode on communication it allows the nuances of skilled tasks to be passed on — without needing extensive translation. “Using graphics, icons and gestures there’s no real need to be able to write anything in Spanish or Mandarin” observes Astwood. Another benefit of this is increased health and safety for workers — wherever they are. Finally, by capturing this data non-intrusively it may give insights into better workflow or optimisation of manufacturing processes that simply couldn’t be available before — potentially leading to increased efficiency and reduced cost.

Further in the future, it may also aid in automation of factories. In February 2014, Airbus launched the Futurassy R&D project where humanoid robots will work alongside humans in aircraft assembly. Could the ‘digitised skills’ of experienced human aerospace workers be passed on to humanoid robots using this technology?

**Google Glass on the factory floor**

Meanwhile, another consumer electronic device may also be heading for the aircraft factory floor — that of a wearable personal ‘HUD’ — Google Glass. Head mounted displays of course, are nothing new for the aerospace industry — having been pioneered by helmet-mounted sights for fighter and attack helicopter pilots. However, now the technology has come full circle with the advent of the first consumer wearable head-mounted displays about to break into the market. Foremost among these is Google Glass — a personal ‘HUD’ that displays information from a linked smartphone such as directions, as well as being equipped with a video and still camera.

The result, when paired with accurate geo-location software and the smart-phones inbuilt GPS, is ‘augmented reality’ where the ‘HUD’ can overlay driving directions, points of interest or other information in 3D space. In the factory, this could be used so engineers could see CAD and CATIA diagrams ‘overlaid’ on the aircrafts structure, or see a real fuselage become a ‘virtual cutaway’ model with wiring, hydraulics, avionics and other systems highlighted beneath the skin when the user looks at the that direction. Says Astwood: “Ultimately we are looking at things like Google Glass so that someone on the shop floor, has access to all the CAD data, work instructions all geo-located in their workspace.”

The technology, when paired with ‘smart tools’ or RFID tracking could also allow supervisors to find lost or missing tools — or optimise work flows by ‘seeing’ the way in which tools are passed on — wherever they may be in the factory. “If you looked at a spanner and you didn’t know what it was for — the Glass would tell you” notes Astwood.

**Summary**

In short, although these are early days, there is much potential using this technology to optimise and transfer skills in the aerospace supply chain using such low-cost technology from video gaming. With civil aerospace manufacturers struggling to keep up with demand, yet constrained by the need to maintain quality with new emerging partners this is one way of bridging the gap. Finally the massive adoption of the iPad by the aerospace and aviation sector demonstrates that the industry is not reluctant to adopt consumer technology where necessary. Will the personal HUD of Google Glass be the next success?
Message from RAeS

- President

"I am very sad to be writing my last Presidential Message. As each month before, this last month has well reflected both my personal plans and the strength and breadth of the Society."

- Chief Executive

"At the time of writing I have today been advised by Westminster City Council that we have been granted planning permission for the major ground floor and basement alterations at No.4 Hamilton Place. This is a major project, supported by Airbus, which will provide for refurbishment of, and improved access to, the Business Suite."

Book Reviews

The Race for Hitler’s X-Planes, X-Planes of Europe and Project Terminated.

Library Additions

Books submitted to the National Aerospace Library.

Aircraft Company Publications

The latest additions to the NAL’s holdings are from the collections of the late Frank Robertson AFRAeS and Michael F Eacock.

Branch Lectures


Diary

7 May

Derby Branch

Sir Henry Royce Lecture

Future Challenges of the Aerospace Business

Dr Tom Enders, CEO, Airbus Group

Obituaries

Dr Assad Kotaite, ‘Sox’ Hosegood and Bill Craigie.

Elections

New Society members elected in the past month.
I am very sad to be writing my last Presidential Message. As each month before, this last month has well reflected both my personal plans and the strength and breadth of the Society.

I was glad to be invited to participate in a *Times* Business breakfast with the discussion topics being STEM in schools and how to encourage more diverse groups to consider engineering as a career. On several occasions now I have highlighted the support teachers of STEM subjects need and how beneficial it would be for them to get ‘regular’ industry work-experience, as well as industrialists supporting schools directly. I was delighted to visit the ‘Flying Start’ challenge at Yeovilton to speak and help judge the model glider competition. There was huge enthusiasm and inventiveness from both the participants and the organisers who were largely graduates from aerospace companies in the region.

I attended three Specialist Group Named Lectures with probably the most challenging being the Air Transport Group’s Tony Lucking Memorial Debate on Airport Capacity in the South East. I was chair for the session which heard strong arguments from the four contenders as well as the audience. The Rotorcraft Group’s Alan Bristow Lecture, jointly delivered by representatives from both Bristow Helicopters and the Marine and Coastguard Agency, on the UK’s new Search and Rescue introduction and operation was interesting and informative. While I hope I never need it, it is comforting to hear the professionalism and commitment from all involved.

I visited five Branches this month. At the Solent Branch’s R J Mitchell Lecture we heard the First Sea Lord’s views on the future of naval aviation. Moog Aircraft Group hosted the Birmingham Branch’s J D North Lecture with a Lightning II lecture from David Short (of BAE Systems) on the manufacturer’s perspective including some fantastic video of high alpha testing, while the Oxford Branch heard from the Head of the Lightning II Project team at the MoD for the Sadler Lecture. In Brussels I met with the Branch, visited Eurocontrol — there was another ‘President’ in town that day — and also participated in a panel discussion at the European Defence Agency Conference ‘Defence Matters’. A keen debate took place on the options for a European Manned Future Combat Aircraft. I was privileged to attend the Leslie Bedford Lecture and Dinner at the Stevenage Branch hosted by MBDA and Airbus Defence and Space. We heard Air Chief Marshal Sir Andrew Pulford describe 21st Century Air Power, linking back to the early days of the RAF.

At the Council meeting in March, which had the theme of ‘Strategy’, we reviewed the developing strategy of each Board together with their key objectives and progress. Council Elections are in progress and if you are eligible to vote I urge you to do so.

Finally, as part of my valediction I would like to express my grateful thanks to all the staff and members who have made this such a splendid, challenging, interesting and stimulating Presidential year and send Air Cdre Bill Tyack my very best wishes for his year as President.

# RAeS COUNCIL ELECTIONS 2014

**HAVE YOU VOTED IN THE RAeS COUNCIL ELECTION 2014 YET?**

Thank you for taking the time to vote in the 2014 RAeS Council Elections. The Royal Aeronautical Society Council Election 2014 opened for voting on 1 March 2014. All voting members will now have received either an email or postal notice enabling you to vote. If you believe that you are a voting member but did not receive either an email or postal notice, then please contact our election provider, mi-voice, using the details below (we would advise you in the first instance to check your email account’s junk folder, in case your email settings determine this email as being spam).

Please note that voting will close at **0900 on Wednesday 21 May 2014**.

Thank you for taking the time to vote in the 2014 RAeS Council Elections.

For queries, Email miVoice at enquiries@miVoice.com or T +44 (0)845 241 4148.
I would like to thank members and staff alike in responding so positively to the initiative to ensure the timely payment of subscriptions this year. Further to the By-Law changes, the Society’s Regulations were changed, bringing forward the final deadline for subscription payments from October to March. I am pleased to say that the importance of this change has been well understood and consequently has resulted in significant benefit to the Society.

Early March was the final Council meeting of Jenny Body’s Presidential year. Jenny has quite literally been ‘here, there and everywhere’ during the past 12 months, covering a remarkable amount of ground in the time available. From a staff perspective, it has been a pleasure to work with Jenny and I would like to express our gratitude for the support Jenny has given to us during her period of office. Air Cdre Bill Tyack will assume the Presidency in May and I am quite sure his year of office will be just as rewarding for the Society and staff alike. We wish Bill and Judy Tyack a very enjoyable year.

The UK Chief of the Defence Staff General Sir Nicholas Houghton delivered a very interesting and very well attended Corporate Partner Briefing recently. In putting together the calendar for these briefings, I continue to be surprised at the support we achieve from speakers and sponsors. Indeed, in the past four to five years, I cannot recall an invitation to speak being declined, which of itself speaks volumes for the Society.

The Society’s Foundation Committee met recently to discuss the ‘bid’ applications for 2014 and onwards. This is an important group within the Society with its grants being funded primarily through Gift Aid donations and other personal donations which we receive with gratitude from our members. Applications are received from, and granted to, a wide range of activities, but frequently they enable initiatives in support of younger people.

Our 2014 Banquet on 21 May is proving particularly popular, with our Guest of Honour being Chief of The Air Staff, Air Chief Marshal Sir Andrew Pulford. As was described to me last year, this “continues to be both an excellent party and a wonderful networking opportunity.”

At the time of writing I have today been advised by Westminster City Council that we have been granted planning permission for the major ground floor and basement alterations at No.4 Hamilton Place. This is a major project, supported by Airbus, which will provide for refurbishment of, and improved access to, the Business Suite. This will include a new access point via the ground floor foyer, new and additional cloakroom facilities, a refurbishment of the Catering Office and, importantly, a new basement passageway which will, in future, mean that visitors will avoid having to pass through the existing catering facilities. Inevitably there will be some disruption while this work is carried but it is our hope that this will be kept to an absolute minimum. I am hoping that the work will begin following our summer Farnborough Reception in July.

Finally, but in many respects most importantly, I am pleased to announce that Emily Cooke will be joining the Society as Head of Venue Marketing. Emily’s most recent role has been at the Marylebone Cricket Club where she was responsible for marketing a wide range of facilities, events and packages. I am sure you will join me in wishing Emily well in her new challenge.
Britain’s 1945 Mission to Capture Secret Luftwaffe Technology
By J Christopher


This volume is a well-researched account of the ‘Fedden Mission to Germany’ which took place in June and July 1945. The Mission was led by Sir Roy Fedden and supported by other experts from the RAE and the aircraft industry. While the core of book is based on Fedden’s official report, the account starts with a brief biography of Fedden himself and, throughout, it sets the itinerary of the Mission in context with the prevailing conditions in Germany, the attitudes of the German personnel who were ‘interrogated’ and the activities of Britain’s erstwhile Allies in the recently-ended conflict. These latter were players in a great game of competing to gain maximum benefit from the treasure trove of facilities, engineering artefacts, drawings and skilled personnel made available to them by the end of the war; each party was hell-bent on its own national interest and any thought of co-operation with former wartime colleagues was consigned to the four winds.

Each of the ‘Targets’ visited merits its own account of the findings made, with quotations of opinions expressed by Fedden and other members of the Mission. The ‘Targets’ (mostly in Germany but latterly also in Austria) had mostly been identified in the earlier weeks following the German surrender by the Air Ministry’s Air Technical Intelligence teams, which enabled the Mission to plan its activities in advance, albeit that it had not been possible to predict the dislocations of German infrastructure [and Allied military bureaucracy] which greatly impeded the Mission’s travel from place to place. Maps show the spread of the places visited. Many accounts are illustrated by relevant drawings, diagrams and photographs, and there is a wealth of background information on the technical detail of the findings investigated, to put everything in logical context. Finally, an Epilogue outlines Sir Roy Fedden’s post-war attempts to design and produce cars and aero-engines.

In a book of such wide scope it is inevitable that a few minor errors have crept in [e.g. the Curtiss P-60 was neither a jet aircraft nor the ‘Shooting Star’, and ‘Schräge Musik’ referred to upward-firing guns rather than rocket arrays] but these are insignificant distractions in a story well-told. The book is enhanced by an extensive bibliography and lists of sources that were consulted, together with a useful index of places, projects and personalities. This book is a mine of information and is thoroughly recommended to students of the subject. If this reviewer was slightly surprised at anything, it was a lack of credit given to British Air Technical Intelligence teams on the ground which had in effect sifted out the Mission’s list of ‘Targets’ in the weeks before it set out for Germany. Perhaps this is explained by the absence of any credits to The National Archives at Kew which holds much material relevant to the subject, and is much nearer to home than the archives in the US that were consulted.

Phil Butler
Affiliate
X-PLANES OF EUROPE

Secret Research Aircraft from the Golden Age 1946-1974
By T Buttler and J-L Delezenne


The 1946-1974 period covered by this book is indeed the golden age of experimental aircraft design and manufacture in Europe. All of the main research aircraft of this period are covered within the 302 pages of this book. A total of 38 aircraft are described, each representing the cutting edge in aircraft design from the British, French, German, Swedish and Swiss aircraft industries.

As well as the well-known aircraft of the period, such as the Fairey Delta 2, this book also provides details of lesser known aircraft. One example being the Swiss Federal Aircraft Factory (FAF) Arbalete, which was intended to provide aerodynamic data for the development of the FAF N-20 fighter aircraft. Also described is the SAAB 210 which contributed flight data for use during the design and development of the subsequent Draken supersonic fighter.

The authors have provided useful information on the flight trial programme for each aircraft and have also outlined any modifications the aircraft required during the duration of their flight trials. The contribution made by each aircraft to the aviation industry is also presented. The authors have also provided the reader with a good overview of the development of VSTOL (vertical short take-off and landing) aircraft within Europe and present the different design solutions taken to achieve this goal by subsequent British, French and German aircraft design teams. The book is both well written and illustrated by excellent photographs and colour line drawings (including hypothetical colour schemes for the Nord Griffon II). Also provided are a number of two-page cut-away drawings of the Bristol 188, Short SC1 and Fairey Delta 2.

The one drawback of these types of historical books is that it brings home the lack of aircraft development over the subsequent years within the aerospace industry. One can only hope that this may now be addressed with the development of unmanned air vehicles and associated flight trial programmes.

Overall this book gives a good account of the aircraft of the period; but, for the reader looking for a more detailed technical analysis of these aircraft it falls a little short. However, it does provide a sufficient level of detail to act as a very good initial reference source.

Dr Malcolm Claus
MRAeS

Above: Leduc O-10 ramjet research aircraft on a Sud-Est SE161 Languedoc carrier aircraft.
Below: The first Bristol 188, XF923, at the end of its maiden flight on 14 April 1962.
All RAeS (NAL).
Famous Military Aircraft
Cancellations of the Cold War
and What Might Have Been
By E Simonsen


This latest offering of the ‘what might have been’ genre concentrates on ten military projects (eight US, one British [the TSR2] and one Canadian [the Avro Arrow]) most of which made it to at least the mock-up stage, although one, the Rockwell B-1B, did eventually make it into service. Each project has a dedicated chapter, progressing chronologically from Northrop’s YB-49 flying wing bomber to the Northrop F-20 fighter of the early 1980s. Where relevant, the author extrapolates the story to the present day with, for example, a description of the Northrop B-2A as the ultimate descendant of the YB-49.

The history of each project from the initial military requirement, through the design process into full development, is ably described, together with the impact of the political, industrial and military factors which eventually lead to its termination. The author’s conclusion is, in all cases, that termination was unwarranted and no substantial counter arguments are aired. However, it would seem logical that the three advanced interceptors (the Arrow, the North American F-108 Rapier and the Lockheed F-12B), together with another two fighter projects (Republic XF-103 and the Convair F-106X), which are covered in less detail, should be viewed as largely alternative, rather than as complementary projects. There are also some interesting insights on the views of the major players involved with some of the projects, such as North American President Lee Atwood on the F-108 Rapier and the XB-70 Valkyrie.

While outline specifications are presented, there is little discussion of any detailed technical aspects or the risks associated with the advanced technologies involved, for example the ‘exotic metal’ heat shield on the Boeing X-20 spaceplane. In technical risk terms the projects range from those, such as the Arrow, which were test flown over a large proportion of their flight envelope, to the Rockwell XFV-12A supersonic V/STOL fighter which never developed sufficient thrust to lift vertically. The book is lavishly illustrated — largely in colour — with photographs and substantial numbers of the author’s highly convincing illustrations of how the aircraft would have appeared in service, in various roles and colour schemes. These include a RCAF Arrow formatting on one in USAF colours and a B-1B in RAF colours escorted by a Typhoon and a Tornado.

Colin Frazer
AMRAeS
Library Additions

AERODYNAMICS

T R Yeocht, American Institute of Aeronautics and Astronautics, 1801 Alexander Bell Drive, Suite 500, Reston, VA 20191-4344, USA. 2014. Distributed by Transatlantic Publishers Group, 97 Greenhain Road, London N10 1LN, UK (T +44 (0)208 8815 5994; E mark.chaloner@tgpdl.co.uk). 700pp. Illustrated. £390 (20% discount available to RAeS members on request). ISBN 978-1-62410-254-7.

HISTORICAL


Numerous colour diagrams and photographs illustrate this history of the pioneering Russian jet aircraft, the first production aircraft (powered by the RD-45F — a copy of the Rolls-Royce Nene II) being completed in December 1948. The aircraft’s numerous variants (including its licensed production in Poland, China and Czechoslovakia) are summarised in detail.


A detailed study of the disappearance on 2 July 1937 of the Lockheed Electra 10-E flown by Amelia Earhart and her navigator Fred Noonan in flight from Lae in New Guinea to Katsura in Japan where he crash-landed during a round-the-world flight attempt.

Navigation


BRITISH AEROSPACE


A detailed biography of the woman pilot who became a household name through her long-distance solo flights, including the first solo flight over the North Pole.


A study of the air operations of Bomber Command and their effectiveness during WW2, including the development of area bombing and the major role played by Sir Arthur ‘Bomber’ Harris.


A very detailed revisionist history of the air operations of the Battle of Britain and how it encapsulated the competing development of aircraft technology in Britain and Germany leading up to the outbreak of WW2.


Incorporating numerous contemporary photographs and personal recollections, this is a detailed history of the V-1 and V-2 attacks on England during WW2.

STRUCTURES AND MATERIALS


TRAINING


For further information contact the National Aerospace Library. T +44 (0)1262 701038 or 701060. E hublibrary@aerosociety.com

Avery detailed account of the major contribution that Anthony Fokker (1890-1939) made to the development of aviation through his pioneering work on the synchronisation of aircraft machine gun fire through to the establishment of the Fokker aircraft manufacturing company as a major global business.


The autobiography of Clarence ‘Kelly’ Johnson who began working for Lockheed in 1933 and was to develop the company’s renowned Advanced Projects Team (Skunk Works) from which was to evolve the SR-71 Blackbird, YF-22, U-2 and other famous designs, continuing the success of the P-38 Lightning, P-51 Mustang and P-104 Starfighter.

Fokker: a Transatlantic F-80 Shooting Star and F-104 continuing the success of the other famous designs, SR-71 Blackbird, YF-12, U-2 company’s renowned Advanced Astronautics, 1801 Alexander Bell Drive, Suite 500, Reston, VA 20191-4344, USA. 2014. Distributed by Transatlantic Publishers Group, 97 Greenhain Road, London N10 1LN, UK (T +44 (0)208 8815 5994; E mark.chaloner@tgpdl.co.uk). 700pp. Illustrated. £390 (20% discount available to RAeS members on request). ISBN 978-1-62410-254-7.


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Aircraft Company Publications

The National Aerospace Library at Farnborough holds an extensive collection of aircraft company publications (brochures, reports, manuals and journals) which have been donated over the decades, mainly by individuals who either worked for, or did business, with those companies.

The Librarians wish to acknowledge the latest additions to its holdings as detailed below which have been catalogued from the collections of Frank Henry Robertson AFRaeS (1912-1996) [presented by his son Malcolm Robertson CEng FRAeS] and Michael F Eacock (1928-2013) [presented by his sons Roger, Michael and Graham Eacock].

These publications are often a unique source of information and record of the evolution of that particular company’s products (including numerous unbuilt aircraft project designs), for the National Aerospace Library’s evolving collection being of particular importance as a historical record as the postwar rationalisation of the aircraft industry led to numerous aerospace company archives being broken up or disposed of.

Phillips & Powis Aircraft (Reading) Ltd/Miles Aircraft Limited

Report on Design, Construction and Testing of Small Aircraft Designed on Miles X Principle

Describes eight-engined aircraft project design of transatlantic range.

Preliminary Design Specification Miles X9
Phillips & Powis Aircraft (Reading) Ltd, Reading, c.1942.

Describes the Miles X9 all-metal laminar flow long-range transport aircraft project design. Includes a number of detailed line arrangement diagrams and sectional views.

M.19 Mk.II — Report on Conversion from Day Trainer to Day and Night Trainer for RAF

F H Robertson, Phillips & Powis Aircraft (Reading) Ltd, Reading. 1943. 3bp + 16 pull-out diagrams. Illustrated.


T.18 — Report on Design of Tricycle Undercarriage Conversion Set for M.18 Aircraft
F H Robertson, Phillips & Powis Aircraft (Reading) Ltd, Reading. 1943. 9pp + 4 pull-out diagrams. Illustrated.

Miles Aircraft Limited, Reading. 1946.

R.T. — Report on Preliminary Design for Glider Tug
F H Robertson, Miles Aircraft Limited, Reading. 1945. 1pp. Illustrated.

The HDM.106 Light Transport Aircraft: Two-Lycoming GO-480 or GSO-408B Engines 8,000 LB AUW (Provisional Specification)

A development of the HDM.105 Experimental Aerovan, describes short-haul freighter concept, including general dimensions, internal layout arrangements and estimated performance graphs.

Saunders-Roe Limited

Saunders-Roe Limited. c.1946. 30pp. Illustrated. Describes the P121/00.3/P121.00.5 (a)/P121.00.5 (b) variants and includes line arrangement diagrams.

Design Study of a Reconnaissance Flying-Boat for Tender to MOS Specification R2/48

Describes in detail the Saunders-Roe P1104 project, including the aircraft’s aerodynamic design, estimated weight/performance, production breakdown, structural strength and stiffness.

Addendum No.1 (As requested by MOS letter Ref.6/aircraft/3120/ C88(b)) to Design Study of a Reconnaissance Flying-Boat for Tender to MOS Specification R2/48

Describes the Saunders-Roe P1104 project.

Saunders-Roe Duchess

Includes technical details of hull characteristics, beaching gear, performance, operating costs and other data/dimensions.

Preliminary Report on Design Study of a Small Twin-Engined Helicopter

Describes in detail the Saunders-Roe P1148 project, including the aircraft’s aerodynamic design, estimated weight/performance, production breakdown, structural strength and stiffness. Concludes with an analysis of the advantages and disadvantages of variable sweep in comparison with fixed wing designs.

Saunders-Roe Princess: Compilation of dimensions/weight estimates/range and take-off performance summary and various photographs.
Saunders-Roe Limited. c.1952. 7pp + photographs.

Notes on Visit to USA in Connection with Helicopters and Seaplanes during March, April and May 1952 (‘Guard — Secret’).
F H Robertson, Saunders-Roe Limited. 1952. Illustrated throughout by numerous photographs, this report reviews the latest designs of Hiller Helicopters, Hughes Aircraft Company, Los Angeles Airways, McMullough Motors Corp, American
Helicopter Co, Rotorcraft Corp, Cessna Aircraft Company, McDonnell Aircraft Corp, Helicopter Air Service Inc, Doman Helicopters Inc., Sikorsky Aircraft Inc, Kaman Aircraft Corp, Piasecki Helicopter Corp, Kellett Aircraft Corp, Bell Aircraft Corp, Convair Ltd, Grumman Aircraft Engineering Corp and The Glenn L. Martin Co. Also summarises visits to the Boeing Airplane Co, United Air Lines Maintenance Base at San Francisco, Fairchild Aircraft Division, Bendix Aviation Corp, the US Bureau of Aeronautics, Naval Experimental Station at Patuxent, NACA Langley Field and Wright Field at Dayton, Ohio.


Percival Aircraft Limited/Hunting Aircraft Ltd/British Aircraft Corporation (BAC)


The History of Percival Aircraft Ltd. Reprinted from The Aeroplane Spotter Vol IX No. 206 7 February 1948. Concludes with detailed Percival Type Number list.


Describes the evolution of the Percival P50 Prince and its variants including the Sea Prince TMk1. Includes a number of sectional diagrams.


Includes cutaway diagrams of the Napier Oxy NO.4 750hph Gas Generator and the Hunting Percival P105 helicopter project powered by the Napier Oxy NO.4 825 gas-horse-power generator.


Describes the Hunting H137/H.137R/H.142 project designs, their economics and loading sequences.


BAC.145 Jet Trainer. 145/1/RB. British Aircraft Corporation, London. January 1965. 50pp. Illustrated. Describes the aircraft’s dimensions, range, flight envelope (including stalling speeds and landing distances), typical training sortie, cockpit, armament, structure, fatigue life and other data.


Describes the aircraft’s dimensions, range, performance, flight envelope (including stalling speeds and landing distances), typical training sortie, cockpit, armament, stores, weapon loads, fatigue life and other data.

Developed from the BAC 145, describes the aircraft's aerodynamic data, range, weight breakdown, flight envelope (including stalling speeds and landing distances), stores, weapon loads, fatigue life, cabin pressurisation systems and other data. Evolved into the Strikemaster.


Shorts


Describes the Shorts PD17 jet-lift aircraft design developed from an English Electric concept.


Describes the Shorts PD25/4 single-seat delta-winged fighter design which was to be powered by eight Rolls-Royce RB108 engines mounted amidships to provide vertical lift and a Bristol Orpheus 12R mounted in the rear of the fuselage to provide horizontal thrust.


Describes the Shorts SC7 Skyvan and records the design philosophy which led to the decision to proceed with the project.


Describes the Shorts PD65 jet-powered design considered as a replacement for the DC-3 (including general arrangement diagrams, aerodynamics, wing/fuselage structure, performance, passenger accommodation, flap system, air conditioning/ hydraulic/fuel systems, operating costs).


Describes the Shorts PD80 low-wing turboprop design (including general arrangement diagrams, aerodynamics, aerofoil geometry, wing/fuselage structure, performance, passenger accommodation, slotted Fowler flap system, Lycoming T53-L-15 engine installation, air conditioning/ hydraulic/electrical/fuel systems, operating costs).


Includes as appendices descriptions of the F H Robertson "Rotacoupe", the McCandless single-seat gyroplane, Short PD66.00.11 4-5 seat autogyro design, Short PD59 Rotolus (a 20-seat autogyro design with fuselage accommodation identical to the PD80) and a report on autogiros compiled by Arthur D Little for Shorts.

Other Papers


Describes a two-seat autogyro design powered by a 210hp piston engine and fixed pitch propeller.


For enquiries regarding this material please contact the librarians at the National Aerospace Library:
T +44 (0)1252 701038 or 701060;
E hublibrary@aerosociety.com
SIR ARTHUR MARSHALL LECTURE

F-35 Lightning II

The Howard Theatre at Downing College Cambridge was filled to capacity for the 14th Sir Arthur Marshall Lecture, the Cambridge Branch annual prestige event, was held on Thursday 13 February 2014. The Society Past President, Phil Boyle, gave the opening address and introduced the speaker, Air Vice-Marshal Malcolm Brecht, who presented a most authoritative insight on 'The F-35 Lightning II Programme'. As Chief of Staff Capability at Headquarters Air Command, the introduction into service of this fifth-generation combat air system is one of his major responsibilities. He described how each of the previous generations of combat aircraft had introduced a step change in capability, explaining how the combination of stealth technology, a variety of sensors, communication links and weapons options can make the most effective contribution to the intelligence, surveillance and targeting requirements of the services. As the sole non-US ‘Level 1’ partner among the many nations collaborating in the programme, the UK has a most important part to play in the exciting technologies and capabilities being developed, with a significant input to the requirements and the involvement of industry. He emphasised the flexibility of the F-35 and how it might integrate with a variety of future scenarios involving both land and carrier-borne operations in all weathers. He concluded by expressing his delight at seeing in the audience cadets of No 104 (City of Cambridge) Squadron Air Training Corps, who had provided a Guard of Honour for the event, telling them that they were of the generation that would fill the cockpits of the Lightning II.

The closing address was given by the Branch President, Air Marshal Philip Sturley, who thanked the speaker for his comprehensive briefing and welcomed the new generation of manned combat aircraft that would take its place in providing future air capability.

Mike Gregory
MRAeS

As the sole non-US ‘Level 1’ partner among the many nations collaborating in the programme, the UK has a most important part to play in the exciting technologies and capabilities being developed.

TEMPLER LECTURE

BAE Systems UAS Development Programmes

On 18 February 2014, Chris Clarkson, Engineering Director, Defence Information, Training and Services, BAE Systems gave the 17th Templer Lecture of the Farnborough Branch. In the presence of Jenny Body, Society President, Air Cdre Bill Tyack, President-Elect, other distinguished guests and an audience of 130, Mr Clarkson gave a comprehensive overview of the company’s unmanned aircraft development work from the initial technology programmes in the late 1990s to the Taranis and Mantis flight vehicles of 2013/2014. He outlined the key technologies involved and placed particular emphasis on how the use of rapid prototyping techniques greatly reduced the time and cost of getting each individual project from initial concept to the flight test vehicle. He concluded by looking at the future potential offered by unmanned aircraft systems and how they could be integrated with conventional manned systems in controlled airspace, not just for military applications, but potentially also in the civil field. Following a lively question and answer session, Sir Donald Spiers, Farnborough Branch President, gave the Vote of Thanks on behalf of the Branch and the Society.

Dr Mike Philpot
CEng FRAeS
EVENTS  www.aerosociety/events

6 May
Training to Fly the Aircraft of the Shuttleworth Collection
Roger ‘Dodge’ Bailey, Chief Pilot, The Shuttleworth Collection
General Aviation Group AGM and Lecture

20 May
The Future of Weapon Systems Trials — A Case for European Collaboration?
Weapon Systems and Technology Group Classified Conference Boscombe Down

21 May
RAeS AGM and Annual Banquet

29 May
Flight Test Group Lecture

LECTURES  www.aerosociety/events

ADELAIDE
6 May — Inventing the Joint Strike Fighter. Dr Paul Bevilacqua, former Chief Engineer, Lockheed Martin Skunk Works. AAA National Lecture Tour.

BIRMINGHAM, WOLVERHAMPTON AND COSFORD
15 May — Branch AGM (6.15 pm) followed by HMS Queen Elizabeth — The UK’s supercarrier. Capt Simon Petitt and Cdr Andrew Blackburn, RN.

BRISTOL
19 June — Autonomous unmanned air systems in civil airspace. Paul Markannen, ASTRAEA Programme, Rolls-Royce.

CAMBRIDGE
8 May — Queen Elizabeth class aircraft carriers. David Downs, ACA Engineering Director.

CANBERRA
14 May — Inventing the dual-cycle rocket engine and its applications. Mark Hempesl, Future Programmes Director, Reaction Engines.

GLOUCESTER AND CHELTENHAM
20 May — Alex Henshaw Sigh for a Merlin. Tony Edwards.

HAMBURG
22 May — X-Planes of Europe — secret research aircraft from the golden age 1947-1967. Tony Butler. Joint lecture with DGLR and VDI.

HIGHLAND
14 May — The Hubble Space Telescope. Chris Stradling. 18 June — Space talk. Dr Robin Catchpole.

The Hubble Space Telescope following release by the Space Shuttle Atlantis after Servicing Mission 4 in May 2009. Hubble will be discussed by Chris Stradling at the Highland Branch on 14 May, NASA.

All lectures start at 18.00h unless otherwise stated. Conference proceedings are available at www.aerosociety.com/news/proceedings
An artist’s impression of a Queen Elizabeth Class carrier. The UK’s programme for two new carriers will be described at Cambridge by David Downs on 8 May and at Cosford by Capt Simon Pettitt and Cdr Andrew Blackburn on 15 May. Aircraft Carrier Alliance.
NEW PARTNERS

The Royal Aeronautical Society would like to welcome the following as Corporate Partners.

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**Contact**
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**Contact**
Joe Brannen, Senior Associate

Keltie is a leading partnership of patent and trade mark attorneys. We act globally in all fields of technology across the full range of intellectual property (IP) law, with a particular interest in the aeronautical sector.

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EVENTS

**Please note:** attendance at Corporate Partner Briefings is strictly exclusive to staff of RAeS Corporate Partners. Both individual and corporate members are welcome at the Annual Banquet and the Aerospace Golf Day. Unless otherwise advised, registration for Corporate Partner Briefings is at 16.30 hrs.

**Wednesday 21 May 2014 / London**
Annual Banquet
Supported by AlixPartners

**Wednesday 11 June 2014 / London**
Managing the future pilot shortage
Corporate Partner Briefing by Mark Searle, Chairman, BALPA

**Wednesday 18 June 2014 / Frilford Heath, Oxfordshire**
Aerospace Golf Day

**Tuesday 1 July 2014 / London**
Corporate Partner Briefing by Bernard Gray, Chief of Defence Materiel, Ministry of Defence
Sponsored by Boeing UK

**www.aerosociety.com/events**

For further information, please contact Gail Ward
E gail.ward@aerosociety.com or T +44 (0)1491 629912

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**Contact**
Judy Groves, Marketing Director

Rigby Group has evolved — through smart, strategic acquisitions — into a £1·8bn portfolio business which now encompasses finance, hotels, aviation, technology and real estate.

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Within the aviation sector, Rigby Group has two principal areas of interest covering regional airports and helicopters. Regional & City Airports Management (RCAM) is a specialist airport management company which is focused on operating airports which accommodate up to three million passengers a year, cargo, freight, corporate and general aviation. As well as owning and operating Exeter and Coventry Airports, RCAM also manages Blackpool and City of Derry airports. British International Helicopters (BIH) is the UK’s largest domestically-owned helicopter operator and the only British-owned company in the offshore sector operating in the UK.
Obituaries

DR ASSAD KOTAITE

FRAeS
1924–2014

Assad Kotaite was born in Hasbaya, Lebanon, on 6 November 1924. He graduated from the French University of Beirut (1948) and received a Doctor of Law from the University of Paris (1952), continuing his studies at the University’s Institut des hautes études internationales, and the Academy of International Law, The Hague.

His aviation career began as Chief of Legal Services, International Agreements and External Relations, Lebanese Directorate of Civil Aviation (1953–1956). He was a member of the Legal Committee of the International Civil Aviation Organization (ICAO), the specialised agency of the United Nations for international civil aviation. He served as Representative of Lebanon on the Council of ICAO (1956–1962), then Chief of Administrative Services for the Lebanese Directorate-General of Transport (1963–1964), and subsequently reappointed as Representative on the ICAO Council (1965–1970).

In 1970, he was appointed as the fifth Secretary-General of ICAO, remaining in this position until becoming the third President of the Council of ICAO in 1976, in which position he served 11 consecutive mandates. He was also President of the International Court of Aviation and Space since 1995.

He retired on 31 July 2006, bringing an illustrious 53-year career in public service to a close.

Donald L Van Dyke
FRAeS
Chairman, Montreal Branch

CHARLES THOMAS DENNEHY ‘SOX’ HOSEGOOD

FRAeS
1921–2014

Charles Thomas Dennehy Hosegood, affectionately known as ‘Sox’, is remembered particularly as an outstanding helicopter test pilot.

He joined the Fleet Air Arm from school in 1939, flying Fairey Seafaxes off HMS Alacrantra, on convoy protection duties. One night the ship was torpedoed and Sox was rescued by an accompanying frigate.

He converted to helicopters on the Sikorsky R4 and became the Navy helicopter test pilot at AFEE, Beaulieu.

He joined the Bristol Aeroplane Company in 1948, later becoming Chief Test Pilot of the Helicopter Division.

Sox was responsible for flying the later marks of the Sycamore and the tandem-rotor types 173 and 192 Belvedere.

He set up several records with the Belvedere including time between London-Paris-London.

Westland acquired Bristol Helicopters and closed the site in 1963. Sox, along with the majority of the innovative and successful Bristol team, found employment at other UK or overseas companies.

Sox joined the South-western Electricity Board to set up its helicopter unit for powerline inspection duties. He remained in that post until his retirement 20 years later.

He died, aged 93, on 17 February. Sox had married Jane Jacob in 1950 and leaves her, their sons Nigel and Ian, and three grandchildren.

Prof Reg Austin
CEng FRAeS

SAMUEL WILLIAM (BILL) CRAIGIE

OBE CEng MIMechE FRAeS
1922–2013

Born on 22 October 1922 in Greenwich, London, Bill was the eldest of four children. Bill’s first professional position was with Siemens in Woolwich. However, he soon moved on to Marconi at Crystal Palace where his father was already working.

Bill was involved in the design and production of early radar systems and was therefore in a reserved occupation. Nevertheless, he joined the Home Guard.

At the end of the war he moved to Aviation Developments where he designed things. Still in use today, the well-known-in-the-trade Avel sheet gripper is one of Bill’s designs.

Bill moved to ML Aviation at White Waltham Aerodrome in 1949 and became based in Maidenhead until his retirement in 1986, helping to design and promote a whole range of differing aircraft handling and on-board equipment. As Project Engineer, he led the design team that produced a system that, for the first time, would safely eject a black box recorder from an aircraft wreck submerged in water. He travelled widely promoting sales of ML airborne weapons release equipment of which he was Chief Designer.

Five patents exist under his name, and it was chiefly the success in overseas sales of these products which led, in 1977, to the award of an OBE. Throughout his career, Bill remained very much a family man and is survived by his widow Lorna, and four sons.

Ken Craigie
SOCIETY OFFICERS

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President-Elect: Air Cdre Bill Tyack

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WITH REGRET

The RAeS announces with regret the deaths of the following members:

Diptish Narayan Bagchi  IEng MRAeS 81
Peter Berry  MRAeS 86
Don Goodrow  Affiliate 84
Thomas Hall  CEng MRAeS 86
Peter John Harding  CB CVO CBE AFC FRAeS 73
William Huyton  CEng FRAeS 91
William Hall McKinlay  CEng FRAeS 90
George Alfred Stanley Palmer  IEng AMRAeS 97
Robin Dale Price  IEng MRAeS 55
Frank Edwin Roe  CBE CEng FRAeS 89
Gerald Charles William Wistow  MRAeS 88
Ronald Bruce Wyke  MRAeS 89

CORRECTION

On p 13 of the 2013 Annual Review we incorrectly stated that Graham Redgrave was Chairman of the Marshall Group, whereas he was Chief Airworthiness Engineer until his retirement last year. We apologise for any confusion caused.

Recent elections to Engineering Council Registration

CHA R T E R E D  E N G I N E E R S

Mahbubul Alam
Christopher James Aplin
Saeeda Awan
Richard Bentley
Duncan John Brodie
David Edward Brown
Laurie Michael Carroll
Ian Richard Child
Hazel Davies
Michael Duffy
James Roger Frankland
Andrew David Harrison
Andrew Harrison
Martin Gregory Hoggett
Peter Frederic Kay
Glenn Alexander Knight
Kevin Charles Lycett
Joseph McKenna
Nicholas John Metcalfe
Jonathan Mhir
Thierry Moes
Jamie Richard Mountain
David James Murray
Heidi Michelle Parker
Trevor William Pierce
Lucy Tamsin Rodger
Simon John Rogers
Douglas John Roser
Michael John Sheath
Simon Andrew Smith
Mark Andrew Wainwright
Jonathan Walters

IN C O R P O R A T E D  E N G I N E E R S

Ioannis Bagkeris
Lee Malcolm Cole
Nicholas James Gabb
Stephen Michael Jackson
Shaun Patrick King
Kosala Rodrigo
Raj Singh

E N G I N E E R I N G  T E C H N I C I A N S

Stacy Clipson

Piecing together airline training for the region

Asia Pacific Airline Training Symposium
23-24 September 2014
Centara Grand Convention Centre
Bangkok, Thailand

2013 Event Statistics
• 402 attendees from 42 countries
• 87 representatives from 36 airlines
• Regulators from 7 countries

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BRISTOL / 22- 24 JULY 2014

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Looking for the haystack

Having been drawn in to the media maelstrom surrounding the loss of MH370, I have even more sympathy for the friends and family of the passengers and crew of the ill-fated flight. The awful uncertainty waiting for news, with the dawning horror of their relatives’ fate soon revealed, is one place I never want to visit. But to be subject to such a long drawn out process before full and final closure might begin is quite another. Worse still, the effects of a 24/7 news frenzy only adds to the pain.

Media abhors a factual vacuum
And what of the output? All too often a search for the truth gets submerged beneath an avalanche of speculation, with often lurid scenarios of an airliner diverted to a secret airfield in a remote part of South Asia: Or a hunt for causation that defies logic, and certainly anticipates any sense of scientific and engineering analysis. No sensible explanation can be presented in the absence of a flight recorder and debris to analyse. This, of course, may take several years — although inspection of the wreckage should rule out several possibilities.

Two interim lessons
What are the interim lessons? Leaving aside the public relations issues of too many press conferences with too little to say, there are a couple of observations that are worth putting down on record.

Despite regional antipathies and tensions, the international response was in the best traditions of aerial and maritime distress. While the Chinese may still have to concede to the leadership of others in co-ordinating a response beyond their shores, the collective will to send expensive assets to literally the ends of the Earth was impressive. This had a basic humanitarian drive; but it also reflected a more pragmatic ‘need to know’. Just as the recovery of the Air France A330 flight recorder helped to diagnose a technical flaw in a piece of equipment, operators of Boeing 777s must be assured that a similar issue does not apply to what has been to date an exemplary safety record.

Second, as has already been noted in AEROSPACE, the international aviation community will have to accept that satellite-delivered continuous data transmission, if only of position, is going to arrive much sooner than expected. The notion that aircraft flying trans-oceanic routes were not radar monitored was, to the non-aviation specialist, something of a surprise. Inmarsat’s superlative analytic performance of scant data notwithstanding, politicians and passengers will want a more effective means of quickly locating that proverbial haystack.

IATA is already on the case with a task force remitted to ‘never let another aircraft vanish’ but developing and creating a standard system will require international agreement, presumably via ICAO. Introductory costs will not be trivial, even if running costs might be just a few dollars a day per aeroplane. However, low-cost carriers operating mainly under ATC control may baulk at a comprehensive imposition of tracking. Nevertheless, by the 2020s, another MH370 will be very unlikely.
The Royal Aeronautical Society Annual Banquet is established as a key event in the social calendar of the aviation and aerospace community.

Attracting high level industry attendance, it offers the ideal opportunity for networking and corporate entertainment.

The 2014 event will be held at The InterContinental London Park Lane. Pre-dinner drinks will be served in the Park Lane Suite followed by a four-course dinner in the Ballroom, with fine wines, coffee and liqueurs included.

Individual tickets and corporate tables are available with discounted rates for RAeS Members and Corporate Partners.

VENUE
The InterContinental London Park Lane,
One Hamilton Place, London W1J 7QY, UK

PROGRAMME
Reception: 7.15pm
Dinner: 8.00pm

DRESS CODE
Dinner jacket and decorations

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Book a private pre-dinner drinks reception at No.4 Hamilton Place, historic home to the Royal Aeronautical Society. Located adjacent to The InterContinental London Park Lane, No. 4 Hamilton Place offers a choice of elegant rooms for your exclusive reception. Package details are available on request.

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OPPORTUNITIES AND CHALLENGES

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THE INTRODUCTION OF AUTOMATION TO OFFSHORE OPERATIONS

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The conference has been endorsed by key stakeholders such as the European Helicopter Operator’s Committee, Oil & Gas UK and the International Association of Oil and Gas Producers.

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