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* Images show hired chairs that would be an extra cost

Volume 42 Number 10
October 2015

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Innovations in cabin designs
Airline interiors are the new battleground between airlines — but how do you make your cabin design soar?


Rogier Westerhuis

Barnstorming to Australia
Tracey Curtis-Taylor prepares to fly a 1942 Boeing Stearman biplane to Australia.

Correspondence on all aerospace matters is welcome at: The Editor, *AEROSPACE*, No.4 Hamilton Place, London W1J 7BQ, UK publications@aerosociety.com

Comment

Turning point for air displays?

It seems like another world now, that black and white footage of Farnborough in 1952 with bodies and wreckage sprawled and black smoke rising. Yet in the terrible events at Shoreham, in which 11 people lost their lives on a sunny afternoon outside the air show boundary, reminds us of the inherent risks in display flying, that, with careful planning can be minimised and reduced, cannot be eliminated entirely. Certainly, for 63 years, the display regulations in the UK have led the world in providing a 'gold standard' for safety at air shows and protecting the public. But, as Shoreham graphically shows, not every eventuality can be foreseen. In these safety conscious times, it is natural then, that the media spotlight has been turned on the small and tightly-knit world of display flying. There is already a great deal of soul-searching going on and, indeed, the CAA's move to place restrictions on vintage jets and high-energy aerobatics is a sensible one, until a more thorough and detailed assessment of air display safety standards can be concluded. Yet some of this is already falling on deaf ears — from some critics who would argue that messing around with fast, dangerous flying machines is merely an aerial equivalent of 'Top Gear' — boys (or girls) showing off. Nostalgia too, for past times and classic aircraft is part of this too and many argue that it is far, far better to see an aeroplane in its natural element, than stuck in a museum gathering dust. That may be but, while air shows are popular, can what might be seen as an enthusiast's hobby justify the loss of life in the 21st century? Yet air displays have a far more critical role. How many readers, I wonder, think back to seeing an air display as a young person and having their imagination sparked by the wonder of flight? How many aviation and aerospace professionals today, then, owe their career to being able to experience the visceral thrill of hearing and seeing (and feeling) a powerful machine be mastered by a human? If air shows are really under threat, it is on this ground that the battle must be fought. Not merely remembering an aeronautical past — but inspiring the aerospace future.

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Including: UK superdrone targets three months aloft, Report on the Taipei Aerospace & Defense Technology Exhibition, In the September issue of AEROSPACE, MMRCA: back to square one?, NASA test flies Mars flying wing.

Duct factor three

Two high-performance 2,600-shp turboshaft engines power the three ducted fans that lift and propel the TriFan. The configuration of the fans allows the aircraft to perform VTOL, hover and horizontal flight. Ducts on the wings tilt for forward flight and upper and lower doors slide over the rear duct to reduce drag during conventional flight.

Reducing risk

The TriFan 600's pilot will use fly-by-wire controls and benefit from improved IFR and advanced avionics. XTI is keen to use existing technologies in manufacturing in an attempt to reduce any risks and delays in final delivery of a first aircraft.

AEROSPACE

Crowdfunded VTOL

A US start-up has launched a 'crowdfunding' campaign for a VTOL business aircraft. XTI Aircraft has begun to gather interest in a concept for a triple-ducted-fan VTOL (vertical take-off and landing) aircraft. With the flexibility of a helicopter and the range of a business jet, the TriFan 600 is designed to provide a true door-to-door service for prospective clients. By using an internal vertical duct and two wing-mounted pivoting ducts, the TriFan 600 would not only be able to take-off and land on any helipad-sized space but also fly like a conventional fixed wing aircraft. Denver-based XTI Aircraft, headed by a team of ex-Sikorsky and Cessna executives, has now embarked on a crowdfunding campaign to 'test the waters' of interest in the TriFan 600. Crowdfunding campaigns are growing in popularity, getting many businesses and products off the ground and XTI believes that this sort of capital generation is the first step to producing the TriFan 600. As *AEROSPACE* goes to press, the funding campaign has already raised over $4·5m. Anyone interested in reserving shares is encouraged to go to www.startengine.com/startup/xti.

Comfort and conformity

The interior of the TriFan offers enormous flexibility to the aircraft's operators, according to XTI. For private and business travel the aircraft comfortably accommodates five passengers. Should the aircraft be required in an air ambulance role, it provides enough space for a horizontal stretcher and up to three medical personnel or companions.

An airport at your door

By taking the advantage of VTOL capabilities and merging them with the style and comfort of business jet travel, says the company, the TriFan will eliminate the need to drive to a busy airport. Instead, the airport is on your doorstep — provided that your doorstep is the size of a helipad — drastically cutting the time it takes to travel from point A to point B.

Specifications

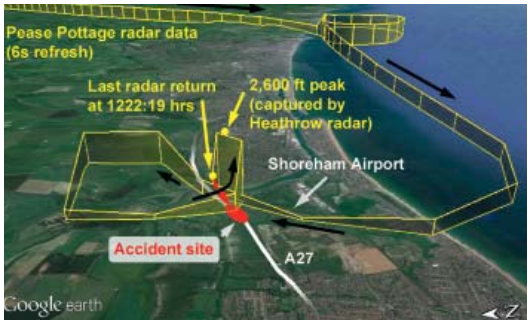
Capacity — One pilot and five passengers
Max cruise speed — 340kt (400mph)
Max cruise altitude — Over 30,000ft
Range — 800-1,200 miles (depending on take-off method/payload)
Vertical lift — three ducted fans
Engines — two x 2,600shp turboshafts
Time to max altitude — 11 minutes
Time to max speed — 90 seconds

XTI Aircraft

Radome

GENERAL AVIATION

Shoreham Hunter crash kills 11 in worst UK air display disaster in 63 years



AAIB

Eleven people were killed on 22 August when a vintage Hawker Hunter T7 crashed onto a road after it failed to pull out of a loop during a display at the Shoreham air show in West Sussex. The accident was the worst tragedy at a UK air show since a DH110 crashed at Farnborough in 1952, killing the two crew and 29 spectators. The pilot of the aircraft survived the crash but is in a critical condition after being thrown from the aircraft on impact. The UK's Air Accident Investigation Branch (AAIB) published an interim report that found that pilot Andy Hill had entered a loop too low and subsequently failed to exit the manoeuvre at the correct altitude. Meanwhile, the UK CAA quickly announced restrictions on vintage jet displays, limiting them to flypasts and banning 'high energy' aerobatics over land.

AIR TRANSPORT

Triple heaven deliveries for Emirates

On 3 September, Gulf carrier Emirates celebrated the delivery of three Boeing 777s.

It is the first time in 15 years that Boeing has delivered three 777s at once to a single customer. Emirates has received two 777-300ERs and one 777 Freighter. Emirates currently has 46 additional 777-330ERs on order with Boeing and is the biggest operator of the aircraft type.

On the same day, the Middle East airline also took delivery of its 66th Airbus A380 — again Emirates is the world's biggest operator of this type, with another 74 yet to be delivered.

AEROSPACE

CSeries makes a splash

Bombardier's new CSeries has successfully completed its water ingestion testing. The test, designed to validate how the aircraft behaves on a rain-soaked runway, took place in Mirabel, Quebec, Canada.

Bombardier

DEFENCE

UK to upgrade Apaches to 'E's?

The US State Department has approved a possible sale of the AH-64E Apache Guardian helicopter to the UK military. The sale of the helicopters, including spare parts and logistical support, is estimated to cost $3bn. The sale would see 50 WAH-64 Mk1 attack helicopters remanufactured to the AH-64E Guardian variant.

NEWS IN BRIEF

Airbus has selected Rolls-Royce to supply the engines for its new A330 Beluga XL heavy lift variant due to enter service by 2019. Airbus' current fleet of Belugas are powered by General Electric CF6 power plants but the European manufacturer has selected the Rolls-Royce Trent 700 for the new aircraft.

The leadership of the Independent Pilots Association has called for its members to vote on 23 October whether to strike against United Parcel Service (UPS). Members of the IPA have been in negotiations with UPS over the shipping company's commitment to securing an industry-leading contract.

UK-based Inzpire has won a five-year contract to provide whole force support to the RAF's Air Warfare Centre. Aviation experts from Inzpire will develop and deliver team and collective training events on behalf of 92(R) Squadron. Inzpire will be central in ensuring all training events are as realistic and valuable as possible.

The world's first all-electric propulsion satellite is now operational after an orbit handover on 31 August. The satellite, built by Boeing for Bermuda-based ABS, expands ABS's communication services in America, the Middle East and Africa. The satellites all-electric xenon-ion propulsion system is expected to last well beyond the spacecraft's 15-year service life.

North American Metro Aviation has contracted an order for six Airbus Helicopter EC145es — a light weight low-cost version of the EC145. Metro Aviation is the first North American customer for the new light twin.

GKN Aerospace has been selected as the core partner for two future Clean Sky2 engineering projects. GKN will contribute to the engine project, headed by Safran, Rolls-Royce, MTU and the Airbus-led Large Passenger Aircraft project. The work will take place at GKN's aero-engine engineering centre in Sweden. Engineers will design and manufacture complex structural and

AEROSPACE

First A350-1000 wing into production

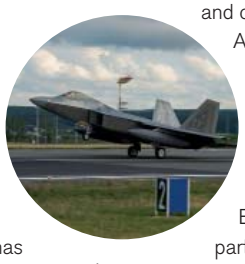
Airbus has begun assembling the first A350-1000 wings at its Broughton production plant in North Wales. Measuring 32m in length, the A350 wing will be the largest single carbon fibre composite material component in use in civil aviation.

Airbus

DEFENCE

F-22 Raptors forward-deploy to Europe

On 28 August the first of four USAF F-22 Raptors began arriving in Germany as part of a new forward-deployed US presence in Europe. The move, the first time the Raptor has been based in Europe, is part of the European Reassurance Initiative and will see F-22s rotating in and out of Europe. As well as Germany, the F-22s have also visited Poland and Estonia as part of USAF and NATO nations training exercises.



USAF

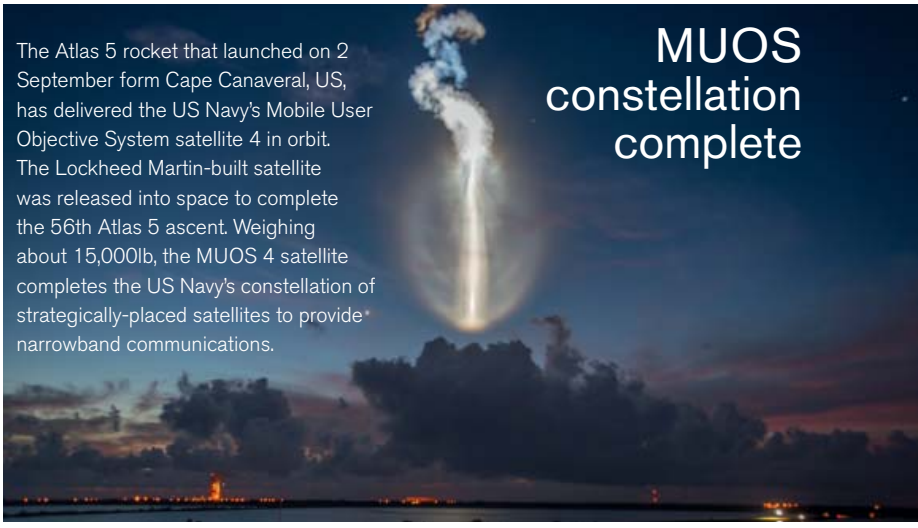
AIR TRANSPORT

BA 777 engine fire at Las Vegas airport

A British Airways Boeing 777 had to conduct an emergency evacuation at Las Vegas McCarran airport on 10 September after suffering from 'catastrophic' engine failure during take-off which caused the engine to catch fire. The flight crew were able to halt the aircraft and safely evacuate all 157 passengers and 13 crew and fire crews extinguished the flames within 5min. Preliminary findings by the US National Transportation Safety Board (NTSB) say that that investigators found multiple breaches of the left engine case in the area around the high-pressure compressor, as well as fragments of the high pressure compressor spool found on the runway.

SPACEFLIGHT

MUOS constellation complete



The Atlas 5 rocket that launched on 2 September form Cape Canaveral, US, has delivered the US Navy's Mobile User Objective System satellite 4 in orbit. The Lockheed Martin-built satellite was released into space to complete the 56th Atlas 5 ascent. Weighing about 15,000lb, the MUOS 4 satellite completes the US Navy's constellation of strategically-placed satellites to provide narrowband communications.

United Launch Alliance

mechanical parts for demonstration models.

German carrier Lufthansa cancelled almost half of its long-haul flights after its pilots' union staged a two-day strike on 8-9 September which affected passengers and cargo flying out of Germany. The Vereinigung Cockpit pilots' union is in a long-running dispute with the airline over pay, benefits and retirement age. The strike was the 13th in 18 months.

The Swiss Parliament voted on 7 September to purchase six Elbit Systems Hermes 900 unmanned air vehicles. The deal, valued at $256m, will see the six UAVs delivered to Switzerland with upgrades to improve performance in the country's mountainous terrain. The Hermes 900 will replace the county's current ADS 95 Ranger system.

A Russian Soyuz rocket has released two Galileo satellites into orbit; bringing the number of the satellite type in service up to ten. The two satellites, named Alba and Oriana, join a fleet that will consist of 30 spacecraft in the future with the intention of giving Europe an independent space-based positioning system. Alba and Oriana were lifted into orbit from French Guiana on 11 September.

The UK's National Police Air Service has placed an order for six Vulcanair P68Rs configured for airborne surveillance missions. The deal will see four role-adapted aircraft, with options for two more, delivered in 2016 and 2017. A single P68R has been on trial with NPAS providing nationwide surveillance support in conjunction with the NPAS's existing helicopter fleet.

Airbus begun production of its first re-engined A330neo on 7 September. The A330neo's engine pylon is being manufactured at the company's Toulouse facility and the first centre wing box is being constructed in Nantes.

Chinese aviation and shipping conglomerate HNA is buying the Irish aircraft leasing firm Avolon Holdings in a deal, worth $2·5bn. The Dublin-based company manages 152 aircraft and HNA is China's fourth largest aviation group.

Radome

AEROSPACE

DARPA

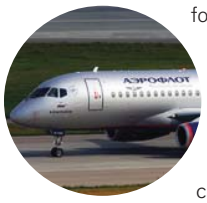
DARPA foresees 'gremlins' drones

The US Defense Advanced Research Projects Agency (DARPA) is conducting research into the concept of saving money on expensive manned and unmanned aerial platforms by using swarms of smaller, cheaper drones which would overwhlem enemy defences. Called 'gremlins' the platforms would be used as alternatives for conventional fighter platforms and one-use missiles. The gremlins would be launched from larger aircraft, including bombers transport aircraft or fighters while out of range of hostile forces which would then surround an enemy target, using a variety of jammers to interrupt radar and communications. Any unused gremlins are then retrieved by a C-130 transporter after the mission is over and taken back for re-use.

AIR TRANSPORT

Russian bear hug for Transaero

Russia's largest passenger airline, Aeroflot, has agreed to take over its closest competitor Transaero. Aeroflot will pay the grand total of one ruble for the indebted Transaero who have blamed the sharp devaluation of the ruble for reduced sales of international flights. The combined airline is expected to carry more than half of all the domestic passenger traffic in Russia.



Superjet

DEFENCE

Eurofighter wins Kuwait deal

Eurofighter

The Italian and Kuwaiti governments have signed a MoU for the supply of 28 Eurofighter Typhoon combat aircraft. The €8bn deal, currently being finalised, makes Kuwait the eighth nation to buy the Eurofighter.

NEWS IN BRIEF

After 20 months of negotiations, Brazil has finalised an order for 36 Saab Gripen NG fighters. Saab announced on 9 September that the full value of the contract is now booked on its order-backlog. All 36 Gripens will be delivered to the Brazilian Air Force between 2019 and 2024.

Russia's Ulyanovsk regional authorities have revoked a deal to lease land to Canada's Viking Air to produce the Twin Otter Series 400. Viking Air and its Moscow-based sales agent, Vityaz Avia, had gained approval to construct a facility to produce the 19-seat aircraft in 2010. However, the Russian administration has backed out of the venture due to a lack of local demand for Twin Otters and the current economic situation in Russia.

The French Justice Ministry has confirmed that a flaperon that washed up on Reunion Island is from missing Malaysia Airlines flight MH370. An endoscope inspection revealed three numbers within the wing component linking the debris with the serial numbers of the missing Boeing 777.

Indonesian authorities may revoke the operating licences of eight airlines unless they meet minimum fleet size regulations. The Indonesian Ministry of Transport will enforce an existing rule that all carriers must have at least ten aircraft of which five must be owned. Airlines that do not meet this standard by 1 October will have their operating licence suspended.

Airbus Defence and Space has begun deliveries of an eventual 85 upgraded German Luftwaffe Tornados based at Holloman AFB in the US. The Tornados have received new avionics, digital video and voice recorders and radios.

Danish astronaut Andreas Mogensen has remotely controlled a Europe-based rover from the International Space Station (ISS). The experiment took place at both the ISS and the European Space Agency's (ESA) ESTEC technical centre in Noordwijk in The Netherlands. Mogensen completed two drive, approach, park and peg-in-hole instructions.

GENERAL AVIATION

Hong Kong Government Flying Service orders H175 SAR

Airbus

Airbus Helicopters has its first order for the SAR (search and rescue) variant of the H175 helicopter. A total of seven of the Pratt & Whitney Canada PT6-powered rotorcraft have been ordered by Hong Kong's Government Flying Service (GFS) with delivery scheduled in 2017-2018.

SPACEFLIGHT

Inmarsat Global Xpress satellite launches

A Russian-built Proton rocket launched on 29 August carrying an Inmarsat Global Xpress broadband telecommunication satellite into orbit. The Proton rocket launched from Baikonur, Kazakhstan, at 17:44 local time. Inmarsat is the UK's biggest satellite operator and this launch provides the third telecommunication satellite to join the Global Xpress network. The successful launch of the Boeing-built Global Xpress is the first Proton flight after a failure back in May which destroyed a Mexican satellite on launch.

ON THE MOVE

Grp Capt S D Ellard is to be Air Cdre and Head Unmanned Air Systems in the Defence Equipment & Support Organisation.

Grp Capt R S Norris is to be Commandant Defence Helicopter Flying School, Royal Air Force Shawbury.

Dr Jens Krueger will become Head of Corporate Communications & Political Affairs for Lufthansa Technik.

Jeff Smisek has resigned as CE, President and Chairman of United Airlines.

Mark Abbott has joined Vertis Aviation Africa as a Partner.

AEROSPACE

First flight of the MRJ

Japanese manufacturer Mitsubishi Aircraft Corporation has announced that the first flight of the Mitsubishi Regional Jet (MRJ) test aircraft will take place in the latter half of October. The exact date and time of the flight will be announced one day before it is due to take place. However, Mitsubishi Aircraft Corporation did disclose that the aircraft will fly from Nagoya Airport, Japan, and will be in the air for one hour.

AIR TRANSPORT

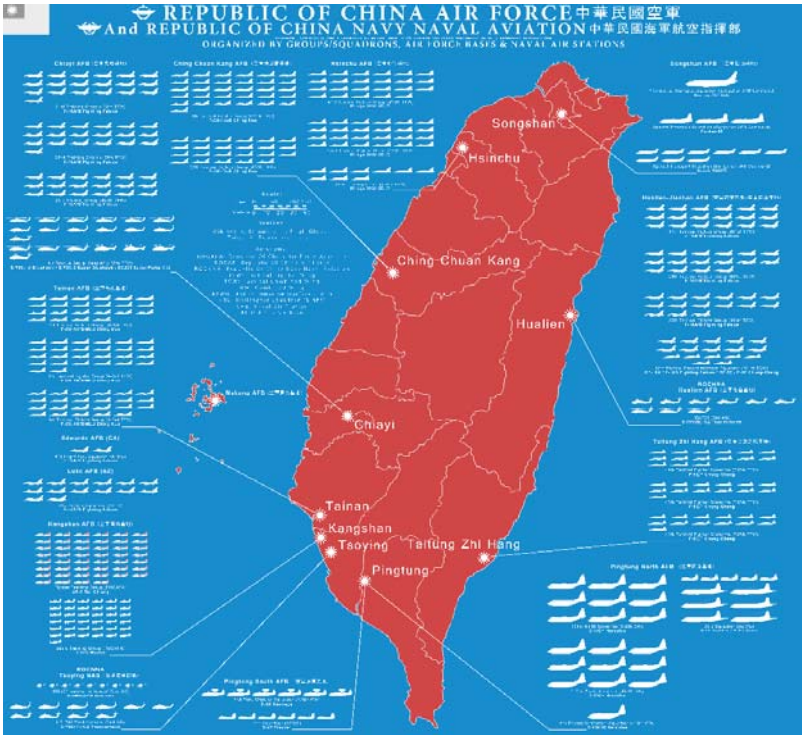
New WestJet 767 logo

WestJet

Canadian carrier WestJet has announced the arrival of its new Boeing 767-300ER. The Boeing 767 that arrived at WestJet's Calgary base in Canada on 27 August is the first of four due for delivery with two more expected by the end of 2015 and a fourth expected in spring 2016. The new 767 is also the first aircraft in the fleet to carry WestJet's new logo.

DEFENCE

INFOGRAPHIC: Taiwan's air power in focus



C/Geography/ http://taiwan-in-perspective.com/

RAF Marham begins ramp-up for F-35

Having had the good fortune of watching the aircraft perform at Eglin AFB in Florida last year and having followed the F-35 programme progress in detail since inception, I need little convincing that the aircraft capability will be a force multiplier for the RAF and RN when full operating capability (FOC) is achieved in 2023.

The first of an initial eight F-35B Lightning STOVL variant aircraft ordered by the UK government is due to arrive at RAF Marham in August 2018. Currently 17(R) Squadron engaged as part of the Joint Operational Test Team (JOTT) operate two F-35B aircraft – BK-1 and BK-2 that have already been acquired by the UK and that are permanently based at Edwards AFB in California. A third acquired aircraft, BK-3, is based at the Marine Corps Air Station, Beaufort, South Carolina and here embedded UK personnel gain initial conversion training and experience building. With seven RAF and RN pilots already trained and UK personnel fully integrated into the USMC squadron, huge progress has been made in training pilots, maintainers, instructors and other personnel.

The excellent position that embedded UK personnel engaged in the US working and training alongside USAF and USMC personnel has been a remarkable achievement to observe. Here in the UK, there remains considerable infrastructure work and difficult reorganisation to be achieved in order to get RAF Marham ready to receive its first F-35 aircraft in three years' time. IOC (initial operating capability) at Marham is planned for the end of 2018 and on the first of the two new *Queen Elizabeth* Class aircraft carriers in December 2020.

In respect of air interdiction and strategic attack, offensive and defensive counter air, close air support and, as the vital air component part of the continuous carrier capability, F-35 adds-up to make truly awesome air power. Add in the potential capability provided for ISR (intelligence, surveillance and reconnaissance) and Air C2 (air command and control) that the platform offers and you have a force multiplier the like of which the RAF and FAA have never had before.

It is worth reminding here that, with the UK being a 'Tier One' partner and 15% of each of an estimated 3,000 plus F-35 aircraft manufactured in the UK, the Joint Strike Fighter programme is hugely important for a large number of UK companies. BAE Systems manufactures all F-35 rear fuselages at its Samlesbury plant and Rolls-Royce, which manufactures the LiftSystem for the F-35B STOVL variant at Bristol, is another hugely important programme supplier. Martin Baker is responsible for manufacturing the ejection seat and other companies such as Cobham and Ultra Electronics are also heavily engaged. Overall the F-35 programme is expected to support over 24,000 jobs within at least 100 UK supply chain companies over the next 20 years.

Apart from the first three evaluation and training aircraft based in the US at the time of writing, the UK Government has so far ordered just eight F-35 aircraft from an intended minimum number of 48. Naturally I do have concerns in respect of the low number of F-35s currently planned, in respect of the size of task that will be demanded when the aircraft achieves FOC in 2023. Leaving that issue aside, another fear is the seemingly slow progress getting on with the enormous infrastructure requirement at RAF Marham in order to house and operate the jet.

Project Anvil

The infrastructure work required to accommodate UK F-35 capability including training, synthetics, engineering and maintainer requirement is considerable. Known as 'Project Anvil' the plan not only involves a total £400m to £500m in infrastructure build requirement at RAF Marham to accommodate 617 Squadron but also includes a considerable programme of demolishing existing buildings, including hardened aircraft shelters that are currently used to house 1X(B) Sqn Tornado GR4 aircraft.

In addition, two large hangars currently used for in-depth GR4 maintenance and other engineering support will also need to be demolished and rebuilt so that F-35 has the required state-of-the-art maintenance, logistics and operational support facilities. Not only does the plan entail building on eight new development sites on-base, including new headquarters for 617 Sqn, new maintenance, logistics and an integrated training centre, but also refurbishment of 90% of the airfield operating surfaces. The latter plan includes main and secondary runways, building of vertical

USAF

The first two USAF 'combat coded' F-35As arrive at Hill AFB on 2 September. Could US F-35s at RAF Lakenheath make for synergies with RAF Marham?

landing pads, together with a STOL strip aside the secondary runway.

Importantly, all this work not only has to be completed with the minimum of disruption to the local area but also while the three remaining Tornado GR4 operational squadrons continue to be the backbone of UK air-to-ground capability until the type OSD (out of service date) in early 2019.

Progress is now being made but it does appear slow. With indicative designs for the F-35 Lightning maintenance, logistics, integrated training and force headquarters now apparently complete, the first application of the infrastructure requirement is expected to take place later this year. This will include moving 1X(B) Sqn to an alternative location on the airfield. However, for the ensuing period and until new buildings have been erected, 1X(B) Sqn will be required to share the existing squadron buildings and functions of 12(B) Sqn and that of 31 Sqn. This may not be quite as bad as it appears because, with 1X(B) Sqn recently departed to RAF Akrotiri in Cyprus where it has replaced 12(B) Sqn on the Iraq Operation Shader mission, for the duration of Shader only two squadrons will be on the Marham base at any one time. The move of squadron location is expected to be complete by the time they return in early December.

Key priorities within the planned infrastructure build required to accommodate 617 Sqn F-35B Lightning capability are based around safety and security of facilities construction. The substantial upgrade due to take place must also be achieved concurrent with Tornado GR4 operation continuing undisturbed throughout. The main runway at Marham will also be out of action midway between 2017-18 for a year, requiring Tornado force and other aircraft capability to use the secondary runway.

Enabling work for the bulk of 'Project Anvil' is now planned to begin during December this year with the main works packages starting in April 2016. Most works are, I understand, planned to be finished midway through 2018, although some, such as the secondary runway refurbishment, will continue through 2019/20.

Tight timing

I would be wrong to ignore concerns in respect of tightness of timing to get all the work done. The first concern of these is in regard of demolishing hardened aircraft shelters that were built during the early 1980s. Clearly these were designed to be formidable structures to protect vital aircraft assets. My fear is that removing sizeable structures such as these could well take longer than planned.

Marham is not untypical of an RAF base that has lacked investment over many years but one other concern that I have is that there are few plans to improve the overall facilities on-base. Keeping fit is a hugely important task for military personnel but, when it comes to gym facilities, I think RAF Marham probably has one of the worst. That said, in terms of housing and mess facilities the base, which will celebrate its one hundredth anniversary next year (RAF Marham opened in 1916 and was closed on May 1919, reopening as a RAF Bomber station in April 1937) is, I suspect, far from being considered one of the worst.

Lastly, I would mention a major concern that, I have to ensure that with the US DoD having now confirmed that two USAF F-35A Sqns, each with 24 aircraft, will be based at nearby RAF Lakenheath sometime during 2020, the UK and US should work together to ensure there is no duplication of effort. Synthetic training and aspects of maintenance spring to mind. Clearly neither country should attempt to reinvent the wheel and working closely together could reduce costs. In an age when money is tight for both the UK and US military it seems to me hugely important to ensure we do not duplicate facilities, particularly when the two bases are just 20 miles and 30 minutes apart.

> I DO HAVE CONCERNS IN RESPECT OF THE LOW NUMBER OF F-35S CURRENTLY PLANNED, IN RESPECT OF THE SIZE OF TASK THAT WILL BE DEMANDED WHEN THE AIRCRAFT ACHIEVES FOC IN 2023

Transmission

LETTERS AND ONLINE

On issues raised by the Airport Commission's report Neither the original report nor this latest follow up report discusses in any detail the role of NATS in analysing the ramifications of an extra runway on the overall air traffic system. The air traffic system is already extremely busy and an extra runway will have major ramifications. There is some talk of improvements in control but it should be kept in mind that more aircraft movements in a busy system means more holding and more delays. Holding does not always involve flying in a pattern but often results in more aircraft flying lower and more slowly. Inevitably this will cause more distress to those people living below the flight paths. It is probable, although not discussed, that an extra runway at Gatwick would be more easily incorporated into the air traffic system than one at Heathrow. The most extraordinary statement in the final report is the proposal to institute an 'Independent Aviation Noise Authority'. This should already be the responsibility of NATS.

Capt John Faulkner AM FRAeS

On Greener by Design workshop on climate change The introduction of the hybrid electric airliner may have a great effect due to the significant reduction in fuel consumption.

Ángel Villalonga Morales

Public safety at air shows

Two Gnats taxi past crowds at a recent Duxford air show.

On the debate over safety at air shows following the Shoreham crash This accident is a terrible tragedy for the families affected as participants, not everything is predictable ... I sympathise with their pain, it is very sad.

Jeff Nalin

It is more than that! Aviation history very much started in the UK and remains an important part of our current industry expertise and global position. Shoreham is a tragedy. However, as we have seen in the past 12 months, aircraft accidents can happen to modern aircraft as well as the older generation, whether displaying or not. Perhaps it is the rules on aircraft displaying which should be reviewed so that the public can safely enjoy 'our' history. As an observation, not to be able to see the Battle of Britain Memorial Flight in the air would be terrible. Could a flight display down The Mall in London potentially become a thing of the past?

Matthew Heath

Watching the Red Bull racing at Ascot, there was considerable risk — no matter how competent the pilots all clearly are. Without knowing the cause of accident at Shoreham, it is difficult to know what measures should be taken. Air displays out over the sea (hopefully not too far from the beach) clearly reduce some of the risk but would be a great shame, as part of the whole experience is seeing the aircraft start, taxi, take-off and land. It seemed from the still photo of the Hunter still in the air over the A27, that the traffic was queued at suspended traffic lights (all covered) — and I suspect that was to facilitate traffic into the air show. The areas in line with the runway should be as sterile as possible of people. Temporary traffic lights or police officers could move the stop line back a few hundred yards. It also brings to mind the crowds that gather at the end of Waddington's runway during displays, as can be seen on YouTube. Difficult decisions may have to be made and, as Matthew Heath states, it may be a terrible loss for several reasons. The approach of the critics regarding this topic is not quite convincing. If due to safety, adding such restrictions to airshows and requesting a complete ban implies that civil aviation must be banned as well as the rate of deaths and accidents are much greater in terms of statistics rather than airshows. 1,713 people were killed in reported road traffic accidents in Great Britain (www.gov.uk) ... this means that driving should be banned as well in the UK. Therefore, a strict approach would never be the solution, but further exploration in the reason of the crashes and adding pressure on investigators to find out before further airshow is essential in bringing the trust in aviation and fixing the shortcomings. This is how aviation has been through its entire history, 'learning from mistakes' and developing to the current well-established state. It is a parallel story to life ... 'learning from mistakes' ... Here I would be criticised for not valuing the fatalities ... in fact, my deepest feeling and support for the families hence I believe it's essential to learn from this mistake and preventing it repeating rather than running away and taking shortcuts to remove the burden of responsibilities. May all their souls rest in peace.

Lee Padgett

If displays were banned on the back of this, in risk management terms it could raise some interesting questions for the CAA. For example, the tragic events at Kegworth, such logic would suggest flying is banned from all airports in close proximity to arterial roads. This would be unthinkable considering the location of the airports. We are fortunate in the UK that our CAA has operated a very sensible risk policy over the years and I have faith that will continue. The restrictions put in place are, I believe sensible interim measures until more is known from the investigation. While this continues our thoughts remain with all of those affected by Saturday's tragic event.

Chris Barratt

On NASA's plan to fly a miniature flying wing over surface of Mars[1] This is a great idea. However, remotely flying (what amounts to) a model aeroplane on Mars poses many difficulties. If I remember my Discovery Channel rightly, Mars has sudden and violent sandstorms. Avoiding them, and taking into account the time taken for a radio command to reach Mars, would be a problem.

Johnny Sadiq

I understand the issues above. As a newly qualified UAV Commercial Pilot and hoping to start a PhD with Derby University on a very similar issue to this. I can see that with the right Project Manager and Technical Director this could be done. I have the technology here and now to do that job. There are lots of challenges. My

PhD proposal would help with these answers as I will be looking at mapping accident sites using the same type of technology that a Mars mission may require. The issue is flying over uneven terrain and at a safe altitude and mapping mountains at the same time. Weather management is similar to Earth issues except that you need, or may be not, a safe haven if it gets bad. As a requirement engineer in the military aerospace business, this is a requirement that needs mitigation. Would be interested in this as an aspect of a PhD.

Eur Ing Robert Shaw

@crp_uk [on BA 777 engine fire at Las Vegas] Very calm. Notable how clear Speedbird's RT was in the Tower vs other local traffic.

@Lexmechanic Am I wrong or does the spread of fire / timing suggest the same failure in the air would likely end very badly?

@PhoenixGMH Issue all cabin crew with tasers. Any pax that go to evac with bags, zap them!

@ComdtCranwell Great skill and teamwork to deliver a safe end to a challenging emergency. Great work.

@FG_STrim [On MS-21 airliner having central locking overhead locking bins] But imagine if locks fail? That happened to me once at an Ibis luggage locker. You'll get 200 enraged pax for routine deboarding.

@ja_pascoe Would that work, or would people just spend more time trying to force open the bins? Also, many under-seat bags these days.

@Aviaponcho would only need to activate in case of emergency quite unfrequently. Will mostly be unlocked. So can only fail to lock?

@DC_Claxton [On Tim Robinson's CNN article 'What is the point of air shows'[2]] excellent article, such shows spark interest and enthusiasm in the young for science and technology.

Andy_E_stone A great piece which certainly speaks true for me and my inspiration for getting into flying.

@alandavison48 Do you think this is a nail in the coffin of heritage displays? A level flypast would do me. Why pull stunts in a 50-yea-old rig?

@kautostar56 Some like me might ask. Airshows yes but why 'barrel roles' and 'loop the loops' at LOW LEVEL over population areas?

Jet-powered biplane oddity

Jet-powered biplane PZL M-15 Belphegor from the Polish Aviation Museum.

@Hamid [On jet-powered biplane in Polish museum] That looks pretty funky. Know the manufacturer/model by any chance? *Puts on reading glasses*

@PaulMarks12 Good God — it was a super-slow Soviet cropduster en.wikipedia.org/wiki/PZL_M-15_… Wing tanks are for pesticide.

@wiredforflight Eastern Europe aviation history is something I have to get up to speed on. So many amazing aircraft.

@TheDroneDealer Wow, they sure have some rare stuff.

@WandrMe Awesome museum there. The MiG parking lot out back is incredible!

@Kinga_Kolasa Happy you liked it! The museum is also a co-organiser of airshow (usually late June), which may be a good reason to come back.

@CardingtonSheds [On HAV backer Bruce Dickinson's latest Iron Maiden song about the R101] Comparing 85-year-old technology to modern state-of-the-art LTA is like comparing the Wright Flyer to a Eurofighter Typhoon.

RAeS (NAL)

Airship R101 at the Cardington mooring mast.

@rogerkb2012 [On RAF targeted drone strikes against UK ISIS fighters] demonstrates how @David_Cameron has no respect for the democratic process, after HOC said no to bombing in Syria.

@GraysonOttaway [on new Aerosociety Heritage website] Nice work! And Kia Ora from one of the new members of the newest chapters found here in NZTG.

1. *http://aerosociety.com/News/Insight-Blog/3387/NASA-test-flies-Mars-flying-wing*
2. *http://edition.cnn.com/2015/08/24/europe/shoreham-air-crash-ban/*

Online

Additional features and content are available to view online at http://media.aerosociety.com/aerospace-insight

Innovation in cabin design

From lie-flat beds to passenger IFE 'pods' — PETER TENNENT, Managing Director of design studio Factorydesign looks at spotting the opportunities in airliner cabin interiors.

There are plenty of people pondering the future of innovation. But, while dreams — of flying in space, perhaps — come cheap, tangible innovation comes by committing time and expense to well-considered design and engineering. Commercially, airlines look for innovation to improve the passenger experience, improve profitability and give themselves a competitive edge. So, innovation is difficult to achieve and must meet very clear criteria to prove its value.

Every now and then an idea comes along that has a huge impact on the industry, when a brave airline is adventurous enough to take that step. British Airways pulled it off with the first lie-flat bed, as did Virgin Atlantic and their chauffeur-driven limo service (albeit an on-the-ground offer). On the heels of BA's bed came seat developments which allowed passengers to 'lie flat at an angle', meaning airlines could reduce the pitch. Thompson Vantage was a pioneer with its lie-flat offer for business class, achieved by overlapping passengers' feet into the armrest in front.

Meanwhile, Jet2.com was the first airline to challenge the notion that low-cost carriers have to have second hand, refurbished seats and instead selected Acro's Superlight seat, also designed by Factorydesign.

Innovation in the premium category has taken a major leap in the past year with the introduction of Etihad Airways' VIP cabin — an idea that came through a unique process — the Etihad Design Consortium, which brought together different design skills and brand experience expertise to deliver something that no other airline can match.

> "THE STARTING POINT SHOULD ALWAYS BE THE PASSENGER — UNDERSTANDING WHO THEY ARE, WHAT THEIR NEEDS ARE AND, INDEED, THEIR ASPIRATIONS

Factorydesign

The next wave

The industry is now considering what the next wave of premium innovation can possibly offer. The most influential element of the air travel experience

NotForWhimps from Factorydesign is a seat concept aimed at the affluent, younger hardcore gamer passenger.

Factorydesign

Etihad's VIP cabin has raised the bar for the high-end luxury passenger experience.

is cabin design, so airlines are trying to work out how best to meet increasing passenger expectations through inventive cabin design.

To meet these growing passenger demands and to continue to improve products to keep ahead of — or even to keep up with — competitors, airlines have no choice but to keep innovating. However, true innovation is rare because it is so difficult to implement effectively.

The fuel for innovation is the competition between airlines and their products. This is what makes the others think and makes them react. Yet innovation can be contradictory. Ingo Wuggetzer's sunroom concept for Airbus is fabulous with its myriad skylights but it's in stark contrast with the proposition from the Centre for Process Innovation which replaces the fuselage's windows with display screens. The starting point should always be the passenger — understanding who they are, what their needs are, and indeed their aspirations, and how those may change over the life of an aircraft.

Is different always better?

Innovation is defined as the pursuit of difference but designers must question whether different is always better for the passenger. For example, it might be an innovation for an airline to go from nine-abreast to ten-abreast in economy, even to standing-room only — I refuse to be negative about such things. Standing or even leaning may appeal to some for very short distances, after all these things are about choice. But we must never lose sight of the passenger experience.

Designers must ask themselves where the opportunities for innovation in the cabin lie. While the tube won't grow, designers and engineers are making efforts to challenge constraints and try to magic more space. The hunt continues for space to deliver more features balanced against pax count, meaning the offer to the passenger versus perceived dollar in the bank. This has led, for example, to configurations becoming increasingly all about interlocking, angling and overlapping.

Airbus' 2050 concept airliner.

Airbus

Factorydesign

'AirLair', a concept created for Zodiac, features vertically stacked pods.

While Thompson Vantage was one of the first to explore the idea of horizontal overlapping, now some major seat manufacturers considering 'vertical overlapping', or bunk-beds. This is manifested in AirLair, a concept Factorydesign created for Contour/Zodiac.

It's easier to innovate in first class or super-premium, because there's more space and money devoted to these areas, and crucially more ambition. The opportunities are lessened slightly in business class, and again in premium economy. It follows that innovation in economy proper is rare, yet when filling the economy section will make a substantial difference to margins, that is, perhaps, where innovation is most needed.

However, designers would do well to question whether these traditional categories of travel are still relevant for modern travellers. They were created in a different time — one where choice was limited, expectations lower, and the understanding of brand and passenger experience was much less. In many other sectors, an understanding that consumers cannot any longer be fitted into a few very limited categories has taken hold. As this fragmentation of passenger types has become the norm, a different approach which is much more flexible should be considered. The increasing blurring of boundaries between classes might hint at a one-size-fits-all mentality. But this sits in stark contrast with other demands for greater flexibility, greater variation in offer, more choice, and such like.

The end of traditional cabin classes

Rather than levelling out the offer, traditional class categories could be broken up. For example, while some are pronouncing the death of first class, others are delivering super-premium products. business class products are getting better and better and are blurring with first class, leading passengers to ask themselves why they should pay the extra for this experience. So we may not be seeing the death of first class, more the evolution of it into different sub-categories.

The huge improvements in business class have also widened the gap between it and economy, which some have filled with premium economy. This category was created by Virgin, and emulated by BA and others, as they have proved to be such commercially successful cabins.

However, premium economy means different things to different airlines. What one may offer as an increase in pitch and free lunch, others will provide in the form of a bigger seat, enhanced inflight entertainment, and better on-board service.

But, crucially, airlines are asking themselves if the success of this fourth class supports a broader opportunity to re-evaluate the way cabins are classified, how we classify passengers and their activities: family zones, sleeping compartments, bars and dining rooms, and so on.

NotForWhimps, a concept for Zodiac (formerly Contour) that targeted a different type of premium traveller explored this idea further. Accepted norms were questioned — are all passengers after a fine dining experience, a bed and a TV screen? What about the deep-pocketed entrepreneurs who want to sit and do gaming for five hours on the trot? The Internet age has created a whole range of passengers who positively revel in taking a different view on the world and their place in it. Not surprisingly, their needs are very different from traditional financiers, even if their spending power is comparable. This passenger is younger, and is engaged with and entertained by different things. They're more XBox than Michelin star. This research demonstrated how an understanding of different passengers' aspirations can provoke innovation.

What about economy?

The economy cabin is at worst a neglected cabin, at best a space constrained by numbers, density and lack of investment. As such it is the cabin which is the slowest to challenge convention. The Holy Grail of fixed-back seating in economy is fixed-back with an integrated recline function. No-one has mastered this yet.

But there are other signs of ambition in this class. As well as the Acro Superlight seat, there is the titanium Expliseat, and Morph by

> THE HOLY GRAIL OF FIXED-BACK SEATING IN ECONOMY IS FIXED-BACK WITH AN INTEGRATED RECLINE FUNCTION

the design agency Seymourpowell: a seat concept that adapts to the shape and size of individual passengers. Less convincing is Perch, a soft pad that standing passengers would lean against.

The hysteria in the industry about weight is particularly acute in economy but how far can the drive towards reducing weight go? There's an analogy to be made here with the ever-decreasing cellphone. Small was considered beautiful, so devices kept shrinking. Then along came the iPhone, which shattered those preconceptions and reinvented the sector. Equally, ever lighter seats will reach a point where the passenger's comfort will suffer. And suffering passengers don't come back.

Perhaps opportunities in economy lie not so much with the weight of each seat but with the cabin itself. Maybe these large, densely populated spaces with row after row disappearing off into the distance can be reconfigured to feel more personal, less cattle truck, more mini-bus, or taxi even.

Beyond the physical product, innovation can be achieved through improvements to hospitality and service offers. Factorydesign's design of the new Jet for the Four Seasons Hotel Group, aims to make it a true hotel brand in the sky. Many premium offers are embracing these services and crucially, the attitudes attributed to the luxury hospitality sector.

This category is all about removing the most annoying things about flying: queuing, noise, delay, other people, other people's kids, your own kids, fatigue and uncertainty. We have already seen nannies, chefs, concierges and butlers, because they all support wellbeing, and wellbeing makes you feel better, and when you feel better, everything is better.

Designers are now trying to search out unexplored opportunities for ever-more service-driven enhancements. Another key influence — or constraint — is the often talked about democratisation of flying. As air travel is now accessible to almost everyone and no longer just the elite, many more of us are doing it. When things become mainstream they tend to become more conservative, safer and, at worst, bland.

To satisfy the majority we end up with compromises to accommodate vast extremes of humans' size, attitude, behaviour, culture, age and so on. That's another good reason to look beyond the standard three- or four-class approach.

At the same time, the industry could consider products that do not multi-function but that can be pre-set to become task-specific for a particular flight; that is, eat, sleep or entertain. And that can be configured to be single or double occupancy, private or communal.

Once every spare inch on an aircraft has been utilised through ever-more ingenious converting seat products, the only option is to give more space to the passenger. Pax count requirements, driven by revenue management, have a huge influence on layouts and on product. So perhaps we should be more creative about load factors and yields. Surely it is preferable to have a better product, so that 90 seats are full all the time, than to have 100 seats at 80% occupancy.

Flexibility needed for cabins *and* regulation

But designers and engineers can't implement innovations on their own. The airline industry and the authorities also need to step in. Airlines should be more flexible, not just in their approach but by introducing adaptable spaces, areas which may change their function through the course of a journey. An on board galley could be arranged to create a larger welcome space and, through moving elements, could convert into a fully-functioning galley in flight.

The authorities need to be more open-minded when it comes to the creation and interpretation of legislation. We all accept the need for diligent and consistent attention to safety but modifying or adding new regulations to cover new cabin or product scenarios can be a repetitious, costly, slow process, adding months or years to new product development.

That won't help make things better for the passenger.

Factorydesign

Lie-flat seat in the Four Seasons Hotel jet cabin.

Factorydesign

Left: Acro's Superlight seat, designed by Factorydesign has been selected by Jet2.



Taiwan broadens its focus

New UAVs, precision manufacturing and tapping into growth in Asia-Pacific air travel were some of the themes at Taiwan's premier aerospace show. TIM ROBINSON reports from the Taipei Aerospace & Defense Technology Exhibition.

This August saw Taiwan showcase its aerospace and defence industries in the biennial Taipei Aerospace and Defense Technology Exhibtion (TADTE).

Held on 13-15 August, it saw 126 exhibitors — up nearly 27% from the previous show in 2013. Last year the Taiwanese aerospace industry was worth NT$87bn — with some NT$46·1bn of these in exports — mainly in the civil sphere.

With restrictions on what it can import and with the ever-present shadow of its large neighbour, (and their turbulent relationship) previous TADTE's have perhaps unsurprisingly focused on the island nation's indigenous military capability.

However, now in its 13th year, TADTE reflects a growing focus toward civil aerospace – from flight training to MRO services, as well as precision manufacturing tools that underpin the global supply chains. Commercial exploitation of UAVs too was a big theme, propelled no doubt by an overlap in consumer ICT which Taiwan is famous for (Foxcomm, Asus, Acer, HTC and others are headquartered here).

That is not to say that old tensions have gone. The defence part of the exhibition, with representation from the Republic of China's Army, Navy and Air Force provided a significant overview of the nation's latest military equipment.

Given the international dimension, many foreign companies, fearful perhaps of Beijing sensitivities, prefer to stay away or keep a low profile but this year the US Pavilion saw big hitters Lockheed Martin, Northrop Grumman and Rockwell Collins attend, as well as smaller firms from Germany, Sweden and Japan. Let's take a look at some of highlights from the show.

Taiwanese 'Reaper-alike' unveiled

Dominating the official MND (Ministry of National Defense) part of the show was a brand new UAV from Taiwan, appearing for the first time in public. This unnamed MALE UAV bore a remarkable resemblence to the ubitiqious Reaper with a V-tail. Details from the developer, Taiwan's military R&D centre National Chung-Shan Institute of Science and Technology (NCSIST) were scarce — apart from the fact its maiden flight was 'recently' and had flown 'many times'. However, NCSIST's Director of Aeronautical Research, Ma Wan-June, did reveal that the nickname so far was 'Big Drone' and that it was not only aimed at military missions but at civil roles too. Currently still undergoing flight tests, he also said it was too early to talk about possible exports for this MALE UAV but is targeting a RoCAF requirement for this class of UAV.

Wing-in-ground effect UAV

Spotted on the Fooyin University stand was this amphibious wing-in-ground effect (WIG) vehicle developed for maritime missions, such as fishing fleet support Dr Jir-Ming Char from the University's R&D HQ, explained how the WIG required a novel flight control system to avoid banking turns at low-level.

This familiar-looking MALE UAV from Taiwan's National Chung-Shan Institute of Science & Technology (NCSIST) dominated the defence part of the exhibition.

Taiwan's answer to SpaceX aims for low-cost space access with composite launcher

One highlight of the show was Taiwan's Advanced Rocket Research Centre (ARRC), from the National Chiao Tung University which is set to launch a composite hybrid-engine two-stage rocket — the HTTP-3 Hybrid Sounding Rocket — to an altitude of100-130km in early 2016 as part of a plan to develop its own indigenous low-cost space access launch system. Already, five earlier sounding rocket flights have flown since 2010. For this latest flight, firing tests of the hybrid rocket motor had been progressively scaled up in power, with the engine using an innovative system to contra-rotate and 'swirl' the propellent with a dual vortical flow. This hybrid motor, notes ARRC, is more efficient (292secs ISP) than Virgin Galactic's SS2 rocket engine. The rocket also includes other innovative technology with a composite structure and fuel tank, as well as 3D printed parts. The launch site for the rocket will be on the southern tip of Taiwan, with an easterly trajectory out to sea. If the test is a success, ARRC will then shift to the development of a larger launcher which it, expects in 4-5 years, will be able to launch 30-50kg micro satellites into LEO and potentially enter the market for low-cost launch services.

AIDC targets trainer requirement

Meanwhile, over at AIDC (Aerospace Industrial Development Corporation) the home aerospace champion was showcasing its range of aeronautical expertise. Responsible for developing the F-CK-1 Ching-kuo Indigenous Defense Fighter (IDF) in the 1990s, last year AIDC was privatised — opening up a new chapter for the company.

At the show this year it revealed three options for the RoCAF's pending requirement for around 66 advanced jet trainers. These were an upgraded AT-3 — called the AT-3 MAX, a simpler IDF named the XAT-5, and a partnership with Alenia Aermacchi to locally build the M346 in Taiwan.

The AT-3 MAX sees the twin engines uprated from 3,000lb thrust each to 5,000lb to provide extra power while the structure would be lightened through use of composites. Meanwhile, the avionics would also be overhauled with options such as a glass cockpit, synthetic radar and an integrated training system.

The second proposal would be using a twin-seat F-CK-1 as the basis for an advanced trainer. The XAT-5 would see the IDF modified with extra fuel, its engines derated to remove the afterburner and a redesigned landing gear.

Finally, the third option would be for AIDC to build the Aermacchi M346 Master advanced trainer locally.

AIDC is also partnered with Lockheed Martin to upgrade the RoCAF's F-16A/Bs to 'F-16V' standard with the Northrop Grumman AESA APG-83 scaleable agile beam radar (SABR), new mission computer and cockpit displays. While the first two fighters will be upgraded in the US, the plan is that the rest of the143 will be retrofitted locally on a Taiwanese production line.

While the upgrade to the F-16V will boost Taiwan's combat aircraft capability, the likelihood of it being allowed to purchase F-35s in the future remains in question and entirely dependent on Washington-Beijing relations. However, that is not to say that a stealth fighter may entirely be out of reach. Talking to *AEROSPACE*, AIDC executives revealed that it has already begun research on critical technology (read LO) for a next generation fighter. Having successfully developed the F-CK-1, could AIDC go it alone if the F-35 was denied to Taiwan in the future?

AIDC is also aiming to become more deeply embedded into global supply chains and expand its business. Already providing components for the Sikorsky S-92, Bombardier Challenger 300 and Mitsubshi MRJ, last year saw AIDC win a key deal from Airbus to become a new supplier for the A320 family — producing composite aft belly panels. It also, since 2010, has been supplying composite engine nacelles to both Airbus and Boeing, among other manufacturers. On display at TADTE 2015

TADTE IN BRIEF

During the show, Lockheed Martin announced that Taiwan had become the 20th International Customer for its Sniper Advanced Targeting Pod which will equip the upgraded F-16s. Two Sniper ATPs and integration support will be provided in the initial contract.

GA group targets mainland growth

Another new exhibitor at TADTE was the Chinese Association of General Aviation Development (CAGAD), which was set up in February 2014. CAGAD is a group of more than 100 companies focused on developing the GA sector, both in Taiwan and in the mainland. In particular, the CAGAD is looking to pass on aviation expertise in human resources, education and training to mainland China, as Beijing moves to open up its airspace. (Below: three-quarter scale LSA homebuilt Tucano kit from CAGAD member).

The MND part of the exhibition featured a number of interactive displays and booths — including this semi-dome tactical UAV simulator from the RoC Army.

Air Asia — an MRO with rich history

With its HQ and main MRO hub located on Tainan, in the south of the island, another new exhibitor to TADTE was Air Asia. No relation to the fast-growing low-cost budget airline group, Air Asia has a particularly colourful history — tracing its origins back to 1946 and General Claire Chennault. It also was the MRO and maintenance arm of the CIA's Air America secret airline during the US involvement in SE Asia, as well as servicing USAF aircraft in the Korean and Vietnam wars. Today that is much changed, with the firm 82% owned by Taiwan Aerospace Corporation (TAC). Now, Air Asia is looking to tap into growth in Asia-Pacific airlines. It holds a large number of licences, particularly for older types such as the 727 or MD80 — but also for newer narrowbodies, such as the 737NG and the A320 — with its latest client to sign being Japan's low-cost Peach airline. Air Asia also provides extensive support and MRO services for government and military non-combat, support and rotorcraft — such as the NASCs (National Air Service Corps) firefighting UH-1Hs and BV-234s (Chinook), as well as OH-58s, C-130s and E-2Ks. Though not finalised yet, Air Asia is also set to provide support Phased Depot Level Maintenance (PDM) for Taiwan's P-3C Orion fleet with a contract to be awarded next year. Maintainer training has already began for Sikorsky UH-60M Blackhawks — with 60 set to replace RoC Army UH-1Hs by 2018.

from AIDC's TACC (Taiwan Advanced Composites Center) was a prototype composite floor beam for the 787-9/10 which the company hopes will win it work on the Dreamliner.

Civil training gets wings

Another new exhibitor this year at TADTE is APEX Flight Academy — which is focused on supplying pilots for the phenomenal expansion of Asia-Pacific carriers. Previously flight training schools in Taiwan have been a non-starter due to its lack of GA sector, and unavailability of avgas on the island. However, the introduction of the Diamond DA 40/42NG with the diesel Austro engine E4 upgrade opened up a new opportunity for a flight training school, according to its founder Wilson Kao. It offers PPL, IR and CPL ratings and, next year, is also hoping to launch the MPL. Licensed in September 2014, it now has 70 students (including a couple of European pilots) undergoing flight training. The only CAA 121 flight training organisation in Taiwan, APEX is based in a new state-of the art facility at Taidong Fong Nian airport with classrooms, briefing rooms and dormitories. It currently operates five Garmin G1000 equipped aircraft (four Diamond DA40NGs and one DA42NG) with four more to join in the next 12 months.

It is also in the process of forming a joint venture with Ansett Aviation Training which will see them operate full motion flight simulators. Ground has already been broken for the first simulator, an A320 FFS from Mechtronix, which will arrive in December. APEX plans to add another A320, a 737NG and an ATR simulator in the future. With this venture, it will thus be able to offer end-to-end pilot training for customers, from initial screening, aptitude tests and selection, to type conversion. With uncompromising standards, APEX is targeting supplying high quality candidates to Asia's fast growing airlines.

Precision manufacturing

Another key strength of Taiwan's economy aiming to increase its share of aerospace business, is its machine tools and precision manufacturing business. In 2014, Taiwan's exports of machine tools were $3·75bn, ranking it fourth in the world. One such company, based in Taichung is Chin Hung Machinery and Electric Industrial (CHMER) which specialises in ultra high-precision drilling and milling machines. In particular, its CNC EDM (electronic discharge machines) are especially suitable for high-tolerance advanced aerospace manufacturing jobs, such as drilling cooling holes in turbine blades. Already supplying engine manufacturers GE, P&W, Snecma and Safran, only 10% of CHMER's business is currently in aerospace. However, the company, and those responsible for promoting Taiwan's aerospace industry, see precision

Armed multicopter drone concept

Spotted on the MND part of the exhibition was this futuristic looking multicopter drone equipped with a submachine gun and two non-lethal net launchers. However, this is just a concept for the moment.



manufacturing tools as a key niche it can exploit with OEMs and the global aerospace supply chain.

Taiwan's 'anti-access' missiles

While much has been written about Beijing's A2/AD (anti-access, area denial) strategy, the defence part of the show also highlighted the Republic of China's latest home-grown missiles to safeguard its skies and coasts. Revealed at the show was Sea Oryx, a naval short-range SAM similar to the RAM defence system. A box launcher holds either eight or 16 IR-guided missiles for close-in air defence of vessels.

Also on display was the Tien-Kung III (Sky Bow III) SAM developed by Chungshan Institute of Science and Technology (CSIST). As well as aircraft, this long-range SAM system, upgraded from previous versions is designed to tackle cruise missiles and tactical ballistic missiles — a key requirement given it is estimated that there are roughly 1,600 ballistic missiles aimed at the island from across the Taiwan Strait. Finally, TADTE also saw another of CSIST's latest missiles on display — the Hsiung Feng III supersonic (Mach 2) anti-ship missile.

An island of UAVs

With Taiwan's reputation for consumer electronics, gadgets and toys, it is perhaps no surprise that TADTE featured a staggering variety of UAVs, particularly for the growing number of civil and commercial applications like precision agriculture. Exhibitor Thunder Tiger, for example, with a background in R/C helicopters since 1979 has now moved into the consumer drone market with its Ghost quadcopter and X650/X850 multirotor drones. Some idea of the growing capabilities of these 'semi-professional' drones on its stand was a Ghost+ quadcopter equipped with a mini-thermal camera from FLIR — a feature that perhaps only a decade ago would have been available on UAV military sensor pods. The Ghost designs, in comparison to nearest rival DJI Phantoms also feature retractable landing gear for 360°camera views.

Meanwhile, a drone from AK Design saw a new use for a multicopter armed with a laser scanner — as an anti-FOD surveillance system. Using a laser sensor, the UAV can scan a runaway in 15minutes to check for dangerous FOD. The system is currently being trialled in a six-month test at Taipei airport, according to the company.

Finally, the show also brought news of an international UAV tie-up between Taiwan's UAVER, and Navmar Applied Sciences Corporation (NASC) which signed to become the US distributor for UAVERs range of small fixed-wing UAS systems. Particulary noteworthy is UAVER's one-year guarantee and its frequency-hopping command and control links — not just useful for military drones but as added safety as spectrums get congested. UAVER also had on display its latest electric-powered UAV, the Besura, which is hand-launched. Retailing under $10,000, this is expected to be attractive for universities and STEM type organisations. UAVER meanwhile are still looking for a European distributor.

Control station for Sea Oryx naval SAM.

New HQ for Geosat shows future of civil UAVs

Another Taiwanese UAV company to watch is Geosat Aerospace Technology. Based in Taichung, it had only moved into a Google-like HQ and factory in a technology park a day earlier than *AEROSPACE*'s visit. With roots in aerial surveying and geospatial data, the company won a national commendation last year for UAV aerial imagery analysis of damage from a mains gas explosion in Kaohsiung. With more than 150 employees, Geosat now offers a range of UAVs from multicopters, to rotary wing UAS and fixed-wing designs — the Sky Arrow 55/100 (below left). This is already being upgraded with winglets, while a follow-on version will use composites to reduce 10% of max take-off weight. Finally, the company has its sights on even larger UAVs, showing off an intriguing model (below right) of a planned 20m-wingspan Global Hawk-alike on its stand at TADTE. Called ARES (Advanced Reconassiance Endurance System) this HALE UAV is aimed at weather reconnaissance.

Big data for everyone

RUPAK GHOSH* and **BHOOPATHI RAPOLU**** explain why big data and the Internet of things hold the key to the future of aerospace.

The advent of big data and the Internet of things (IoT) has transformed business and consumer sectors across the world. Facebook has over 1·4bn subscribers generating in excess of 600 terabytes of data every day. The impact on data-heavy sectors like aerospace has been even more revolutionary. The figures already dwarf those found in the consumer space, both in terms of the volume and the impact that they're having across the industry. For example, Bombardier's CSeries jetliner has Pratt & Whitney's Geared Turbo Fan (GTF) engine — an engine that comes with 5,000 sensors and that can generate up to 10Gb of data per second. A single twin-engine aircraft with an average of 12 hours flight-time can produce 844TB of data. With an order book of over 3,500 GTF engines, Pratt could potentially download zeta bytes of data once all their engines are in the field.

These scales, combined with the level of storage and computing infrastructure required to handle such volumes, are mind blowing. It seems, therefore, that the data generated by the aerospace industry alone could soon surpass the magnitude of the consumer Internet.

For the GTF engine, it uses this incredibly valuable information to build artificial intelligence and predict the demands of the engine to adjust thrust levels. As a result, GTF engines are demonstrating a reduction in fuel consumption by 10% to 15%, alongside impressive performance improvements in engine noise and emissions.

Beyond this, big data and the IoT are having a huge impact on the industry through the advent of predictive maintenance. These developments are driving massive reductions in costly aircraft on ground time (AOG), as well as transforming the passenger experience, creating truly connected aircraft as a result.

Predictive maintenance

IoT is having a growing influence over the maintenance side of the aerospace industry. This is important because of the resultant reduction in AOG. Every second of every minute that a plane is not in the air, it loses money; with Airbus China recently estimating the daily cost of a grounded Airbus A380 to be $1,250,000. With operators under pressure to streamline their costs and increase their revenues, aircraft maintenance procedures play a fundamental role in reducing this.

Through sensors, IoT helps airlines collect and subsequently translate vast volumes of data into meaningful business information that can then be applied to determine the status and performance of particular systems and subsystems within an aircraft. Sensors are now being distributed throughout the aircraft, for example, monitoring key performance parameters such as fuel burn in the engine. When the flight has landed, this information can be downloaded and analysed by the ground staff, enabling appropriate action to be taken to correct any minor faults or

make alterations and get the aircraft back in service as soon as possible. Five years ago, this post-flight analysis used to take an engineer up to four days to process data from one engine, whereas now there are solutions available that are providing useful information within minutes of a plane landing.

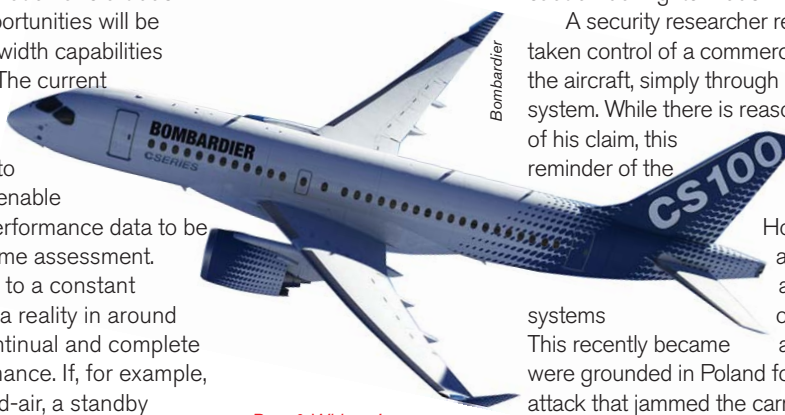
Though the real-time health monitoring is limited to some of the new generation aircraft due to bandwidth limitations, the opportunities will be endless once we have the bandwidth capabilities required to support this activity. The current bandwidth for in-flight data transfer is around 400kbps and the next planned upgrade is up to 10mbps. Faster speeds yet will enable increasing amounts of critical performance data to be shipped to the ground for real-time assessment.

Ground staff having access to a constant stream of information could be a reality in around five years' time, giving them continual and complete visibility of the aircraft's performance. If, for example, one of the engine vitals fails mid-air, a standby system would kick in and run all of the necessary functions to enable it to complete its journey safely. An alert would then be sent to the ground staff, who could use the real-time information to determine the cause of the failure, before engaging the necessary personnel and sourcing the components required to get the aircraft back up and running as soon as it lands. Getting all of this preparation done while the aircraft is still in flight would help the airline to vastly reduce the chance of it being placed in AOG, therefore helping it to reduce maintenance costs and also keep passengers happy.

Connecting passengers to aircraft

Passengers are also driving another major trend in the use of big data and IoT in aerospace. The latest smartphones, tablets and wearable devices are in the pockets of every passenger and there is an expectation to be able to use them at 39,000ft, just as we do in our living rooms. Airlines are responding with investment in improving in-flight wi-fi and the development of custom-built airline apps to allow passengers to interact with the plane and inflight systems from their own device. There are multiple functionalities possible, including the ability to download movies to smartphones and tablets, adjust ambience settings, order food and drink or call for attention.

This increased engagement with the aircraft produces data — such as information on the movies that are being downloaded, the food that is being ordered and when, by whom and in what quantity. With the right systems in place, airlines can ensure that they are able to extrapolate insight from this data to improve the passenger experience. This could be done through promotions on favourite food items for example, or recommendations on similar films.



Bombardier

Pratt & Whitney's new 1500G engine which powers Bombardier's CSeries regional jet (above) is fitted with 5,000 sensors which can generate up to 10Gb of data per second.

Airlines are responding to demands for increased connectivity with improved in-flight Wi-Fi and customised apps which allow passengers to interact with the aircraft and in-flight systems using their own devices.

Securing the future of IoT

Of course, with every innovation comes a new risk. In-flight wi-fi can leave aircraft vulnerable to hacking and the US Government Accountability Office has repeatedly tried to bring this to the Federal Aviation Administration (FAA)'s attention as a word of caution during its modernisation plans.

A security researcher recently claimed to have taken control of a commercial airliner from his seat on the aircraft, simply through hacking the entertainment system. While there is reason to doubt the veracity of his claim, this is nonetheless a stark reminder of the challenges we have to address in this area. However, the vulnerabilities are not confined to the aircraft cabin; the company systems on the ground remain at risk. This recently became a reality when ten aircraft were grounded in Poland following a major hacking attack that jammed the carrier's systems. The industry needs to come together to find new solutions and increases in regulations. Updates to security, network and data safety are crucial if there are to be further advancements in big data and IoT.

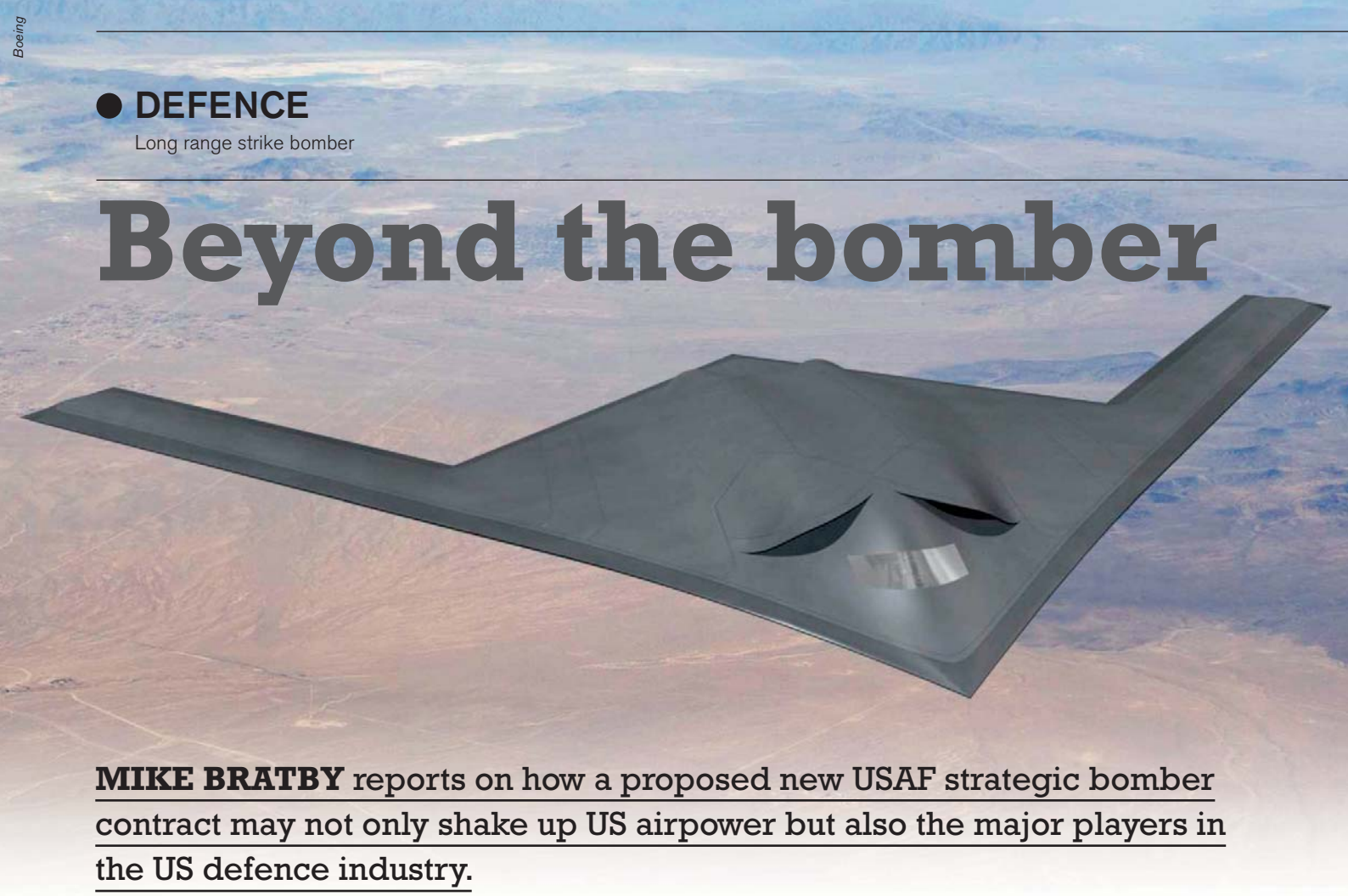
Security concerns aside, there has never been a more exciting time to be working in the aerospace industry. Soon, thousands of sensors will be embedded in each aircraft, allowing data to be streamed down to the ground in real-time. Who knows, in time, this could drive the famous black box to simply become a backup device! The potential benefits include reduced AOG from predictive maintenance as well as innovation in the passenger in-flight experience, making the truly connected aircraft a very real and present possibility.

*** VP, Cyient,**
**** Head of Analytics EMEA, Cyient**


Emirates

Boeing

Beyond the bomber



MIKE BRATBY reports on how a proposed new USAF strategic bomber contract may not only shake up US airpower but also the major players in the US defence industry.

> A US AIR FORCE CONTRACT ... IS SET TO UP-END THE APPLE CART AND COULD WELL SEE A MAJOR MOVE BY ONE OF THE LEADING CONTRACTORS TO ACQUIRE ONE OF THE OTHERS

The new Long Range Strike Bomber (LRS-B) contract for the USAF, expected to be announced in October, is claimed by some to lead to a dramatic shake-up of the US combat aircraft industry. But other commentators believe its influence is being overstated. So where does the truth lie and how important is this new programme for future US airpower?

Bomber competition

The US military's three prime combat aircraft companies have recently been enjoying a good run of commercial success. US industry analysts are warning that this is unlikely to last and that a US Air Force contract due to be awarded later this summer is set to up-end the apple cart and could well see a major move by one of the leading contractors to acquire one of the others.

The programme in question is the USAF's secretive Long Range Strike Bomber contract. Details of this highly sensitive project remain scarce, although it is believed that development has been proceeding for years. The Pentagon plans to spend $100bn on it. The programme will deliver 80 to 100 aircraft at about $550m each, eventually replacing the Air Force's legacy fleet of B-52 and B-1B bombers with a stealthy, long-range strike aircraft capable of delivering both conventional and nuclear weapons and due to enter service around 2020.

A project this big will certainly impact American military aerospace priorities for the next one or two decades. However, its effect will also be in the short term, when the Pentagon decides whether Northrop Grumman or a partnership between Boeing and Lockheed Martin will get the contract. Lockheed Martin would be better placed to withstand losing the LRS-B contract, as it is in the middle of the F-35 Joint Strike Fighter programme, worth $400bn to the company. Something may have to give for Northrop Grumman and Boeing. Northrop Grumman's last prime contract was for the B-2 stealth bomber over a decade ago. Only 21 were built. Boeing's combat aircraft production line is expected to close down in 2018 when current orders for the F-15 and F/A-18 fighters end. Pundits claim that, basically, two of the three prime contractors are running out of work, which is why this contract is seen as make or break.

If Boeing and Lockheed Martin win the LRS-B contract, Northrop Grumman could still survive, buoyed by its high technology units that produce everything from EW components to radars to unmanned drones. With no new combat aircraft contracts in the pipeline, it would probably want

Pre-LRS-B concept artwork from Boeing showing a flying wing bomber.

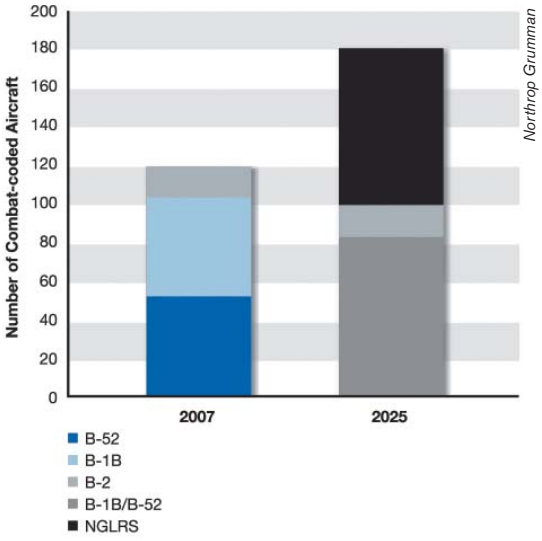
to sell off its aircraft unit and Boeing would be the obvious buyer. Northrop Grumman might then come under pressure to sell off other units, and could come out of the competition looking a quite different company. In turn, this might cause complications for the Pentagon which has been discouraging mergers and acquisitions that reduce competition for the big defence contracts. Ash Carter, the current US Secretary of Defense, and formerly the Pentagon's Chief of Technology Acquisition, is a supporter of the LRS-B and a vocal critic of mergers that reduce the Pentagon's technological pool. He has made clear he does not support mergers between primes.

No reshuffle of military primes

First the LRS-B, while it may be the largest new military aircraft programme, is not the only one. The Air Force TX trainer programme and the Navy's Unmanned Carrier Launched Airborne Surveillance and Strike (UNCLASS) programme is also underway. In the 2020s there should also be a sixth generation fighter programme and very likely one or more 'black' programmes over the same period.

The situation facing the combat aircraft primes is also different from that in previous decades. None face the complete close down of production lines. Lockheed Martin still has the C-130J and, more important, the F-35 which will remain in production for many years. Northrop Grumman is part of the F-35 team and also still has the Global Hawk long-range surveillance drone programme. Depending on new orders, the Navy's F/A-18 may also stay in production into the next decade. Additionally, Lockheed Martin and Northrop Grumman both have large diversified portfolios of electronics, space and support business while Boeing has the P-8 Poseidon maritime surveillance aircraft and KC-46 tanker transport programmes, alongside space and electronics programmes. Of course, there is always Boeing's huge commercial aircraft business to be counted.

Some commentators assert that, if Northrop Grumman wins LRS-B, Boeing will want to buy it. However, there is not much evidence that Boeing management is encouraging this line. The company already has a sizable defence portfolio alongside its large commercial business and may not see the need to pursue a constant balance between commercial and defence business.



Northrop Grumman

A graph from Northrop Grumman's 2008 research paper 'The 2018 Bomber: The Case for Accelerating the Next Generation Long-range Strike System' showing how the new strategic bomber will replace and enhance the USAF's existing bomber fleet.

$33bn
LRS-B initial acquistion costs

$24bn
Cost of upgrading remaining B-2 and B-52 bombers

Reducing costs with mature technology

The defence scene has changed since the last generation manned bomber, the B-2 Spirit, was developed. Arguably that programme assisted Boeing in developing its next generation commercial aircraft, notably composites on the 777. Since then, commercial R&D has outstripped defence R&D and LRS-B is believed to rely on relatively mature technologies. This may help keep its cost down but it means LRS-B will be less important as a technology driver in developing new aerostructures or network capabilities. Additionally, European rivals, namely Airbus, don't appear to have any advanced airframe project that could challenge Boeing's hegemony with respect to technology transfer.

Will the bomber get through?

Given the secretive nature of LRS-B, this is a difficult question to answer. Retired USAF Lt Gen David Deptula, currently Dean of the Air Force Association's Mitchell Institute, has little doubt it will. In a statement recently prior to a 'Beyond the Bomber' report launch, he points to Russia and China's updating of their bomber fleets as an endorsement of US policy. Russia is currently planning to reintroduce its Tu-160 Blackjack long-range bomber into production, as well as developing a next generation PAK DA strategic bomber. China,

Under wraps

No details have been revealed as to what either of the two competing USAF bomber concepts might look like. However, there are a number of images released by Lockheed Martin and Northrop Grumman which might provide a clue.

Northrop Grumman

An enigmatic poster from Northrop Grumman hints at a tailless design.

Lockheed Martin

A Lockheed Martin poster shows the U-2 (left), SR-71 Blackbird (centre), F-117 Nighthawk fighter (right), plus an unidentified aircraft in the foreground.

Lockheed Martin

An earlier example of concept art from Lockheed Martin.

meanwhile, is pursuing a new bomber project as replacement for its ageing Xian H-6K or Chinese copy of the Tu-16 Badger. Deptula reminds his audience that bombers can deliver many times more precision bombs per sortie than a tactical fighter and stay airborne far longer but that the Air Force's current inventory of B-52, B-1B and B-2 bombers is looking increasingly aged, and 87% are not designed for stealth operations.

Deptula joins other pundits in warning against the number of new bombers being squeezed by a looming spending hump of other new military aircraft projects in the 2020s, such as F-35, KC-46 and JSTARS replacement, just when production of LRS-B is due to be ramping up. Initial acquisition costs of the new bomber could be $33bn. How the Pentagon intends to absorb that remains to be seen. An additional $24bn will also be required to upgrade the remaining B-2 and B-52 bombers over the same period. LRS-B is already facing a proposed $460m budget cut for financial year 2016 but this does not unduly worry the Air Force, as spending on the programme will be constrained anyhow until after the contract is awarded. Deptula insists that the LRS-B will be a 'US asymmetric advantage' and provide a key ingredient in the future US air power mix.

How operationally effective will the new bomber be?

Not everyone agrees. One school of thought is that relying on relatively mature technologies indicates LRS-B will be no more survivable on penetration missions against high-end air defences than the current B-2 Spirit and may have to rely on escorts and roll-back suppression of enemy air defences to achieve its mission. While mass single integrated operational plan (SIOP) level strikes to clear away enemy defences are less likely in a future conflict, the issue by which LRS-B is judged will be probably its ability for assured penetration to carry out limited nuclear or conventional strikes to, for instance, remove a weapons of mass destruction (WMD) capability, collapse a hardened storage site or hit transporter erector launchers (TELs) in the field.

This may happen in the presence, not of an already disrupted integrated air defence system (IADS) with multiple penetration corridors cleared by preceding inter-continental ballistic missile (ICBM)/ submarine-launched ballistic missile (SLBM) strikes, as in a Cold War scenario, but against a fully functioning air defence. This means that if tactical air (TACAIR) has not arrived in theatre when a time-critical strike is authorised, the stealth bomber may well be going in alone.

If the bomber is to rely on already established technologies this begs the question how effective will LRS-B be in these circumstances. Replacing

the current trio of US bombers with another one suggests an upgrade of an existing design, say the B-2, with new engines, advanced composites design and the latest low observable technology may be a cheaper alternative, especially if this enables a smaller overall load out. If you consider the latest missile developments, such as joint air-to-surface standoff missile (JASSM) and long-range anti-ship missile (LRASM), that also provide stand-off capability for naval and overland missions and the GBU-53 as another option to bring down weight and multiply stores stations, each aircraft could deliver four to eight cruise weapons and 40 to 80 small diameter bombs. This would be in preference to engagement by hypersonic SAMs and heavy-weight free-fall munitions, such as GBU-31, which have very short range, making detection of the bomber by modern VHF radars, such as Sky Watch, comparatively simple.

On the other hand, if you are intending purely a stand-off platform, to exploit future advanced missile technologies, it is questionable whether you need a bomber type configuration. A modified transport aircraft would be suitable, equipped with launchers for a large number of anti-ship missiles (ASMs) and cruise missiles. Equally, the way ahead may well favour advanced UCAVs capable of delivering a variety of short- to medium-range stand-off weapons. However, costs and predictions of future capability suggest that the hypersonic missile may be the best option with a high (Mach 8) performance and very low radar cross section (RCS). Missiles can be made compatible with submarines and surface ships as well as air power, increasing persistence without the hazards to launch platforms from extended range air defences or enemy weapons such as DF-21D carrier killer missiles.

Opening up the debate

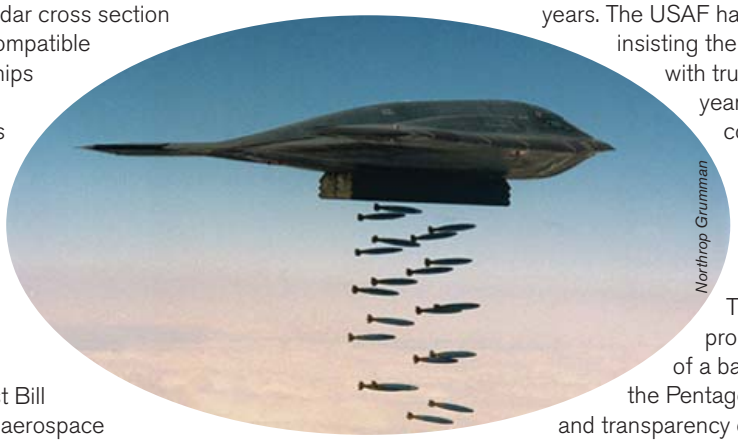
It has been claimed by journalist Bill Sweetman writing in influential aerospace magazine *Aviation Week & Space Technology* that the future US nuclear defence posture is evolving without a soundly budgeted plan behind a veil of secrecy without its goals being clearly defined. US


Boeing

The LRS-B will replace many of the USAF's existing bomber fleet — including the B-1B Lancer, seen here refuelling from a KC-46 tanker.


USAF

Some of the USAF's fleet of B-52s will be retired while others will be upgraded.


Northrop Grumman

The LRS-B may also eventually replace the B-2 Spirit bomber.

Air Force Assistant Chief of Staff for Strategic Deterrence, Major General Garrett Hareneak has stated on Capitol Hill that he is in favour of opening up the debate on the future directions of US strategic air power but many critics still see fundamental questions that need answers such as: what sort of strategic weapons systems does the US need? Should it include a new generation of long-range manned bombers? Does the next generation aircraft require stealth for penetration missions, or should it be a stand-off sensor-shooter platform, as suggested by David Deptula? Or should the focus be on satellites, UCAVs and a new generation of hypersonic missiles?

More of the same?

Cynics are already saying that the LRS-B is shaping up to be a typical 'more of the same' solution from the US military industrial complex, with concern over the fate of military aircraft primes and maintenance of a fleet of large long-range bombers taking precedence, and the inevitable retreat back into the secret world of black projects meaning that the true cost and capability of the aircraft will remain hidden for some time. Perhaps the only sure thing will be that, in keeping with almost every other major defence project, LRS-B is likely to be over budget and behind schedule. In fact, this process has started already, with cost estimates for the new bomber rising by 76% this year, to $58·2bn over ten years. The USAF has quickly moved to refute this, insisting the programme remains stable with true costs at $41·7bn over ten years. Nevertheless, the projected cost of $550m per aircraft is based on 2010 dollars and all 100 aircraft being purchased. Few pundits expect the USAF to buy 100 aircraft, so unit cost is almost certain to rise. The recent exchanges are probably only the opening shots of a battle between Capitol Hill and the Pentagon over the cost, management and transparency of the programme: so watch this space!

The author would like to thank AM Iain McNicoll, Chair of the RAeS Air Power Group, for his valuable assistance.

Barnstorming to Australia

On 1 October, Tracey Curtis-Taylor will fly her 1942 Boeing Stearman biplane to Australia in honour of one of her heroines, Amy Johnson. Monsoons and bureaucracy allowing, she will arrive in Sydney in January next year. ANDREW DRWIEGA talked to her about the epic journey ahead.

In 1928 Mary Heath made history as the first woman to fly solo the length of Africa and back to Britain. In 2013 Tracey Curtis-Taylor flew nearly 10,000miles from Cape Town to London in honour of that momentous feat.

On 1 October, she will take on another legendary flight, that of Amy Johnson's 19-day solo 11,000mile journey in 1930 from Croydon to Darwin in northern Australia. Curtis-Taylor's trip will take a lot longer, by design, and will add on another two thousand miles by finishing in Sydney.

Heath's aircraft was an Avro Avian while Johnson's was a second hand Gipsy Moth named *Jason*. Curtis-Taylor will fly in *The Spirit of Artemis*, a restored vintage 1942 Boeing Stearman.

Born in Stamford, Lincolnshire, at the age of two Curtis-Taylor's family emigrated to Canada and spent nearly nine years there. They then returned to the UK and the Lake District (as her parents were both originally from Manchester). Following work at De Beers and the Foreign Office in London — not to mention an overland journey from Johannesburg to London in a Bedford truck, she finally went to New Zealand.

Tracey Curtis-Taylor

Q. How did your love of flying begin?

I undertook my first flying lesson when I was 16 years old but started in earnest when I was 21 in New Zealand. I could only afford to fly every couple of weeks and it was an awful lot of waitressing and odd-jobbing to get through both a private and a commercial licence.

Q. What did you learn from your African odyssey that has helped prepare you for this next epic flight?

There were serious lessons learned in Africa. We went in with some measure of naivety and I had already flown down in an old Antonov An-2 on a delivery run from Kiev to Cape Town with a Russian crew where I was helping to manage the ground logistics and documentation which was invaluable experience.

We were making a film and there was a wave of media and communications tasks to do every time I arrived at a new destination. This aspect made a lot of demands. There is a psychological dimension to this which is a constant distraction from the flight. We had some serious problems in Africa and I was unhappy with aspects of how it was managed. There were a lot of pressures because of the filming and the very tight schedule and constant logistical issues which were intensely frustrating. One of the biggest operational issues is fuel — avgas for piston-engined aircraft is becoming a very rare commodity in the world — so this needs to be positioned in most places at great cost. The lessons

RAeS/NAL

Amy Johnson and her DH Gipsy Moth *Jason* at Croydon Airport before the start of her adventure.

learned in Africa have served me well in preparing for this next trip.

On top of that there are the clearances and permits; during these trips you are constantly crossing borders and there are often time limits on the paperwork. I now treat Africa as fantastic practise for the Australia flight.

Q. Why a Boeing Stearman?

I have been mad about them for years. This is the iconic biplane for me. I love radial engines and did my early training on North American T6s. I still have my own PT22 Ryan Recruit which is the prototype built by PC Ryan who built the Ryan NYP (otherwise known as the *Spirit of St Louis*) for Charles Lindbergh.

I have owned shares in other biplanes, including an SE5a which was my first open cockpit biplane in New Zealand, as well as a T6 Harvard, a Chipmunk and a Piper Cub. I now just own the Stearman and the Ryan.

Q. What role does manufacturer Boeing play?

Boeing celebrates its centenary next year and these epic journeys in my Stearman embody something of the heritage and pioneering ethos which is the Boeing hallmark. I am thrilled to be taking their brand around the world with me. Likewise my other principal sponsor, Artemis Investment Management who have been magnificently supportive and my plane is named *Spirit of Artemis* in their honour.

When I met the Boeing team at the Royal International Air Tattoo (RIAT) in 2012 I met with several women executives who loved my idea of recreating Mary Heath's African flight. Boeing has proven itself to be a company ready to promote women and equality. They have been fully behind both projects.

Q. As you fly VFR, what are your main technical aids?

I have a Garmin NGS 430 in the cockpit which is my comms/nav/GPS system but I can only really use the A-B function which doesn't give me terrain information. I also have my iPAD with Air Nav Pro and Jeppesen FliteDeck Pro, the latter being one of our global suppliers for aeronautical data, charts and digital maps. But I was trained in WW2 navigation to fly visual flight rules (VFR) and I love maps, so I still have my paper map onboard regardless.

Q. How did you decide on the route down to Australia?

We are working on longer stops in five main locations. These are: Turkey, the United Arab Emirates (Dubai), India, Singapore and Australia. The stops in between are mainly transit locations to allow the journey to be properly planned in terms of distance flow and my endurance. In those five main locations we can spend time on engineering, engage with the media, visit aviation academies and so on. There is a Women in Aviation conference at the Dubai Airshow (8-12 November) which I am looking forward to attending. However, time is rationed, this journey is already taking three and a half months, don't forget.

Tracey Curtis-Taylor

I can't fly Amy's route, as it took her from Turkey through Syria to Iraq and Iran, so I needed to find an alternative route. My biggest fear is the weather which becomes a real issue from Myanmar south. Between Singapore, Indonesia and across northern Australia I will hit the inter tropical convergence zone which is the monsoon line. I hope to reach that in time to have it behind me and, hopefully, blowing tail winds for the 300nm sea crossing from Indonesia to Australia. My only other concern is that we don't hit any tropical cyclones. I don't want my airplane to end up being left outside, as happened in Egypt. Finding hangar space in bad weather is a problem — and I am vulnerable to that.

Q. So what next after Australia?

I will crate the aircraft and send it to Seattle to arrive at Boeing's home of Seattle during their centenary year. From there I will fly across America along the early air mail route. It would be lovely to finish with a flight around the Empire State Building in New York.

Summary

However, that is another story. My final question addressed how she would return to England. Would it be a circuitous route via Greenland and Iceland? "Absolutely not," she said. "My final tribute to the 1930s will be by luxury cruise liner, sipping a long pink gin…"

> ONE OF THE BIGGEST OPERATIONAL ISSUES IS FUEL — AVGAS FOR PISTON-ENGINED AIRCRAFT IS BECOMING A VERY RARE COMMODITY IN THE WORLD — SO THIS NEEDS TO BE POSITIONED IN MOST PLACES AT GREAT COST

Rogier Westerhui

India: a new dawn

With 'Make in India' the new mantra, NEELAM MATHEWS reports on the advent of the private sector in India's aerospace industry.

A decade of policy paralysis is giving a new ray of hope to the sluggish Indian aerospace industry — until recently dominated by slothful staid public sector companies plagued with delays with neither the will, nor the inclination to innovate or move forward. Driven by the promised speedy and transparent policy for aerospace manufacturing by the, now over one year old, Narendra Modi Government, that has made 'Make in India' its mantra, the entry of private sector into forbidden territory is changing the very dynamics of the business.

While there remains a slip between the cup and the lip, $30bn worth of contracts cleared by the Defence Acquisition Council (DAC) in the past year are awaiting release of Request for Proposal (RFP) that, in theory at least, needs to be closed within a year. The new defence procurement policy once announced, it is hoped, will ring in a new age in the country's manufacturing ecosystem from the present low grade component manufacturing, moving up the value chain to high-tech products. The new policy envisages that, in future, RFP for large procurement will nominate platforms in advance which will then have to be under the Make in India programme. While the prime will be an Indian company, it will be the OEM that will choose the best company with the lowest cost it deems fit to produce its product in India. "Unlike the present Defence Procurement Policy (DPP) 2013, that puts the liability of equipment manufactured on the prime that is an Indian company — DPP 2015 mandates that the two partners share the risk jointly… New guidelines will also ensure that the military will have its choice of equipment and qualitative requirements which are often changed midway, will be clearer from the start," said a defence ministry official to *AEROSPACE*.

Neelam Mathews

Earlier this year, an Indian company supplied the first Indian-built rear cargo ramp and aft pylon assemblies for the Boeing CH-47F.

Building Tier 1 competence

"There is substantial capability being created at Tier 2 level from simple to complex geometrics for aerostructures in India," said Rahul Gangal, Global Partner, Roland Berger Strategic Consultants, to *AEROSPACE*. He added while Tier 1 development is happening for rotary wing, private sector participation for fixed wing aircraft appears to be 18-22 months away with the Airbus-Tata partnership for the Avro replacement programme with the C-295, that will become "A milestone program for building Tier 1 fixed wing competence."

Even the Russians are changing their fidelity, moving away from government-owned companies to service and manufacture their equipment. Privately owned Reliance Defence will produce Kamov Ka-226T helicopters in a joint venture following a government-to-government deal for procurement of 40 flyaway and production of 160 Kamov Ka-226T helicopters. Spread across 86 acres, the facility includes a helicopter assembly

Neelam Mathews

and components manufacturing at Nagpur airport in the Western state of Maharashtra, at the Reliance-owned Dhirubhai Ambani Aerospace Park. The contract, once it has been signed at the Russia-India annual summit in December, will make Reliance the country's first private helicopter manufacturing facility, and it will ready by early 2017.

India's large and medium private companies have already made their presence felt and are attracting business from western OEMs. Those that stand out include Tata Group, Dynamatic Technologies, Larsen & Toubro, Axis, Aequs, Samtel Avionics and Mahindra Defence Systems.

Too fragmented?

Things are not easy. A common refrain is that aerospace manufacturing in India is fragmented. "The only high-tech project in India that is closest to call is the Light Combat Aircraft Mk1 that has 80% foreign parts. There is an anomaly in the policy that expects 60% of indigenous content. If barely 20% of aircraft parts for an aircraft made in India are indigenous, how does the government expect 60% to be sourced in India?," said an engineer.

"Aerospace requires R&D and the private sector is not interested in investing in it, as it is a chicken and egg situation. Without contracts who will want to put in the money?" He cites the example of a contract to HAL for 187 reconnaissance and surveillance light helicopters even as its first flight has been delayed despite the design being based on an existing model built under licence, the Advanced Light Helicopter, Dhruv. "If you cannot remodel the existing model, what kind of player are you?" adding "We couldn't make a basic trainer and are now attempting to build a fifth generation fighter aircraft." However, today, few can deny that HAL, working on numerous aircraft greenfield projects, no longer holds a monopoly. Increasingly, component sourcing and high value projects are moving towards private companies where trust and reliability is the primary factor, given that India's Foreign Direct Investment is limited to 49%, where the OEM does not have an equal nor controlling stake.

While Tata Advanced Systems (TASL) has already established joint ventures (JVs) with US companies Lockheed Martin and Sikorsky to produce Lockheed Martin C-130 Hercules empennage and centre wing-box structures, and cabins for the Sikorsky S-92 medium-lift helicopters, it is the almost invisible but high-tech up-the-value-chain manufacturing that is starting to gain attention of Western OEMs.

Growing avionics expertise

"Strong suppliers who possess economies of scale in their cost structure and have the balance sheet strength to invest in risk sharing programmes will most likely succeed and step up the production rate," said a recent report by Deloitte. The medium-sized Delhi-based Samtel Group, the first Indian company in defence and airborne electronics, is living up to this, having registered many patents in display technology. Its technology for ruggedisation of LCD panels and multi-functional displays (MFD) for the Su-30MKI, is now being customised for other vendors. Samtel Thales Avionics, a joint venture between Samtel Avionics and Thales, recently dispatched the first batch of MFDs for 49 Mirage 2000 upgrade projects of the Indian Air Force. "Our policy is to move up the value chain in the technical domain," said Puneet Kaura Executive Director. He added the company was looking at servicing OEMs globally and "partnering with customers to be part of their global supply chain." International partnerships are growing. Samtel's long-term contract with Honeywell to develop EFIS-40, an electronic flight instrument system, has helped break Japan's monopoly. It also has an agreement with Saab to jointly develop and market the RIGS head up display (HUD) to provide helicopters with a cost effective display solution.

Dynamatic Technologies and a smaller medium enterprise, Aequs with a management that has moved away from a feudal architecture, have followed the road to hi-tech manufacture methodically and efficiently. "Hopefully, the professionalism showed by some of these companies will erase the memory of archaic government-owned defence manufacturer, Hindustan Aeronautics Ltd, that virtually had a monopoly in the defence business," said an industry official. Quality issues have plagued the image of the industry yet in its infancy and will need to be addressed. Boeing recently terminated a contract to HAL for poor quality of production of weapons bay doors for the US Navy P-8 MPA.

Partnering the global OEMs

Based on a track record of military industrial capability on the ground, Dynamatic has built a value chain of macro assemblies, detailed parts and engineering parts, creating an eco-system, Udayant Malhoutra, CEO and managing director Dynamatic

Sikorsky S-92 cabin produced by Tata Advanced Systems.

> IT WILL BE THE OEM THAT WILL CHOOSE THE BEST COMPANY WITH THE LOWEST COST IT DEEMS FIT TO PRODUCE ITS PRODUCT IN INDIA

MoD

Russian Helicopters

Ka-226T helicopters built in India will be produced by India's first private sector helicopter facility.

told *AEROSPACE*. The company started its initial work as a developmental partner of the Defence Research Development Organisation (DRDO) producing indigenous products including the wing and rear fuselage for India's Lakshya pilotless target aircraft, ailerons and wing flaps for the Intermediate Jet Trainer HJT-36 and major airframe structures for the Sukhoi Su-30MKI fighter. Experience gained is yielding results. Today, it is a single source supplier of flap track beams for A330 airliners. The work is divided between Dynamatic's main facility in Bangalore and the Bristol facility of its UK subsidiary Dynamatic Oldland.

Precision engineering Dynamatic-Oldland Aerospace has complex five-axis machining capabilities for the manufacture of aerospace components and tooling. "We married the highly automated robotics and low cost of capital available in UK with the artisanal manufacturing in India to create a global delivery model of quality, cost, delivery and engineering," said Malhoutra.

"Dynamatic was selected based on its technical capabilities, cost competitiveness and skill base," said Airbus India Managing Director, Srinivasan Dwarakanath, adding that it is part of the airframer's plan to boost its aerospace supply chain in India. "Through these partnerships, we can proudly claim that there's a bit of 'Make in India' in all our aircraft programmes," he added

Dynamatic has also been engaged in the development and production of airframe components for the Bell 407 since December 2013. Having completed the First Article Acceptance of aft fuselage detail parts, it ships the parts to Bell's aircraft assembly site in Mirabel, Canada. Last year following an agreement with Textron Systems and Bell Helicopter, Dynamatic was declared a single source supplier for major airframe assemblies for the Bell 407GX and 407GT. The agreement "represents a significant milestone in Bell Helicopters' global sourcing strategy and brings efficiencies to our manufacturing process for the Bell 407," said Mike Loeffler, Bell Helicopters' Vice President, Supply Chain. Earlier this year, the company produced the first set of aft pylon and cargo ramp assemblies for Boeing's CH-47F

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Chinook helicopter, mentioned by the Indian Prime Minister, Narendra Modi, during his inaugural address at Aero India 2015 in Bangalore.

"The Chinook is an advanced helicopter requiring complex manufacturing processes, and this Make in India capability demonstrates that Indian companies can deliver high standards of quality and productivity within a competitive cost structure that is essential for the aerospace sector," said Dennis Swanson, VP, Boeing Defense, Space & Security India.

UAVs pathfinding the way

A major project of Dynamatic is the co-development of a new generation lightweight unmanned aerial system (UAS) with AeroVironment of the US. Called the Cheel (Hindi for Eagle), the design evolved from the 5kg Raven and 12kg Puma UAS. The project is one of the six 'pathfinder projects' identified under the US-India Defense Technology and Trade Initiative (DTTI) earlier this year. "The first Cheel will fly 11 months after formal approval," said Malhoutra. He added: "We look at drones as part of our larger strategy. We have integrated battle management systems, as we already have ground robots, birds that fly and ground control mobile stations."

What was once a dream now seems a lucrative reality for the company as it readies to start a 30-acre facility near Bangalore airport where the first factory will be opened by the end of the year. Multiple plants planned include facilities for composites, assembly, detailed parts, engineering parts and final assembly.

Aerospace manufacturing in India never had to compete globally as HAL was delivered business on a golden platter. "But when we win packages on a global basis, expectations are different," said Aravind Melligeri, Founder and Chairman of Aequs, a company that too has attempted to move up the value chain producing integrated assemblies rather than just components and sub-assemblies. Aequs specialises in precision machining, sheet metal fabrication, assembly, forging and special processing

Test rig at Samtel for Su-30 MFDs.

Neelam Mathews

Udayant Malhoutra Dynamatic CEO with Airbus A330 flap track beam.

for the aerospace, automotive and oil and gas industries, with clients that include Airbus, UTAS, Eaton, Baker Hughes, Halliburton and Bosch.

Spread across 250 acres just 150km from Goa, the Aequs Special Economic Zone in Belgaum provides one of the first integrated ecosystems for aerospace component manufacturing by India's private sector. Aequs has a definite advantage, having essential capabilities of an aerospace cluster that include component manufacturing, machining, surface treatment, forging and assembly within the same space. Clients include Airbus, Honeywell, Saab, Magellan and United Technologies.

Like Dynamatic, Aequs too has found benefits in foreign acquisition. It acquired Paris-based aerospace component maker T&K Machine for $10m, renamed Aequs Aero Machine. A second acquisition worth around $50m may be made soon. "We are looking at companies in areas where we lack gaps. Landing gear components, actuations and long bed machining," said Melligeri.

Being a start-up in manufacturing, Melligeri went the orderly way. "We initially got expats from Manchester in 2011 to address cutting tool challenges for people to just understand the machining process. Our business is in generating chips — the faster we generate, the more money we make. The idea was to change mindsets by showing them how efficiently the work could be done."

Melligeri said he is now comfortable in bidding for large projects. Recently, the company won a seven-year global contract from Premier Aerotech. "We are now building 45 new parts every month — up from 10-15 a month a few years ago — and might have to triple the number," he says.

Challenges remain that slow down growth, the major spoke being high tax according to Melligeri. "Returns need to go back into business. We need much more incentive to grow." Material issues such as getting titanium on time too are a constraint. "Titanium used for the 787 is 5553 type patented Boeing grade and is much harder. We had a tough time with the landing gear shackle we manufacture." Forgings from VSMPO are machined in India and sent back to the OEM. Aequs recently made a minority equity investment in the Farinia Group's Spartacus3D, an upcoming French company specializing in additive layer manufacturing (ALM), also known as 3D printing technology. "We are working to bring our first customer to India," says Melligeri.

The Airbus supply chain supports more than 5,000 workers in India

Moving up the supply chain tiers

Aequs recorded $45m revenues this year, taking six years to break even. Melligeri claims he is the first Indian company to be Tier 1 to Airbus, having started by supplying detailed parts to its UK facility. "We have reached a million hours of capacity that we had forecast for 201!" he added. "However, this industry must be able to absorb economies of scale. Companies get into aerospace because they want to diversify." The Aequs JV with Swedish SAAB called Aero Assemblies India was established "to develop a robust aerospace business focused on build-to-print assemblies for the emerging market opportunities in India," said Melligeri.

Europeans are increasingly looking at emerging markets like India for consolidation of supply chain of small suppliers and a need for dollarisation and lower costs. Melligeri feels challenges to source a reliable and sustainable supplier base from India will include enough scale of suppliers who are diversified, reliable with a roadmap of $100m revenue by 2020.

However, things at the moment are slower than envisaged. "While 'Make in India' is a good concept, projects need to be awarded. The process is long and bureaucratic."

Melligeri is clear that the industry has no shortage of work. Competition is not between Indian suppliers but globally (now)."

Malhoutra agrees. "The most important part is 100% delivery performance. Why restrict OEMs to set up 100% subsidiaries? It will be good for India (if opened up), as it will get investment, technology and create jobs. We should encourage the best manufacturers to bring in their business. (Besides) We make the parts…."

Component assemblies at Aequs' facility.

Neelam Mathews

AgustaWestland

From biplanes to tiltrotors

100 years of aviation in Yeovil

JEREMY GRAHAM looks at AgustaWestland's first century of aeronautical achievement — a journey from patriotic gesture to global vertical lift influence.

AgustaWestland's aeronautical heritage stretches from the Short 184 biplane of WW1 (top right) through to the AW609 tiltrotor (left) and AMI Combat SAR AW101 of the modern day.

AgustaWestland

This DH4 was delivered ballasted with a barrel of cider strapped to the observers cockpit. Such deliveries to the Western Front were declared as ballast required to balance the DH4 when flown with a single crew.

It was April of 1915 when the board of Petters Ltd, an established manufacturer of oil engines based in Yeovil, Somerset, agreed to offer the entire resources of their company to the Government for the purpose of war work. This unconditional offer was made in response to a call from Government for the industrial capacity of the United Kingdom to be brought to bear on supporting the needs of the troops fighting a war that was clearly different from all others that had gone before.

Petters was not alone in making this offer nor were they alone in having no prior experience of munitions manufacture. It is likely that the expected demands would have been for oil engines and similar heavy engineering machinery and components. When the Admiralty responded with a request that the company build Shorts sea planes the news was received with trepidation, but the offer had been unconditional and the Petters board set out to honour their offer as best as they could.

One hundred years later to the day of that first offer, on 27 April 2015, Bill Tyack, President of the RAeS, unveiled a heritage plaque in the presence of the AgustaWestland Managing Director, a role that has a lineage back to the founding Petter family and in particular to Earnest Petter who, with his twin Percy, founded the company and oversaw its transition into aviation.

These intervening years span almost the entire history of viable aviation and aeronautical engineering and the Yeovil site is the only known location where contiguous aircraft manufacture has been undertaken for a century.

AgustaWestland

Percival Petter.

The era of wood, canvas and wire

The first Shorts 184 was flown in January 1916 from Hamble; the fourth aircraft spotted the German fleet at Jutland in June, operating from HMS *Engadine*. Further contracts to build additional Shorts sea planes followed along with contracts to build Sopwith and Airco (de Havilland) types. Land to the north of the Petters Westland foundry was levelled to provide an airfield in 1916 and a purpose-built assembly hall was erected.

In 1917 the factory converted from building DH4 to DH9 in line with the Government strategy to standardise on the latter. However, the promise that the new type would offer superior performance was not realised and the RFC officially described the aircraft as 'obsolete' as soon as it began to appear on the Western Front. However, the need for aircraft outweighed any disappointments with its performance and so, along with many other factories, the Westland Aircraft Works produced the DH9 as quickly as was possible. de Havilland proposed re-engining the DH9 with the American Liberty engine to improve its performance but it was the Westland Aircraft Works that received the contract to complete this task. The result, the DH9A (aka Ninak) was an immediate success, transforming the performance of the type and creating an entirely contemporary fast day time bomber. During 1918, production at Yeovil and elsewhere was converted to this new version of the DH9 and early aircraft arrived on the Western front as the armistice approached.

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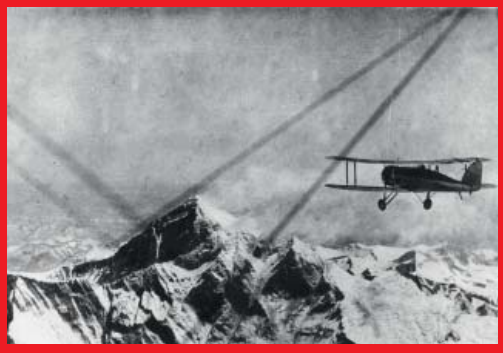
An advert for Westland as a civil aircraft manufacturer published in The Aeroplane, *in 1917.*

From one aircraft in January 1916 to over 800 aircraft delivered by November 1918, the Westland Works achievement may not have been unique but nonetheless impressive from a standing start by a heavy engineering company only three years earlier.

Following the declaration of the armistice, the need for military materiel sharply declined and many contracts were terminated with immediate effect or allowed to run to a conclusion with no expectation of renewal. The young aircraft industry was typified by manufacturing sites having no history in aviation and hence little infrastructure beyond manufacture. Many of these organisations did not survive the peace dividend and this might too have been the fate of the Westland Aircraft Works division of Petters Ltd if it had not been for its unique situation. The Aircraft Works had a proven design capability, it could lay claim to the Ninak, which was to become the standard RAF general purpose aircraft of the post war period, and it existed within a Company that had a wider engineering portfolio. It was these three factors that allowed Petters to weather a period that many others found they could not.

In October of 1926 the Westland Aircraft Society was formed with the purpose of providing lectures in accordance with the recently published examination syllabus for ground engineers. Within two months the local society had become the local Branch of the RAeS. Together with Coventry these two Branches were the very first to be recognised.

Peak performance


AgustaWestland

In 1933 a Westland aircraft became the first to fly over Mount Everest. The Houston Mount Everest Expedition set out to prove that a British aircraft with a British crew could fly over the highest point on Earth and use the opportunity to contribute to scientific knowledge by photographing inaccessible and dangerous terrain. The aircraft involved were two modified Wapitis, a PV3 Houston-Westland and a PV6 Houston-Wallace flown by Auxiliary Air Force pilots Douglas-Hamilton, Lord Clydesdale and Flight Lieutenant David McIntyre, with observers Colonel LVS Blacker and SR Bonnet (cinematographer with the Gaumont British News). The first flight successfully achieved the summit and a second flight, against orders, achieved the Expedition's scientific goals. Unknown to the expedition leader, pilots Clydesdale and McIntyre flew a second mission to retake photographs lost due to a faulty camera. Clydesdale and McIntyre were reprimanded by the RAF for their breach of conduct and then awarded the Air Force Cross.


AgustaWestland

Westland Wapiti

The transition to metal

Against stiff competition it was a Westland design, based on a modernised DH9A, that was selected as the replacement for this venerable but, by 1925, outdated aircraft. The design would eventually eschew wood completely in its primary structure but could be built from the outset using available wooden wings mated to a metal fuselage structure. This aircraft was quickly placed in mass production as the Wapiti and, in the five years from 1927, some 569 aircraft were built: vital work that likely would not have come to Yeovil but for the DH9A re-engining contract let in 1917.

From 1930 the Petters board sanctioned the build of an improved Wapiti which, as the Wallace, saw RAF service across the Empire until the start of WW2. Most famously, the two Wallace prototypes were chosen by the Royal Geographical Society as the aircraft that would equip the first over flights of Everest, which was achieved in April of 1933.

During the 1920s and 30s experimentation was nurtured by Government sponsorship and entrepreneurial investment alike, enabling aviation companies to maintain their design and manufacturing skills by building prototypes in a period when mass production was uncommon. At Westland two types stand out against a backdrop of biplanes: the Widgeon, designed and built to satisfy a Government-sponsored search for a light flying club two-seater, and the Pterodactyl series of flying wings. The latter flew four prototypes in the period 1926 to 1936 engineered at the Westland Aircraft Works by a team lead by Captain Geoffrey Hill. Hill's intent was to create an aircraft that would not lose control at low speed and in this respect at least it mirrors the efforts of his Spanish contemporary, Juan de la Cierva, who was focused instead on the rotating wing.


AgustaWestland

Pterodactyl flying wing.

Possibly the most significant contribution of the Pterodactyls to the future of Westland was that a young Chief Designer was appointed when Hill left the company with the last Pterodactyl unfinished. The son of Earnest Petter, by now the Chairman of Petters Ltd, William Edward Willouby (Teddy) Petter was a fresh postgraduate in 1929 when he was taken on the staff of Petters Ltd to learn the business from the ground up: in effect he became the first postgraduate apprentice to be employed in what has become a long tradition in Yeovil. A graduate of Cambridge he was appointed Chief Designer in 1934, quickly followed by Technical Director.

Winning the contract to re-equip the Army Co-operation Squadrons with what would soon be known as the Lysander was a turning point for Teddy Petter and the Company. This aircraft combined innovative aerodynamics with conventional construction and a well-known engine to produce an aircraft that possessed impressive and useable STOL performance.

With the Lysander well established in production, Teddy Petter turned his attention to the RAF requirement for a high-performance cannon-armed fighter and a contract was awarded to Westland in 1937 to build his twin-engined four cannon single seat fighter, the Whirlwind. The design was as uncompromising as it was modern. The Whirlwind saw Squadron service from mid-1940 and found its forte in the low level ground attack role where its firepower, speed and twin engine reliability made it a very effective weapon.

Running close behind the Whirlwind was the high-altitude Welkin fighter using a high aspect ratio wing, twin Merlin power and a pressurised cockpit. Investigation of unexpected flying behaviour at altitude provided Petter with the grasp of high Mach No flight that he would later apply to the Canberra jet bomber, a project started in Yeovil but completed by English Electric after Petter moved to lead the design team being established at Warton.

Alongside the design and build of Westland types the factory at Yeovil was again employed in the mass production of other types, most notably Seafires but also a small number of Fairey Barracudas as well. Wartime production exceeded 4,000 aircraft built at the Yeovil site.

Teddy Petter's final design at Yeovil is found in the early stages of work on what would become the Wyvern heavy fighter for the Fleet Air Arm. Many innovative features were to be offered but with Teddy gone the design team lead by Davenport took a more traditional approach with innovation put aside save for its use of a turboprop power unit.


AgustaWestland

Lysanders lined up for delivery at Yeovil.

Rotary wing focus

Cierva may be regarded as the father of the modern helicopter but his early autogyros were characterised by poor control at low speed. So it was that in 1922 an approach from Cierva suggesting collaboration with Petters was declined for concern that the technology was not mature. It was not until 1930 that Cierva was able to demonstrate autogyros with effective slow-speed control and at this point the Westland Aircraft Works elected to collaborate with him to build a five-seat, enclosed cabin, autogyro. This aircraft was a victim of 'ground resonance' which was not understood at that time and the aircraft was struck off charge without ever achieving flight. As the newly appointed Technical Director, Teddy Petter took up the challenge of the autogyro and arranged for a second collaboration, this time with Cierva and George Lepère, in 1934. This aircraft was flown by Cierva himself, Alan Marsh and Reggie Brie but was considered to be underpowered.

Not until post WW2 was the rotary wing aircraft to feature again at Yeovil and this time it was the result of a very deliberate strategy. With an increasing preponderance of jet-powered aircraft it was clear that the future of Westland Aircraft Ltd at Yeovil in fixed wing activities could not be secured. Helicopters had begun to show their value in WW2 but access to the required technology was required quickly. The solution was a licence arrangement with Sikorsky and the first example of this collaboration, to be known as the WS-51 Dragonfly, flew from Yeovil in October of 1948. From here on the focus for aviation at Yeovil would be the helicopter although support to fixed wing continued with the build of the world's first vectored thrust jet fighter based on a Meteor together with maintenance activities on Meteors, F-86 Sabres and finally the Fairey Gannet.

The WS-55 Whirlwind arrived as a company-owned demonstrator in 1951 with licence production deliveries starting in 1954 to the Royal Navy. The experience with Whirlwind allowed the company to develop a derivative of the WS-51, known as the Widgeon, which gave a taste of what has become the modern five-seat civil helicopter.

The close association between Westland and Sikorsky allowed the Yeovil site access to a heavy-lift rotor and transmission (taken from the S-56) which, when combined with transmission modifications and Napier Eland gas turbines, created the Westminster. The aircraft flew in 1958 and pre-dated Sikorsky's use of the turbine for heavy-lift application by four years.

AgustaWestland

The vectored thrust Meteor jet fighter demonstrator preparing to ground run at Yeovil showing the Nene engine placed ahead of the wing and the deflector jet pipe.

AgustaWestland

Same idea, different generation — Widgeon and Gazelle helicopters simultaneously operational at Yeovil.

Alongside the experimental Westminster, the WS-58 was following the Whirlwind into production as the Wessex and together these two types achieved a combined production run of 700 over a 20-year period.

A new identity with a familiar name

The Duncan Sandys White Paper of 1957 resulted in a merging of the UK aerospace companies. Westland Aircraft Ltd became the focus for helicopters, combining the production strength of the Yeovil company with the technological strengths of Fairey, Bristol and Saunders-Roe (née Cierva). The famous names of Hafner, Ciastula and Hislop, now joined Fitzwilliams and Hollis-Williams as the core of the new design team based in Yeovil.

Production in the early 60s was centred on Yeovil with the Whirlwind and Wessex but the Belvedere production run was completed under cover of the new alliance at Weston Super Mare and development of the Scout/Wasp completed at Eastleigh. The AB-47 Sioux licence build at Hayes was contracted after the merger and was the first liaison between Westland and Agusta SpA of Italy.

The merger with Fairey brought with it the Rotodyne project. An adventurous convertiplane concept, it had already achieved a world speed record and held the promise of high-speed city to city transportation. Heralding a new era in rotorcraft, the Rotodyne was the subject of license build agreements with Kaman in the USA and also slated for operation by BEA in the UK and Okinagan Helicopter Group in Canada. The Board of Westland Aircraft chose to support continuation of the Rotodyne as the path to the future of heavy vertical lift but when BEA distanced itself from the programme and Government support also waned then the fate of the programme was sealed along with any viable prospect of rejuvenating the suspended Westminster.

The gap left by the cancellation of Rotodyne was large but could be filled with work on the Whirlwind and Wessex, production of the Scout/Wasp, studies into a Scout/Wasp replacement (to mature as the Lynx) and a wide ranging Government-sponsored study of intercity transportation known as the Short Range Transport Study. The latter activity concluded that a 100-seat tilt-wing would serve the emerging European short-haul market best, combining minimal airport facilities with the ability to cruise at turboprop speeds. A demonstrator was proposed but in the end the SRT convertiplane envisaged by Raoul Hafner was stillborn for lack of Government support. Unmanned rotorcraft studies and projects in this period were

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Merlin HC3A helicopter.

AgustaWestland

Westland Whirlwind – the Iron Chicken last Mk 7.

AgustaWestland

Westland Sea Kings Mk 1, 2, 3, 4 and 5.

AgustaWestland

Lynx Mk 9A.

undertaken to establish the feasibility of this technology but the SUPERVISOR demonstrator programme was cancelled in 1979 before the concept could be fully proven and a subsequent bid for the follow-on PHOENIX programme proved unsuccessful.

Towards the end of this decade the final liaison of note with Sikorsky was formalised with the agreement to licence build the S-61, Sea King. The first arrived in 1979 and the 330th production aircraft was delivered to Norway in 1992. Sea Kings were delivered in numbers to customers across the globe, many of which remain operational today some 40 years on.

Entering the 1980s, the company was financially strong and elected to embark on rotor blade, transmission and avionics technology research that would be injected into coming projects. A move into civil mass production was also planned but with a foundation that was at least in part based on the realisation in the UK of a Puma replacement to meet the requirements of Air Staff Target 404. It is a matter of fact that AST 404 did not come to fruition but the civil programme was committed and pursued with vigour though was ultimately to prove an unsustainable financial burden. In this context by the mid-1980s Westland Helicopters could be characterised as technologically strong but financially precarious. The subsequent 'Westland Affair' has been well documented elsewhere but the outcome for the company was a significant change in respect of its shareholders and its internal organisation.

As the re-structuring process came to a close in 1986 the board took a decision to make an attempt on the helicopter FAI world speed record. Lynx had already gained a class record early in its life but this new attempt was to be more adventurous. Nothing less than the absolute record would suffice. At the heart of the bid would be the new technology BERP III rotor blade. Some close attention was paid to airframe drag reduction and, with help from Rolls-Royce, maximising power available from the engines. The result was an average speed of over 400 km/hr, a record that still stands today.

During the coming decade minority shareholding taken earlier by GKN was converted to a successful take-over in 1994 and the collaboration with Agusta saw the Merlin placed into production The anticipated contracts with the UK and Italian Navies were closely followed by contracts to deliver additional Merlins for the RAF and a SAR configured type for the RCAF. Lynx developments were created for both home and foreign markets establishing the type as the small ships helicopter of choice around the World. 1990 saw SUPERVISOR unmanned air vehicles being refurbished under contract to Martin Marietta and the aircraft free flown in trials in the USA.

With the closing of the millennium approaching the GKNWestland Helicopters/McDonnell Douglas team won the competition to equip the UK Army Air Corps with a dedicated attack helicopter, the Royal Navy and RAF Merlin production contracts were in full swing and the first re-engined Super Lynx 300 was delivered. After the financial crisis of the mid 80s, stability and growth had been re-established.

The first decade of the new millennium would be more exciting still when the US government announced that it had selected the EH101 (later renamed the AW101) as the VVIP presidential transport for the future. The contract for nine aircraft was executed with all aircraft delivered by USAF C-17s to the US. In the event, the US procurement process for the follow-on full fleet build was halted and so the US President will never use the AW101 in this role but the experience gained has been put to good use in modernising the base aircraft and in configuring it as a VVIP transport without peer. A derivative of the AW101 was submitted to the USAF competition for a replacement Combat SAR aircraft and in support of this activity the BERP IV rotor development was demonstrated and the first air-to-air refuelling trials flown by a Westland design completed. Both of these features are now embodied in production versions of the Merlin and the AW101.

Collaboration, a defining principle

Collaboration across national boundaries as the means to design and develop new types has become the accepted norm. In 1967 the Anglo French agreement for Gazelle, Puma and Lynx set the scene for Westland. Since then the EH101 programme has developed the Merlin in collaboration with Agusta SpA, the NH-90 programme was originally developed in a collaboration with the UK, France, Holland, Germany and Italy, the A129 LAH programme with the UK, Holland, Spain and Italy and the BA 609 (now AW609) tiltrotor with Bell. Production collaborations extend to the WAH-64 Apache with McDonnell Douglas, now Boeing, the Royal Navy Merlin with IBM (now Lockheed Martin), the AW139 originally with PZL in Poland (now an integrated member of the Finmeccanica Group), and the NH-90 with Airbus Helicopters and Fokker Aerostructures.

Collaboration with Agusta has evolved beyond a matter of convenience, initially realised as a joint venture agreement in 2001 between GKN and Finmeccanica to form AgustaWestland. In 2004 Finmeccanica acquired GKN's 50% stake of AgustaWestland to become the sole shareholder. Programmes apply design and operations resources irrespective of geography as necessary and a civil production line has been established at Yeovil for the first time in 30 years to expand the civil production facilities available across the AgustaWestland group to meet a growing demand.

The Petter twins prided themselves on achieving international success. Success with aircraft production may have initially been stimulated by the demands of national security but export was quickly established following WW1 and has been a vital ingredient of the aviation activities at Yeovil ever since.

AgustaWestland

On 12 July 2015 AgustaWestland held a special event at Yeovil to celebrate its 100 anniversary.

AgustaWestland

Women working in the Detail Shop at Yeovil during WW1.

AgustaWestland

Undergraduates working to refurbish the Lynx helicopter which broke the speed record in 1986.

Ownership and the future

Sir Earnest and Percy Petter were undoubtedly the guiding lights of the company which grew out of their father's ironmongery business. Aircraft were built at the Petter's Westland foundry from the outset and by the 1930s this work had come to dominate the factory site. Oil engine production continued in Yeovil until 1937 when production was moved to Loughborough. As of 1934, Westland Aircraft Ltd was established to run the aviation business and in 1937, as the oil engines were being moved from Yeovil, the controlling shares in Westland Aircraft were sold to John Brown and Company, shipbuilders. John Brown oversaw a significant development of the site in Yeovil during the run up to WW2 with a large assembly hall being built to the north of all other buildings and the company retained a significant shareholding until 1994 when GKN secured full ownership of the Westland Aircraft Group. Ten years later GKN was to sell all of its interest in the Company to Finmeccanica who retain ownership to this day.

The Finmeccanica vision for the future of AgustaWestland is one that recognises technological innovation as crucial in an increasingly competitive global market place. The convertiplane is finally becoming a civil aviation reality with the AW609 TiltRotor now progressing towards civil certification. This will be joined by other products in the same vein but within a portfolio that also includes a return to remotely-piloted air systems and, at its core, the modern, efficient, and versatile helicopter.

AgustaWestland's Yeovil facility is the UK's only manufacturer of rotorcraft and one of only a handful of sites in the world that has the capability to design, develop, manufacture and support complete rotorcraft systems. With the backing of Finmeccanica, AgustaWestland is well positioned as it enters a second century of aircraft manufacturing at Yeovil.

Afterburner

www.aerosociety.com

Diary
4 November
Brabazon Lecture

James Hogan, CEO, Etihad Airways

Etihad Airways received its first A380 in December 2014. Airbus.

Message from RAeS

OUR PRESIDENT

Martin Broadhurst

AS WE REMEMBER THE EVENTS OF 75 YEARS AGO, IT IS APPROPRIATE THAT THE SOCIETY SHOULD BE ACTIVE IN PUTTING FORWARD THE VIEWS OF OUR PROFESSION IN RESPECT OF TODAY'S DEFENCE CONCERNS ...

I was privileged to be able to attend one of the commemorative events marking the 75th anniversary of the 'Hardest Day'; the day of greatest losses on both sides during the Battle of Britain. There will, of course, be more events as we lead up to Battle of Britain day on 15 September which will provide additional opportunity for us to remember and thank all those people who played their part during that remarkable period of our history.

The history of the Battle of Britain is interwoven with the history of the Spitfire and the story of this aircraft and the people involved in its development, production and deployment, many of whom are members of our Society, is brilliantly portrayed in Paul Beaver's latest offering *Spitfire People* — providing insight into the courage and determination of that generation.

As we remember the events of 75 years ago, it is appropriate that the Society should be active in putting forward the views of our profession in respect of today's defence concerns and to this end the Society has generated a paper for contribution to the debate surrounding the 2015 UK *Strategic Defence & Security Review* (*SDSR*), see *http://www.aerosociety.com/News/Discuss-Papers*. It argues that to deal with new, changing international developments in a cost-effective way, a genuinely strategic approach to defence provision is required by the UK Government. The Society assesses the current international landscape and sets out the broad capabilities, and the more detailed aerospace capabilities, required to deal more effectively and efficiently with these new threats. The Paper makes the case for a force construct that meets a series of generic requirements, that in turn will improve the flexibility of the UK to adapt to the evolution of global security challenges; argues for further reform of procurement processes to improve the efficiency and affordability of defence acquisition; makes the case for continuing long-term Government-industry partnerships to capture and exploit the full suite of economic, security and social gains; and sets out the benefits of maintaining regional and global alliances. We look forward to ongoing engagement with government as SDSR progresses.

Equally the Society concerns itself with the challenges facing the environment and has recently published its *Greener by Design Annual Report 2014/2015* (see *http://www.aerosociety.com/About-Us/specgroups/Greener-by-Design/annualreports*). The environmental challenge of reducing carbon emissions remains one of the most important issues facing the world today and the aviation aspects of this challenge will further be addressed in October when Greener by Design hosts its annual workshop — 'Contrail-cirrus, other non-CO_2 effects and Smart Flying'.

Finally, on behalf of the Society, I wish to offer sincere condolences to the families and friends of all those who lost their lives in the terrible air crash at Shoreham on 22 August, as well as our best wishes for a speedy recovery to those who are injured. There will be lessons that must be learned from this tragedy and the Society stands ready to support the investigation and formulation of subsequent recommendations.

TRUSTEE TALK

Welcome to the first Trustee Talk which will be published following each meeting of the Board of Trustees.

Directly elected by the Society's members, Council is the body responsible for the outbound delivery of all the Society's multitude of services and publications. However, as a registered UK charity the Society must, by law, ultimately be governed by a Board of Trustees who are personally responsible for ensuring that the organisation meets all its legal and Charity Commission obligations. In truth the Board's activities tend to come in the 'boring but important' category.

During the past few months the Board of Trustees, among other activities, has:

1. Approved the Ten Year Strategy for the Society which was developed by the Society's President-Elect and which took an inclusive approach with eight work-streams working on a variety of areas such as Membership, International, and Digital and Media.
2. Reviewed the Specialist Group Regulations which form part of the Society's main governance Regulations. These will be available on the Society's website as soon as the amendments suggested by the Trustees have been implemented.
3. Received an update report on the Memorandum of Understanding (MoU) with the Aeronautical Society of Mauritius which was signed by the President of the Society in April 2015. The Trustees were pleased to see that two Presidential Invitations have been approved in relation to the MoU and that the Aeronautical Society of Mauritius has invited the Society's President to visit Mauritius to deliver a lecture in 2016.
4. Reviewed the risk register put together by the Society's Executive Team and discussed the key risks facing the Society.

Phil Boyle CEng FRAeS
Chair of the Board of Trustees

OUR CHIEF EXECUTIVE

Simon C Luxmoore

THE SOCIETY, TOGETHER WITH THE ROYAL ACADEMY OF ENGINEERING, HAS SUCCESSFULLY DELIVERED THE AEROMSC BURSARY SCHEME, WITH THE 500TH BURSARY BEING AWARDED TO LOWRI NICHOLLS AT THE END OF AUGUST

- This month sees Aerodays, the European Commission's flagship event for aviation research and innovation, come to London. The Society has been working closely with the Commission and ADS group to deliver the Young Researcher Competition, which aims to showcase some of the best undergraduate and postgraduate research across Europe with the opportunity to present to delegates and a jury of experts. I encourage you to attend these sessions if you will be visiting Aerodays on 20-23 October and support the talented pipeline for researchers from across the region.
- Our events team have also been working closely with the Air Accident & Investigation Branch (AAIB) to organise their Centenary Conference, which will be held on 14 October at No.4 Hamilton Place. In view of recent air accidents, this technical programme of international speakers will consider the important work carried out by the AAIB and what the future holds for accident investigation, so I hope to see many of our members in attendance to contribute to the debate.
- The Society submitted a written representation to the Chancellor of the Exchequer in advance of the Comprehensive Spending Review, due for publication by HM Treasury on 25 November. The RAeS submission provided the Government with recommendations for the aerospace sector that would promote growth and productivity, deliver greater efficiency and value for money across the public sector and promote innovation.
- A new Policy & Public Affairs section has been added to the Society website as a central hub where details of the RAeS' external influencing and public profile activities can be found, including Society press releases, responses to consultations and submissions to inquiries, and our latest policy briefings. *www.aerosociety.com/Policy*
- At No.4 Hamilton Place, the Publications Department has been relocated to the fifth floor with the room that they have vacated on the third floor now being refurbished, following a very generous donation the Society recently received from Mr Ralph Hooper OBE FRAeS. This latest move completes the move of staff to the fourth and fifth floors making all the accommodation in the building, from the basement up to the third floor, available for meetings, conferences and events.
- The Centennial Scholarship Committee was pleased to see a high number of good quality applications to the 2015 Scholarship Fund and have made 12 team awards and ten individual awards totalling £59,050. The aim of the Centennial Scholarship Fund is to support the future of aeronautics by providing financial assistance to individuals completing relevant courses and for organisations arranging events and activities to promote aeronautics, aerospace and aviation to young people.
- We're feeling quietly pleased with ourselves now that the Society, together with the Royal Academy of Engineering, has successfully delivered the AeroMSc bursary scheme, with the 500th bursary being awarded to Lowri Nicholls at the end of August. This award fulfils a commitment made by the Aerospace Growth Partnership to award 500 MSc tuition fee bursaries for home students to pursue aerospace-related MScs at a wide range of top UK universities. Since its launch by the Prime Minister in 2012 at the Farnborough International Air Show, the Aerospace Masters Bursary Scheme has been developing a pipeline of talented individuals looking for a career in aerospace who, but for the bursary, would have been unable to study at that level. The scheme has an impressive list of business sponsors: Airbus, BAE Systems, Bombardier Aerospace (Belfast), Finmeccanica UK, GE Aviation, GKN, MBDA Missile Systems, Messier-Bugatti-Dowty, Rolls-Royce and Spirit AeroSystems. It has also been supported by the Department for Business, Innovation and Skills and the Department for Enterprise and Learning in the Northern Ireland Administration. Lowri's achievement was celebrated at No.4 Hamilton Place on 7 September when she joined senior members of the profession at our New Fellows Reception offering the chance for us to celebrate both today's high achievers, and tomorrow's.
- October sees the annual renewals for membership subscriptions being sent out to all members. For members living in the UK (UK taxpayers only) it is an opportunity for them to Gift Aid their subscription (if they have not previously completed a Gift Aid form) which will allow the Society to claim back 25% of these subscriptions from HMRC; these funds are used by the RAeS Foundation to support the Society's on going charitable objectives. To donate Gift Aid please complete the form sent with the renewals or check out the Society's website (*www. aerosociety.com/foundation*) to find out more about Gift Aid and other ways to donate to the Society.

Book Reviews

ARMY OF THE SKY

Russian Military Aviation before the Great War 1904-1914

By G Vitarbo

Peter Lang Publishing, Moosstrasse 1, CH-2542 Pieterlen, Switzerland. 2012. 256pp. £51. ISBN 978-1-4331-1490-8.

As its title implies, this book is about the birth of Russian military aviation before WW1. It is not about the Russian aircraft designers who were building aircraft during this period, such as Sikorsky, Gakkel, Khioni, Steglau and others for the very good reason that the Russian military preferred to purchase aircraft from abroad — Deperduissin, Farman, Nieuport etc. Grand Duke Mikhailovich "argued forcefully and repeatedly that the Russian Air Force must be built primarily with foreign technology," mainly French; France being considered to be the leader in aircraft development during this period.

Russia, at this time, had suffered defeat in the Far East at the hands of Japan and from a poorly developed industrial capability and large numbers of badly educated peasants could no longer ensure Russia's military might by weight of numbers against sophisticated modern weaponry, on the ground, at sea and in the air.

Catalogue of the first International Aeronautical Exhibition, held in St Petersburg in 1911 and organised by the Imperial Russian Technical Society. RAeS (NAL).

The rivalry between the Aviation Section of the Officers' Aeronautics School, established at the Gatchina aerodrome in 1910, and the Sevastopol Aviation School of the Department of the Air Force is repeatedly referred to. This did not help to build a fully functional air force but nor did the Russian class system at the time, with most of the pilots belonging to the 'Officer Class' while the equally vital role of the ground based mechanics, who kept the planes in flying condition, was largely drawn from the despised peasantry. There is a section of notes on each chapter, which is useful, as well as a detailed bibliography.

This book is likely to be of interest to those seeking an explanation of some of Russia's failings when war came in 1914 and ultimately contributed to the revolution in 1917.

Nigel Eastaway
OBE Affiliate

AUSTRALIA AND THE WAR IN THE AIR

The Centenary History of Australia and the Great War Vol 1

By M Molkentin

Oxford University Press, 253 Normanby Road, South Melbourne, Victoria 3205, Australia. 2014. 284pp. Illustrated. £60. ISBN 978-0-19-557679-5.

Scholarly books on WW1 in the air are rare, and readable ones even rarer. Michael Molkentin's *Fire in the Sky: the Australian Flying Corps in the First World War* (Allen & Unwin. 2010) achieved this double distinction. This new book is based on his doctoral thesis and is the first in a series on Australia and the Great War.

As the author points out: "Other books concentrate on the technical aspects of aeroplanes or the personal experiences of airmen, this book takes on a broader perspective." The earlier book covered the experience of the Australian Flying Corps (AFC) at the tactical level. In this one he looks at the role of Australia and the AFC at the strategic, Imperial and political level. He begins with the origins of military aeronautics in Australia before turning to organisation, administration, recruitment, training and reinforcement. The various theatres of war where the AFC was employed are then dealt with chronologically. Australia was the only Dominion to insist on a distinctive air component but Molkentin also includes the work of Australians within the wider Royal Flying Corps (RFC), which enables him to discuss the part air power in general played on the Western Front and in the Middle East. In this respect it is similar to S F Wise's *Canadian Airmen and the First World War: the Official History of the Royal Canadian Air Force Vol 1* (University of Toronto Press. 1980). Unfortunately the AFC did not have a bomber squadron which means that this aspect is not dealt with at any length. While some might disagree with his generally rather favourable assessment of the RFC's higher command, his case is well argued and stimulating.

HMAS Australia I *launching a Sopwith Pup.* Commonwealth of Australia.

All aficionados of WW1 will wish to read this book

The book is well furnished with photographs, maps, statistics and appendices and a bibliographic essay. All aficionados of WW1 will wish to read this book. It is just regrettable that a similar work on the RFC or other national air forces is unlikely to be published in this country.

Christian Busby

The Evolution of the British Fighter Force Through Two World Wars: Volume 1 Prelude to the Air War — the Years to 1914

By M C Fox

Helion & Company Limited, 26 Willow Road, Solihull B91 1UE, UK. 2014. 314pp. Illustrated. £34.95. ISBN 978-1-909384-14-9.

To Rule the Winds offers an interesting and accessible, and extensively illustrated, overview of the development of military aviation in Britain during the pre-WW1 period. By building on a solid foundation of primary sources, Fox is able to demonstrate that there was more to early British aviation theory, policy and practice than a simple focus on air power as an aid to reconnaissance in the land and maritime environments.

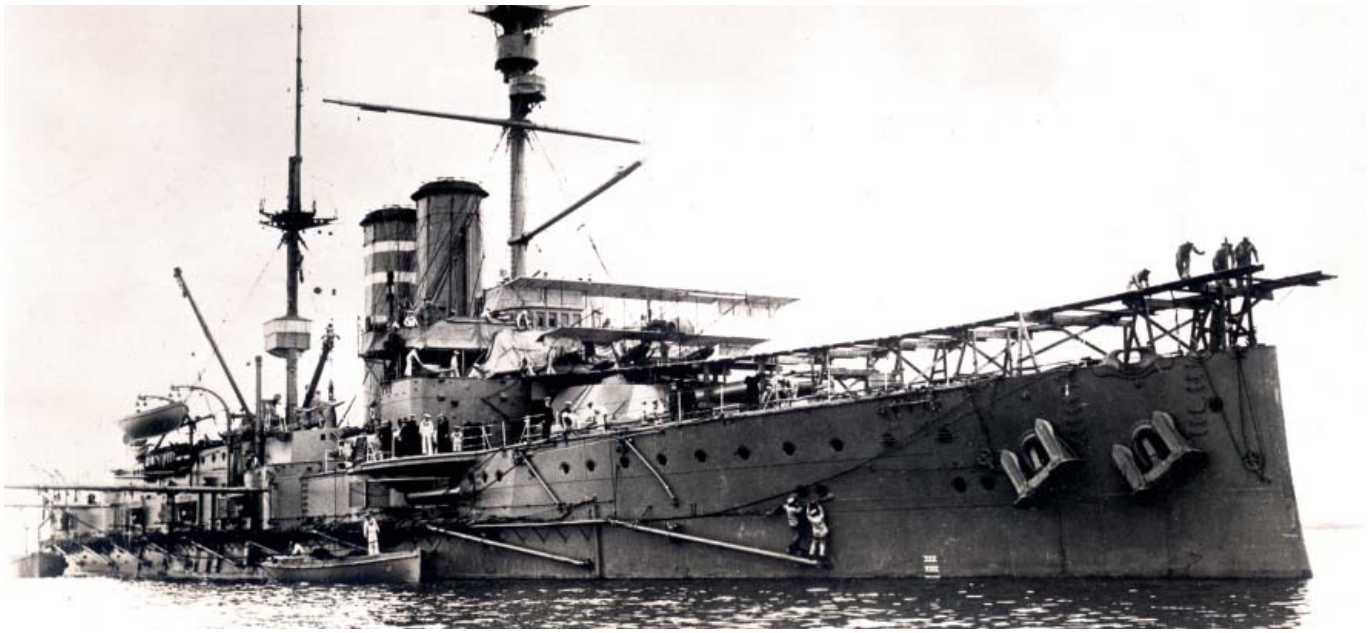
Fox illustrates that an inherent aspect of early British air power theory and policy, reflected in lectures given by military professionals at forums such as the Aeronautical Society of Great Britain and the Royal United Services Institute (pp 115-116 and 158-161), was that there would be a need to fight to establish control of the air; a position reflected in government policy that led to the creation of the Royal Flying Corps (RFC) in 1912 (pp 121-126) and in the RFC's first doctrinal publication, the *Training Manual* (pp 194-196). Fox continues by demonstrating that the RFC took active steps, if only limited, to develop fighting aircraft in the pre-war period, including a programme of aerial weapons testing (pp 234-249). These are important conclusions, which challenge popular perceptions regarding the focus of British military aviation during the period. Fox's bibliography also warrants close attention, particularly the primary archival sources (pp 294-298).

In a more critical vein, Fox's extensive use of lengthy quotations, an approach justified by the 'intrinsic value' of primary evidence (pp xv-xvi), lends a somewhat disjointed feel to the prose. This also leaves the study feeling a little unbalanced in terms of the ratio of narrative to analytical content; disappointing considering Fox's obvious talent for analysis. Fox's conclusions would also have been strengthened with an overt engagement with the current historiography and he does not generally position his study in relation to the conclusions of other historians. For example, Ash's biography of Sykes — *Sir Frederick Sykes and the Air Revolution 1912-1918* (Frank Cass Publishers. 1999) — would have provided further context to Fox's conclusions.

However, such issues do not detract from what is an interesting, useful, and detailed narrative. The remaining volumes of the series will be keenly anticipated by enthusiasts and historians alike. To conclude, it is important to commend the work of Duncan Rogers and Helion, who are publishing some wonderful works of military history at an affordable price.

Dr James Pugh
Centre for War Studies
University of Birmingham

To conclude, it is important to commend the work of Duncan Rogers and Helion, who are publishing some wonderful works of military history at an affordable price



HMS Hibernia *with the temporary launching ramp and the Short S38, as used on 9 May 1912 for the first flight from a ship underway in Great Britain.* RAeS (NAL).

SO YOU WANT TO BE AN ENGINEER?

A Guide to a Wonderful, Mysterious Profession with Sketches from an Aeronautical Engineer's Album — Second edition

By G D Padfield

Published by the author. 2015. 260pp. ISBN 978-0-9929017-2-1.

Airbus

Professor Padfield has, with this book, taken up the very topical challenge of enthusing young people about engineering to motivate them to consider it as a career choice. Hence the book is aimed at a readership ranging from early sixth form school students to undergraduates in the middle of engineering courses. The author's style in this book is colloquial and the book is lavishly and appropriately illustrated with many interesting photographs, CAD drawings of engineering products, diagrams, sketches and story-line cartoons. As a result it is very readable and I am sure will be found attractive by the target readership.

The author's aim, which is certainly achieved, is to demonstrate the excitement of engineering as a subject and as a lifelong career. The reader is taken through the different facets of the engineering process from concept through design and manufacture to product, the need to consider the whole life-cycle and the procedures of testing, correction and design modification. The author's background is in aeronautical engineering, first in the aircraft industry, then government research, both rotorcraft, and then latterly as head of a university engineering department with a strong aerospace course.

Inevitably, therefore, the majority of the examples in this book are drawn from the aircraft industry. The second edition of the book broadens this somewhat by introducing examples from the car industry, although this is still an industry not too dissimilar from the aircraft industry, both being geared to moderate to large number production of a product with similarities in the system design, safety and efficiency considerations. Hence the book focuses more on this type of engineering rather than, for example, the one-off project-approach of much of the civil engineering industry. Nevertheless, the majority of the engineering philosophy and procedures which are described are applicable over the whole range of engineering, as the author makes clear.

The book also devotes sections to the areas of engineering and engineering education which relate to the increasingly important societal issues, particularly risk, value, sustainability and ethics. There is an excellent discussion of leadership, the point being emphasised that engineers most often work in teams and the importance of developing inter-personal skills.

Most of the chapters in the book are essentially descriptive and will be very accessible to even the early sixth form end of the intended readership. However, a couple of chapters, because of the mathematical underpinning of engineering, do present a fair amount of mathematics but mostly basic mechanics and kinematics, such as simple harmonic motion, non-planar trigonometry and some linear algebra. In the past the majority of these topics would not have caused any great problem to most students taking an A-level maths course. Nowadays, unfortunately, a large proportion of UK A-level maths students lack the same degree of experience in these topics and I suspect that some may find these sections difficult.

The final section of the book contains a number of short biographies of engineers in mid-career, mostly ex-graduates of the Engineering Department of Liverpool University — which the author headed — and finishes with the author's account of his own career. These examples serve well to fix the whole message of the book in reality.

This is a very readable book with an important aim and, if it manages to catch the attention of the intended sector of young people, will perform a most useful function.

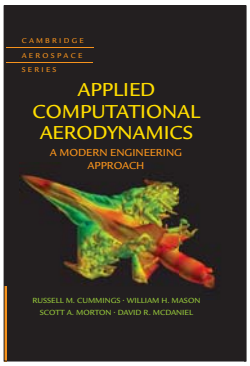
Professor J M R Graham
CEng FRAeS

Professor Padfield has, with this book, taken up the very topical challenge of enthusing young people about engineering to motivate them to consider it as a career choice

Library Additions

BOOKS

AERODYNAMICS



Applied Computational Aerodynamics: a Modern Engineering Approach. R M Cummings *et al.* Cambridge University Press, The Edinburgh Building, Cambridge CB2 8RU, UK. 2015. 861pp. Illustrated. £75. ISBN 978-1-107-05374-8.

AEROACOUSTICS

Acoustics and Aerodynamic Sound. M Howe. Cambridge University Press, The Edinburgh Building, Cambridge CB2 8RU, UK. 2015. 295pp. Illustrated. £55. ISBN 978-1-107-04440-1.

FLIGHT TESTING

Harnessing the Sky: Frederick 'Trap' Trapnell, the US Navy's Aviation Pioneer, 1923-52. F M Trapnell Jr and D Trapnell Tibbitts. Naval Institute Press, 291 Wood Road, Annapolis, MD 21402, USA. 2015. Distributed by Eurospan Group, 3 Henrietta Street, London WC2E 8LU, UK. 238pp. Illustrated. £24.50. ISBN 978-1-61251-848-0.

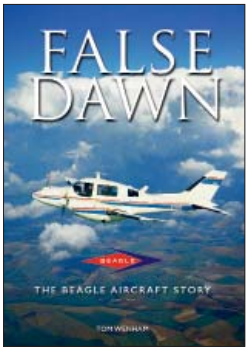
Set in the context of the evolution of US naval aviation, a biography of a leading test pilot who was to head the Flight Test Section during the crucial wartime years of May 1940 - May 1943 overseeing the service introduction of the Vought XF4U-1 Corsair and Grumman F6F Hellcat — and becoming the US Navy's first jet pilot when he flew the Bell P-59A Airacomet on 21 April 1943 — subsequently flight testing nearly every naval aircraft prototype over the next decade as he defined the operating requirements for carrier-based jet aircraft.

GUIDED FLIGHT

Intercept 1961: the Birth of Soviet Missile Defence. M Gruntman. American Institute of Aeronautics and Astronautics, 1801 Alexander Bell Drive, Suite 500, Reston, VA 20191-4344, USA. 2015. Distributed by Transatlantic Publishers Group, 97 Greenham Road, London N10 1LN, UK. 309pp. Illustrated £32. [20% discount available to RAeS members on request; E mark.chaloner@tpgltd.co.uk T +44 (0)20 8815 5994). ISBN 978-1-624103-49-0.

HISTORICAL

Retribution and Recovery: German Aircraft and Aviation 1919 to 1922. L Andersson and R Sanger. Air-Britain (Historians). Air-Britain (Trading), Causeway House, Chiddingstone Causeway, Tonbridge, Kent TN11 8JP, UK (E sales@air-britain.co.uk). 2014. 274pp. Illustrated. £39.95 (Air-Britain members), £59.95 (non-members). ISBN 978-0-85130-467-0.



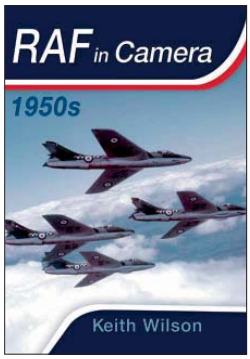
False Dawn: the Beagle Aircraft Story. T Wenham. Air-Britain (Historians). Air-Britain (Trading), Causeway House, Chiddingstone Causeway, Tonbridge, Kent TN11 8JP, UK (E sales@air-britain.co.uk). 2014. 454pp. Illustrated. £39.95 (Air-Britain members), £59.95 (non-members). ISBN 978-0-85130-479-3.

The Age of Air Transport: a Condensed History of Douglas Commercial Transports. Douglas — Aircraft Division, Long Beach, CA. February 1966. 16pp. Illustrated.

A concise overview of the evolution of the famous Douglas Commercial (DC) series of airliners from the first flight of the DC-1 on 1 July 1933 — and the subsequent development of the DC-2/DC-3/DC-4/DC-6/DC-7/DC-8 — through to the DC-8-61 and DC-9.

Javelin Performance Summary for Technical Sales (Secret). Gloster Aircraft Co. Ltd, Hucclecote. April 1953. 7pp. Illustrated.

SERVICE AVIATION



RAF in Camera — 1950s. K Wilson. Pen & Sword Aviation, Pen & Sword Books, 47 Church Street, Barnsley, S Yorkshire S70 2AS, UK. 2015. 304pp. Illustrated. £35. ISBN 978-1-47382-795-0.

RAF in Camera — 1960s. K Wilson. Pen & Sword Aviation, Pen & Sword Books, 47 Church Street, Barnsley, S Yorkshire S70 2AS, UK. 2015. 320pp. Illustrated. £35. ISBN 978-1-47383-776-8.

Numerous captioned colour and black-and-white photographs illustrate these year-by-year chronicles of key decades in the Royal Air Force's history which saw the service introduction of many new military jet aircraft types, within the context of the development of thermonuclear weapons during what became known as the 'Missile Era' and overseas air operations in Malaya, Indonesia, Cyprus, Kenya, Rhodesia, Aden and Libya, among other countries.

A Detailed History of RAF Manston 1931-1940: Arise to Protect. J Bamford *et al.* Fonthill Media Limited, Millview House, Toadsmoor Road, Stroud GL5 2TB, UK. 2015. 176pp. Illustrated. £18.99. ISBN 978-1-78155-095-3.

Recording the operations of RAF Squadron No3/48/79/206/234/235/253/600/601, the evolution of the School of Air Navigation and the No3 School of Technical Training and the Kent airfield's key involvement in the Battle of Britain and the Dunkirk evacuation.

Check Six!: a Thunderbolt Pilot's War Across the Pacific. J Curran and T G Porpravak. Casemate, 10 Hythe Bridge Street, Oxford, OX1 2EW. 2015. 350pp. Illustrated. £20.99. ISBN 978-1-61200-2996.

The WW2 experiences of an American 348th Fighter Group pilot flying the Republic P-47 Thunderbolt during the Pacific War as the theatre of aerial battles spread from New Guinea to the Philippines are vividly recalled in these memoirs, which is interspersed with extracts from official accounts of the campaign.

Northern 'Q': the History of Royal Air Force Leuchars. I Smith Watson. Fonthill Media Limited, Millview House, Toadsmoor Road, Stroud GL5 2TB, UK. 2015. 208pp. Illustrated. £20. ISBN 978-1-78155-192-9.

The history of one of the oldest remaining active airfields in the UK, from its origins operating balloons under the Royal Engineers, its interwar evolution into an elementary training flying station ultimately under Flying Training Command, the WW2 operations of Coastal Command and its post-war role as a key Air Defence Fighter station.

Blood, Sweat and Courage: 41 Squadron RAF 1939-1942. S Brew. Fonthill Media Limited, Millview House, Toadsmoor Road, Stroud GL5 2TB, UK. 2014. 960pp. Illustrated. £35. ISBN 978-1-78155-296-4.

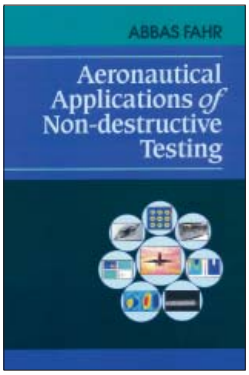
A very detailed day-by-day account based on official sources — and incorporating summary biographies of every pilot who flew with the squadron from September 1939 - July 1942 — of 41 Squadron's air operations during the crucial formative years of WW2.

Harrier Boys: Vol 1 — Cold War through the Falklands 1969-1990. B Marston. Grub Street, 4 Rainham Close, London SW11 6SS, UK. 2015. 192pp. Illustrated. £20. ISBN 978-1-909808-29-4.

A compilation of informal recollections from RAF pilots and other service personnel of the experience of operating the famous V/STOL 'jump jet' aircraft from its initial introduction and flight testing trials through to the major role it was to play in the Falklands conflict.

STRUCTURES AND MATERIALS

Mechanics of Aero-Structures. S Nair. Cambridge University Press, The Edinburgh Building, Cambridge CB2 8RU, UK. 2015. 182pp. Illustrated. £39.99. ISBN 978-1-107-07577-1.



Aeronautical Applications of Non-destructive Testing. A Fahr. DEStech Publications, Inc, 439 North Duke Street, Lancaster PA 17602-4967, USA. 2014. 479pp. Illustrated. $179.50. ISBN 978-1-60595-120-1.

Design and Analysis of Structural Joints with Composite Materials. R B Heslehurst. DEStech Publications, Inc, 439 North Duke Street, Lancaster PA 17602-4967, USA. 2013. 459pp. Illustrated. $195. ISBN 978-1-60595-034-1.

Modeling the Effect of Damage in Composite Structures: Simplified Approaches. C Kassapoglou. John Wiley and Sons, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, UK. 2015. 238pp. Illustrated. £74.95. ISBN 978-1-119-01321-1.

PAMPHLETS

Experiments on the Forces acting on the Wings of a Biplane ('Secret'). J R Pannell and E A Griffiths. Confidential Information Memorandum No 7. RN Air Department, London. March 1917. 8pp.

Report of experiments undertaken at the National Physical Laboratory based on RAF 6 section aerofoil.

For further information contact the National Aerospace Library. T +44 (0)1252 701038 or 701060 E hublibrary@aerosociety.com

WEYBRIDGE BRANCH AGM

At the 2015 Weybridge Branch AGM, Chairman Christopher Orlebar gave a roundup of their 2015/2016 lecture season.

Good evening Ladies and Gentlemen and welcome to the 2015 AGM of the Weybridge Branch of the Society.

At the close of our 2014/15 lecture season, I can say that we have had nine most interesting evenings at our Branch. In spite of a reduction in the membership, the attendance is not decreasing as quickly.

The first lecture on Wednesday 17 September 2014 was by Frank Ludwig who is the Director of Manufacturing at Rolls-Royce cars and responsible for the R-R Wraith. He emphasised the importance of researching the needs of customers and building a relationship with them — obvious for articles selling at over a quarter of a million pounds; but often forgotten for cheaper purchases. A video clip of an artist applying a thin speed line along the body work of a car by hand illustrated the care taken in producing these mechanical marvels. A shame that, unlike the R-R jet engines, the R-R cars are foreign owned.

On 24 September three days before the 50th anniversary of the first flight of the TSR2, Michael Simmons, brother of the Branch's membership secretary Alan Simmons, gave a short presentation about some of TSR2's technology, hitherto unpublished. The Brooklands documentary film that followed showed a clip of the TSR2, built at Weybridge in flight. Its test pilot Roland Beamont remarked how smoothly it coped with turbulence due to its high wing loading, the Lightning chase planes had had a rougher ride. Mike Salisbury, one of our Branch's vice-presidents was closely involved with its design.

On Wednesday 15 October Prof Riti Singh from Cranfield University gave us a very polished talk about future propulsion in aircraft. Electric propulsion would be good for the environment. However, the energy density of a battery is not nearly as good as that of kerosene. Perhaps a gas turbine could generate electric power which would be distributed to motors using superconducting cables. Interesting too were his researches into people's attitude to travel and the environment.

Above: Rolls-Royce Wraith. Mtaylor848.
Below, from left: Allan Winn, Jean Brown, Capt 'Winkle' Brown, Prof John Allen and Chris Orlebar at the 2014 R K Pierson lecture.

> HE EMPHASISED THE IMPORTANCE OF RESEARCHING THE NEEDS OF CUSTOMERS AND BUILDING A RELATIONSHIP WITH THEM

On 5 November Richard Deakin, Chief Executive of NATS, National Air Traffic Systems gave the talk. He spoke of the increase of density of aircraft flying in our airspace. He showed how the direction and concentration of air traffic varied throughout the day. He discussed how procedures and equipment were coping with ever more air traffic. The Boris Island Airport would concentrate air traffic over the south east unnecessarily. A parallel runway to the south west of Heathrow would be preferable.

On 13 March Paul Sternberg, a Brooklands volunteer, organised a visit to NATS in Swanwick (between Southampton and Portsmouth). The NATS Operations Director, Juliet Kennedy, gave us a comprehensive talk with slides. She spoke about direct routes, continuous descents and the elimination of holding through earlier *en route* speed reduction. Finally she rolled up the blinds behind the audience to reveal ATC in action — calm efficient and professional; exactly what the tired crew member needs having wrestled with the 'High frequency' communications over the Atlantic, always fettered with distorted pops and crackles.

The 62nd R K Pierson Lecture was given by Prof John Allen, Fellow of the Science Museum, on 26 November. It was his 60th to the RAeS and titled 'The 2014 Longitude Prize, an Aeronautical contribution' in deference to the original 18th century prize for the determination of longitude. The object of the 2014 prize was to stimulate research into several problem areas whether in antibiotics, water purification or flight without emitting carbon dioxide. By the time the RKP lecture was given, the 2014 prize had already been awarded to the group protecting antibiotics. Not discouraged, Professor Allen proposed the kind of machines we might develop if his idea of 'mass dynamic' propulsion were possible. To the scepticism of some in the audience he showed how a mission to Mars might be undertaken in months rather than

years. After all, three centuries before the appearance of the internal combustion engine, Leonardo da Vinci had 'invented' machines which required horse power rather than man power. Professor Allen hopes that his vision of the future may take less than three centuries. Could the study of 'dark energy' be the entry into fuel less flight? A very positive vote of thanks was given by 'Winkle' Brown — test pilot and aeronaut extraordinaire and at 95, two years older than the lecturer.

Then, thanks to the generosity of BAE Systems, 71 invited guests including R K Pierson's son, grandson and several former colleagues of the lecturer, sat down to dinner in the Bluebird Room next to the Napier Room — venue for the lecture.

On 14 January, Air-Vice Marshal Graham Skinner spoke about the introduction of the jet aircraft into the Royal Air Force. This fundamental change required the acquisition and deployment of different fuel, different lubrication oil, new ground support equipment and training — Herculean.

On my 70th birthday, 4 February, Andrew Matters of BAE Systems spoke to us about the Royal Navy's new aircraft carriers. Should they have been nuclear powered? No, too expensive and able only to visit the ports of close allies. How many 'through-deck cruisers' were represented by one new carrier? No committal. These two carriers, each displacing 70,600 tonnes, have space for 40 F-35B short takeoff and vertical landing (STOVL) fighter bombers and/or a variety of helicopters. In contrast the *Invincible*-Class of 'through deck cruisers' displaced 22,000 tonnes and carried, depending on mission, 18 Harrier GR7/9 and four Sea King helicopters (Wikipedia).

On 25 February the Branch met in the new Vickers Suite. Preceding the lecture, Allan Winn, Vice President of the Branch and Director of our lecture venue, the Brooklands Museum, announced that the museum had won a National Lottery award and work had started on the moving and refurbishment of the wartime hangar currently positioned on the finishing straight of the circuit.

Brooklands was the birthplace of the Viceroy which was the last engineering feat of R K Pierson Chief Designer at Vickers. It was renamed the Viscount, as India became independent from the British Empire. The Viscount was the subject of the lecture given by John Gough, who was a Hawker's aerodynamicist and John Caton, who was manager for the production of Vickers aircraft. John Caton told us that in 1942 Lord Brabazon, then Minister for Aircraft Production, had been sacked by Churchill for suggesting too publicly what an advantage it would be if the Germans and Russian destroyed each other at Stalingrad. His expertise had to be harnessed, so he was asked to chair the committee named after him to suggest aircraft types suitable for building in post war Britain. One of the recommendations turned into the de Havilland Comet 1; nearly a success; another, the enormous and slow Bristol Brabazon, was a failure. However, one became the Vickers Viscount, the first turboprop airliner. Worldwide sales exceeded 400; it was a stunning success.

Vickers Viscount 701, G-AMOG, Robert Falcon Scott, *of BEA.* RAeS (NAL).

The final lecture of the year was given on 18 March by Jeremy Graham, the Chief Project Engineer of the Sea King and Apache helicopters. He told us about the history of the AgustaWestland aircraft company. He described the Westland aircraft involved with the filming flight over Mount Everest, which occurred in 1933. This expedition was financed by a wealthy widow, Lady Houston. She was very concerned with its technical safety and asked no lesser person than Squadron Leader Orlebar for his assessment. The former leader of the winning Schneider Trophy team financed by Lady Houston, approved; the expedition was a success.

We all appreciate Chris Farara's excellent summaries which are frequently published in *AEROSPACE*, the Society's monthly members' magazine. The encouraging attendances to our lectures are in no small part due to Chris's hard work. I would also like to say how much I value the help of the committee members who make the existence of our Branch possible.

We are everlastingly grateful for the help and co-operation given to us by the Brooklands Museum Trust.

The first lecture of 2015/16, on Wednesday 16 September, was arranged by the IMechE. On 21 October (Trafalgar Day) a lecture on 'Concrete Piercing Bombs' will be given by Reg Milne. This subject will be of great interest to former Brooklands' engineers.

Christopher Orlebar
FRAeS
Chairman, RAeS Weybridge Branch

> HOWEVER, ONE BECAME THE VICKERS VISCOUNT THE FIRST TURBOPROP AIRLINER, WORLDWIDE SALES EXCEEDED 400, IT WAS A STUNNING SUCCESS

BATTLE OF BRITAIN 75th ANNIVERSARY EVENTS

Allied Air Forces Memorial day

On Sunday 6 September, the Yorkshire Air Museum at Elvington near York hosted its 30th annual Allied Air Forces Memorial Day which this year commemorated the 75th anniversary of the Battle of Britain and the 70th Anniversary of the return of Elvington's French Bomber Command Squadrons to France to form the nation's post war air force. The event was attended by the Chief of the Air Staff ACM Sir Andrew Pulford KCB CBE ADC RAF, ACM Sir Stephen Dalton, the High Sheriff of North Yorkshire, the Lord Mayor of York, Royal Air Force Station Commanders and high level diplomatic/Air Force representatives from France, The Netherlands, Germany, Russia, Australia, New Zealand, USA, Canada and Qatar, as well as other dignitaries.

Above: Marchpast led by the Yorkshire Band of the Royal British Legion with Corps of Drums in front of the museum's Handley Page Victor K2.
Below left: The YAM's restored Handley Page Halifax provides a backdrop as ACM Sir Stephen Dalton welcomes participants to the Memorial Day service in the main hangar.

The event included a flying display by a Spitfire in Polish Battle of Britain colours piloted by Flt Lt Charlie Brown, as well as live engine runs of a replica SE5A and Eastchurch Kitten, a Douglas Dakota IV, de Havilland DH104 Devon and Hawker Siddeley Nimrod MR2. Other events included a parade made up of Air Training Corps cadets, serving RAF personnel and members of numerous RAF Association, Royal British Legion, Royal Observer Corps and other Associations with Standards, followed by a 'Drumhead' commemorative church service held in the main display hangar in front of the restored WW2 Handley Page Halifax bomber.

Unfortunately, the final highlight of the day — a flypast of the XH558 Avro Vulcan bomber — did not take place, after the aircraft suffered an operational problem the previous day in which its front undercarriage locked in the down position.

Bill Read

Hendon's Spitfire 10K run

The runners began with a warm up session conducted in 1940's period style in front of one of the museum's preserved Lancaster bombers, before leaving the Museum for two loops of a flat road course around Colindale.

The RAF Museum at Hendon commemorated the 75th Anniversary of the Battle of Britain on 6 September with a 10km Spitfire 10k fund-raising run attended by over 600 runners. The event raised over £10,000 which will be used to support the 'Historic Hendon' project which will tell the story of the museum's former life as an airfield from which Spitfires flew in the Battle of Britain and Winston Churchill first learned to fly.

AEROSPACE MASTERS BURSARY

500th MSc bursary student

A ground-breaking scheme to keep the UK at the forefront of the global aerospace industry has recruited its 500th student. The scheme — jointly funded by industry and government with £3m each — awards bursaries to study Masters (MSc) degrees in aerospace engineering and will help meet the urgent demand for engineers in the UK.

Lowri Nicholls, aged 24 of North Wales, was awarded the 500th Aerospace Masters bursary, on 8 September, fulfilling a commitment made by the Aerospace Growth Partnership to create an additional 500 MSc places. Already with a BSc in Mathematics, she will study an MSc in Materials Science and Engineering at Leeds University.

Since its launch by the Prime Minister in 2012 at the Farnborough International Air Show, the Aerospace Masters Bursary Scheme has been developing a pipeline of talented individuals looking for a career in aerospace who, but for the bursary, would have been unable to study at that level.

Lowri Nicholls with Martin Broadhurst, RAeS President, at RAeS HQ.

The scheme, managed by the RAeS with the Royal Academy of Engineering, has an impressive list of business sponsors — Airbus, BAE Systems, Bombardier Aerospace (Belfast), Finmeccanica UK, GE Aviation, GKN, MBDA Missile Systems, Messier-Bugatti-Dowty, Rolls-Royce and Spirit AeroSystems. It has also been supported by the Department for Business, Innovation and Skills and the Department for Enterprise and Learning in the Northern Ireland Administration.

Emma Bossom

RAeS 2016 MEMBERSHIP SUBSCRIPTIONS

Membership Grade	2016 Subscription Rate £
Fellow or Companion	340
Fellow or Companion — 20% discount	270
Member	229
Member — 20% discount	184
Associate Member	142
Associate	131
E-Associate	46
Affiliate	118
Student Affiliate	0/44
Apprentice Affiliate	0/44
Baseline Rate	118

Notes

1. CPI Rate — Average 12 months to July 2015 — 0·5%.
2. 2016 Membership Subscriptions increased by CPI (rounded up/down to nearest £).
3. Members who have or will be reaching normal retirement age in 2016 are entitled to pay subscriptions at the Baseline Rate.
4. Members who have or will be retiring during the course of the year can apply for the 20% discount on their subscriptions. Note — if the 20% discount takes the subscription below the Baseline Rate then the Baseline Rate will apply.
5. Student (full time) and Apprentice Affiliates can either choose online membership only (Free) or membership which includes a subscription to the Society's *AEROSPACE* publication at £44pa — see the Society's website for more information.
6. Members have the option to pay their subscriptions by Direct Debits either in one sum in January 2016 or in ten monthly instalments from January 2016.

Administration Fees

Grade	Application Fee	Transfer Fee
Fellow or Companion	£143	£52
All other grades	£72	£52

Note 1: Please note the admin fees are paid in advance and are non-refundable.
Note 2: Employees working for companies which belong to the Society's Corporate Partner Scheme have the Entry and Transfer Admin Fees waived — check www.aerosociety.com/Corporate for details.

2016 Engineering Council Registration Fees

Category	2016 Annual Fees CEng	IEng	EngTech/ ICTTech	2016 Entry Fees CEng	IEng	EngTech/ ICTTech
Full	£36.80	£31.10	£17.90	£47.80	£40.40	£16.50
Interim	£13.10	£13.10	£13.10	£9.80	£9.80	£9.80
Reduced	£16.60	£13.90	£8.00	-	-	-

EVENTS www.aerosociety/**events**

6 October
Aeromedical Aspects of Flight Simulation
Dr Helen Hoar, AME/Pilot, Virgin Atlantic Airways
Aerospace Medicine Group Lecture

7-8 October
RPAS — Achievements and Challenges
President's Conference

Crown copyright/AAIB

14 October
100 Years of Accident Investigation — What's Next?
AAIB Centenary Conference

19 October
UK Wind-Tunnel Capabilities: Strategy Application and Verification for Future Requirements
Aerodynamics Group Conference

20 October
Cierva Lecture: The Theory and the Reality of Tiltrotor Convertiplane
Andrea D'Andrea, Integrated Project Team Lead (Future Tiltrotor), AgustaWestland
Rotorcraft Group Named Lecture

22 October
Contrail-Cirrus, Other Non-CO_2 Effects and Smart Flying
Greener by Design Workshop

26 October
The 1955 Supply of Military Aircraft White Paper: The First Post 1945 Procurement Crisis
Prof Keith Hayward
Historical Group Lecture

29 October
Trenchard Lecture: The Trick Cyclists: Neuropsychiatry and the Management of Aerial Warfare in the Royal Air Force, 1939-1945
Lynsey Shaw Cobden, University of Oxford
Air Power Group Lecture

30 October
Sustainability Solutions: Technology and Diversity
Women in Aviation and Aerospace Committee Conference

4 November
Brabazon Lecture
James Hogan FRAeS, CEO, Etihad Airways
Named Lecture

6 November
Careers in Aerospace LIVE 2015

11-12 November
Simulation-Based Training for the Digital Generation
Flight Simulation and Young Persons' Groups Conference

16 November
Light Aircraft Design
General Aviation Group Conference

All lectures start at 18.00hrs unless otherwise stated. Conference proceedings are available at **www.aerosociety.com/news/proceedings**

LECTURES www.aerosociety/**events**

A Harrier GR7 of 1 Squadron RAF during deck operations onboard HMS Illustrious. *Sir Donald Spiers will describe the Harrier at Medway on 21 October.* Crown copyright/LA (PHOT) Billy Bunting.

BEDFORD
ARA Social Club, Manton Lane, Bedford. 7 pm. Marylyn Wood, T +44 (0)1933 353517.
14 October — The ESA Rosetta Mission: Flying around a Comet. Dr Colin Snodgrass, Open University.
11 November — Flying the Shuttleworth Collection. Roger 'Dodge' Bailey, Chief Pilot.
9 December — Modern flight deck design. Les Evans.

BIRMINGHAM, WOLVERHAMPTON AND COSFORD
The National Cold War Museum, RAF Cosford. 7 pm. Chris Hughs, T +44 (0)1902 844523.
15 October — Flying and displaying historic vintage aircraft. Rod Dean.
26 November — The e-Go story. Adrian Hillcote, Chief Executive, and David Boughey, Sales and Marketing Manager, e-Go Aeroplanes. *Venue TBC.*
17 December — Warton flight operations in the 1970s. Eric Bucklow, 1970's Tornado Test Pilot.

BOSCOMBE DOWN
Lecture Theatre, Boscombe Down. Refreshments from 5 pm. Lecture 5.15 pm. Visitors please register at least four days in advance (name and car registration required) E secretary@BoscombeDownRAeS.org
13 October — 29th Sir Henry Tizard Lecture. Spitfire restoration. John Romain, ARC Duxford. *Ticket only.*
27 October — Catalina operations over the Antarctic. Tony Dyer, QinetiQ. *12.15 pm.*
10 November — Flight testing the e-Go. Keith Dennison, e-Go Aeroplanes. Joint lecture with the ETPSA.
24 November — The Human element — a disturbing trend in recent air accidents. Dr Garnet Ridgway, QinetiQ. *12.15 pm.*
8 December — myCopter: paving the way for personal air vehicles. Dr Mike Jump, University of Liverpool.

BRISTOL
Concorde Room, BAWA, Southmead Road. 6.30 pm. E elizabeth.cole@airbus.com
6 October — Transatlantic adventure. Eddie McCallum, Microlight Pilot. Joint lecture with LAA Bristol Strut and Bristol Aero Club. *Room 1, BAWA, Southmead Road. 7.30 pm.*
12 November — First Collar Lecture. Aeroelastics. Prof Jonathan Cooper, University of Bristol. *Pugsley Lecture Theatre, Queens Building, University of Bristol, University Walk, Bristol.*

BROUGH
Cottingham Parks Golf & Country Club. 7.30 pm. Ben Groves, T +44 (0)1482 663938.
14 October — Technology transformation and capability. Mike Murray, BAE Systems.
11 November — The last flight of Lancaster DV403. Prof Trevor Kerry.

CAMBRIDGE
Lecture Theatre 'O' of the Cambridge University Engineering Department, Trumpington Street, Cambridge. 7.30 pm. Jin-Hyun Yu, T +44 (0)1223 373129.
8 October — 100 years of aircraft manufacture at Yeovil. Dr Alisdair Wood, AgustaWestland.
29 October — The winning fuel in Formula 1 — passion, education and dedication. Ian Greig, Mercedes-Benz Grand Prix Future Cars Group, Brackley. Young Persons Lecture, joint lecture with IMechE and IET. Buffet (by ticket) at 6 pm, lecture follows.
19 November — Aircrew equipment — performance with protection. Dr Michael Trudgill, Head of Aircrew Equipment & Integration, RAF Centre of Aviation Medicine.
17 December — The Boeing RC-135V/W Rivet Joint. Wg Cdr Garry Crosby, RAF Ret'd. *Marshalls, Cambridge Airport. Visitors are required to register their attendance in advance with the Branch Sec at jin.yu@marshalladg.com or +44 (0)1223 373129.*

CANBERRA
ADFA Military Theatre. 6 pm. Jon Pike, E jonpike@grapevine.net.au
13 October — Assembling, testing and operating a Jabiru aircraft. Roger MacRury and associates.
10 November — Branch AGM.

CHESTER
The Airbus Conference Suite, Airbus UK, Chester Road, Broughton. 7.30 pm. Keith Housely, T +44 (0)151 348 4480.
14 October — Carbon fibre wing spar manufacture and fixed trailing-edge assembly for the Airbus A350 XWB. Darren John Winter, GKN Aerospace.
9 December — Airfix — scaling down reality. Simon Owen, Lead Researcher, Hornby Hobbies.

CHRISTCHURCH
Cobham Lecture Theatre,

Bournemouth University, Fern Barrow, Poole, Dorset. 7.30 pm. Roger Starling, E rogerstarling593@btinternet.com
22 October — Horseless carriage to helicopter: 100 years of Westland. Jeremy Graham, AgustaWestland.
26 November — Airfix Models. Simon Owen, Lead Researcher, Hornby Hobbies.
17 December — Palmair — Bournemouth's airline. Mike Phipp.

COVENTRY
Lecture Theatre ECG26, Engineering and Computing Building, Coventry University. 7.30 pm. Janet Owen, T +44 (0)2476 464079.
21 October — John Boyd Dunlop Lecture. From animals to aircraft: biological inspiration and bio-inspired air vehicles. Prof Graham Taylor, Department of Zoology, Oxford University.
12 November — Annual Dinner and Talk. Shipwrecked in the Antarctic. Georgina Hale. *Holiday Inn, London Road, Ryton on Dunsmore, Coventry.*
9 December — *Queen Elizabeth*-Class aircraft carriers — flagships for the future. Andrew Matters, QE Class Support Integration Manager, BAE Systems.

CRANFIELD
Vincent Auditorium, Cranfield University, Cranfield. 6.30 pm.
27 October — Lord Kings Norton Lecture. The work of the Aviation Safety Regulator. Padhraic Kelleher, Head of Intelligence, Strategy & Policy, CAA.

CRANWELL
Room 64, Whittle Hall, RAF Cranwell. 7.30 pm. Prof Trevor Kerry, E tk.consultancy@ntlworld.com
5 October — Do17Z — recovering and preservation. Darren Pridday, Manager, Conservation Centre, Royal Air Force Museum Cosford.
2 November — WW2 fighter combat — compare and contrast the main fighters. Paul Stoddart.
7 December — Ethics in the operational use of drones. Dr Peter Lee. *Daedalus Officers' Mess, RAF Cranwell. 7 pm.*

FARNBOROUGH
BAE Systems Park Centre, Farnborough Aerospace Centre. 7.30 pm. Dr Mike Philpot, T +44 (0)1252 614618.
13 October — The future of the Hawk. Graeme Codner, Chief Engineer Hawk, BAE Systems.
17 November — Cody Lecture. Aerodynamics as the basis of aviation. Dr John Ackroyd.
8 December — Green Lecture. Aircraft safety and evacuation. Prof Ed Galea, Director, Fire Safety Engineering Group, University of Greenwich.

A CV-22 Osprey and a MH-53 Pave Low fly over the coastline near Hurlburt Field, Florida. The V-22 will be discussed by Lt Col James Peterson at Loughborough on 13 October and by Rick Lamaster at Preston on 14 October. USAF/Senior Airman Julianne Showalter.

GATWICK
CAA, Aviation House, Gatwick Airport South. 6.30 pm. Don Bates, T +44 (0)20 8654 1150.
7 October — 3D printing and digital technology. Kevin Smith, Global Applications Director, Voxeljet and Steve Ashworth, Technical Director, Aeromet International PLC.
11 November — The A400M in RAF service. Sqn Ldr J J Harrison, OC C Flt, XXIV Sqn.
2 December — The Air Accident Branch. Keith Conradi, Chief Inspector of Air Accidents.
15 December — Airline safety. Capt David Heath, Training Captain, easyJet. Joint lecture with CILT. Harlequin Theatre, Redhill.

GLOUCESTER AND CHELTENHAM
Messier-Bugatti-Dowty, Restaurant Conference Room, off Down Hatherley Lane. 7.30 pm. Peter Smith, T +44 (0)1452 857205.
20 October — Spitfire Squadron. Paul Fowler, Enstone Flying Club.
17 November — Aviation and intelligence. Mike Bryant.
15 December — Ageing aircraft — keeping the Hawk flying. Wg Cdr Ross Priday.

HAMBURG
Hochschule für Angewandte Wissenschaften Hamburg, Berliner Tor 5 (Neubau), Hörsaal 01.12, Hamburg. 6 pm. Richard Sanderson, T +49 (0)4167 92012.
19 November — Aircraft conservation — the Dornier Do17. Darren Pridday, Manager, Conservation Centre, Royal Air Force Museum Cosford. Joint lecture with DGLR, HAW and VDI.
24 November — Annual Christmas Dinner and Lecture. David Owens, Airbus Senior Director, Flight Crew Training Policy. *Anglo-German Club, Harvestehuder Weg 44, 20149 Hamburg. 7 pm. Registration required.*
3 December — The cabin environment and crew performance. Prof Michael Bagshaw, Visiting Professor of Aviation Medicine, Kings College London.

HATFIELD
University of Hertfordshire, Hatfield. 7 pm. Maurice James, T +44 (0)7958 775441.
21 October — Pilot psychology. Prof Peter Orton.
18 November — HIRF/lightning protection. Peter Moore.
16 December — e-Go flight test programme. Keith Dennison, e-Go Aeroplanes. *6.45 pm.*

HEATHROW
Theatre, British Airways Waterside, Harmondsworth. 6.15 pm. For security passes please contact David Beaumont, E secretary. raeslhr@gmail.com or T +44 (0)7936 392799.
8 October — Aircraft fatigue from Comet to Boeing 787. Dr Andrew Halfpenny, Chief Technologist HBM-nCode.
12 November — RPAS operations and integration in civil and military airspace. Dr Stuart Gilmartin, Director, Gilmartin Global Consultancy.
10 December — Charles Abell Lecture. Marshall of Cambridge — past, present and future. Terry Holloway, Support Executive — Marshall Group.

LOUGHBOROUGH
Room U020, Brockington Building, Loughborough University. 7.30 pm. Colin Moss, T +44 (0)1509 239962.
13 October — The CV-22 Osprey — a truly versatile workhorse. Lt Col James S Peterson, 7 SOS Operations Manager, RAF Mildenhall.
3 November — Human-powered flight. Dr Bill Brooks, P & M Aviation.
17 November — Typhoon: current and future capability. Mark Bowman, Chief Test Pilot BAE Systems. Joint lecture with the Loughborough Students Flying Club (LSFC).
8 December — The Future of safety in air traffic management. Sam Espig, Head of Safety Strategy Development, NATS. Joint lecture with Loughborough University Velocity Society.

MEDWAY
Staff Restaurant, BAE Systems, Marconi Way, Rochester. 7 pm. Robin Heaps, T +44 (0)1634 377973.
21 October — The life and times of the Harrier. Sir Donald Spiers.

MUNICH
Deutsches Museum München (Ehrensaal). 7 pm.
28 October — Willy Messerschmitt Lecture. Fliegende Simulatoren und Technologieträger. Prof Hameln.

OXFORD
Magdalen Centre, Oxford Science Park, Oxford. 7 pm. Nigel Randall, E oaktree.cottage@btinternet.com
17 November — A new light aircraft design and development project. Andrew Barber.

PRESTON
Personnel and Conference Centre, BAE Systems, Warton. 7.30 pm. Alan Matthews, T +44 (0)1995 61470.
14 October — V-22 Osprey. Rick Lamaster, Boeing.
11 November — Westland 100th anniversary. Jeremy Graham, AgustaWestland.
9 December — Taranis flight testing.

PRESTWICK
The Aviator Suite, 1st Floor, Terminal Building, Prestwick Airport. 7.30 pm. John Wragg, T +44 (0)1655 750270.
12 October — How tiny spacecraft are revolutionising the space industry — the story of Clydespace. Craig Clark.
9 November — Cody to Concorde. Richard Gardner. Joint lecture with IMechE.
14 December — Going bush. Paul Catanach.

QUEENSLAND
Hilton Cairns Hotel, Queensland.
25-27 November — Seventh Asia-Pacific International Symposium on Aerospace Technology (APISAT).

SEATTLE
Museum of Flight, 9404 East Marginal Way South, Seattle, Washington. 6.30 pm.
14 November — Joe Sutter Dinner Lecture. The strange career of the American Spaceplane: NASA and the quest for routine human space operations. Dr Roger D Launius, Associate Director of Collections and Curatorial Affairs at the Smithsonian Institution's National Air and Space Museum.

SOLENT
Southampton University. 7.30 pm. Chris Taylor, T +44 (0)1489 445627.
20 October — Planning the journey for hybrid-electric propulsion for commercial passenger aircraft — a Rolls-Royce perspective. Kevin Daffey, Global Head of Electrical Power and Control Systems, Rolls-Royce.

Afterburner
Diary

SOUTHEND
The Royal Naval Association, 79 East Street, Southend-on-Sea. 8 pm. Sean Corr, T +44 (0)20 7788 0566.
13 October — BAC One-Eleven. Stephen Skinner.
10 November — Cosford Lecture.
8 December — The development of aircraft simulation — a vital part of aircraft design and airline training. Capt Hugh Dibley, Consultant Flight Instructor, Airbus Training UK.

STEVENAGE
The Lunch Pad Restaurant, Airbus Defence and Space, Gunnels Wood Road, Stevenage. 6 pm. Matt Cappell, E raesstevenage@gmail.com
13 October — SSTL — changing the economics of space composites — the engineering challenges. Chris Hamar. Joint lecture with IMechE. *6.30 pm.*
12 November — Engineering for the Red Planet: the ExoMars Rover. Abbie Hutty.
18 November — RAF Halton Trenchard Museum and Tring Brewery Trip.
1 December — Hawker Hunter Aviation. Matt Potulski.

SWINDON
The Montgomery Theatre, The Defence Academy of the United Kingdom, Joint Services Command Staff College, Shrivenham. 7 pm. New attendees must provide details of the vehicle they will be using not later than five days before the event. Photo ID will be required at the gate (Driving Licence/Passport). Advise attendance preferably via email to raeswindon@gmail.com or Branch Secretary Colin Irvin, T +44 (0)7740 136609.
7 October — The Berlin Airlift. Alec Chambers.
4 November — In-flight refuelling, past, present and future. James Kemmett.
2 December — The V force and the Cold War. David Head.

TOULOUSE
Symposium Room, Airbus SAS/HQ, B01, Campus 1, Blagnac. 6 pm. Contact: Pass@RAeS-Toulouse.org for a security pass.
20 October — Space tourism — rocketing to new heights. Joint lecture with 3AF.

WEYBRIDGE
Brooklands Museum, Weybridge. 6.45 pm. Ken Davies, T +44 (0)1483 531529.
21 October — Concrete piercing bombs. Reg Milne.

YEOVIL
Dallas Conference Room 1A, AgustaWestland, Yeovil. 6 pm. David Mccallum, E david.mccallum@agustawestland.com
15 October — 20th Penrose Lecture. Wildcat operations. Cdr Louis Wilson-Chalon RN.

BAC One-Eleven 407AW, YS-18C, of TACA International at Managua, Nicaragua. The BAC One-Eleven will be discussed by Stephen Skinner at Southend on 13 October. RAeS (NAL).

PETER JAMES CONCHIE

A full obituary for Peter may be found on the Society's website at: http://www.aerosociety.com/News/Society-News/3582/OBITUARY-PETER-CONCHIE

OBE FRAeS
1928-2015

Peter joined GEC Research Laboratories in Wembley straight from school to work on valves and cathode ray tubes. He was called up for National Service in the RAF in 1946 where he repaired radar equipment and he returned to GEC Wembley in 1949. While there, he began an external degree at London University. In 1953 Peter joined de Havilland Propellers in Hatfield as a Flight Observer and Electronic Engineer.

In the mid 60s Hawker Siddeley Dynamics (HSD), as it had become, at Stevenage won the contract to design and build the ESRO II spacecraft to study solar astronomy and cosmic rays and Peter was called on to obtain and install several vacuum chambers of varying sizes. He was also invited to be the Assembly Integration and Test Manager for ESRO II but, even more significant was that when preparing the paperwork for the justification and installation of the largest 8 x 8 foot chamber he met Anne. They married on 31 May 1967.

The European communications satellite was born but, to justify the investment, the MESH Consortium had to be seen selling this capability round the world. This led to Peter instituting an OTS improvement programme to increase its performance to make it truly competitive on the world market. The family of five European Communications Satellites (ECS) for Eutelsat was the result.

With this job done, Peter was conveniently offered the chance to return to Hatfield in 1978 to run the Infra-Red Division and he was given responsibility for the design and build of the guidance head for the new Advanced Short Range Air-to-Air Missile (ASRAAM).

Soon promoted to Executive Director Aircraft Equipments, Peter took over the Propeller Division too, with two main products, cold air units (CAUs) and windpower generators.

By this time Peter had become Director ASRAAM and HSD, by now the Air Weapons Division of the British Aerospace Dynamics Group, had won the Tornado ASRAAM.

In 1982/3 Peter became Director Air-to-Air Missiles at Hatfield just as there was talk of the site being shut down and the Division moved to Stevenage Site A. Fortunately, he was offered what was effectively his old job back at Stevenage Site B and he became Business Development Director for what was now British Aerospace Space and Communications.

Peter retired in 1990 and continued to pursue his hobbies with his usual energy and enthusiasm, supporting the Nene Valley Railway and making violins and cellos.

Corporate Partners

NEW PARTNERS

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

ARPAS UK
Sherwood House, 41 Queens Road, Farnborough, Hants GU14 6JP UK
E info@arpas.uk
W www.arpas.uk
Contact
Paul Rigby, UK & EU Regulations

ARPAS UK is the professional trade association for remotely piloted aircraft systems in the UK. It is a not-for-profit association run by an elected committee. We represent the membership on a number of working groups, safety partnerships and industry co-ordination groups with the CAA, NATS and the DfT. All members are actively encouraged to be involved in our activities and we have a thriving support network. In addition to being a learned association we actively promote collaboration and business opportunities between members.

ACCELERATE CORPORATION
34 Churchill Tower, South Harbour Street, Ayr KA7 1JT, UK
W www.acceleratecorporation.com
Contact
Bruce Thomson, Managing Director

Accelerate Corporation is developing SpaceIPX (Space IP Exchange) which is a digital portal that facilitates strategic growth through a genuine holistic approach to the exploitation of space through both existing and future technologies. The SpaceIPX system has processes that values space intellectual property, the intellectual asset (IA) is underwritten and then the IA is leveraged through a tax efficient finance raising system collateral to maximise the commercial value.

Accelerate Corporation also has a large drone system called Metaranis under protocol development to determine exact offshore situations and to accurately report on real-time weather. MaCloudAir is potential new direct long-haul airline.

EVENTS

Please note: attendance at Corporate Partner Briefings is strictly exclusive to staff of RAeS Corporate Partners.

Monday 12 October 2015 / London (*registration at 16.30 hrs*)
Being an intelligent MoD customer
Corporate Partner Briefing by AM Sir Stephen Hillier, Deputy Chief of Defence Staff (Military Capability), Ministry of Defence
Sponsored by:
Raytheon

Thursday 22 October 2015 / London (*registration at 17.30 hrs*)
SDSR Update (title TBC)
Corporate Partner Briefing by Philip Dunne MP, Minister for Defence Procurement, Ministry of Defence
Sponsored by:
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For further information, please contact Gail Ward
E gail.ward@aerosociety.com or T +44 (0)1491 629912

THE AIM OF THE CORPORATE PARTNER SCHEME IS TO BRING TOGETHER ORGANISATIONS TO PROMOTE BEST PRACTICE WITHIN THE INTERNATIONAL AEROSPACE SECTOR

Contact:
Simon Levy
Corporate Partner Manager
E simon.levy@aerosociety.com
T +44 (0)20 7670 4346

RAeS Corporate Partner Scheme

The RAeS is the ONLY professional body dedicated to the entire aerospace community.

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By joining the Society's Corporate Partner Scheme, your organisation aligns itself to the Charter of the Royal Aeronautical Society and demonstrates a commitment to professional development of engineering and technical staff within the aerospace community.

AIM
The aim of the Corporate Partner Scheme is to bring together organisations to promote best practice within the international aerospace sector. With over 200 members worldwide, the scheme provides a respected and recognised independent forum of discussion and information exchange on issues facing the aerospace sector, as well as providing unique networking opportunities with influential figures in the industry, government and public sector.

Recent elections to Engineering Council Registration

FELLOWS

Srinivas Bhamidipati
Andrew Cornish
Gary Elliott
Charles Gummow
Gregory Hood
David Jacobson
Shelley Robertson
Bishnujee Singh

MEMBERS

Rizwan Ahmed
Peter Antonenko
Damian Penneck
Ralph Petritsch
Gordon Thomson

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Georgy Markin
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James Bairstow
John Konnakkottu
Michael Lovering
Milan Odedra
Gareth Roberts
Charith Johanne Wijesinghe

AFFILIATES

Robert Adams
Claude Castan
Spencer Ferrier
Suranga Samarasinghe
Peter Trafford-Smith

STUDENT AFFILIATES

Duncan Bewick
Finn Catling
Sebastian Hall

CHARTERED ENGINEERS

Isaac Alcaide
Paul Ashcroft
Sam Ashworth
Timothy William Baker
Alan Bassett
Stephen Paul Briancourt
Hamesh Bukhory
Christopher David Burke
David Henry Carr
Nigel Phillip Dean
Paul Eccleston
Thomas James Fell
Beth Alison French
Sharon Louise Fuller
Tanya Louise Gamble
Richard Quine Gilbertson
Kenneth James Gill
Paul Anthony Gilmartin
Kajal Haria
Justin John Harwood
Andrew James Hegg
Steven William Holland
Satish Christoph Khakhar
James McKenzie Kneller
Kostas Ladiellis
Ian Anthony Lakin
Ben Lambert
Richard John Lipscomb
Helen Louise Lockett
Stuart John Mackrell
Miranda Rose Mills
Gregory John Mitchell
Rachel Moore
Paul Henry Morgan
Adam James Newman
Graham Alexander Nimmo
Russell James Nowy
Paul O'Gara
Jonathan Paisley
Adam Roy Pike
Marc Ridings
Ian Jonathan Ross
Gareth David Rudge
Gary John Norman Slavin
Lara Elizabeth Small
Malcolm Alexander Smye
Brian Richard Spalding
Robin Michael Trewinnard-Boyle
Matthew Paul Walton
Gary Stuart Way
Jonathan Charles Richard Williams
Nam-Taan Woods Mestre
Yizhi Zhi Wu

INCORPORATED ENGINEERS

Thomas Carl Bartlett
Mark Andrew Bayley
Simon Robert Blackburn
Eleri Louise Cooling
Simon Robert Deeks
Michael Bernard Hollings
Timothy Charles Kingswell
Mark Lennards
Cameron Andrew McKay
Danny Lee Moore
Andrew Geoffrey Parker
Matthew Charles Read
Gavin Jamie Scott
Jonathan Sixsmith
Jack Small
Devon Sumner
Michael John Whitehead
Stephen Whitehouse
Stephanie Louise Wilde

ENGINEERING TECHNICIANS

Joseph Daniel Cocks
Peter Janik
Jeremiah Leshao Matayian
Deborah Ann Needham

Copy date
for the next issue of *AEROSPACE* is 2 October.

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President-Elect: **Prof Chris Atkin**

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New Zealand: **Gp Capt Frank Sharp**
Pakistan: **AM Salim Arshad**
South African: **Dr Glen Snedden**

WITH REGRET

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

Alan Barlow CEng FRAeS 93

Timothy Michael Birchman ARAeS 72

Malcolm Humby Brown AMRAeS 81

Albert David Fowler CEng MRAeS 88

Lawrence Frank Gillard CEng FRAeS 86

Leslie James Green CEng FRAeS 89

Jeffrey Arthur Lane CEng MRAeS 83

Herbert Harry Pearcey CEng FRAeS 93

Derek John Rowlands AMRAeS 78

Peter Duncan Stewart CEng MRAeS 87

Ivan Ray Yates CBE FREng FRAeS 86

The Last Word

COMMENTARY FROM

Professor Keith Hayward
FRAeS

Son of Hotol — and more conventional routes to space

So Airbus has an American patent for a hypersonic aircraft. Stories of Europe to the Far East in less than three hours immediately leap into the media. Shades of the all-British Hotol and its more recent manifestation in the Reaction Engines' Sabre project. Certainly hypersonic propulsion is on the leading edge of aerospace, with active programmes in the US and elsewhere. At one point, the Japanese were in the field to leapfrog into a world lead. There are some signs that China may also be in the field.

The US has DARPA and the USAF teamed to follow up work done on the X-51 demonstrator; but the interest here is as much directed at potential military uses as a future strategic bomber as reviving 'Concorde commuting' (any hypersonic airliner is likely to be aimed at a very high premium passenger). But let's not get too cynical too quickly: all of this is still very much in the realms of concept work. A 30-year wait for a ticket to Tokyo will make Virgin Galactic's timescale for a lob into near-space very near term.

Reducing the kilogram cost to orbit

If this technology turns up a way of dramatically reducing the cost of putting stuff into space, that would be a very worthwhile result. The Virgin team, as well as Elon Musk's SpaceX, is already trying its best to revolutionise launcher economics, although the former for the moment is confined largely to putting small satellites into near-Earth orbit. Both imply a game-changing moment in the space business. Musk intends to charge half the price of a current telecommunications satellite launch with a heavy-lift Falcon. This has put a rocket — forgive the pun — under the current players and their comfortable business models that contain a heavy element of public subsidy or closed markets.

Ariane 6 is go

News that agreement has been reached on terms to develop an Ariane 6 has therefore come at a very opportune moment. Aiming to be in service by 2020, the new Franco-German team of Airbus-Safran launchers is also looking to cut Ariane launch costs by half, getting close to a SpaceX price but implying the Ariane premium for proven reliability. This entails the radical step of imposing commercial discipline on the way in which European space programmes are developed. Instead of allocating subcontracts on a 'fair return' basis — one Euro of national investment equals one Euro's worth of work — Ariane 6 will seek the best bids for a long-term contract. In return, the European Space Agency will be able to cut its launch price subsidy.

This may have some political costs if junior members of the European space industry lose out and become less inclined to support future space activities: there are also signs of a rearguard action from the French national space agency CNES, which may also see some of its direct influence over European launcher development, diminish. The French are certainly prepared to lead investment in new infrastructure at the French Guiana launch complex.

Reusability is the key

But Ariane, and its contemporaries, is still old-style technology: linear descendants of the pioneering rockets and ballistic missiles of the 1950s. Later versions of Falcon will have some reusable elements further to cut launch costs — a development that has seen an ESA investment in similar concepts. True reusability — probably based around a hypersonic aircraft — will eventually have its day and, as from the dawn of space exploration, military interest will drive things forward. At that point Europe may find itself following, rather than leading, unless substantial sums can be found to stay in the field.

> TRUE REUSABILITY WILL EVENTUALLY HAVE ITS DAY AND, AS FROM THE DAWN OF SPACE EXPLORATION, MILITARY INTEREST WILL DRIVE THINGS FORWARD

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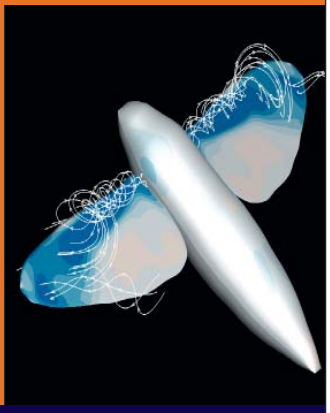

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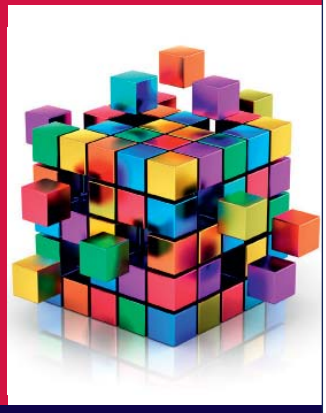

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