

AERO SPACE

www.aerosociety.com

COMMAND PERFORMANCE

AIRCRAFT COMMANDERS AND
DECISION MAKING IN THE
COCKPIT

June 2014

**AIRBUS PLANS
ELECTRIC FUTURE**

**COMING STORM:
TYPHOON UPGRADES
GATHER PACE**

UAVS OVER AFRICA



ROYAL
AERONAUTICAL
SOCIETY

FUTURES DAY

18 JULY 2014



GET THEIR CAREERS OFF TO A FLYING START IN AEROSPACE & DEFENCE



Futures Day 18 July 2014

Futures Day at Farnborough International Airshow 2014 has been designed to give groups of young people aged 11 – 21 a chance to see the exciting career opportunities available in the dynamic sectors of Aerospace and Defence.

Groups from schools, universities and youth associations can experience the exciting prospects available and be motivated in their study of STEM subjects.

The interactive, informative and engaging programme enables them to see first-hand the variety, innovation and expertise that makes a career in these key sectors so rewarding.

NOT TO BE MISSED...

-  Careers fair
-  Interactive area
-  Demonstrations
-  Lectures
-  Flight simulator
-  Awards presentations

RESERVE YOUR FREE TICKETS TODAY!

Contact Claire Parsons on 020 7091 4507 or email claire.parsons@adsgroup.org.uk
www.adsfarnborough.co.uk/futures



Command performance
What makes a good aircraft commander? A report on RAeS Flight Operations Group conference.

14



Birds of prey
The USAF's CV-22 Osprey brings a new long-range platform to its Special Operations Command.

26

Contents

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

Comment

Hands off my 'drone'

Only as recently as perhaps ten years ago, the concept of using unmanned aerial systems (UAS) for civil or commercial uses was a fringe idea — championed only by a few individuals. The UAS (or RPAS) was seen as a military spy asset and killing machine. Today, while the military UAS still outnumber civil UAS, the peaceful uses and applications for this aerial technology are coming thick and fast. Civil UAVs now encompass everything from aerial photography and surveying, to wildlife protection (See UAVs over Africa p 22), to the aviation maintenance sector. Create a 'drones to deliver X' story — whether 'X' be beer, books, pizza or engagement rings and you have an instant headline. Gimmicks aside, the creative uses for civil UAS, now seem to be expanding at an exponential rate. Indeed, it could be argued that the catch-all word 'drone' is slowly losing its negative connotations as more and more an image of a mini quadcopter replaces the Predator in UAS news stories.

But, as small UAS invade the civil sphere, so do the societal and legal challenges. Already in the UK we have seen the first prosecution for unlawful UAS flying — the CAA sending a strong message that unmanned vehicle operators need to comply with the rules. In the more litigious US, however, the legal challenges are now coming from the UAV community itself. In one case, a non-profit search and rescue organisation from Texas is fighting the FAA to overturn its blanket ban on commercial UAS use.

In another campaign, the FAA is being challenged by 'drone journalists' that its restrictions are a threat to the First Amendment freedom of speech. The UK CAA's own rules on 'drone journalism' seem to be clear — that any imagery sold — even if acquired 'accidentally' while the owner is flying for pleasure means that it is work for commercial gain and thus needs a prior permit.

Yet, this entirely sensible ruling ignores the fact that today many news photographs, (especially of breaking news such as accidents, riots and disasters) come from 'citizen journalists', or members of the public armed with smart phones and video cameras. In short, battle lines are being drawn on both sides of the Atlantic. In the UK, the CAA has ruled that UAS are aircraft, first and foremost. Meanwhile in the US — the 'drone journalism' lobby is arguing that these small UAS are essentially 'flying cameras' — and that any barriers are an attack on press freedom to report the news. Expect these sorts of legal tussles between flight safety and freedom to exploit civil UAVs to only increase in number as this disruptive technology continues to outpace legislation.

Tim Robinson

tim.robinson@aerosociety.com

Editor-in-Chief
Tim Robinson
+44 (0)20 7670 4353
tim.robinson@aerosociety.com
Deputy Editor
Bill Read
+44 (0)20 7670 4351
bill.read@aerosociety.com
Publications Manager
Chris Male
+44 (0)20 7670 4352
chris.male@aerosociety.com
Production Editor
Wayne J Davis
+44 (0)20 7670 4354
wayne.davis@aerosociety.com
Editorial Assistant
Alfonso Serrano Alcalá
Editorial Office
Royal Aeronautical Society
No.4 Hamilton Place
London W1J 7BO, UK
+44 (0)20 7670 4300
publications@aerosociety.com
www.aerosociety.com

AEROSPACE is published by the Royal Aeronautical Society (RAeS).

Chief Executive
Simon C Luxmoore

Advertising
Emma Bossom
+44 (0)20 7670 4342
emma.bossom@aerosociety.com

Unless specifically attributed, no material in AEROSPACE shall be taken to represent the opinion of the RAeS.

Reproduction of material used in this publication is not permitted without the written consent of the Editor-in-Chief.

Printed by Buxton Press Limited, Palace Road, Buxton, Derbyshire SK17 6AE, UK

Distributed by Royal Mail

AEROSPACE subscription rates:
Non-members, £150

Please send your order to:
Dovetail Services Ltd, 800 Guillat Avenue, Kent Science Park, Sittingbourne, Kent ME9 8GU, UK.
+44 (0)844 848 8426
+44 (0)844 856 0650 (fax)
ras@servicehelpline.co.uk

Any member not requiring a print version of this magazine, please contact: membership@aerosociety.com
USA: Periodical postage paid at Champlain New York and additional offices.

Postmaster: Send address changes to IMS of New York, PO Box 1518, Champlain NY 12919-1518, USA.

ISSN 2052-451X

Regulars

4 Radome
The latest aviation and aeronautical intelligence, analysis and comment.

10 Antenna
Howard Wheeldon considers the UK ISTAR and MPA capability — are there brighter skies ahead?

12 Transmission
Your letters, emails, tweets and feedback.

58 The Last Word
Keith Hayward on the US Tea Party coalition, the Exim Bank and public spending on advance technology.

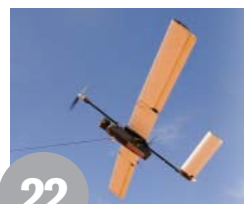
Features



Eurofighter/Callaro

18

In the Typhoon's path
How new missile capabilities and the Aerodynamic Mod Kit will enhance the Eurofighter Typhoon.



WWF

22

UAVs over Africa
The rise of UAVs in Africa for civil and military applications.



Ministry of Economic Development Trade & Employment

34

Made in Ontario
Report on the powerhouse of Canadian aerospace that is Ontario.



38

30 Thriving through turbulence
Facing the financial challenges of globalisation.

It's electrifying
Airbus enters the GA sector with a new, electric aircraft family.

41 Afterburner

- 42 Message from our President
- 43 Message from our Chief Executive
- 44 Book Reviews
- 47 Library Additions
- 48 Cuthbert-Hodgson Collection
- 50 Education & Skills Committee update
- 52 Diary
- 53 Alan Bristow Lecture
- 54 Corporate Partners
- 55 Obituaries
- 56 RAeS Elections

Online

Additional features and content are available to view online on www.media.aerosociety.com/aerospace-insight
Including: UK steps up F-35 preparations, Game on for aerospace, Shooting yourself in the foot — again, Airships — A new dawn?

Radome

INTELLIGENCE / ANALYSIS / COMMENT

Rotor hub

Elastomeric/metal rotor hub — developed from the S-92. Fail-safe bearings accommodate blade lead, lag, flap and pitch movement without requiring oil lubrication.

Gearbox

Split-torque transmission developed from RAH-66 Comanche maintains high speeds for longer durations. Three input modules take power from one engine and divide it between four shafts driving output gear turning the main rotor.

Fourth generation blades

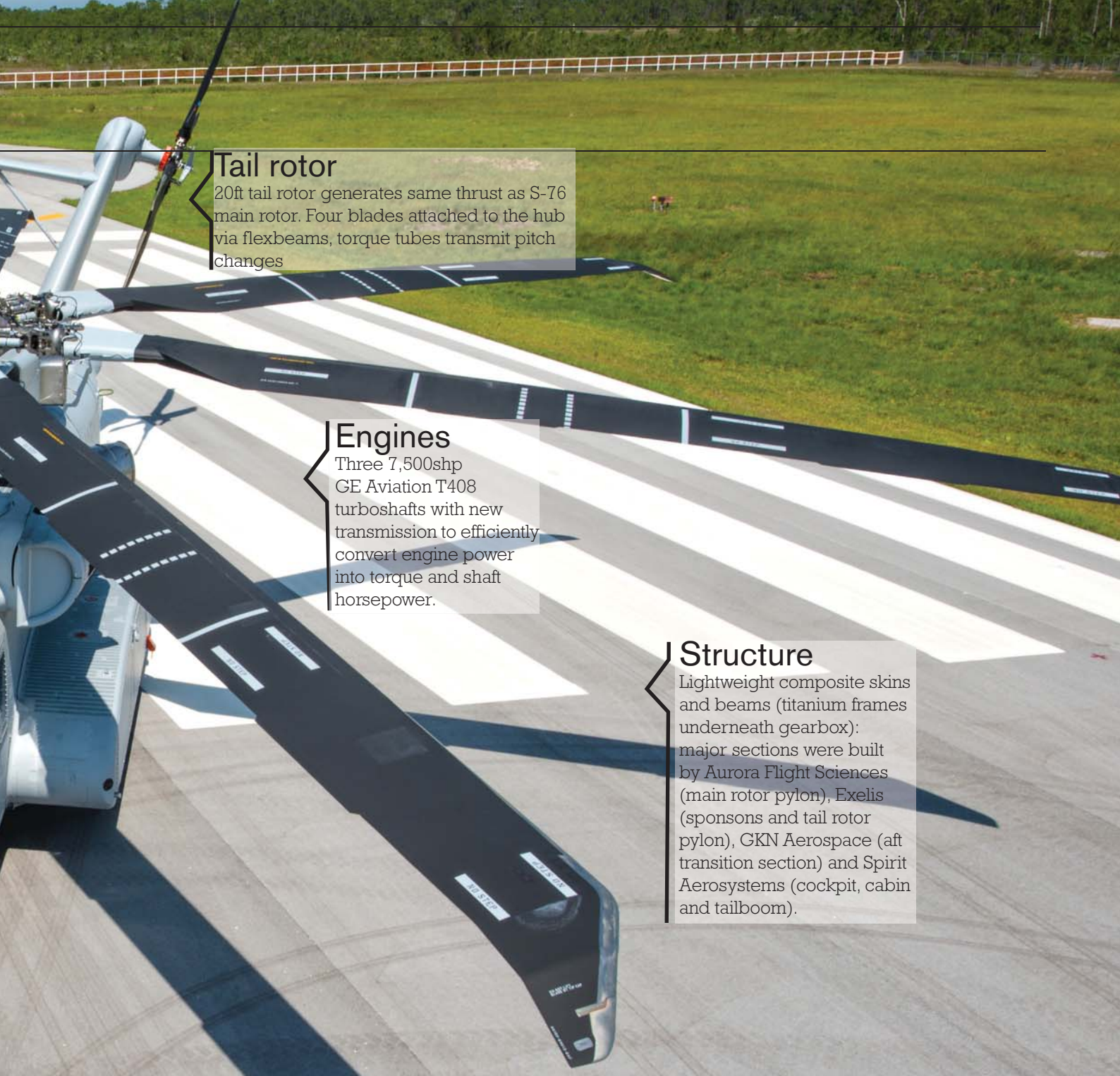
Seven composite blades 35ft long, nearly 3ft chord. New aerofoils feature twist, taper and tip shape optimised to increase performance in hover and forward flight. Main rotor has automatic blade fold.

Cockpit

Rockwell Collins digital glass cockpit with five liquid-crystal flight displays. Derived from Common Avionics Architecture System used in special ops MH-60M. Sidestick cyclic controllers are used with tactile cueing.

Performance

Payload: 27,000lb
Mission radius: 110nm
Gross take-off weight — 88,000lb max



Tail rotor

20ft tail rotor generates same thrust as S-76 main rotor. Four blades attached to the hub via flexbeams, torque tubes transmit pitch changes

Engines

Three 7,500shp GE Aviation T408 turboshafts with new transmission to efficiently convert engine power into torque and shaft horsepower.

Structure

Lightweight composite skins and beams (titanium frames underneath gearbox): major sections were built by Aurora Flight Sciences (main rotor pylon), Exelis (sponsons and tail rotor pylon), GKN Aerospace (aft transition section) and Spirit Aerosystems (cockpit, cabin and tailboom).

DEFENCE

Hail to the King

Rolled out on 5 May was the Sikorsky MH-53K heavy lift helicopter for the US Marine Corps. Now dubbed the 'King Stallion' the CH-53K will replace the CH-53E in USMC service. Compared to the 'E' model the King Stallion can carry three times the payload, with engines that have 57% more power, yet with 20% lower fuel consumption. Seven composite rotor blades provide 12% more surface area than the CH-53E's rotors. First flight for the King Stallion is set for the end of 2014, with entry into service in 2019. The USMC will field 200 King Stallions.



Radome

SPACEFLIGHT

Inmarsat to offer free aircraft tracking

In the wake of MH370, UK-based satellite operator Inmarsat has offered a free tracking service to all the world's passenger airlines which would check the position of aircraft every 15 minutes. Inmarsat says that its tracking equipment

is already fitted to 90% of current wide-body aircraft and that it would bear the £3m annual cost of tracking aircraft. The company already provides a similar service to ships with no charge for distress calls.

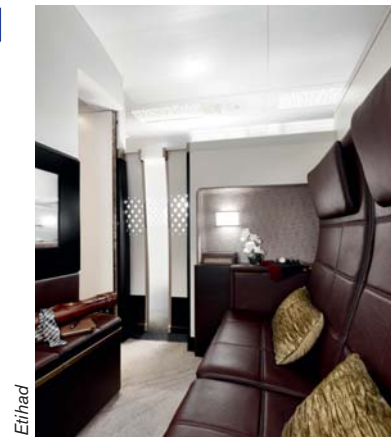
AIR TRANSPORT

Etihad reveals VIP A380 'The Residence' suites

UAE airline Etihad is taking luxury to new heights by launching exclusive VIP suites onboard the upper deck of its A380s.

Called 'The Residence' the suite includes a lounge

(right), double bedroom, ensuite shower and a personal butler. A one way ticket for The Residence is £15,000. The suites will debut on the carrier's Abu-Dhabi-London A380 services later this year.



Etihad

AEROSPACE

Dassault makes history with UCAV formation flight



On 20 March Dassault Aviation made aeronautical history when it conducted the first mixed formation flight with manned aircraft and a UCAV. The formation saw Dassault's nEUROn demonstrator fly in close formation with a Rafale fighter and Falcon 7X for an hour and 50 minutes out over the Mediterranean.

Dassault

EC225 gearbox fix

EASA has certificated a redesign of the Airbus Helicopters EC225 gearbox shaft. The redesigned vertical bevel gear shaft follows an investigation into the types' gearbox after Super Puma ditchings in the North Sea. It will be retrofitted to all the EC225s concerned.

NEWS IN BRIEF

The UK CAA has commissioned a study from Airbus Defence and Space to look at the feasibility of using passive radar for air traffic management.

Parent company of BA and Iberia, IAG, has announced a reduced 1Q loss of €150m down from €278m in Q1 2013. The group attributes the recovery to a halving of losses at Spanish carrier Iberia which is now expected to

return to profit this year.

The Lockheed Martin F-35 Lightning II is to make its international air show debut in the UK this summer at the Royal International Air Tattoo and Farnborough Air Show. Three F-35B STOVLs are set to make a transatlantic trip — one UK F-35B and two USMC fighters.

The unmanned NASA spacecraft LADEE has ended its 100-day Moon

exploration mission by being crashed on to the lunar surface. During the \$280m mission, LADEE identified various components of the thin lunar atmosphere — neon, magnesium and titanium, among others — and studied the dusty veil surrounding the Moon kicked up by impacting micrometeorites.

Four people are reported to have been killed when a Piper PA-32 light aircraft

collided with one of 27 213ft high wind turbines in South Dakota. The incident occurred on 27 April during foggy conditions.

On 11 March, Sikorsky conducted the first test flight of an 'optionally piloted' UH-60 Black Hawk. The flight test took place at the company's facility in Florida, where the modified helicopter was remotely controlled using a man-portable ground station. The trial forms part

of a US Army/Sikorsky project called MURAL (manned/unmanned resupply aerial lifter).

Air traffic in California was thrown into chaos and hundreds of flights delayed on 30 April after a U-2 spy aircraft at 60,000ft triggered a software bug that caused ATC computers to attempt to re-route all aircraft below it.

Denmark has issued requests for information

AEROSPACE

FAA UAV ban challenge

Sixteen US news organisations have filed a brief with the NTSB against a \$10,000 fine imposed on aerial photographer Raphael Pirker from flying a UAV near the University of Virginia while making a commercial video. The groups claim that news gathering is a First Amendment right and that the FAA cannot impose rules against the commercial use of UAVs

when it hasn't yet issued regulations regarding their use. Meanwhile, a Texas-based search and rescue charity has filed a lawsuit against the FAA for its ban on non-recreational UAV flying. EquuSearch, says the ban on UAVs being used for search efforts to locate missing persons, is "unlawful, arbitrary, capricious, an abuse of discretion and not otherwise in accordance with the law."

AIR TRANSPORT

easyJet to use UAVs for MRO checks



easyJet

UK budget carrier easyJet has revealed it is to trial mini UAVs to help inspect its fleet of Airbus A319s and A320s. The UAVs will use laser scanning, potentially cutting inspection time from more than a day to a couple of hours. The airline is also testing 'augmented reality' glasses.

DEFENCE

First F-16 for Iraq AF flies



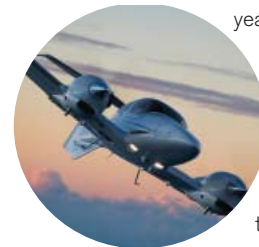
On 7 May, Lockheed Martin conducted the first flight of a F-16IQ Block 52 destined for the Iraqi Air Force from its plant in Fort Worth, Texas. The two-seater is the first of 36 to be acquired by Iraq.

Lockheed Martin

GENERAL AVIATION

Diamond shines anew

The Canadian subsidiary of Diamond Aircraft is rehiring workers at its London, Ontario, plant. It cut



Diamond Aircraft

back its workforce last year from 200 to 40 employees but is now reported to have increased its staff up again to 130.

for a new fighter type to replace its aging F-16 fleet. Calls for information have been sent to Boeing for the F/A-18F Super Hornet, to Eurofighter for the Typhoon, to Lockheed Martin for F-35A and to Saab for the Gripen E. Candidates are expected to return information by July and a selection is planned in mid-2015.

Arianespace successfully launched the Kazakhstan Earth observation satellite

KazEOSat-1 on 30 April. The Airbus Defence and Space-built satellite was carried aboard a Vega launcher taking off from French Guiana.

AgustaWestland has completed autorotation trials of its AW609 tiltrotor helicopter. Operating from Arlington in Texas, the aircraft completed over 70 power-off conversions from aeroplane mode to helicopter mode, during which test pilots and

engineers were able to develop flight manoeuvres which will allow the training of commercial pilots in a full flight simulator.

The Airbus A350 XWB MSN 2 test aircraft is undergoing extreme weather testing at the McKinley Climatic Lab at Elgin Air Force Base in Florida. During the tests, the aircraft, its systems and cabin installations will be subjected to extreme hot and cold temperatures.

As *AEROSPACE* goes to press, loss-making Manston Airport in the UK is set to close after no buyer was found. Some 150 jobs will be lost in the closure.

BAE Systems has won the first international order for the Advanced Precision Kill Weapon System (APKWS) laser-guided rocket from Jordan. It will field the APKWS on its C-235 light gunship.

Japan is to launch seven GPS satellites which will enhance positioning systems, so that locations can be pin-pointed within centimetres rather than metres. Named Quasi-Zenith Satellite System (QZSS), the project will enter commercial service in 2018.

China's COMAC has won the first order for a business jet version of its ARJ21 regional airliner.

Radome

AEROSPACE

MRJ static test aircraft rolled out



Mitsubishi Aircraft

On 7 May Japanese manufacturer Mitsubishi rolled out the first MRJ regional jet ground test aircraft. The aircraft, which will be used for static strength tests, was transferred from the final assembly plant at Komaki South to a testing station near Nagoya Airport.

DEFENCE

Pro-Russian forces down Ukrainian helicopters

Pro-Russian forces in the eastern Ukrainian city of Sloviansk are reported to have shot down two Ukrainian Mi-24 attack helicopters with anti-aircraft missiles on 2 May, killing two pilots. A Mi-8



transport helicopter is also reported to have been damaged. The aircraft were being used in an attack on the city which is currently being held by separatists.

NEWS IN BRIEF

Internet giant Google has purchased Titan Aerospace, a manufacturer of long-endurance 'atmospheric satellite' UAVs. Google aims to use these solar-powered HALE UAVs to beam Internet access to parts of the world not served by telephone wires or mobile phone towers.

Qatar has opened the new Hamad International Airport (HIA), Doha, to

passengers. A total of ten carriers are to begin flights from HIA with national carrier Qatar expected to move to the new airport by 27 May.

Australia has OK'd the purchase of a further 58 Lockheed Martin F-35A Lightning IIs — in a deal worth \$11.5bn. The purchase brings the total of F-35s ordered by Australia up to 72 aircraft. First delivery of RAAF F-35s is set for 2020.

The third SpaceX Dragon unmanned cargo spacecraft has docked with the International Space Station (ISS). The capsule arrived at the ISS on 20 April carrying close to 2.5t of supplies.

A skydiving flight in Finland went tragically wrong on 20 April when a Comp Air 8 light aircraft suddenly descended 10,000ft and crashed into the ground. Eight skydivers were killed

while two other passengers and the pilot managed to bail out using parachutes.

On 7 May, the EU officially approved the launch of the Clean Sky 2 R&D programme. The €4bn green civil aviation project will run for 2014-2024 and investigate Open Rotor, laminar flow, and compound helicopter and tiltrotor technology.

Chinese carrier Shandong Airlines has placed an

order for 50 Boeing 737s in an order worth some \$4.6bn. The order for the Air China subsidiary, breaks down into 16 737-800s and 34 737 MAXs.

UK Army Air Corps Apache AH1 Attack helicopters have reached the milestone of 50,000hrs on combat operations in Afghanistan. Flying in-theatre since 2006 supporting UK and Coalition troops, this total represents a third of all UK Apache flying hours.

GENERAL AVIATION

German bizav access battle won

Vienna-based Austrian business aviation operator, International Jet Management has won a key legal battle affecting European business operators and German approval for flights. Its five-year legal battle saw the European Court of Justice rule that Germany

has no right to demand three-days notice for foreign bizjet operators seeking to fly into the country, and charge average fines of €2,200 per flight for short-notice flights. The ruling opens up short-notice flights into Germany for the rest of the business aviation sector.

SPACEFLIGHT

US military launch monopoly under attack from two fronts

Space X founder Elon Musk has filed a legal complaint accusing the US Government of shutting it out of the launch market for US Air Force military payloads. Space X's complaint alleges that giving USAF launches to Boeing-Lockheed Martin United Launch Alliance (ULA) wastes more than \$1bn a year through a lack of competition and additionally funnels money to Russia, thanks to the use of Russian rocket engines.

Meanwhile, in related news, Russia announced that it would ban the export of its RD-180 for US military launches — in reaction to US sanctions over Crimea. Moscow has also said it will cease co-operation with the US over the ISS in 2020.



AIR TRANSPORT



Heathrow, Gatwick unveil final submissions

Heathrow and Gatwick Airports have both unveiled their final submissions for expansion to the UK's Airports Commissions. Heathrow's proposal for a third runway (rendering above) would see it

hand-out £550m worth of compensation to homeowners affected by the plan. Meanwhile, Gatwick's updated second runway plan offers the creation of 120,000 jobs and would cost £7.8bn.

AEROSPACE

Jet fuel from water

An international team is reported to have created the world's first jet fuel from sunlight, water and CO₂.

The EU-funded SOLAR-JET project uses a very high temperature solar reactor to split a metal

into metal and oxygen ions to which are added CO₂ and water vapour to produce a 'syngas' mixture of hydrogen and carbon monoxide which then can be converted into kerosene using the Fischer-Tropsch method.

ON THE MOVE

NASA's new Commercial Crew Program (CCP) Program Manager is Kathy Lueders.

Nick Frisch is the new Director of Sales and Marketing for Glasair Aviation.

Development Director John Holland-Kaye has been appointed the new CEO at Heathrow Airport. He replaces Colin Matthews.

Martin Wright, Executive Director and CEO of the North West Aerospace Alliance (NWAA) is to step down.

Dr Nadine Alameh is the new CEO of geospatial and ATM software company Snowflake Software.

Newly elected AUVSI directors for 2014-17 are David Agnew, Neil Hunter, Leonard Ligon, Paul McDuffee, Ben Miller and Suzy Young.

Orbital, ATK to merge

Space company Orbital Sciences and Alliant Techsystems (ATK) Aerospace and Defence Groups are to combine in a \$5bn merger. The new aerospace, defence and space company will be called Orbital ATK, and will employ 13,000 workers.

GENERAL AVIATION

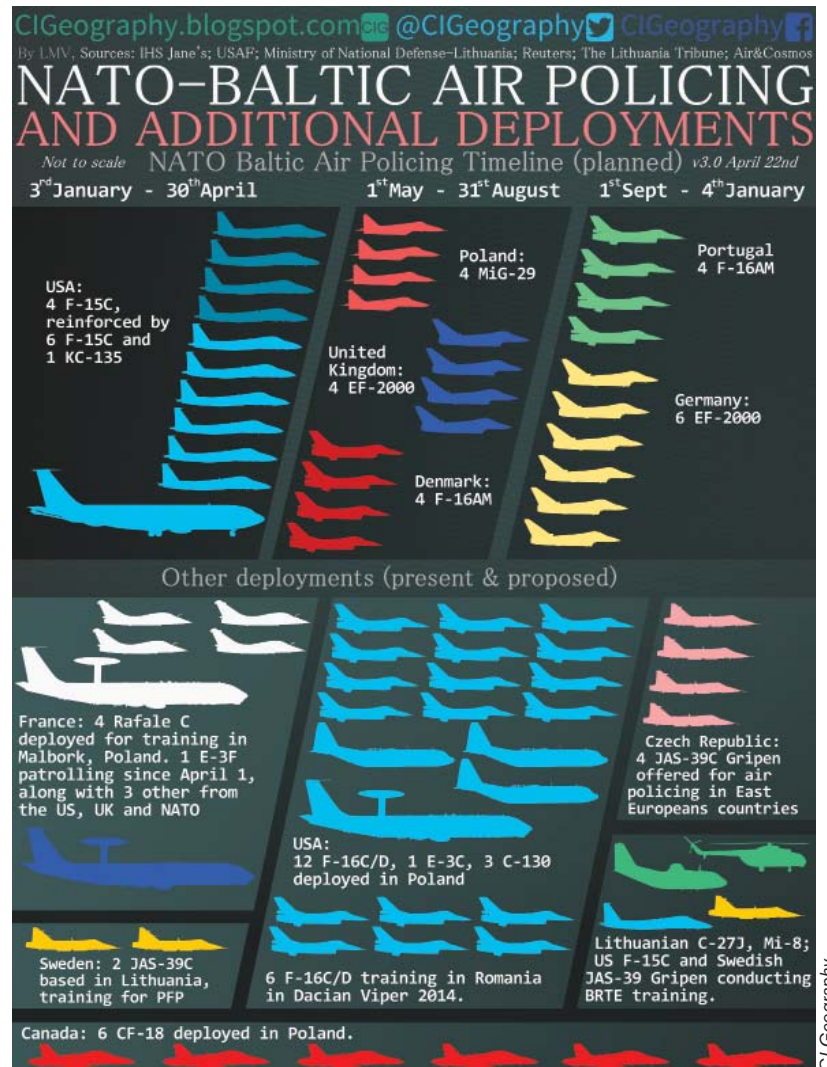
Chinese Challengers

An order from China's Minsheng Financial Leasing for ten Bombardier Challenger 350 business jets was confirmed at

the ABACE show in Shanghai. The Challenger 350 can carry up to eight passengers and has a range of up to 3,200nm.

DEFENCE

INFOGRAPHIC: NATO beefs up Baltic/Eastern Europe air policing





REVIVING MPA CAPABILITY IS NOW BEING CONSIDERED WITH A DEGREE OF URGENCY BY THE MOD AND THAT AS A CONSEQUENCE, MPA WILL BE TREATED AS A PRIORITY WITHIN THE SDSR 2015 PROCESS

UK ISTAR & MPA: lacking vision?

Whether talking about Royal Air Force Sentry E-3D capability, the robust Sentinel R1 capability currently manned by both RAF and Army personnel operating the ASTOR radar surveillance system or the increasing role that Remotely Piloted Air System (RPAS) capability plays in the ISR (intelligence, surveillance and reconnaissance) arena or the three planned RC-135W 'Rivet Joint' signals intelligence-gathering aircraft that will eventually play the most persistent and important role in terms of the wider combat-ISTAR platform capability role there is no doubting that the ISTAR/ISR component is crucial to success of any defence related mission.

Neither, in terms of the ISTAR capability role, should we ignore the increasingly valuable role that fast jet air power capability in the form of Tornado GR4, Typhoon and eventually, the F-35 do and will play in the ISTAR component capability role or for that matter, the crucially important role that the Royal Navy also plays with its venerable yet well-equipped fleet of Sea King Mk 7 helicopters.

For all that, while the UK has good combat ISTAR capability it struggles in terms of availability and capacity to conduct the full role demanded with ease. A well-defined policy and strategy for intelligence and reconnaissance gathering combined with the ability to quickly disseminate information provided is considered key capability within all forms of the military combat arena. As the immediate former Chief of the Air Staff, Air Chief Marshall Sir Stephen Dalton put it a couple of years ago, "it is no use fighting an enemy that you can't see".

Reducing uncertainty and confusion that is so often presented and prevalent within 'theatre' combined with the ability to know where the enemy is as opposed to physically seeing is a pre-eminent importance of modern warfare strategy. The ISTAR/ISR component provided by the RAF is not just about high altitude, high resolution photographic reconnaissance and radar technology capability provides. It is also about providing wide area surveillance capability and, when the combination of sophisticated technology and the human eye are needed in equal measure, provision of aircraft capability that is able to be used at low level to seek and find.

Getting the message

The current lack of UK Maritime Air Patrol (MPA) capability has, ever since Nimrod MRA2 and the proposed MRA4 capability was effectively scrapped within SDSR 2010 proved to be the most serious omissions in current UK defence policy and strategy thinking. Time moves on and my judgement today is that the Coalition Government has finally got the message about the need for MPA capability and that within SDSR 2015 the intention is to treat the revival of MPA capability as an absolute priority.

It is not my purpose to delve into the various potential MPA related offerings that could provide the next generation aircraft capability at this stage but I can say that reviving MPA capability is now being considered with a degree of urgency by the MoD and that as a consequence, MPA will be treated as a priority within the SDSR 2015 process. I also believe that by 2019 we may well have aircraft capability that will combine the wide area scan capability currently provided by 'Sentinel' with physical wide area search and surveillance role capability that is demanded within a good MPA platform.

The tragic and so far unexplained loss of the Malaysian Airlines flight MH370 combined with the ongoing search for the missing Boeing 777-200 aircraft by various air forces and navies of a large number of nations, notably Australia and New Zealand, has provided strong ammunition to those long concerned at Britain's lack, since 2010 of MPA capability.



Crown Copyright



While the RN has been able to lend a hand in the search for MH370 the point is that had a similar tragedy required that the UK was responsible for searching a large area of sea a thousand miles offshore neither the RAF or RN have a suitable aircraft available for physical search with sufficient duration.

There is no use beating about the bush on the MPA issue or dreaming that the clock can be turned back. For whatever reason, rightly or wrongly, the ageing yet hugely successful Nimrod MRA2 fleet along with those of its planned successor, the MRA4 and that as platform should have provided combined ISTAR and MPA capability are gone not to return.

Military observers and we defence commentators have been increasingly vociferous in pointing out the harsh reality that while the UK is strong in Intelligence, surveillance, target acquisition and reconnaissance (ISTAR) capability compared to other NATO countries, as witnessed for example by the support that RAF Sentinel aircraft provided to the French in Mali, when it comes to physical MPA capability the only air power related availability that the UK currently have in terms of physical wide area search capability are RN Mk 7 Sea King Helicopters. Brilliant though these soon to be replaced aircraft clearly are the longstanding problem with rotary and particularly in wide area search is that it is limited by both by weather and being severely restricted by durability.

From Cerberus to Crowsnest

Having determined that replacing Nimrod MPA capability was not a priority in SDSR 2010 the Government also confirmed that the existing fleet of Royal Navy Sea King Mk 7 Airborne Surveillance and Control, the so-called baggers based with 849 Naval Air Sqn at the Culdrose, would be replaced by upgraded Merlin Mk 2's helicopters that would be capable of fulfilling several roles including the provision of Airborne Surveillance and Control capability.

RAF Sentinel R1 takes off from a Middle East location.



In terms of ISTAR capability there is little doubt that when fitted in 2002 the 'Cerberus' system of 'Searchwater' radar capability changed the Sea King Mk 7's from being a pure AEW platform to one that could offer multi mission capability with around 3.5 hours duration. The venerable Sea King Mk 7's will be missed but the long delayed announcement late last year that the Crowsnest Airborne Command and Control System will be fitted to the replacement Merlin Mk 2 helicopters is very welcome. Using high power radar Crowsnest is expected to provide brilliant long-range air, maritime and land tracking capability.

There can be little doubt that the ill-fated decision to scrap the ageing fleet of Nimrod MRA2 aircraft, to abandon the MRA4 development programme on affordability and risk potential grounds and to prematurely withdraw the three Nimrod R1 electronic signals gathering version (ELINT) aircraft ahead of providing any immediate form of replacement capability left a dangerous gap in the maritime air ISTAR capability. While it is true that the Government announced that the three Nimrod R1's would ultimately be replaced through the acquisition of three RC-135 Airseeker 'Rivet Joint' signals intelligence (SIGINT) aircraft to be purchased directly from the US the 'new' capability is intended to be phased in over three years from 2014.

SDSR 2010 also confirmed that 'Sentinel R1' capability would likely only be retained until UK forces had departed Afghanistan in 2014. While this plan has now been unofficially rescinded my understanding is that while 'Sentinel R1' capability is to be extended until 2018 the number of actual aircraft has been cut from five to four and the number of trained crews halved.

The value of Sentinel together with SIGINT and the Boeing E-3D Sentry aircraft capability was very apparent in Libya and Afghanistan. ISTAR and ISR capability may be defined as crucial enablers that allow those on the ground, at sea or in the air to coordinate and act decisively with precision.

As an island race it has been as amazing as it has been unacceptable that for the past three years neither RAF nor RN held suitable levels of durable air power capability able to maintain wide area visual surveillance at sea.

The bottom line is that the UK is extremely vulnerable in its inability to provide MPA capability and that the present position is unsustainable. I am pleased that the issue is now considered a priority by the MoD and that the unfortunate and damaging gap decision taken in SDSR 2010 is to be reversed. However I remain concerned that to pay for it unless the money required is taken from the estimated near £5bn of two year budget underspend that the RAF will be placed under considerable and unacceptable pressure elsewhere.



RN Sea King ASACs have been providing airborne ISR in Afghanistan.

Transmission

LETTERS AND ONLINE

Bristol 188

In the Book Reviews on p 45 of *AEROSPACE* May 2014⁽¹⁾, there is a photo at the bottom captioned as 'The first Bristol 188, XF923, landing at the end of its maiden flight on 14 April 1962'. As a Filton student apprentice I joined Flight Test Dept in my last year and was part of the 188 team throughout the project until the final flight of the second aircraft, XF926, on 11 January 1964. The first flight of XF923, with landing gear and communication problems was to Boscombe Down, where it landed from the wrong direction much to the surprise of the photographer, who missed it! All but one of XF923's flights, including those to the 1962 Farnborough Air Display, were from Boscombe Down. The captioned photo background is clearly Filton so it must have been its penultimate flight on 15 November 1962 when it returned from Boscombe Down or its last flight on 30 November 1962. I am currently putting together a PowerPoint presentation 'Flight Testing the Bristol 188 Stainless Steel Research Aircraft', which includes test results and some of my personal colour photos, for the 8 October meeting of the RAeS Gatwick Branch.

John Thorpe FRAeS

Looking for the haystack⁽²⁾

Prof Hayward is undoubtedly right in 'Looking for the haystack' that there will be a rush to mandate satellite based tracking. He is wisely silent on its benefits, likely none, but he is on shakier ground on the effects of the recovery of the Air France 447 flight recorder. Far from helping

'to diagnose a technical flaw', it told us nothing we did not know about the loss of reliable airspeed data due to pitot icing. This was after all about the 30th such incident and the modification program was already underway. What the recorder did reveal, however, was shocking, the jaw-droppingly incompetent response of the crew. Sadly the full import of this has yet to dawn — upset recovery training and greater simulator fidelity are worthy but quite useless if crews have lost basic instrument flight skills.

**Alex Fisher
OBE AMRAeS**

Airships — a new dawn?⁽³⁾

As Head of Aircraft Certification in the RSA I was involved in an attempt to build and certify an airship. I found it an intriguing exercise with many hurdles but, if they can be overcome, I think the potential is tremendous. Unfortunately in the RSA they were not overcome and the project floundered. I hope this venture continues to prove as successful as the Zeppelins were until the use of hydrogen was their undoing.

**Christopher Michael
Purnell**

What happened to Flight MH370?⁽⁴⁾

This is the best technical summary I have seen on what might or might not have happened to flight MH370. And of course there is lot more one could have visualised. RAeS must be congratulated for a fine job done but it should continue to pursue the matter until such time some tangible explanation is found for the 'mysterious' disappearance



The Edgley Optica will be at this year's Farnborough Air Show.

RAeS NAL

of the airplane leaving no visual trace, at least so far.

Salim Mehmud

This article is a bit out of date but as nothing has yet been found any theories are possible. As far as access to sensitive parts of the aircraft, see the link below for a weakness identified several years ago. Up until the MH flight there were 100 views of this link. Now there are over 8,000. Boeing is now offering a locking system to operators for \$5,000. Even if not the reason behind MH370, it might be behind the next if not addressed. For critics, ALL regulators were advised of this several years ago (including the FRAeS) but nothing has yet been done. And I am/was a B777 captain at the time I did my thesis on this three years ago. Matt B777 link <http://www.youtube.com/watch?v=mLmzvF2qkDY>

Matthew Wullemin

Sadly, suicide is the only explanation I can think of for the flight profile and actions.

I understand the Captains wife had just left him with the children — at top of climb the F/O leaves the cockpit to, say, use the toilet — With the new post 9-11 flight deck doors he

could be now kept out of the flight deck — The Capt depressurises the aircraft — masks drop out in the cabin — aircraft begins an emergency descent profile (to maybe make it look like a pressurisation problem?) — short time later (12 mins?) passenger oxygen generators run out but Capt on flight deck bottle supply still OK — aircraft climbs back up to 45,000ft where useful time of consciousness without oxygen is about 15-20 secs — Capt re-programmes Flight Management Computer to head off out to sea — takes off his oxygen mask and 20 secs later is unconscious — aircraft flies until it runs out of fuel. I do hope they find the CVR and flight data Recorders to prove me wrong though.

John Broomfield

Mind the skills gap⁽⁵⁾

As always the answer is simple, PAY THEM MORE!! How else will we ever prise clever innovative young minds away from the banks and legal companies.

Laurence J Stewart

It is a cultural issue. 'Engineering' as a whole in the UK is completely and totally socially constructed

as a loser 'profession'/ industry sector. Its image, brand and historical place serves to reinforce its second class status.

David Anderson

There is a certain type of person that enjoys a practical side to their work, that will get much more satisfaction from various sides of engineering than just pure maths in a banking environment. We need to tap into these people, but as is emphasised, at a much earlier level in their education and supporting their choices in an engaging way throughout the educational system.

Ian Jones

Nobody seems to have commented on the elephant in the room. As far as the UK is concerned we have given up building and flying exciting new manned aircraft. How can we inspire youngsters, when the end products we manufacture so competently, be it wings, engines, satellites or widgeons end up on aircraft or rockets designed and test flown outside of the UK? Until we have some high profile national programmes to inspire young people we will trade on our past glories

and continue to decline. We need to reverse the institutional incompetence that resulted in the Nimrod MR4 cancellation and back a national winner. That needs government commitment. What a hope!

John Bradley

The answer is simple. You need to pay a proper rate, and treat people as the highly qualified individuals they are. I have been working in this industry for 35 years now, all the time paid way less than any of my university contemporaries, and having to work much longer hours with less holiday and no other positives than any of them. I often get people asking me to encourage more people into engineering, yet I can only tell them to do something else. They say the bankers need huge salaries and bonuses to attract the right people, so why pay engineers less than plumbers, and generally be overseen by totally incompetent and unqualified people?

Martyn Copcutt

Johnny S Independent Airlines/Aviation Professional

[On Game on for aerospace⁽⁷⁾] I seem to remember that an F-16 was being developed, some years ago, with a 'virtual cockpit' in which the pilot did not need to see outside but viewed a presentation of symbols representing terrain and targets, plus other aircraft. The plane had no instrument panel but the pilot's virtual helmet viewer showed one that could be used by a special glove. There was also a project at the same time for a voice-activated cockpit. There does not seem to be any progress and it appears that these ideas have been abandoned. I think that 'gesture controls' if attempted, would go the same way. Pilots would be afraid to sneeze!



@testpilotpete [On Edgley Optica being at Farnborough] can I just say that I evaluated the Optica as my ETPS pre-preview. The project pilot with me was — Neville Duke! Special moment!

@NZAircraftFan [On FAA cracking down on UAV journalism footage of a tornado in Arkansas] Why? Do they think it might crash and do some more damage to a town which is already flattened?

@vazsingh Anyone studying aviation/aerospace in or around London must get involved with the RAeS (@AeroSociety). Gr8 events at 4 Hamilton Place.

@StephenEThomas [On Optica's film role] Slipstream film with Mark Hamill bombed. Character sucked across canopy into engine. Prob also did it no favours!

@deepakslore [On USAAF operations from Indian bases in WW2] yeah. I actually met a USAF veteran stationed at (near) Agra who flew 'the hump'. Courageous would not even begin to describe it.

@COMINT_AU [On new Australian LPD ship being equipped with a ski-jump for potential F-35Bs] no ramp doesn't add a helo spot, plus not enough fuel or weapons bunkerage on LHD001 & 002. Option is there to cross-deck occasionally but that's about it.

@Jazifer [On report of an air prox between a Swedish airliner and Russian intelligence aircraft] 90 feet? Seriously? This has gone far enough. The macho Cold War muscle flexing is stupid, unnecessary and dangerous.

@mmsBA [On A400M progress towards RAF service] spent a little bit of time discussing EIS with the Requirements Manager and team. Top bunch: complex programme.

@PaulMarks12 [On RAeS Aeronautical Journal] Are there key aviation papers by eg R J Mitchell and Frank Whittle they could put free online? Would like to read 'em ;-)

1. Book Reviews: X-Planes of Europe, *AEROSPACE*, May 2014, p 45.
2. The last Word: Looking for the haystack, *AEROSPACE*, May 2014, p 58.
3. <http://www.aerosociety.com/News/Insight-Blog/2081/Airships-a-new-dawn>
4. <http://www.aerosociety.com/News/Insight-Blog/2007/What-happened-to-flight-MH370>
5. <http://www.aerosociety.com/News/Insight-Blog/2074/Mind-the-skills-gap>
6. Antenna: UK steps up F-35 preparations, *AEROSPACE*, May 2014, p. 10.
7. Game on for aerospace, *AEROSPACE*, May 2014, p 38.



Geoffrey W Chartered Senior Aircraft Structural Design and Development Engineering Professional

[On Howard Wheeldon's F-35 blog⁽⁶⁾] The F-35 in all variants are fine aircraft for the future force structure and I am proud to have been part of their design development especially the F-35B SWAT. Combined with future UCAVs they will make a powerful force.

@Rob_Coppinger [On E-Fan] EASA certification should be a fun experience...

@ThisisAirTV [On E-Fan debut] Seems incredible Tim — can't wait to see one up close! Any ideas on flight times vs charge for the 2 Seat?

@aerospacenz [On E-Fan debut] So what is the range/endurance of these #eFan aircraft? Similar issue to that holding back electric cars?

@michalputo [On E-Fan debut] Cool! A-10 on a diet!



The E-Fan is a technology demonstrator of a fully electrically-powered, all-composite general aviation training aircraft.

Airbus Group



Command performance

What makes a good aircraft commander and should decision making in the cockpit be an individual or a collective process? **BILL READ** reports.



LEADERSHIP IS AS MUCH ABOUT THE PEOPLE BEING LED AS THOSE DOING THE LEADING

On 25-26 March the RAeS Flight Operations Group held a two-day conference with the title of 'The Aircraft Commander in the 21st Century: Decision making — are we on the right path?'

The first subject debated was to define leadership. "The purpose of leadership is to unite, motivate and give direction," declared Capt Richard Hill, COO of Etihad Airways. "A leader has to build a team and give it structure. He must set an example and be the role model. There are different levels of leaders, from the longer-term strategic, operational or tactical and management of resources and people."

Leadership in the cockpit

What qualities are needed to be a good cockpit commander? "A good leader makes decisions, manages situations, assesses risk and uses crew

resources, keeping assets available at the right level," said Capt Andre Vernay, Human Risks Programme Manager, French National Aviation Authority (DGAC). "Effective team leaders establish authority, involve all resources, communicate tasks and responsibilities and delegate tasks," added Capt Trevor Dale, Director, Atrainability.

There are also different styles of leadership. Capt Mike Freeman from the RAeS Human Factors Group listed six (see right hand column) while Richard Hill included directing, coaching, supporting, delegating, dictating, domineering, autocratic and bullying — although he did recommend that this last style was one to be avoided.

Some airlines have different styles as part of their company culture. Capt Steve Hawkins, Head of Training, British Airways, quoted an example from when British Airways took over British Midland whose crews were used to a more formal, authoritative command structure in the cockpit and

had to get used to a more open briefing style. BA's policy is to hold a joint briefing with cabin crew to address such topics as operational safety, technical issues and passengers. Capt Cem Firat, Manager Flight Training, at Turkish Airlines explained how his airline held meetings between pilots and management in which everybody could ask questions and provide feedback.

Additional factors

Another factor is enthusiasm. "Aviators still have enthusiasm for the job, the people and aircraft," remarked Mike Freeman. "It is up to the captain to enthuse and motivate." "Enthusiasm can create the right environment," agreed Dr Tom Reader, Lecturer in Organisational and Social Psychology, London School of Economics. "Without enthusiasm, communication is more difficult." "Experience is important and enthusiasm is infectious," assented Ewan Duncan.

"There has been lots of focus on leaders but what about followers?" asked Capt Trevor Dale, Director, Atrainability. "To be effective, team members need to exhibit many of the same behaviours as a leader — to be supportive, anticipate each other's needs, put team needs before their own, to be assertive when required and to be calm under stress but admit to be overloaded." "Leadership is as much about the people being led as those doing the leading," agreed Air Cdre Bill Tyack, then RAeS President Elect. "Those being led need confidence in their leader. Leaders need to study and understand their people, exploiting their strengths and mitigating their weaknesses."

Automated cockpits

One factor noted by many of the speakers was how the development of electronic aircraft systems had changed the way that aircraft were flown. "Aircraft are becoming more automated and complex," said FAA Aviation Safety Inspector, Capt Deke Abbott. "To fly nowadays, pilots are also having to become system managers."

Capt Michael Varney, Senior Director, Flight Training Policy, Airbus, explained how the aircraft manufacturer has developed technology to help pilots fly more safely, including envelope protection through fly-by-wire and flight management and

guidance (FMS) systems which provided horizontal and vertical information, providing more enhanced situational awareness and reducing workload.

Dr Ratan Khatwa, Senior Chief Engineer, Human Factors at Honeywell, listed some of the recent flight deck innovations that his company produced to support flight crew decision making. These included enhanced weather radar which features a vertical picture of weather clouds, as well as a synthetic vision system which fuses together data from the aircraft's FMS, TCAS (traffic collision avoidance system) and EGPWS (enhanced ground proximity warning system) to enhance the pilots' spacial and terrain awareness and avoid the risk of landing on the wrong runway or airport. Honeywell has also developed a SmartLanding system which provides oral cues as aircraft approach the ground to mitigate the risk of unstabilised approaches and long landings.

Pilot in the machine

It was also noted by several speakers that the introduction of advanced technology intended to increase safety may turn into a safety problem if pilots are not properly trained. The continuous use of auto pilots does not help develop manual flying skills and computer savvy pilots may not have the basic 'hands-on' abilities of their predecessors."

"Automation is obviating commanders," says Mike. "Many new aircraft systems rely on pilots keying in data."

"First and second generation jet airliners supplied data which required mental manipulations by the pilots to convert

it to information and knowledge," explained Don Harris, Professor of Human Factors, Coventry University. "Nowadays, pilots need different skill sets to operate fourth and fifth generation aircraft, as modern flight decks are now data rich. However, data is no good on its own, as the information needs to be changed into knowledge. The more data that pilots have to process, the more opportunities for error. What is needed is to give pilots information rather than data. Modern flight deck automation has the ability to transform raw data from sensors to supply information and knowledge to the pilots via the displays. For example, instead of showing a pilot

As aircraft become more automated, pilots not only have to manage their own teams but also know how to use and interact with cockpit systems. (CAE)



BA

Six different styles of leadership:

Coercive
demands immediate compliance

Authoritative
mobilises people towards a vision

Affiliative
creates emotional bonds and harmony

Democratic
builds consensus through participation

Pacesetter
expects excellence and self-direction

Coaching
develops people for the future.

*Captain Mike Freeman,
RAeS Human Factors
Group*

● FLIGHT OPERATIONS

Aircraft commanders

Capt Masami Tsukamoto described how Japanese culture had influenced the development of AQP (advanced qualification programme) pilot training for the Boeing 787 at All Nippon Airways (ANA). As the launch customer of the Boeing 787-8, ANA took delivery of the first Dreamliner on 21 September 2011 but work for the acceptance of the first aircraft began with Boeing in 2004. "I was transferred to the Boeing Company as the liaison person between the FAA, Boeing and the JCAB (Japanese Civil Aviation Bureau) to join the 787



East meets West

Pilot Qualification Plan," explained Tsukamoto. "On the one hand, it was a great honour to be the launch customer of the 787-8 but, on the other hand, we faced the challenge to qualify 787 pilots to meet world standards. This meant we had to qualify on the most advanced aircraft while our training programme was not quite ready.

"The CRM training showed up cultural differences between Boeing and ANA," he continued. "It provided a challenge to change our way of traditional thinking and ANA had to change some of its concepts. For example, we changed our concept of 'humans are never allowed to make mistakes' to 'humans do make mistakes'. Japanese culture believes in respect for age, rank and loyalty to a firm. In ANA, pilots have more individual command. Junior captains find it difficult to question decisions made by the captain and there was a concern that a junior officer would be less likely to speak up about potential mistakes or problems. However, we hope that CRM can be adapted to take advantage of the strengths of a particular culture and to decrease its weakness."



MOST DECISIONS ON FLIGHT DECKS ARE TAKEN AS PART OF A TEAM SUPPORTED (OR PREDICATED) BY INFORMATION SUPPLIED BY AIRCRAFT SYSTEMS OR EXTERNAL ELEMENTS

Don Harris

Professor of Human Factors, Coventry University

how much fuel is left onboard an aircraft, it would be far more useful to know how long it will last."

CRM

A subject that came up frequently during the conference was that of crew resource management (CRM) training. Designed to improve air safety, CRM is a set of training procedures which focuses on leadership, communication and decision-making in the cockpit. The training is concerned less with technical knowledge for operating the aircraft and more with the interpersonal skills and mental processes needed to solve problems, maintain situational awareness and make decisions through communication and teamwork. A key element of CRM aims to foster a climate in which subordinates are allowed to respectfully question authority in the cause of safety — a concept that is sometimes difficult in more traditional hierarchical societies. CRM training is a mandated requirement for most pilots around the world and is also used in air traffic control, as well as a number of other areas, including military and medical operating rooms.

Capt Peter Shaw, Flight Operations and Training Inspector from the UK Civil Aviation Authority (CAA) explained how the objective of CRM training is to enhance the communication and management skills of flight crew members with an emphasis on the NOTECH (non-technical) aspects of flight crew performance. However, communication is not listed as one of these skills.

There was much debate over how democratic

a cockpit should be and how much authority should remain with the aircraft commander, compared to the more 'open debate' concepts of CRM.

British Airways, 777 Training Captain, Howard Burton, was keen for pilots to delegate more responsibility to co-pilots, arguing that the 'guy in the righthand seat' needed to develop experience of skills and leadership in practice. He was also keen on aircraft crews holding post flight briefings where they could talk to each other and share technical and operations information. He also suggested that pilots could enhance their leadership skills by dealing with situations outside the flight deck, including talking to passengers to support the cabin crew.

Communication

Another leadership factor highlighted was that of communication. "Effective communication is a multi-faceted skill," declared Mike Freeman. "Cockpit communication is the number one means of trapping errors and countering risk and threat. Like any skill, it has to be trained, practised, mentored and developed."

Freeman explained how communication within the cockpit needed to be adapted for different situations. In routine low workload situations, it was acceptable for the flightcrew to chatter in order to maintaining situational awareness. In abnormal situations, it might be necessary for a more disciplined structure with the pilot more in command and only receiving relevant communication. "When everything is calm, communication is easy," he said. "However, it deteriorates in crises and that is where

leadership comes in.” During question time, some delegates suggested that too much communication might cause errors to creep in and asked whether quiet ‘sterile cockpits’ might be a better solution.

Communication can also be affected by the national culture of different pilots. “Cultural differences are important,” asserted Freeman. “In general aviation, it is more common for the same pilots to share the cockpit on each flight. This is not usually the case in commercial aviation where two pilots may be different on each flight and differences in language, age, gender and culture can sometimes act as blocks to communication.” “It is not what you say but the way you say it,” agreed a conference delegate. “Colloquialisms are not always understood. Questions may sound like statements and vice versa.”

Distributed cognition

An additional subject discussed was that of distributed cognition. “Decisions are not taken in isolation,” said Don Harris. “Most decisions on flight deck are taken as part of a team supported (or predicated) by information supplied by aircraft systems or external elements, such as air traffic control.”

He then explained how an aircraft could be considered as a ‘joint cognitive system’, relying on the interaction between people engaged in common activity, including the flight and cabin crew, ATC, airports and MRO systems. Flight deck systems serve as a ‘cognitive amplifier’ with tasks being distributed between pilots and aircraft. Thus, it might not be necessary for the individuals to know everything all the time, although certain situations would require everyone to have a common understanding of the situation (see slide on right).

Leadership training

The conference also looked at ways that pilots could develop their leadership skills. These included using simulator training not just to check that standards were being maintained but also to develop skills. It was suggested that co-pilots could develop their skills both by learning from the captain and also being allowed to take command in certain situations. The lessons developed from ATQP (alternative training and qualification programme) could be used in new initiatives, such as EBT (evidence-based training).

New pilots

There was also discussion on the anticipated need for many more pilots in the future, particularly in the Far East, and where they might come from. At present, most pilots have to self-finance their

Medical lessons

The work done by aviation in crew resource management has attracted the attention of the medical profession who are keen to adopt some of the same techniques to medical operations. “There are many similarities between aviation and medicine,” explains Dr Tom Reader. “Both have hierarchical multidisciplinary teams which rely on complex technology, use simulation as a training tool, are subject to fatigue and stress and rely on leadership and communication for safety. The medical profession currently has a more rigid hierarchical structure than aviation. Reader quoted a recent survey in which 24% of surgeons and 2% of pilots thought that junior team members should not question decisions made by senior team members. In addition, 25% of pilots and 70% of surgeons thought they could still perform effectively when tired. “Like co-pilots, junior doctors often have to work with a variety of different senior consultants and will often adapt their behaviour according to their personalities,” Reader explained. The medical profession is aiming to use CRM and checklists as a tool to improve communication, team working and situational awareness — one example being the introduction of a surgical checklist similar in concept to pre-flight checks.



training and are not always guaranteed a job at the end of it. Questions were raised as to why there were not more female pilots, why most airlines don’t usually consider cabin crew as a flight crew career progression and whether civilian UAV pilots might be needed in the future. Other topics debated included military leadership in the RAF, safety and training regulations and pilot decision-making relating to airport runway approaches.

In addition to discussing issues relating to the role of the aircraft commander, the conference also had a second objective — to help the RAeS establish guidelines that can be used in the development of training programmes, identifying matters of importance that justify research and exchanging ideas on how operating standards could be improved.

Shared cognition and cognitive off loading in the wider joint cognitive system. (Coventry University)

Agent	Perception	Comprehension	Projection
Weather Radar	Senses radar returns of storm clouds	Compiles picture of extent of cloud formation, distance and bearing	Displays information (along with projected track) in appropriate color to alert pilots
First Officer	Sees storm cloud formation on weather radar/navigation display	Determines thunderstorm may present a risk to the aircraft	Needs to quickly determine new route to avoid the storm
Captain	Sees First Officer interrogate Navigation Display, Flight Management System and charts	Determines thunderheads present a risk to passengers and crew	Re-plans flight and initiates a diversion

The next RAeS Flight Operations Group conference is on 4-6 November and will be addressing Research Aircraft Operations. A conference call for papers is currently open and further information can be obtained from conference@aerosociety.com

● DEFENCE

Eurofighter upgrade progress

In the Typhoon's path

Europe's premier superfighter is gaining new capabilities. **JOE COLES** spoke to Airbus Defence & Space Test Pilot Chris Worning to find out more about Eurofighter upgrades.

Europe's most important fighter aircraft, the Eurofighter Typhoon, is 20 years old. Today, refinements are being planned for the Typhoon that could make the aircraft more agile, longer-ranged and give its pilots greater situational awareness. Added to this, the aircraft's arsenal of air-to-ground weapons is growing, and it is soon to be armed with the formidable Meteor air-to-air missile. But is this enough to keep the aircraft survivable both in combat and in the export market?

The AMK — an aerodynamic free lunch?

Typhoon's supersonic agility is reportedly unbeatable, but its current angle-of-attack (AoA) limits at lower speeds are less impressive; a Cassidian (Airbus Defence & Space) -led effort is testing an aerodynamic modification kit for Typhoon that would remedy this. The 'Aerodynamic Mod Kit' (AMK) will include new re-shaped strakes, leading-edge root extensions (which have already been tested), and extended trailing-edge flaperons. The AMK aims to deliver increases to the maximum wing lift, the AoA limit and the roll rates at high AoA. The

First flight trial of Eurofighter Typhoon with Storm Shadow cruise missile.

Eurofighter/L Callaro

strakes will generate vortices that will maintain a controlled airflow over the wing surface even at high angles-of-attack. According to Airbus Defence and Space Test Pilot Chris Worning: "The first stage was to proof the concept. Do some measurements to see if the strakes did what we thought they would do ... we will fly the Aerodynamic Modification Kit next. We have a mod kit and we're hopefully going to fly it here (Manching) this summer. This is basically what you could put on a series production aeroplane."

Flying at high angles-of-attack can be helpful in close-in combat, allowing a fighter to point its nose quickly and accurately (this is one of the reasons why the F/A-18 remains such a nasty opponent in the WVR arena). The Typhoon's current AoA limit is slightly more than 24°, approximately the same as the Lockheed Martin F-16 (which is around 25°). The new changes are expected to increase the limit to at least 34°. Worning was keen to point out that flying at high AoA in combat must be performed with due consideration. "You have to remember when you have a very high AoA there is also a disadvantage: you're creating an awful lot of drag." Worning admitted that, currently, the Dassault Rafale has a slightly higher maximum AoA (29° in the air-to-air mode) than the Typhoon but is confident that the new kit will at least equal, and probably surpass, the higher figure of the French rival. The flight testing of AMK is expected this year and will be a verification of the computer modelling. Once tested, Airbus Defence & Space will be able to develop the flight control software for a strake on an operational aircraft. The strake is designed to improve agility at subsonic speeds; it will not affect the aircraft in the supersonic regime but, as Worning confidently added, "there's not much you can improve there, to be honest". There's rarely a 'free lunch' in aerodynamics but the strake (which will weigh only few kilos) seems to come close.

The dogfight isn't dead

According to Worning, the customer interest in AMK (which will probably cost less than €1m per aircraft) is increasing: "Looking into the future and with emerging threats, people are saying we have to optimise what you can do in close-in combat. There was a school of thought a few years ago, that everything was going to happen at beyond visual range: nowadays we have new radars and missile for the BVR mission but you have to look at all parts of the envelope and this is increasing the maneuverability at the lower end. This is something the Luftwaffe and the Royal Air Force are interested in. When you go into the very high AoA, you are now entering into an area where the drag really increases, you must apply that capability with brains: you don't need to be careful — you won't crash

but you might lose the dogfight. People primarily need the high AoA to 'point' but one way you can point a missile with this aircraft is with the helmet (instead of pointing the whole aircraft). As we have the helmet-mounted sight, it's not that bad but fighter pilots want everything. Short of those that have TVC and use post-stall manoeuvring, we will be able to cope with all of those threats." According to Worning, Typhoons proved superior to Indian air Force Sukhoi Su-30MKIs during joint exercises: "The RAF went up against them several times and said they were no match for Typhoon ... We've flown against the big Sukhoi's (the Su-30) and they're no match for us, even today. They're too heavy and even when they try that trick (using TVC) they can't shake a Typhoon off."

Thrust vectoring for Typhoon?

Though the Typhoon has not been used in any actual air-to-air combat (though it has carried out bombing and combat air patrol missions above Libya), it maintains a reputation for being the second most capable air superiority fighter after the Lockheed Martin F-22 Raptor (which has not flown in combat in any capacity); but with the service entry of the Sukhoi Su-35, testing of the Sukhoi T-50 (in support of the PAK FA programme) and China's new aircraft (the Shenyang J-31 and Chengdu J-20), will it remain relevant? Considering the paucity of accurate information available on the PAK FA and its early stage of development, Worning was reluctant to give a concrete answer but was keen to point out the benefits that thrust-vectoring could bring to the Typhoon: "I know too little about it (PAK FA) but there is no doubt they have will post-stall manoeuvring and thrust vectoring, which is something we're looking at. We have simulations with strakes but also with strakes and thrust vectoring. Thrust vectoring is certainly a possibility for us. We have shown people simulations of what TVC would do for the low-speed manoeuvrability of the aircraft: it is eye-watering! There is a 3D nozzle design for the EJ200 but nobody is willing to pay for it."

It is anticipated that developing flight control software to make the most of TVC would be straightforward with the physical modifications to the engine representing the greatest expense. Frustrating as it may be, the funding simply isn't there at the moment to develop TVC for Typhoon. Time will tell if Typhoon ever receives this upgrade but in mid-2014 it does not appear likely.

Cockpit technologies

Several rival fighter programmes (including the Lockheed Martin F-35 Lightning II and Saab Gripen E/F) are developing large touch-screen cockpits, raising the question of whether Eurofighter is

Angle-of-attack limits:

24°

Eurofighter

25°

F-16

29°

Rafale

34°

AMK Eurofighter

DEFENCE

Eurofighter upgrade progress

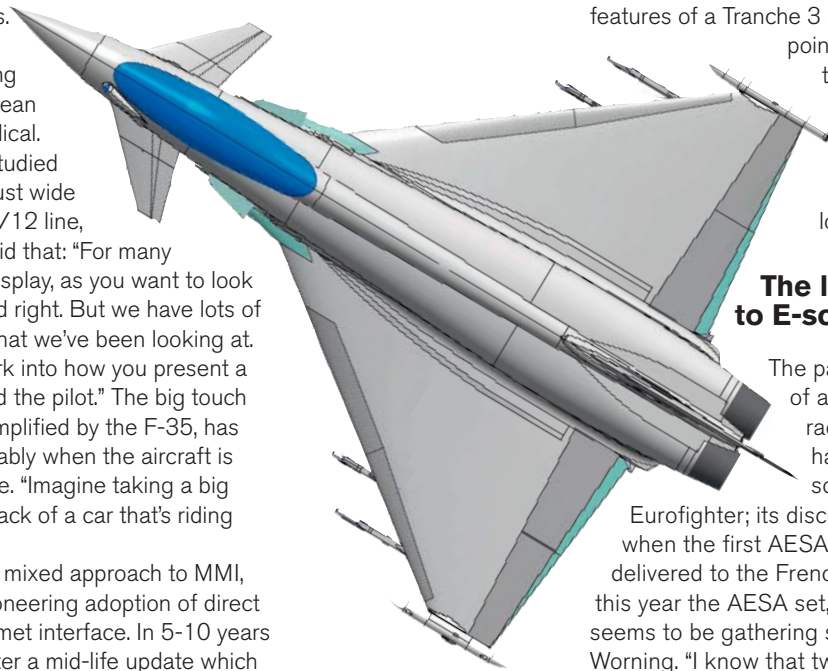
planning similar upgrades. In fact, some of the cockpit technologies being researched for the European fighter are even more radical. The 'big screens' being studied for the Typhoon are not just wide but extend down in the 6/12 line, forming a 'T'. Worning said that: "For many things you need a long display, as you want to look far ahead and not left and right. But we have lots of different configurations that we've been looking at. We have done lots of work into how you present a 3D representation around the pilot." The big touch screen approach, as exemplified by the F-35, has some disadvantages, notably when the aircraft is shaking due to turbulence. "Imagine taking a big iPad and using it in the back of a car that's riding over cobblestones."

Eurofighter favours a mixed approach to MMI, such as the Typhoon's pioneering adoption of direct voice control and the helmet interface. In 5-10 years the aircraft is likely to enter a mid-life update which may include a new cockpit. The Typhoon boasts one key advantage of its US, French and Russian peers and that is the world's leading (operational) helmet-mounted display/cueing system (the Rafale has yet to operationally field a helmet-mounted system). Considering how hard it is to develop a modern HMD/S, Typhoon's Helmet Equipment Assembly is a major coup that took years to get right.

Cruise missiles and conformal fuel tanks

Since 1998, speculative artworks of Typhoons with conformal fuel tanks (CFTs), similar in design to those carried by late Block F-16s, have been publicised by Eurofighter; wind-tunnel testing of CFTs was started in 2002 but, 12 years, on they remain on the drawing board. A catalyst for CFT development came in late 2013 when Typhoon began tests with the MBDA Storm Shadow and Taurus KEPD 350 cruise missiles as the only weapons pylons strong enough to support these big weapons are the two 'wet' stations on the wings. As well as limiting the aircraft to a small centreline tank, these bulky weapons are draggy and reduce the aircraft's range. With this in mind, it was clearly time to accelerate work on the CFTs; currently BAE Systems is back in the wind-tunnel testing models with CFTs.

The two CFTs will carry 1,500 litres each and are expected to increase the Typhoon's combat radius by 25% (one of the few visible identification



Eurofighter's Aerodynamic Mod Kit (AMK) will include new re-shaped strakes, leading-edge root extensions and extended trailing-edge flaperons. (Airbus Defence and Space)

features of a Tranche 3 aircraft is the presence of points on the rear fuselage for their provision). Worning noted: "You will want conformal tank if you are doing air-to-surface offensive missions where long range is needed."

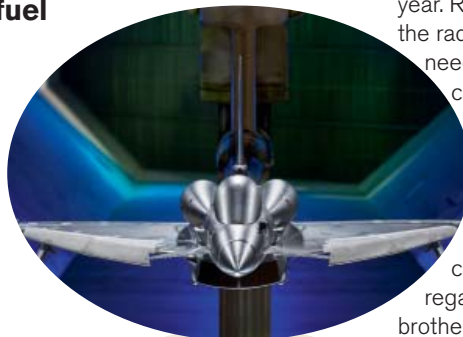
The long journey to E-scan

The painfully slow development of an electronically scanning radar for the Typhoon has been a source of some embarrassment to

Eurofighter; its discomfort was compounded when the first AESA-equipped Rafale was delivered to the French Air Force in 2013. But, this year the AESA set, dubbed Captor-E, finally seems to be gathering some steam, according to Worning. "I know that two experimental aircraft are going to fly with AESA this year. I believe we need to have a fully operational set by 2016. When the first customers will get it, I don't know. We expect a contract signature for the E-scan radar in 2014."

It is expected that the first flight with the Selex Captor-E, on Instrumented Production Aircraft (IPA) 5, will take place this year. IPA 8 and an RAF aircraft loaned to BAE Systems will also take part in the test programme which will take at least a year. Reasons for the delays include the weight of the radar and its increased cooling and electrical needs, as well as the convoluted multi-national customer-supplier relationship that has long dogged the programme.

The most unusual feature of Captor-E will be the inclusion of a swashplate mechanical repositioner which is planned to solve one of the main problems of conventional AESAs; their limited 'field of regard'. Experience with the Captor-E's little brother, the Gripen E/F's Selex Raven ES-05 (which uses a technologically more ambitious repositioning system), will aid development. Whereas today's AESA sets have a view of around 60° off boresight, the Captor-E will be able to scan the air more than 90° to the side (beyond 3 and 9 o'clock). The tactical benefits of this will include the ability to perform 90° 'F-pole' (the slant angle from the launching aircraft to the target when a missile impacts) manoeuvres during beyond-visual-range missile (BVR) engagements. Some functions of the defensive aids suite will also be able to use Captor-E and it is likely to have an 'offensive' jamming function.



Wind-tunnel tests of conformal fuel tanks. (BAE Systems)

Weapons

Virtual evaluations of the European Fighter Aircraft prior to its first flight revealed that a longer-ranged missile was needed to ensure an adequate superiority over a notional 'super Flanker' (a projected threat similar to the Su-35) in BVR engagements. The future BVR missile for all of the euro-canards will be the long-range MBDA Meteor. According to Worning: "The Meteor will go into frontline service with Typhoon in 2017. In Europe the Typhoon will remain the most potent air-to-air fighter for many, many years. To this we are adding to the air-to-surface abilities with the Taurus and the Storm Shadow."

Recently, Typhoon has been test flown with both cruise missiles. Again this is an area where the aircraft is well behind its arch-rival; the Rafale was qualified to use the Scalp EG in 2004. Typhoon is well behind most competitors in terms of the integration of air-to-ground munitions (partly as a result of the continuing relevance of the Typhoon's predecessor, the Tornado) but work is being done, in some cases driven by Saudi requirements. Another new weapon option is the Paveway IV, though Typhoon still lacks an air-to-surface missile like the Brimstone (though this is likely to be next).

Summary

It would be a bold observer that would predict large future sales for what looks to be Europe's last manned fighter. Despite this, the Typhoon of 2018 will be a potent, albeit expensive, fighter-bomber. The idea that the aircraft will become obsolete in coming decades because of the arrival of VLO (or LO) threats is debatable. For the time being, NATO's strongest air superiority assets are the F-22 and Typhoon and, accordingly, co-operative tactics are being developed. Stealthy aircraft will not operate in isolation, and in the future will be able to provide targeting information to conventional assets like Meteor-armed Typhoons (to some extent negating the importance of the shooter's radar cross-section). Though air-to-air combat has become a rare event, it is possible that this will change. Whether the US would be happy to commit a force-multiplier as valuable as the Lockheed F-22 Raptor to combat that could stray into the WVR regime is a question worth asking; with limited numbers of F-22s, and the air-to-ground optimised Lockheed Martin F-35 Lightning II requiring fighter support (in a high threat environment), Typhoons will retain an important role within the NATO force structure for some time. Despite the effort to create a fighter-bomber, it may be the Typhoon's fighter capabilities that prove a rarer, and more valuable commodity.



Airbus Defence and Space

Close-up of the strakes modification.

Airbus Defence and Space



The new strakes and other AMK modifications will increase the Eurofighter's maximum wing lift, angle-of-attack limit and the roll rates at high angle-of-attack.

UAVs over Africa



TOM HART reports on the rise of UAVs in Africa for civil and military applications.



Left: A Falcon UAV is bungee-launched on a demonstration flight with Namibian Ministry of Environment & Tourism wardens and World Wildlife Fund Wildlife Crime Technology Project experts for the aerial detection of tagged wildlife.

If unmanned aerial vehicles (UAVs), popularly known as 'drones', capture the headlines, it is almost guaranteed to be the controversy over the US government's air strikes in Yemen, Pakistan and Afghanistan. Civil sector development remains constrained until UAVs gain approval — and that could be a long, slow process. In the US, recent Federal Aviation Administration (FAA) initiatives have established new test sites in Nevada, New York, North Dakota, Alaska, Texas and Virginia, showing commitment to UAV development for the civil sector.

Africa provides a contrast to European and American caution. Aside from military applications, UAVs are being used on the continent for tasks that range from monitoring wildlife to providing Internet to remote areas currently without access.

Military UAVs

For the time being it is military applications that dominate UAV technology. In Africa this comes in two forms. Firstly, there are military forces, particularly the US and French deploying armed UAVs throughout sub-Saharan Africa. Then there is the indigenous UAV industry centred in South Africa which is a mature UAV manufacturing market. South African companies have produced UAVs since the late 1980s.

Mali, Niger, Djibouti and Somalia are the focal points for military UAV activity in Africa. The US has invested over a billion dollars in a new AFRICOM site in Djibouti. From here it co-ordinates MQ-9 Reapers that operate from Niger and, occasionally, fields in Ethiopia. The focus for US operations is Yemen, Somalia and now the western Sahel region which saw renewed fighting between government forces and Islamic militants last year. Somalia and the ongoing confrontation with the al-Shabaab movement is also crucial.

French military intervention in Mali in 2013 has led to a change in French government policy in relation to UAVs. Previously, the French prioritised UAVs for surveillance work and operated the EADS Harfang, a medium-altitude, long-endurance (MALE) UAV. The HarFang was successfully deployed in Libya. However, Francois Hollande's government soon requested two MQ-9 Reapers from the US. Surveillance endurance seemed to be the key consideration for the French but the Reaper's capabilities and historic deployments indicate that this might be the beginning of a more aggressive French deployment in the region. France will acquire 16 Reapers, a total deal worth around \$1.6bn.



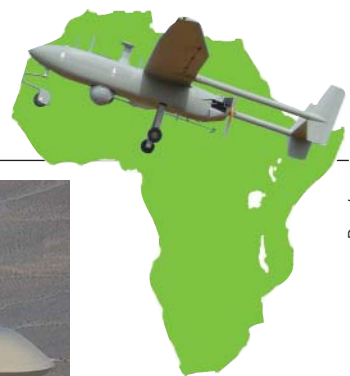
A French Air Force General Atomics MQ-9 Reaper flying at Creech Air Force Base in Nevada. The French Air Force has two unarmed Reapers based in Niger which will be used for surveillance over Mali and the sub-Saharan region.

South African lead

With the continent's most developed aviation and defence industry, South Africa has taken the lead in indigenous UAV production. UAVs have been in service with the South African Air Force since 1987 when the Seeker 1 was used for surveillance during the conflict with the front line states, particularly Angola. Operation Modular in 1987 proved an important testing ground for the UAV. The UAV was also used more peacefully to monitor South Africa's first free general elections in 1994. Indeed, prototype systems had been in use since the early 1980s.

Denel has been working to develop a UAV with surveillance and signals capability which can serve as a rough equivalent to the MQ-1 Predator. Development has been on-going for ten years but early interest expressed from the Brazilian Air Force seems to have not been converted into firm orders. The project has been subject to delays, a prototype was expected to fly in 2006. The major potential customer, the South African Air Force, has varied from enthusiasm to scepticism toward the project. This UAV has a wider remit than pure military applications with firefighting, security, disaster management and search-and-rescue all possible roles for the craft. Other markets for the Seeker series have included Saudi Arabia, which purchased the armed version of the Seeker 400 UAV and can carry the company's Mokopa or Impi missiles. The UAV has a range of 250km and of 16 hour duration. Denel also has a lightweight offering, the Hungwe, which is aimed at launch from 4X4 vehicles. With endurance set at about an hour, a 100km line-of-site and an operating ceiling of 12,000ft the UAV has applications in civilian and military areas.

Paramount Group is Denel's main South African counterpart. The company offers four UAVs: the Vulture, the Roadrunner, the Kiwit and the Sentinel-LE. The Roadrunner is a miniature UAV which weighs less than 10kg with 2kg payload. Endurance is limited to 45-60 minutes. The Kiwit is even



Denel Seeker UAV.



ASIDE FROM MILITARY APPLICATIONS, UAVS ARE BEING USED ON THE CONTINENT FOR TASKS THAT RANGE FROM MONITORING WILDLIFE TO PROVIDING INTERNET TO REMOTE AREAS CURRENTLY WITHOUT ACCESS

smaller, at 4kg it packs into a small case. Its range is about 5km. The focus is on a lone operator who needs a UAV deployed extremely fast. The Vulture and Sentinel-LE are larger models aimed at artillery spotting and long-range reconnaissance missions.

Congo peacekeeping

The United Nations Department of Peacekeeping Operations (DPKO) has been a key organisation in advocating UAS use for the United Nations in Africa. Back in 2008 the Irish Army deployed a UAV in a EUFOR operation in Chad and the Central African Republic. When the UN took over operations the UAVs continued to fly in support of UN troops. The Irish Army flew Orbiter Mini UAVs, an Israeli-produced UAS which provides over the hill information on threats, a system quite different to the MALE units that are now being deployed to support UN operations in the Democratic Republic of Congo (DRC).

UAV support for the Congo has been a long time coming, having first been requested six years ago. The advantage in the DRC is obvious. For years the country has been riven with civil war, often stoked by cross-border involvement from neighbouring countries. As opposed to the deployment in Chad where UAVs were used to protect military activities, the DRC UAVs are expected to play a role in protecting a new civil society. Elections and ceasefires will be monitored.

The Congo is about the size of Europe, so there are large areas to observe and police. Infrastructure is in a very poor state of repair, with many roads impassable. The UN relies on helicopters and aircraft to move around, but there is a heavy price to pay. Around 28 UN peacekeepers have died in aircraft crashes since 2011. The UAV selected for operations in the DRC is the Galileo Avionica/Selex ES Falco. Awarded as part of a three-year contract, the drone will be active in eastern DRC. With a range of 250km (155 miles) and surveillance range over a wider area, the Falco was well set to provide monitoring to the UN mission. It has up to 12 hours duration and the capability to operate day and night. The ability to fly at night is crucial because UN resources are stretched in the DRC with only 17,000 soldiers in their current mission. Most do not have access to night vision devices. Rebel groups are aware of these deficiencies and ready to exploit the loophole.

The mission also marked the first time a civilian contractor has provided UAV services to the UN. The units were delivered via Italian Air Force C-130Js last November. This is no simple test for the Falco. M23 rebels scattered government and UN forces to take provincial capital Goma in the same month. While



From December 2013 the Selex ES Falco tactical unmanned aerial system has been supporting UN MONUSCO peacekeeping operations in the Congo. (Selex ES)

the Falcos have support from the DRC government, the government of neighbouring Rwanda has been less enthusiastic. The big players are behind intervention in the DRC. Security Council support for intervention attracted votes from all members of the Council. State Department spokesperson Victoria Nuland told Voice of America: "The United States does support the UN's proposal to use unarmed, unmanned aerial vehicles. We're also looking at other missions where this might be possible. We think that building on MONUSCO surveillance capacity will better enable it to protect civilians and will support the efforts of the DRC to restore stability in the eastern part of the country." The UAVs represent a major commitment for the mission at a cost of around \$15m for the lease — about 1.5% of the UN mission's budget. Among the priorities for the UAVs is monitoring the current truce in the civil war but also checking up on smuggling operations on the country's border. Rich in precious metals, the DRC has proved a popular target for smugglers.

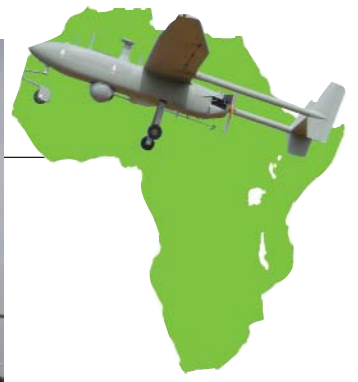
Painted white and stamped with the UN logo, the two Selex UAVs are not difficult to miss. Bad news for the mission came in early January 2014 when one Falco crashed on landing from Goma Airport. The air vehicle is slated for repair. There were no casualties. The question remains as to whether the UAVs will become a permanent feature in UN operations, or if this is a one-off. It also remains to be seen if the UN will take advantage of UAVs produced in the region, and whether these could be more quickly adapted for surveillance roles.

Preventing poaching

There have been a number of projects experimenting with using UAVs to monitor poaching activities. Rhino poachers in South Africa have been monitored using UAVs, specifically the Falcon. The Falcon is a miniature UAV that can be hand or bungee-launched, and can navigate between pre-established GPS waypoints or through joystick control. The UAV itself costs around \$55,000 but much depends on the payload and existing control facilities. At the moment the programme is still in the exploratory stages. The question is whether the UAVs will actually prove useful in tracking poaching activities — the main priority of which is finding the poachers. The Kenyan Wildlife Service remains silent on the type of UAVs to be deployed and even the location. This information would be useful to the poachers, who often use violence against rangers in the Kenyan parks. Nonetheless, Kenya's example represents the first comprehensive drone deployment to combat poaching in Africa rather than an exploratory study. It seems likely that more lightweight UAVs will be deployed.



BUILDING ON MONUSCO SURVEILLANCE CAPACITY WILL BETTER ENABLE IT TO PROTECT CIVILIANS AND WILL SUPPORT THE EFFORTS OF THE DRC TO RESTORE STABILITY IN THE EASTERN PART OF THE COUNTRY



MONUSCO

The United Nations' Under-Secretary-General for Peacekeeping Operations, Hervé Ladsous (left), inspects a UAV in Goma, Congo. The UN has begun using UAVs to enhance protection capabilities as part of the UN Stabilization Mission in the Democratic Republic of the Congo.

Proving ground

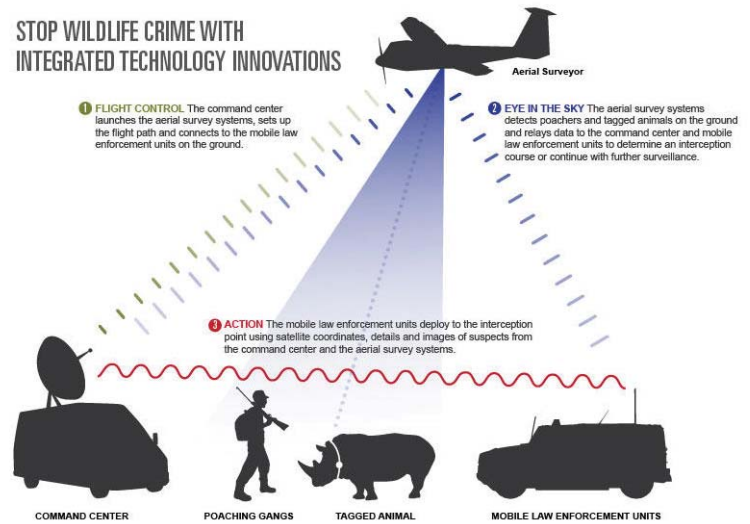
Africa may prove to be the best proving ground for UAV technology. Military deployment on the continent is not so different to operations elsewhere in the world but, in an environment where air forces operate on modest budgets, UAVs may quickly become a significant contributor to armed forces in the region. Industrial support for UAVs is already well-developed. The question is whether South Africa's defence industry can move away from supplying markets in the Middle East.

Aside from the military applications for UAVs Africa is well placed for experimentation in the civil field. Wildlife monitoring is one such practical application. Africa's bounty of rare and endangered species means there is no shortage of work in that regard. On the more prosaic side, a radio station in Johannesburg is set to use a UAV to monitor traffic jams. This is one area where UAVs could be extremely useful. A network of UAVs monitoring traffic patterns would be far more comprehensive than traditional helicopters.

Google's recent purchase of Titan Aerospace is also an important development for Africa. Titan's UAVs, which fly at 65,000-70,000 feet, are intended to provide global Internet coverage. Large parts of Africa are still Internet black spots. If cheap Internet access becomes universal it may come with help from UAS.

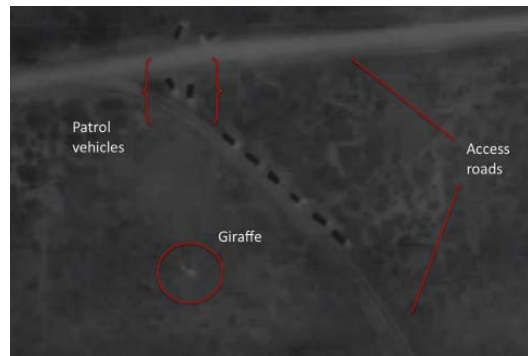
Finally, Africa's airspace is relatively clear, which removes many concerns over managing UAVs in crowded environments, or over large population centres. There is, in short, considerable potential for the UAV to be for Africa what the automobile was for America — a technology that is inextricably linked with a continent.

STOP WILDLIFE CRIME WITH INTEGRATED TECHNOLOGY INNOVATIONS



WWF

The WWF Wildlife Crime Technology Project joins the Namibian Ministry of Environment and Tourism and select technology innovators to field test a suite of integrated systems for anti-poaching and wildlife monitoring applications.



WWF

The WWF UAVs are fitted with high-resolution night vision and daylight cameras which can wirelessly send real-time video footage from the air into a central command centre combined with other surveillance streams.

Birds of Prey

As the USAF's CV-22 Osprey detachment in the UK continues to ramp up to full strength, **TIM ROBINSON** reports from the 16th Raoul Hafner Memorial Lecture at the UK's Defence Helicopter Flying School based at RAF Shawbury which saw presentations on the entry of AFSOC's tiltrotor into service.

The Bell/Boeing V-22 Osprey has had a difficult and highly public gestation. Though the dream of a fixed-wing aircraft that can also hover and land like a helicopter is almost as old as aviation itself, the dreams of engineers have produced few operational, production examples. Today, the Osprey is, after the Harrier, the most successful of these VTOL designs and now, with over 250 delivered and combat service in Afghanistan, Iraq and Libya, along with humanitarian missions recently in the Philippines, the V-22 has proven its worth. It still is new, evolving technology, but no one now disputes that it provides US forces (and will provide foreign customers) with a unique air mobility capability.

On 1 May at the Defence Helicopter Flying School VIPs and students were privileged to hear from the USAF's UK-based Osprey unit — the 7th Special Operations Squadron at RAF Mildenhall in the 16th Raoul Hafner Memorial Lecture. Giving the operators' perspective, was Captain Tyler Oldham (an Osprey pilot and instructor now on his second tour) from RAF Mildenhall. He was unusual in that he was one of the first CV-22 pilots to go straight into tiltrotors direct from training — rather than, has been the case until now, from either the fixed-wing or rotary-wing community.

The CV-22

So what are the differences between the MV-22 (US Marines Corps) and the CV-22 (USAF) Ospreys? Captain Oldham made an analogy using cars — with the MV-22 being the base model, and the CV-22 coming with the optional extras — such as leather seats, electric sunroof and the like. The main external differences are bigger fuel tanks, and the terrain-following and avoidance radar (TFR). The TFR allows flight down to 100ft. The CV-22 also features four crew (two pilots and two flight

The first two
AFSOC CV-22s
for RAF Mildenhall
arrived in 2013.



US Air Force

engineers — one of whom sits up front with the pilots on a jumpseat). This, given the CV-22s highly complex missions, is one more crew member than the MV-22 Marine version. The CV-22 also features a digital colour moving map and sophisticated navigation avionics including three INS systems and a GPS. This allows the crew to navigate to any point on the globe in perfect darkness. The aircrafts navigation avionics can store 999 waypoints and can allow missions to be replanned in flight to take account of changing situations.

The CV-22 also features an extensive EW and defensive aids suite — which Capt Oldham was careful not to elaborate about in this professional, yet open forum. For communications AFSOC's Osprey also features UHF/VHF/FM radios as well as SATCOM. These digital radios not only allow the special operations troops to communicate with external assets, but can also relay ISR imagery, including full motion video to SF commanders on board. The CV-22 features 24 seats in the back, but in practice this would be 18 fully equipped SOF troopers. The aircraft also comes with a hoist and a fast-roping system to allow troops to insert without the Osprey landing.

The CV-22 Osprey's range (500nm) is also enhanced by the dedicated MC-130J Commando II special operations aircraft able to refuel it in flight — giving it a full range of 2,100nm or four-to-five hours in the air.

The 7th SOS at RAF Mildenhall

The 7th SOS, part of 352nd Special Operations Group, Air Force Special Operations Command (AFSOC), provides long-range, all weather, day or night, clandestine personnel insertion or extraction. With RAF Mildenhall-based MH-53 Pave Lows deactivated in 2007, the arrival of the first CV-22 Ospreys in June of 2013 resurrects a key long-range vertical insertion /resupply role. As noted above, AFSOCs CV-22s at RAF Mildenhall provide a rapid deployable capability for covert special operations forces — at twice the *enroute* airspeed of the helicopter it replaces. As well as the fast-roping and hoist, the CV-22 can deploy SF forces via military free-fall from the back ramp. The CV-22 is able to conduct shipboard deck landings and fully blacked-out operations at night in all weathers, as well as NVGs at low-level.

The unit has five CV-22s at Mildenhall and at full strength will field ten Ospreys in the next year or so. As of May, the 7th SOS has seven crews for those aircraft. So far the according to 7th SOS Operations Officer, Lt Col James Peterson, the experienced crews are evenly split between fixed-wing and rotary backgrounds, but he says now two-thirds of new pilots joining the squadron are now direct entrants

straight from training — and can come from either rotary or fixed wing pipelines.

For CV-22 pilot currency, the goal is 15hrs a month in the actual aircraft and 10hrs per month in the simulator — one of which is installed at Mildenhall.

Meanwhile, Lt Col Peterson, speaking to AEROSPACE explained that initially as a new type, the CV-22 had been restricted in the use of UK airspace by the UK MoD — with early training flights taking place in Norfolk around the home base. This has now been lifted and Ospreys are venturing further afield, with recent visits to the 'Mach Loop' in Wales. The 7th SOS are also now looking for unprepared (but surveyed) landing sites around the UK to hone their skills.

Lt Col Peterson explained the Ospreys appeal to AFSOC: "The thing that's important is you now have expanded time, because you can get somewhere, twice as fast and you now have more time to do whatever you need to do at that location". Given that many missions of the CV-22 take place at night, this capability to squeeze extra mission time before daylight breaks is key.

AFSOC will eventually field 50 CV-22s in total — with its full operational capability scheduled in 2017.

From the pilot's perspective

During the lecture, Capt Oldham explained some of the nuances and capabilities of the tiltrotor. For example, if flying down a narrowing valley or tightly constricted terrain, then the pilot could tilt the nacelles to 60degrees and slow down to 110kts, enabling the CV-22 to hug the ground lower or reduce its turning circle dramatically. Approaching a potential threat area — a CV-22 pilot also has the option, unlike helicopters, of climbing higher to 25,000ft and overflying the threat at high speed — although he admitted that they rarely flew that high.

The Ospreys high speed is one of its chief advantages. Its cruise speed in 230kts, with a dash speed of 280kts. Capt Oldham explained that the 7th SOS is already training with other US and UK air assets, including AAC Apaches from nearby Wattisham. Requests from Apaches to 'escort' the CV-22s airborne on local training flights does take place — but Oldham noted that the Apaches have difficulty keeping up with the Ospreys until the CV-22s slow down to land.

The high speed of the V-22 also brings benefits in the medvac/casevac role. While the Osprey can carry 12 stretcher litters there is (yet) no dedicated medvac version. However experience with the Marines in operational theatres has found that a lack of paramedics onboard has been more than offset by the higher speed of the V-22 in whisking



HAVING FLOWN
NUMEROUS
OTHER
HELICOPTERS
I FEEL MORE
COMFORTABLE
IN THIS
MACHINE,
MAYBE MORE
SO, THAN
ANYTHING
ELSE I'VE EVER
FLOWN

Lt Col James Peterson
Operations Officer, 7th
SOS, 352nd SOG, USAF

US Air Force



the injured to hospital far faster than rotary wing platforms in the 'Golden Hour'.

Captain Oldham explained for very heavy weights a running takeoff similar to a fixed-wing aircraft is used from the runway, but this more of the exception. Saving fuel here, when the aircraft is at max weight, thus pays dividends later on when it may need that extra fuel to manoeuvre or conduct VTOL landings. At lower weights helicopter-style takeoffs are very common, with the nacelles at 80degrees to provide a 'jump' into the air.

Much interest at the lecture was on the Osprey's landing and autorotation performance. Capt Oldham admitted that it was heavy (50,000lb max take-off) aircraft and thus the CV-22's deceleration to landing was not like a helicopter: "you need a power margin to stop a 50,000lb aircraft". Though it is a heavy aircraft, its limited autorotational ability has more to do with the low inertia rotor system and beta governing of the blades than the aircraft weight.

Pedal spot turns in the hover though, are quite spritely, with the same (30 deg per second) turn rate as a normal helicopter. Lt Col Peterson, an ex-Pave Low pilot, meanwhile had high praise for the Osprey's fly-by-wire system after ten years flying it: "It's about the most stable aircraft I've flown". He added: "Having flown numerous other helicopters I feel more comfortable in this machine, maybe more so, than anything else I've ever flown."

Ospreys around the world

Some 259 Ospreys have now been fielded — the majority with the USMC and as AFSOC continues to move towards full operational capability with its Ospreys, the V-22 is on the verge of finding new operators and potentially new roles and missions. Also speaking at the Raoul Hafner Lecture was Robert Torgerson, Senior Manager, Rotorcraft Business Development, Boeing, who outlined the development history of the V-22, its current operators and expanding potential. On the latter,

Inside the CV-22 rear cabin. Rear seats are often removed for extra space.

“AFSOC AND BELL/BOEING ARE STUDYING A POTENTIAL GUNSHIP VERSION OF THE CV-22 — TO GIVE THE AIR COMMANDOS ADDED PUNCH

the type has recently won its first export orders with Israel and is set too to be potentially purchased by Japan.

Meanwhile new roles are also being proposed for the V-22. Only earlier this year at the Singapore Air Show it was revealed that AFSOC and Bell/Boeing are studying a potential gunship version of the CV-22 — to give the air commandos added punch. Meanwhile air-to-air refuelling trials have already taken place using an Osprey as a tanker and a F/A-18. There were, said Torgerson, "lots of modular applications" including SAR, MEDVAC, and VIP roles.

Probably the 'most significant' opportunity, explained Torgerson, was the hotly contested US Navy's Carrier On-board Delivery (COD) requirement. Responding to a question from the floor, Torgerson quipped that a V-22 COD version would also be useful for "any country" with "two large aircraft carriers" — a pointed reference to the UK's Queen Elizabeth ships. Whether the V-22 one day might ever wear a UK military roundel is unknown — but from the audience there certainly seemed to be no shortage of volunteers to fly the Osprey — even as exchange pilots.

Finally the comments from AFSOC and Boeing at the lecture indicated that while, as the first operational tiltrotor in the world, the V-22 was 'still a learning process' — the cost per flying hour and reliability of the platform have been improving — especially in the past few years. Lt Col Peterson

US Air Force



says of the CV-22: "Like any rotary-wing aircraft, generally they are maintenance intensive machines — but our readiness rates and aircraft availability are in line with mature helicopters". This was echoed by Boeing's Torgenson: "A lot of reliability issues are a thing of the past". Indeed, it was noted that as the first of a new type of flying machine, the true comparison for reliability arguably might be the Sikorsky R-4 — the first large scale production helicopter.

Furthermore, while the V-22 is currently a niche capability for America's special operations and first-to-deploy amphibious forces — the tiltrotor, it seems, is here to stay. AgustaWestlands AW609 is aiming firmly at the civil market, while a concept from Bell and Lockheed Martin for the US Joint Multirole Rotorcraft (JMR) sees a smaller, tiltrotor, the V-280 Valor — that, if selected, would see the tiltrotor become as ubiquitous as the UH-60 Black Hawk.

Summary

In conclusion then, this lecture provided a fascinating insight into the use and missions of this niche tiltrotor. At a time when NATO is quickly bolstering its forces in Europe due to uncertainty and tensions with Russia, this reconstitution of AFSOC's long-range VTOL CSAR and insertion capability at RAF Mildenhall could not be more timely — and provides US decision-makers and the Pentagon with a unique air power tool.

CV-22 figures

Cruise speed

230kt

Dash speed

280kt

Range

500nm

Range (with AAR)

2,100nm



Bristol had studied a tilting concept the late 1950s.

The 16th Raoul Hafner Memorial Lecture

The annual Raoul Hafner Lecture, held by the Defence Helicopter Flying School (DHFS) and strongly supported by Royal Aeronautical Society, seeks to link the science, engineering and art of rotary-wing flight with the students attending one of the world's foremost helicopter training schools. Giving the introduction at the lecture was retired flight test engineer and aviation historian David Gibbings FRAeS MBE, who observed that aviation pioneer Raoul Hafner, the designer of the Bristol Sycamore and Belvedere had proposed a very unusual passenger tiltrotor design in the 1950s. This unusual concept would have taken-off and landed vertically as a tailsitter — attaching itself to the side of riverside wharf buildings like the 1950s Ryan X-13 Vertijet. The seats would have rotated around an axis for horizontal flight. It would have been, observed Gibbings, a 'sporty take-off' for passengers.

The 2014 lecture on 1 May was followed by a highly informative and penetrating question and answer session from the floor, on the Osprey's flying characteristics, its handling and manoeuvrability. Finally the event finished up with a drinks reception sponsored by Boeing.



Left: VIPs at the lecture (from l to r): Ben Clothier — Raoul Hafner's Grandson, David Gibbings — Yeovil RAeS, Colonel Mike O'Donoghue (Ret'd) — RAeS Rotorcraft Group, Bob Torgenson — Boeing, Captain Paul Shawcross Royal Navy — Commandant DHFS, Captain Tyler Oldham USAF — 7th SOS, RAF Mildenhall, Jenny Body — RAeS President, Lt Col James Peterson USAF — 7th SOS, RAF Mildenhall, Robert Dompka — Bell Helicopter Textron, Colonel Neale Moss (Ret'd) — Boeing Defence UK.





Thriving through *turbulence*

JANE MIDDLETON* looks at the financial and other challenges facing aerospace businesses in today's volatile economic environment and offers some tips for success.

Earlier this year I agreed to give a talk on the 'The new financial challenges facing businesses'. As I began to give the topic some thought, I realised that, in reality, there are no *new* financial challenges facing businesses. Instead, we are experiencing the same old challenges and what we need to do is take a *new* approach to how we deal with them!

Before I explain what I believe to be the same old challenges, let's first look at what a business needs in order to be successful:

☞ It needs a good customer base from customers that have a need and actually want to buy your

products or services.

- ☞ It must sustain the business. Nurturing it and following a well planned strategy enables the business to grow either organically or by acquisition.
- ☞ There needs to be a strong cash flow to support the business needs. This will be on a day-to-day basis as well as any large investments required.
- ☞ Whilst costs are inevitable in any business, the key to success is controlling them and keeping fixed overheads to a minimum.
- ☞ There is no point in being in business unless you are profitable and providing value to your shareholders.

☞ Lastly, to do all this there needs to be a competent, willing and able workforce. Looking at the above attributes for a successful business, there are four areas which need a new, more flexible approach in how we handle the challenges they provide: globalisation, regulation, cashflow and human resources.

Let's take a closer look at each one of these:

Globalisation

Domestic markets are maturing and becoming saturated. Some large UK-based customers, such as the Ministry of Defence (MoD) have no cash or appetite for new projects, so defence suppliers need to look at overseas markets. Eight years ago a German radio manufacturer realised its home market was reducing rapidly and they needed to do something drastic to stay afloat. They developed a strategy which built their future business overseas, reducing their marketing spend and presence within their home market. This led directly to the manufacturer becoming a major player in the global market and a force to be reckoned with. The company experienced immense growth whilst securing their future.

Many businesses these days have supply chains and customers overseas, so we need to consider currency issues. Some companies take the easy route and just hedge the exchange rate but that can also have a negative impact. Companies need to examine their options and, in some cases, that might mean quite literally taking an option to mitigate exchange risk! The longer the project time line, the more of a foreign exchange strategy you will need and this may need to change over the lifetime of the project.

I have seen an example where hedges were put in place for six years and the currency moved in the wrong direction. Had the company in question used options instead of a long term hedge, it would have benefited from the large swing to the tune of £60m which would have flowed straight to the bottom line. Many would say the hedge was there to protect the company and they would be right, as it did in the early years. That said, management has a duty to their shareholders to make money so, when the downside can be protected for a small cost and the company still has the opportunity to take advantage of the upside should it occur, why would you not take the option approach?

The driver behind this mistake was a Chief Financial Officer who did not fully understand the tools available to him and a Business Unit Finance Director who did not want to take an upfront charge to the programme.



Companies that are looking to do business overseas may lack local knowledge and need some guidance in how things work.

When a company is looking to do business overseas they may lack local knowledge and need some guidance in how things work and how local companies do business. Some of the more commercially astute banks, such as HSBC and J P Morgan, now provide services that tap into their local overseas networks and provide invaluable market data as well as introductions to local relevant companies.

Beware hidden or forgotten costs! Export licences, transport costs and other relevant expenses should be costed into your bid or your pricing model.

Local taxation can be a challenge. Some countries will look to tax a company's worldwide revenues if they are seen to have staff permanently based in another country or even just a team sent out to train local staff. This taxation risk is not restricted to small undeveloped countries. I have seen issues with a UK company supplying training to Southwest Airlines in Dallas! So, be aware and take advice ahead of doing any deals — it may be a false economy not to!

Regulation

Ever increasing regulation brings with it additional costs of doing business and these costs come straight off the bottom line, reducing profits.

Such costs could be for additional resources to ensure compliance, extra licence fees or, even worse, changing business processes and equipment in order to meet new regulations.

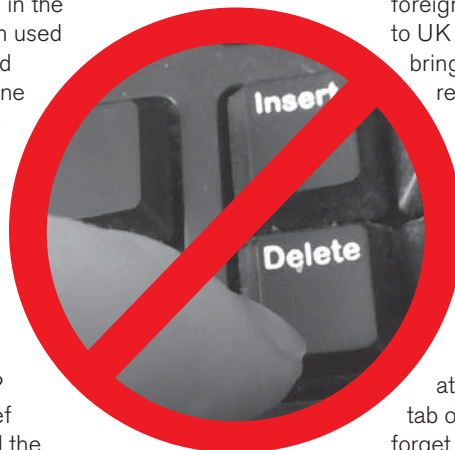
Regulations can come from anywhere and could be government or industry-driven. The challenge, (apart from paying for it) is how do you keep up with them and know when they are coming. Companies doing business overseas will be subject to additional regulations in the foreign country which may bear no resemblance to UK requirements. Auditors and advisers should bring any new regulations to your attention on a regular basis. So, don't just hit delete when their newsletters arrive in your inbox — it is always worth a quick scan to see if there is anything new you need more information on. We are all busy but you will be even busier if you fail to comply with regulations that you didn't know about. Ignorance is no excuse and can prove very costly!

Where possible, companies should look at having their customer pick up the regulatory tab or meet any requirement for changes. Do not forget to cover any such agreements within in your contracts.

Regulation is one of the fastest growing issues and cost drivers for businesses in 2014.

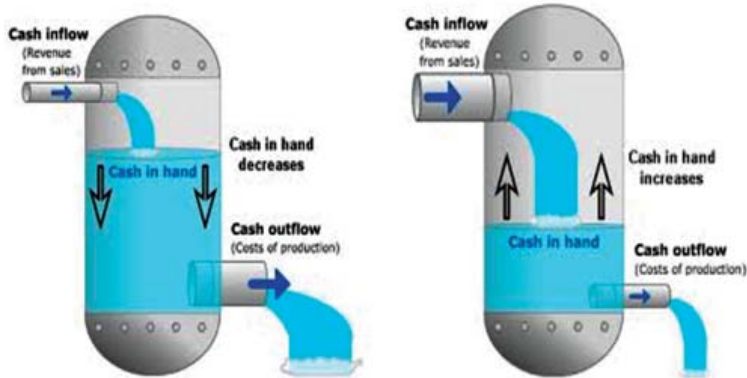


Local taxation can be a challenge



Don't just hit delete when auditor's newsletters arrive in your inbox.

Cashflow



Authentic ASSOCIATES

Bad cashflow is where less money comes in than flows out (left) and good cashflow is where more money comes in than goes out (right).

Cashflow

There is no secret formula to good cashflow within a business. It is all about money in vs money out and getting the timing right.

There is *bad* cashflow — less money comes in than flows out and there is *good* cashflow — more money comes in than goes out.

These days customers want products and services but they do not necessarily want to pay for them straight away. It may be that simple, or it may be that a large original equipment manufacturer (OEM) expects its supply chain to design, manufacture a product but will not pay for it until the fully assembled platform has been delivered to the end user and accepted into service. Another example is a cockpit upgrade that a government wanted to pay for over a period of 30 years!

Such demands can put huge strain on a manufacturer's cashflow — so companies need to find ways of funding the pipeline during that initial phase.

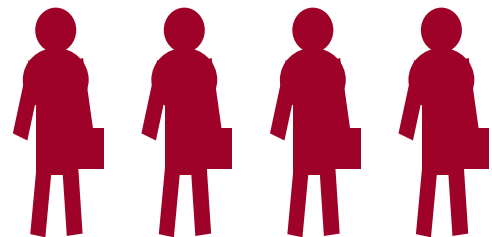
Finance Directors have to find creative ways of funding their businesses and the growth they need. A recent example of such creativity is a company that provides asset-tracking devices which was asked to supply 20,000 units to a client which did not want to spend £2m upfront on capital



expenditure. More to the point, the client didn't have £2m to spend. Rather than lose the sale, the management team found a niche leasing company and devised a solution. The leasing company purchased the units from the tracking company which could realise an immediate profit. The leasing company then leased the units to the end user who paid for a service by way of a fixed amount per day, per unit.

The great thing here is that, at first, the end user believed they just needed trackers to track their kit. But now they had a cost effective way of knowing which assets are where and, suddenly, it had an efficient and cost effective way of managing its logistics, fulfilling orders quickly and all while tracking their valuable assets at the same time.

Other sources of financial assistance available to companies include UK Government grants and a number of local authority schemes which can be used to ease cashflow challenges. Two such sources are the well established R&D tax credit scheme and the new patent box scheme which allows companies to pay less corporation tax on profit generated from products where there is a registered patent in place. There are reputable firms out there who will prepare claims and receive a percentage of the claim as their payment — all of which goes to help the cashflow.



Human resources

This crosses all the topics already covered and will affect all areas of a business. Human resources can either be part of the problem or they can be part of the solution.

Companies need to make their workforces as 'fit for purpose' as possible. As companies mature they need different skills and staffing levels, so must keep developing the human element.

Flexible working does not fit all workplaces but, where there are employment costs within the manufacturing and delivery process, companies need to be able to scale up and down as demand dictates.

Companies now look to buy in skills and expertise at all levels, as and when they need them. I am not necessarily talking about consultancy but actual workers, sometimes known as 'body shopping'. As new generations join the workforce, money and material items are not so much of a

driver as they were in previous generations. There are a new breed of managers entering the workplace who want, and in fact expect, not to work long hours and want more time off, so businesses need to devise ways to make that work in order to retain the brightest and best employees.

All of this needs strong HR management, supported by contracts that protect both the employer and the employee.

As technology develops we see automation replacing staff. Whilst this can work well it does involve high up front costs and may not be the answer in all cases. Plus, over automation can destroy a product or a service brand.

The way forward

Some of you may say not all of these challenges are financial but every single challenge, new or old faced by a business and its management team will have a financial impact somewhere within the business.

So the million dollar question is: How can businesses continue to be successful in an ever changing, dynamic environment?

Flexibility

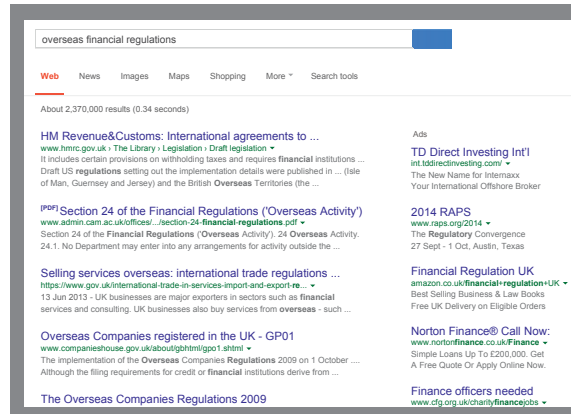
Companies need to constantly improve processes and procedures. Use the lean concept no matter the size of the business to drive constant improvement. It is very easy as a business leader to try to stick to something we have always done — it is a known environment and no one wants to take a risk and be seen to fail.

New ideas

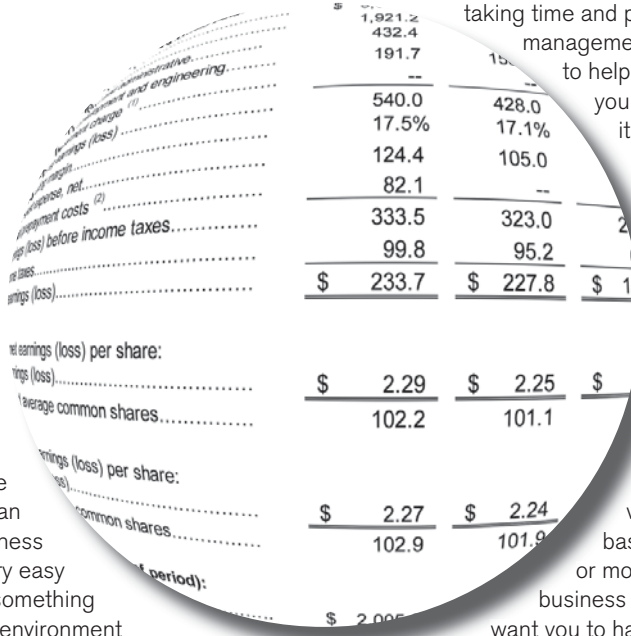
Companies must think outside the box. Look to the younger members of the workforce to come up with new ways and ideas.

Partners

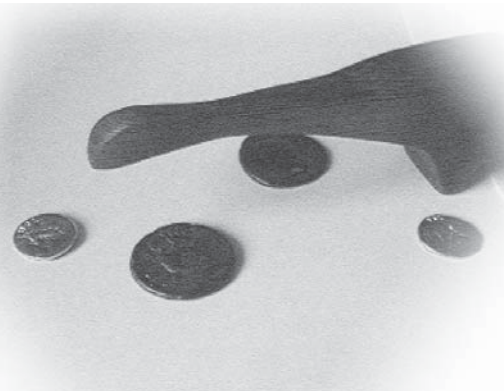
A business is not an island and does not work in isolation so where possible work with partners again think outside the box here and look for synergies from joining forces. A partnership does not need to be 50/50 or just financial but it must benefit both parties.



The Internet is a cost-effective tool to gain knowledge.



Use the financial information you have available.



Businesses must evolve their financial practices to survive.

Tools

We live in the technology age, so use the tools available to you. At no time has research been so easy or could it have been done so cheaply as by using the Internet. After all, whatever you are trying to do must be covered by an app somewhere!

Financial figures

Lastly, proactively use your company's financial reporting. Many businesses just read the monthly finance pack that is produced and never remove information that has become obsolete or add in new areas of focus. It is worth taking time and planning what information the management team need on a regular basis to help them run their business. Then you need to review the content and its value on a regular basis. All too often there is dread around the figures coming out instead of them being a welcome insight into how the business really is performing. Make sure you know what is being measured and what needs to be measured, so that well informed decisions can be taken. Managers need to work with the finance team to receive relevant, timely and valuable reports on a regular basis — this could be daily, weekly or monthly. It will be determined by the business needs not what the finance guys want you to have. If the finance team are not lock step alongside the business managers, knowing what is going on and supporting the business with relevant data — get a new one.

Conclusions

This has been a whirlwind tour of my thoughts on some of the new approaches we need to take to business and it is by no means an exhaustive list.

Remember it is not the challenges that businesses encounter but how they deal with them that separates successful businesses from those that fail.

** Jane Middleton is Managing Director of Authentic Associates.*

● INDUSTRY

Ontario's aerospace sector

PAUL E EDEN reports from Ontario on how Canada's 'other' leading aerospace province contributes to the country's aviation industry.

Ontario has a wide-ranging aerospace industry from original equipment manufacturer, through Tier 1 and 2 suppliers, to operators and importers. Its continued success and future expansion seems assured, as strong alliances are forged with local education providers and powerful support is delivered at Provincial government level.

Canada's aerospace sector has an annual impact in the region of Can\$12bn of GDP, around a quarter of that from Ontario. The province boasts an original equipment manufacturer in Bombardier, with its Q Series airliner and Global business jet production lines, but Tier 1 and 2 companies drive the majority of its aviation business. It is a combination that serves Ontario well, since its suppliers support not only home-grown airframes, but contribute to aircraft and space production programmes globally (80% of sales), in civil and

military markets, delivering key systems and ensuring diversity.

Ontario boasts major contributions to several of the world's leading aircraft programmes, including the Airbus A320, A330 and A350 XWB; Boeing 737, 777 and 787; Bombardier Global series; Embraer E-Jet; and Lockheed Martin F-35 Lightning II. By far and away the major beneficiary of Ontario's suppliers, the A320CEO/neo, for example, is likely to generate delivery values in the region of US\$230bn from more than 35 suppliers in the period 2013–22.

Speaking to company executives and provincial government aerospace players, it soon becomes apparent that Canada's aviation heritage, but more particularly that of Ontario, is something of which they are intensely proud and feel they are

Bombardier Q400s in final assembly at the company's Downsview factory.

A large Bombardier Q400 turboprop aircraft is shown in a factory setting, likely the Downsview factory. The aircraft is green and white, with the number 4454 visible on the nose. It is surrounded by various pieces of equipment, including a white generator with the number 188. The background shows the industrial structure of the factory.

Made in Ontario

an important part. Aerospace in Canada stretches back almost to the dawn of powered flight and the country's rugged terrain and sparse, widely dispersed population created fertile ground for the development of air services and industry.

With water bodies frequently more accessible than stretches of level ground long enough to accept an aeroplane, floatplanes became especially common. Noorduyn took the best features of the disparate fleet of aircraft serving Canada's remote communities and distilled them into the 1935 Norseman float and landplane. The aircraft continued in production post-war under Canadian Car & Foundry ('Can Car') ownership, Can Car built Hawker Hurricanes at its Fort William, Ontario facility, later building Curtiss Helldivers and North American Harvards under license.

Meanwhile, Victory Aircraft turned out Avro Lancasters at its Malton, Ontario factory, close to today's Toronto Pearson Airport, while de Havilland had set up its Canadian production facilities across Toronto at Downsview, building various Moths and, perhaps more importantly, Mosquitos. Post-war, Victory Aircraft became Avro Canada remaining,

along with its Orenda engine subsidiary, on the Malton site. The

Malton factories eventually passed to their current owner, Magellan Aerospace.

Over at Downsview, de Havilland Canada became the major Canadian aerospace player, working through the DHC-1 Chipmunk and

rugged DHC-3 Beaver, created in the spirit of the Norseman, to the DHC-8 Dash 8, ancestor of today's Q Series airliner. After a brief flirtation with Boeing from the mid-1980s, de Havilland Canada became part of the Bombardier group.

Made in Ontario

At a March press call to Ontario's Ministry of Economic Development, journalists were directed towards the Global bizjet, UTC Aerospace Systems' A380 undercarriage work and Aeryon Labs' Scout small UAV as particular provincial success stories, but there is actually very much more to behold. The Toronto area has become a centre of excellence in undercarriage design and manufacture, focusing on UTC (formerly Goodrich), Magellan and newcomer Sumitomo Precision Products Canada Aircraft (SPPCA), while Héroux Devtek and Messier-Bugatti-Dowty also have a presence.

The capacity of SPPCA's Mississauga workspace is the first clue to its Ontario ambition. Opened in March 2013, the unit contains a large area of, so far unused, office and shop floor space, ready for expansion from the company's present line of CRJ700/900/1000 undercarriage components and dressings, and Gulfstream G450/500/550 and IV side brace actuators. A very light jet undercarriage programme is expected and the Canadian division works closely with its Japanese parent, exploring research and development possibilities, as well as future manufacturing opportunities.

At its nearby Oakville site, UTC Aerospace produces landing gear on the grandest of scales. Its high-tech machine shops and lean manufacturing techniques produce major undercarriage components for, among others, the A380 (wing and body units), as well as dressed gear for other aircraft including the Boeing 747 and 777. At Magellan the story is one of undercarriage and a number of other components, as well as overhaul and manufacturing work in support of legacy programmes.

The company has maintenance contracts with the Canadian government, supporting the CF-188 Hornet, and takes General Electric J85 turbojet work from Northrop F-5 operators around the world. Magellan seems even more aware of its heritage in an aerospace cluster where history is seldom forgotten; enter the factory floor and the large-scale Avro Canada CF-105 model, sitting alongside the latest in computer-controlled milling machines, is as surprising for the political machinations it recalls as for the pride it still invokes in Malton's management team.

Supply and finishing

While Bell Helicopter builds its commercial line at Mirabel, Québec, Ontario boasts the Airbus

Global supplier

Aerospace programmes with Ontario content:

A320ceo/neo
A330
A350 XWB
A380
B737
B747
B777
B787
CRJ700/800/900
Global
Q400
E-Jet
G450/500/550
F-35
EC135
AStar
EC145
EC225



Heritage in the workplace
— Orenda engine and Avro Arrow on the factory floor.



Ministry of Economic Development, Trade and Employment

AStar helicopter at Airbus Helicopters Canada.

Helicopters Canada facility, at Fort Erie, in the Niagara region. As well as performing final assembly, customer completion and pre-delivery work on all new machines ordered by Canadian customers, the Fort Erie plant develops, engineers and certifies local modifications, including an AStar floor window for use in crane operations. It also manufactures composite components for the EC135 and EC145, recently using the expertise gained to win major new work on the EC225.

Announced on 4 February 2014, Airbus Helicopters Canada's EC225 engine cowling contract was won through a competitive process and will result in 40 new jobs being added to the 235 already sustained at the site. The facility's floor space is being rearranged to accommodate the work even as Airbus Helicopters Canada continues to innovate and expand on its composites expertise.

Major components of Fort Erie's helicopter business are finishing aircraft to customer requirements and their subsequent maintenance, repair and overhaul. The same is true of a very different outfit based at Peterborough, on the opposite side of Lake Ontario. Flying Colours is a family concern, specialising in business aircraft completion, as well as MRO work. Refurbishing or working on green airframes, Flying Colours has the capability to take cabin design from concept through to finished product, its skilled workforce delivering everything from traditional cabinet-making to upholstery, IFE customisation to avionics installation and exterior paint to fuel system engineering.

Currently capable of handling aircraft up to CRJ size, Flying Colours' hangars are benefiting from company investment, while its Peterborough airport site received Can\$7m funding each from the federal and provincial governments. With match funding from the City of Peterborough, the runway was extended and airport infrastructure improved. Flying Colours has an ambition to move into ACJ and BBJ work, and is in discussion with Bombardier to take on more completions, secure in the knowledge that its airfield base offers facilities to match.

Among the most recent airport additions, a building opened in January 2014 houses the senior

component of Seneca College's Bachelor of Aviation Technology programme. This awareness of the need to educate young people to become tomorrow's specialist workforce is typical of Ontario's aerospace sector, with Flying Colours keeping a close eye on activities just across the apron.

Flying Colours itself is typical of another trend in Ontario's aviation industry, in that it enjoys very limited staff turnover and enviable loyalty from its employees. Indeed, turnover is so low that Executive Vice President Eric Gillespie struggled to put figures on it, suggesting that it had no real relevance to the company's activity.

Teaching aerospace

Around ten colleges offer aerospace education, through 20 dedicated programmes. Among them, the University of Toronto has an Institute for Aerospace Studies, Ryerson University has an Institute for Aerospace Design and Innovation, and Centennial College has an Aerospace Centre for Training and Education. These three, along with York University and a plethora of manufacturers, including Bombardier, UTC, SPPCA, Honeywell and Pratt & Whitney Canada, have joined forces to create the Downsview Aerospace Innovation & Research (DAIR) group.

It aims to develop an aerospace research and training hub centred on Downsview airport, where the industry partners and academic institutions can work together on research and "collaborate to develop the next generation aerospace workforce and technologies". Among the key DAIR funding strategies, on 29 October 2013, the provincial government announced Can\$26m in support for Centennial College to build an aerospace training facility in the old de Havilland building at Downsview Park adjacent to the airport.

This so-called aerospace campus will also house the DAIR group office and is scheduled for a late summer 2015 opening, to offer state-of-the-art teaching in fields including avionics, maintenance, structures and composites repair, with specialised training from Bombardier available onsite. It will undertake collaborative research and has the aim of expanding Centennial's aerospace intake from 383 to 900 students. As the college's enthusiastic president and CEO Ann Buller notes, Centennial takes a somewhat different approach to local universities, although offering a number of joint courses with them. Its current Aviation Technician Program delivers a widely recognised Ontario College Diploma in either Aircraft Maintenance or Avionics Maintenance over two years.

Established as Toronto's first public college in 1966, Centennial has a large number of students, many from poor backgrounds, achieving in high tech industry below degree level. It specialises in



FIGURES FROM THE BOMBARDIER FLIGHT TEST PROGRAMME SUGGEST THAT THE C SERIES WILL ACTUALLY BE QUIETER THAN THE DASH 8



Milling machine at UTC Aerospace.

delivering young people equipped to deliver the highest standards of work in demanding sectors, including aerospace, not only educating them, but also tempting them into industries they may never have considered, including engineering.

This important recruiting work can take the most basic of forms and Buller recalls a group of young teenage girls set to work on a couple of old cars, changing wheels and generally tinkering with tools and components in a supportive environment where possibilities could be explored. Her very firm belief is that the college should produce students equipped for the workplace and passionate about their career and today's oil-streaked 14-year old could easily become tomorrow's avionics technician.

Pioneering Porter

Pioneering innovation and consolidation around core competencies are cornerstones of Ontario's aerospace sector, supported in no small measure by the Ontario Aerospace Council (OAC). Comprising representatives from something like 220 companies, the OAC is a not-for-profit organisation dedicated to creating and delivering aerospace collaboration in the region, as well as promoting the province's capabilities globally. Working at provincial and federal level, it represents a united front for Ontario's aerospace players at international events, including the Farnborough and Paris air shows.

Porter Airlines, based at Billy Bishop Toronto City Airport, epitomises the pioneering spirit that seems endemic to Ontario's aerospace organisations. The carrier offers a wide choice of destinations from the unusual airport, operating all-Canadian equipment in the form of the Bombardier Q400. Its aircraft are elegantly furnished and attractive to business customers, for their comfort and convenience — Billy Bishop is within easy walking distance of downtown Toronto.

On the other hand, its position in Lake Ontario and lack of connection to the city other than by regular ferry — the crossing takes but a few minutes — means that flyers living in the lakeshore high rises are denied the possibility of walking directly to the terminal. However, major building work is underway, as the airport is redeveloped for expanded Porter services. A pedestrian tunnel will provide direct terminal access and Porter hopes that passengers arriving by foot will join those on the ferry arriving to travel on an expanded route network.

Much of the airline's future relies on the Bombardier CSeries — yet another Canadian connection, albeit not Ontarian — for which it has conditional purchase agreements. As many as 12 CS100 and 18 CS300 aircraft could join Porter's ranks, offering the possibility of services to destinations as far away as Florida and the Caribbean, but much depends on the local

Porter Airlines is hoping to swap its Q400s for CSeries jets at Billy Bishop Toronto City Airport.

population. The runway would need extending into the lake at either end for safe operation, work that Porter says can be done without detracting from the enjoyment or safety of the region's many boating enthusiasts. With the CSeries configured from the outset for steep-approaches, an important factor at Billy Bishop, the remaining concern is that of noise.

Figures from the Bombardier flight test programme suggest that the CSeries will actually be quieter than the Dash 8 aircraft originally operated from the airport, but local opinion will need to be swayed, a fact to which large banners draped from several balconies facing the airport and proclaiming 'NO JETS' testify. To prove its case, Porter really needs to get a CSeries into the airport circuit but it seems confident that progress will be made.

Porter's approach to the problems of expansion at Billy Bishop, as well as its unusual business model, offering gate areas uniquely configured as lounges with free self-service beverages and snacks included in the regular ticket price, is in keeping with the innovation and confidence found throughout Ontario's aerospace sector. The province has found itself with a broad-based aviation capability, in industry, education and service provision, through little more than historical serendipity. But rather than leave that capability to its own devices, it has embraced it, promoting it as an asset and helping ensure its future through training for the next decade and the years thereafter. Should any of the world's aerospace hubs find themselves in need of an operational model, they could do little better than to take a look at Ontario.



● TECHNOLOGY

Electric aircraft



It's Electrifying

On 25 April, Airbus Group Innovations' E-Fan electric aircraft demonstrator made its first public flight, in Bordeaux, France. **TIM ROBINSON reports from this first demonstration.**

In April, a select group of VIP and media were guests for a public flight of an unusual technology demonstrator from giant European aerospace and defence group Airbus. First seen in public in the static display at the Paris Air Show in 2013, the E-Fan electric aircraft was developed in 18 months by Airbus Group Innovations (formerly EADS Innovation Works). It has been built to test and explore new technologies in greener, zero-emission, cheap flight for the GA sector and beyond.

The all-composite E-Fan uses lithium-polymer batteries in the wings to power two 60kw electric motors. Battery charging, according to the E-Fan test pilot, Didier Esteyne, takes as short of an hour and a half.

The two-seat demonstrator has a tandem seating arrangement and has a wingspan of 9.5m — sized to be the same as a typical GA aircraft. It has an empty weight of 500kg and a cruising speed of 160km/h.

Extending the endurance

At the time of the first public flight it had notched up over 22 flights. Endurance for the E-Fan, is currently over 30 mins, with the goal bring it up to an hour. The flight test campaign is expected to last until the end of 2014 or 2015.

As well as the battery-powered electric ducted fans, the eFan also features other innovations. It

has, for example an electric motor that is connected to the rear main undercarriage (the eFan uses a tandem gear design with outriggers similar to the Harrier or U-2). The E-Fan also includes as a safety feature a ballistic parachute.

The event at Bordeaux-Mérignac Airport, France in April was attended by VIPs and media, eager to see the first public flight of this demonstrator. The eight minute flight wasn't long — but was highly impressive. In particular, the start-up of the two-electric ducted fans right in front of the crowd was hardly louder than a vacuum cleaner. Once in flight, it was, from the ground, to all intents and purposes, silent.

Meanwhile the wider public will be able to see (and hear) for itself next month when the E-Fan demonstrator will appear and fly at the Farnborough Air Show in July.

eFan 2.0 & 4.0

Yet the eFan is only the beginning. At the media event in Bordeaux it was revealed that such is the success of the demonstrator that Airbus Group (with partners) intends to go straight into production of larger and more capable models, with the aim of the first flight of the next production model in 2017. Said Airbus Group CEO, Tom Enders via video: "In three years time, we will see a new aircraft, smart and small, in the air and on the market — fully operational, fully industrialised, and fully electric".



THIS ENTRY INTO THE GA MARKET ALSO OFFERS THE FIRST STEP TO A LARGER, EVEN MORE EXCITING GOAL — AN ULTRA-GREEN, ULTRA-QUIET AIRLINER



To that end, Airbus is partnering with Aero Composites Saintonge (ACS) (which also worked on a tiny Cri-Cri aircraft modified to fly on electric power), along with Daher-Socata, Safran, Siemens and Zodiac Aerospace. To manufacture these new models a new subsidiary, VoltAir will be launched. The project has also received funding from French regional funds, as well as the civil regulator, the DGAC.

VoltAir's first product will be the E-Fan 2.0, a two-seat, more refined version of the original prototype with side-by-side seating (important for flying training schools). The E-Fan 2.0 would also feature a more conventional fixed tricycle undercarriage. This will be aimed at flight training schools. An ultra-quiet training aircraft, say Airbus, will be major benefit when training the huge amounts of pilots needed by the aviation industry in the future. Said Airbus Group Chief Technology Officer, Jean Botti: "The E-Fan represents the answer to the question of how to train thousands of airline pilots for future."

This two-seat trainer will be followed two years later by a larger four-seat trainer/tourer called the E-Fan 4.0 which will build on the earlier technology and offer enhanced endurance with a small 'range extender'. This hybrid design, set to fly in 2019, utilise batteries and a potentially a small combustion engine as an 'extender', which would give the E-Fan 4.0 a potential endurance of two hours (or three and a half hours with the range extender). The 'range extender' engine could be powered by either kerosene or potentially biofuel.

Meanwhile, research from Airbus Group's Innovation centre in Singapore may also boost endurance. An automated flight path optimiser has demonstrated the potential to extend the E-Fan's battery life by 50%, compared to an average human pilot, by routing around turbulence.

The production aircraft will be equipped with Garmin glass cockpits in common with many GA types today. For the initial purchase cost, Airbus say it expects this be 'comparable' with existing GA training types — and Airbus CTO Botti also hinted that the business model may include operators being 'leased' batteries for the aircraft. However,

the use of electric batteries is expected to result in much lower operating costs than today's equivalent GA aircraft.

Factory of the future

But the E-Fan is not just a GA aircraft for the ultra-green flyer. The project also represents a flagship aerospace manufacturing plan for the revival of the French economy, and is one of 34 key national industry roadmaps set by Paris. The E-Fans will be built at a new factory near Mérignac. This facility will be an aerospace 'factory of the future' and is intended to be a showcase of manufacturing, innovation and assembly with virtual reality and robotics (See 'Game on for aerospace', *AEROSPACE*, May 2014). The assembly of E-Fans here will be no garage kit-plane operation — the goal is to build 80 aircraft a year.

A regional airliner?

However, this entry into the GA market also offers the first step to a larger, even more exciting goal — an ultra-green, ultra-quiet airliner. Airbus Group sees the potential of this technology for larger aircraft — in particular scaling up the E-Fan 4.0 hybrid concept to a larger 90-seat regional airliner.

This would combine the electric-hybrid technology of the E-Fan, with Airbus's work with Rolls-Royce on distributed propulsion — called E-Thrust (see Technology Horizons, *AEROSPACE*, June 2013). Marrying the E-Fan with E-Thrust could deliver a regional airliner able to fly for three hours on electric hybrid propulsion in the 2030 timeframe.

While the fuel savings are obvious — a hybrid-electric airliner, like the eFan would also be extremely quiet. For current airports facing restrictions because of noise, a virtually silent airliner could conceivably allow 24-hour operations, along with more efficient flights without having to thread around densely populated areas. This would allow existing airport capacity for short-haul flights to be massively increased — without any extra concrete needed. A silent (or near silent) regional airliner would also provide a boost for city-centre airports

E-Fan test pilot, Didier Esteyne speaking to the press after the flight.



E-FAN

9.5m
WINGSPAN

500kg
EMPTY WEIGHT

200km/hr
MAX SPEED

160km/hr
CRUISING SPEED

The E-Fan flying at Marignac on 25 April.





Artist's impression of the E-Fan 2.0 and E-Fan 4.0



and open up the possibility of future urban air terminals for commuter air services.

But perhaps the biggest and more startling advantage for airlines would be vastly reduced operating costs using hybrid electric technology. Maintenance costs, too compared to comparable regional turboprops, are also expected to be lower for a hybrid-electric airliner.

However, it is unknown at this early stage whether this would become a project under the existing ATR regional airliner consortium — or whether it might be an aircraft within the Airbus family, or whether it would require an entirely new company.

Are friends electric?

Electric aircraft, like electric cars are not a new idea and others are also experimenting with similar concepts, including electric-powered gliders or even re-engining a Cessna 172 with batteries. However the backing of a giant aerospace, defence and space group like Airbus (formerly EADS) is highly significant in having the R&D, industrial and marketing muscle to make this a reality — a mainstream option for flying schools, rather than a niche invention. Designing the E-Fan family from the beginning as electric aircraft also brings advantages instead of attempting to shoehorn into a legacy kerosene-powered design or adapt a glider to fit the technology. Longer term it is clear that Airbus Group have even bigger plans — and a hybrid-electric airliner of 2030 would help meet the aerospace and aviation industry's own goals for sustainability. Europe's Flightpath 2050, for instance, has stringent targets for CO₂ nitrous oxide and noise reduction.

If successful, in the future you will no longer have choose between being an ethical, ultra-green traveller and flying — you will be able to do both.

The second factor is the 'Tesla effect'. Thanks in part to Elon Musk, electric vehicles are no longer seen as inventions by crank scientists or consumer products aimed only at sandal-wearing lentil-eaters. They now are seen in many quarters as cool, sexy and desirable and are thus seen in greater and

greater numbers. This then, too will help move the idea of electric GA aircraft into the mainstream.

Third, the advent of 'e-mobility' with electric and hybrid cars moving into the mainstream, as well as existing consumer electric devices like iPads and smart phones still continues to drive the unremitting development of smaller, lighter and more efficient battery technology. Though one airframer has already found that pushing the boundaries of battery technology may also have its challenges as well as its opportunities, the underlying trend is that these energy storage devices will become cheaper, smaller and ever more powerful.

Finally, the promise of a hugely lower operating costs and 'cheap' flight is an irresistible lure for airlines and for the private sector. Affordable GA flying (with near-low noise concerns) could conceivably revitalise the GA sector in Europe and elsewhere, and (coupled with other technologies in development) lead to a new era in personal transportation.

Conclusion

There is no doubt that this is an extremely exciting project — not just for the general aviation sector — but also for the wider French manufacturing and economic revival plan. Should the technology prove successful — then Airbus truly has a direct path from these GA designs to a larger hybrid-electric regional airliner — a 'game-changing' concept that may be as significant to aviation as the first jet airliner. Indeed this technology — zero-emission, ultra-quiet aircraft, promising significantly lower operating costs may be a 'Holy Grail' for both regional airlines and the GA sector.

However challenges remain. The timescale to fly, manufacture and productionise a brand new aircraft — along with a factory of the future in only three years is ambitious. The safety certification of these electric aircraft will also break new ground. And like electric cars, there may be residual worries about range and whether there is enough e-infrastructure (eg: charging stations) to support the early adopters. It may be early days yet — but this is a bright spark for aerospace.

“
A ZERO-EMISSION, ULTRA-QUIET AIRCRAFT, PROMISING SIGNIFICANTLY LOWER OPERATING COSTS MAY BE A 'HOLY GRAIL' FOR BOTH REGIONAL AIRLINES AND THE GA SECTOR

Afterburner

www.aerosociety.com

Diary

4 June

Edwin A Link Lecture

Simulation — Before, During and After Flight Test

Capt Randall L Neville, 787 Chief Test Pilot, The Boeing Company
Flight Simulation Group Named Lecture



Boeing 787 Dreamliner of Qatar Airways. Boeing.

42 Message from RAeS

- President

"Looking ahead, this year I wish to focus largely, but not exclusively, on membership and engagement. As I said, the Society is in good heart. Membership is increasing, but it is also ageing; so, if the Society is to continue to flourish, we need to step up our recruiting of new members."

- Chief Executive

"One of the highlights of the year is the Society's 'Ballantyne Day', our annual careers awareness and information event which aims to familiarise young people with some of the aerospace and aviation issues of the day with, most importantly, most of the presentations and activities being predominantly delivered by young people."

44 Book Reviews

The Avro Type 698 Vulcan, The Hovercraft and Flying with the Larks.

47 Library Additions

Books submitted to the National Aerospace Library.

48 Conservation of the Cuthbert-Hodgson Collection

The work being done at the National Aerospace Library to achivally preserve one of the world's finest collections on early ballooning.

50 Education & Skills Committee update

52 Diary

Find out when and where around the world the latest aeronautical and aerospace lectures and events are happening.

53 Alan Bristow Lecture

UK SAR capability 2015 and beyond.

54 Corporate Partners

Two new members join the Society's Corporate Partner Scheme.

55 Obituaries

Capt Dick Hadlow, Frank Roe and William McKinlay.

56 Elections

New Society members elected in the past month.

OUR PRESIDENT

Bill Tyack



I WISH TO CHALLENGE EVERY MEMBER OF THE SOCIETY TO RECRUIT AT LEAST ONE NEW MEMBER THIS YEAR

I am very honoured to be taking over as President of our great Society. This is an exciting time, with a growing recognition round the world of the importance of aviation and aerospace to society at large and to the economy. As the oldest and, arguably, the most influential aeronautical society, the RAeS has an important part to play in reinforcing this message.

Over the past few months I have visited several Branches and I have taken part in a large number of events in No.4 Hamilton Place. It is clear to me that the Society is in very good heart and is forging ahead with a whole range of exciting, relevant and influential activities. I wish to take this opportunity to pay special tribute to Phil Boyle and Jenny Body who, as Chairman of Trustees and President respectively, have skilfully steered the Society through a period of significant change. Jenny has also been an outstanding champion of careers in STEM (science, technology, engineering and mathematics) and of diversity, both within the RAeS and on a much wider canvas. I am very grateful that she has agreed to continue these activities this year. I also wish to thank Simon Luxmoore and all our dedicated members of staff for everything they do to keep the Society running smoothly and efficiently.

Looking ahead, this year I wish to focus largely, but not exclusively, on membership and engagement. As I said, the Society is in good heart. Membership is increasing, but it is also ageing; so, if the Society is to continue to flourish, we need to step up our recruiting of new members. I am convinced that the best 'recruiting sergeant' is the individual member, who can offer a personal recommendation to a friend or colleague. Therefore I wish to challenge every member of the Society to recruit at least one new member this year. The other side of this coin is to assure members that the Council and staff are constantly looking for ways to improve membership benefits.

On engagement, I wish to encourage all our members and Corporate Partners to make greater use of their membership by engaging more closely with the Society. Equally important, I wish to encourage the Society in all its manifestations to pursue a wider, deeper and more influential engagement with the outside world: the aerospace and aviation communities, academia, the public, international organisations and governments.

Finally, I look forward to meeting as many as possible of you during my year in office.

NEW PRESIDENT

Air Cdre Bill Tyack CBE FRAeS RAF (Retired)

Bill Tyack was born in Scotland in 1944 and educated at the Methodist College Belfast. He spent 37 years as a navigator in the Royal Air Force, retiring in 1999. He flew operationally on Shackleton, Nimrod and Canberra aircraft in the UK and overseas. Bill also spent four years at Boscombe Down, conducting trials on a range of aircraft, mainly the Nimrod and the Comet 'flying laboratory'. In the 1980s he commanded No 51 Squadron (Nimrod R1) and then RAF Wyton. His several appointments in the Ministry of Defence covered operations, policy, operational requirements and personnel. Bill is a graduate of the Aerosystems Course, the Royal Naval Staff Course and the Royal College of Defence Studies. He edited the first edition of *British Military Doctrine*, published in 1997,

and his final job in the RAF was as the Senior Military Officer in the Defence Evaluation and Research Agency (DERA), helping to prepare the agency for privatisation. Bill then worked for DERA and QinetiQ in business development roles until 2006. He was awarded the CBE in 1997.

Bill has been a member of the Society since 1980 and a Fellow since 1993. He is a long-standing member of Council and has chaired the Learned Society Board, the Society's Pension Fund Trustee body, the Farnborough Branch Committee and the Heritage Awards Steering Committee. He was awarded the Sir Robert Hardingham Sword in 2008.

Bill is married to Judy; they have three married daughters and six grandchildren. He holds a private pilot's licence.

OUR CHIEF EXECUTIVE

Simon C Luxmoore



... WE ARE APPROACHING THE BRANCHES CONFERENCE, THIS YEAR TAKING PLACE IN DERBY, WITH THE VERY KIND SUPPORT OF ROLLS-ROYCE ...

- One of the highlights of the year is the Society's 'Ballantyne Day', our annual careers awareness and information event which aims to familiarise young people with some of the aerospace and aviation issues of the day with, most importantly, most of the presentations and activities being predominantly delivered by young people. The theme of this year's event was 'Diversity', certainly in its broadest sense very 'topical' today, and we are particularly grateful to our friends at Raytheon for their very generous support of what turned out to be a most successful day.
- At the time of writing we are approaching the Branches Conference, this year taking place in Derby, with the very kind support of Rolls-Royce and where in excess of 50 delegates will be in attendance representing over 30 Branches worldwide.
- Last month we said goodbye to Christine Woodward who retired from her role as Librarian at the National Aerospace Library. We of course thank Christine for her years of sterling service at Farnborough but I am delighted to welcome Tony Pilmer to our team as her replacement.
- Paul Bailey, the Society's Deputy Chief Executive, who has been with the Society for two spells, most recently for a period of six years, has decided to accept an invitation to join the Engineering Council as its Deputy Chief Executive. I am delighted for Paul who will be taking up this new appointment in July, and on behalf of the Society's members I wish him well for the future and extend to him our gratitude for his excellent contribution over the years.
- The Annual Banquet will have been and gone by the time this editorial is published but certainly it will have seen the highest attendance for many years. I believe our formula for this event — combining an excellent networking opportunity with very much a 'party' atmosphere — works well for the Society, and our ability to attract industry leaders as our guests of honour reflects well on the event.
- Finally, for those who are still able to swing a golf club please do not hesitate to enrol for the Society's Golf Day on 18 June — an excellent event to which our regulars always return. There must be a message there!

The Aeronautical Journal Leading aerospace into the future



The world's longest continuously-produced aeronautics journal

International readership and content

Published monthly

All subscriptions include online access to all papers produced since 2003

All RAeS members receive an 80% discount

Papers peer-reviewed by an international team of respected Associate Editors and referees from the world of aerospace academia and industry

Reporting current research providing an invaluable source of knowledge for academics, engineers, scientists, technologists and enthusiasts involved in aerospace

Subscriptions

Non-members

Non-member subscriptions are available from:
Royal Aeronautical Society

Publications Subscriptions Department
Dovetail Services Ltd, 800 Guilla Avenue, Kent Science Park,
Sittingbourne, Kent ME9 8GU, UK.

Tel: +44 (0)844 848 8426 Fax: +44 (0)844 856 0650
email: ras@servicehelpline.co.uk

RAeS members

All RAeS member subscriptions
receive an 80% discount from:

The Membership Department
Royal Aeronautical Society,
No.4 Hamilton Place, London W1J 7BQ, UK.

Tel: +44 (0)20 7670 4300 Fax: +44 (0)20 7670 4309
email: membership@aerosociety.com

THE AVRO TYPE 698 VULCAN



The Secrets behind its Design and Development

By D W Fildes

Pen & Sword Aviation, Pen & Sword Books, 47 Church Street, Barnsley, S Yorkshire S70 2AS, UK. 2012. 487pp. Illustrated. £30. ISBN 978-1-84884-284-7.

The previous Royal Aeronautical Society Chief Executive Keith Mans and I first met on the flight deck of an Avro Vulcan B2 at RAF Oakington in 1967. It had been brought in to convince trainee multi-engine pilots that we should join No 1 Group of Bomber Command and Keith was sufficiently smitten to wax lyrical about the mighty delta. It would be ten years before I got to fly the Vulcan and Keith was right — it was a tremendous machine and one for which I have only the fondest memories. I nearly lost a Canberra once — never a Vulcan, and the fact that it looked after a whole host of aircrew while being a primordial weapon of war spoke volumes for the firm foundations on which 'the flatiron' was built.

David Fildes' overview of the design and development of the Vulcan is an obvious labour of love. There have been some terrible 'cut and paste' histories of the Vulcan over recent years but as soon as I saw that this volume had been endorsed by Harry Holmes, chairman of the Avro Heritage Centre, I knew we were in safe hands. This isn't a chatty read — rather a marvellous compendium of the evolution and chronology of the Vulcan from the original specification through every bit of kit on



board to advice for model makers. It is a tremendous book for dipping into and for finding yet another serendipitous piece of fascinating information. I interviewed many of the original design teams in the 1970s and I propped up the bar with Roly Falk at the 25th anniversary evening at Scampton in June 1981. But I never knew that some Avro bright spark proposed a target marker version in the 1951 Type 698 Design Brochure. Best of luck with that...

The content and the price of the book are right. Like a clever clogs I tried to find some howlers to point up but I couldn't.

I will leave the last word to Harry Holmes. "I have no hesitation in commending this book as the definitive work on what has become an icon of aviation, the Avro Vulcan." I couldn't have put it better and David will not write a better book.

Andrew Brookes
FRAeS

*Above: Avro Vulcan B2.
Left: The first prototype Avro
698 Vulcan, VX770.
All RAeS (NAL).*

The content and the price of the book are right. Like a clever clogs I tried to find some howlers to point up but I couldn't

THE HOVERCRAFT



A History By A Hollebhone

The History Press, The Mill, Brimscombe Port, Stroud, Gloucestershire GL5 2QG, UK. 2012. 189pp. Illustrated. £16.99. ISBN 978-0-7524-6479-4.

Ashley Hollebhone is a young author and his book presents a comprehensive, well-researched and refreshing account of the hovercraft saga. The book explores the origins of the hovercraft principle, expounded with great enthusiasm by Christopher Cockerell, later Sir Christopher, that arose from studies and experimentation by pioneers such as John Thornycroft in the late 19th century to reduce the water drag of boat hulls using some form of air lubrication.

A full account is given of the work done by Christopher Cockerell with models and test rigs to demonstrate the hovercraft principle and the development of the first full sized hovercraft, the SRN.1 built by Saunders-Roe at East Cowes in 1959, which led to an early proliferation of designs and the promise of a transport revolution and a supporting industry to build hovercraft on the grand scale. This era of development was at its peak with the construction of the SRN.4 Mountbatten Class passenger and car ferry hovercraft that remained in service for over 30 years on cross-Channel routes. The military uses of hovercraft were evaluated by the Royal Navy and Army for some years. However, it was left to the US, the USSR and China to exploit the benefits of hovercraft to support military logistics needs.

The book is superbly illustrated with many photographs and artists' impressions of a bewildering variety of hovercraft produced under government and industry funding and by amateur builders. The rise and fall of the hovercraft industry

is covered in depth together with the emergence of a more practical approach to hovercraft design currently being carried forward by the British company Griffon Hoverwork.

Without detracting from the good work that has been done by Ashley Hollebhone to produce what must be the definitive work on the subject of hovercraft, it is worth pointing out that there is an error on p 83 where the Rolls-Royce (formerly Bristol Siddeley) Marine Proteus is identified as the power plant used by Concorde. This is not the case as the Concorde power plant was the Olympus gas turbine engine whereas the marine Proteus installed in the SRN.4 was developed from the Proteus turbo propeller aero engine used to power the Bristol Britannia airliner.

In conclusion, this book is highly recommended as an important and thorough account of the hovercraft in all its forms and applications. It stimulates much thought on the subject of human behaviour when faced with something new, in this case resulting in something equivalent to the 'railway mania' that happened in Victorian times, and what might have been if the hovercraft had originally been seen as a unique transportation concept in its own right rather than as a form of low flying aircraft or helicopter.

Bob Wealthy

Solent Aeromarine Enterprises



Above left: Saunders-Roe SRN.1 hovercraft, G-12-4.
Above right: Westland SRN.6, SR-N6-150, of Hovertravel, leaving the Southsea Terminal en route to Ryde, Isle of Wight.

Below left: Britten-Norman Cushioncraft CC-2, CC-002, being fuelled at a BP Service Station at Bembridge, Isle of Wight.

Below right: Westland SRN.4 hovercraft, GH-2007, The Princess Anne, of Seaspeed. All RAeS (NAL).

In conclusion, this book is highly recommended as an important and thorough account of the hovercraft in all its forms and applications

FLYING WITH THE LARKS

The Early Aviation Pioneers of Lark Hill

By T C Brown

Spellmount, The History Press, The Mill, Brimscombe Port, Stroud, Gloucestershire GL5 2QG, UK. 2013. 200pp. Illustrated. £14.99. ISBN 978-0-7524-8989-6.

When, on 16 October 1908, the first recognised flight in this country took place, it was no more than a faltering and not altogether happy step forward. After that, another two years were to pass before an aeroplane operated by British Army personnel took to the air, in an exercise which was itself of limited value and with an aeroplane which was to play no further part in army aviation's preparations to become a new and significant factor in the war which by then was only four years distant.

However, the location of those flights, Larkhill on Salisbury Plain, was to play a major part in those preparations, joining Farnborough as the other cradle in which the country's infant air arm was nurtured. Those four years which remained before the outbreak of war saw the very birth of British military aviation and it is a pity that the importance of that period has not been reflected in its literary coverage, at least in comparison with the great output of books about the more obviously exciting events of the four wartime years. The appearance of this addition to that coverage is therefore much to be welcomed, dealing as it does with a particularly historic site, hitherto sorely neglected but whose story, previously scattered in other more general works, has now been usefully gathered up in one account.

This is not to say that the book is without its blemishes: there are a number of small but irksome errors, represented by either 'typos' or full-blown spelling mistakes, which argue less than attentive proof-reading. If these are no more than minor irritations, there are also, more importantly, certain factual errors which ought not to have been allowed to creep into a work which, in most respects, should be serviceable to future students of the subject.

Samuel Cody's first historic flight was made, not as stated from Laffan's Plain, to which he moved only later on, but from Farnborough Common, some way to the east alongside the Farnborough Road and handy for the Balloon Factory, as it then was. It is on turning to Appendix D that we find the most glaring error. Having noted the title of the appendix: 'Royal Flying Corps Personnel, 1914', we are surprised to be confronted immediately below with a list of officers at the head of which is the name of Sir Alexander Bannerman, 'Commandant', followed by that of Captain Broke-Smith, 'Adjutant'. As we



Top: The Avro G being assembled at Larkhill in August 1912.

Above: Test pilot Harry R Busted in the Bristol-Coanda Monoplane competing at Larkhill in August 1912.

Left: Maurice Tétard flying a Bristol Boxkite at Larkhill in 1911.

All RAeS (NAL).

read on, it becomes clear that the list is intended to be not the one indicated, but that of the officers of the RE Air Battalion in 1911-12 — a very different animal indeed.

Although the presence of these errors is to be deplored, the work is clearly the result of much deep and wide-ranging research and the author is to be thanked for his exertions in presenting us with a book which plays its part in painting in sharper detail our picture of that short but seminal period when British military aviation was struggling from infancy to a useful, if early, maturity.

Malcolm Hall
CEng MRAeS MCIL

... the location of those flights, Larkhill on Salisbury Plain, was to play a major part in those preparations, joining Farnborough as the other cradle in which the country's infant air arm was nurtured

Library Additions

BOOKS

GENERAL

IHS Jane's All the World's Aircraft: Development & Production 2014-2015.

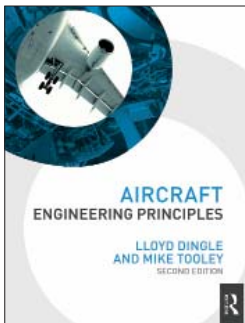
Edited by P Jackson *et al.* IHS Global Limited, Sentinel House, 163 Brighton Road, Coulsdon, Surrey CR5 2YH, UK. 2014. 1024pp. Illustrated. £740. ISBN 978-0-7106-3093-3.

AERODYNAMICS

Incompressible Flow —

Fourth edition. R L Panton. John Wiley and Sons, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, UK. 2013. 878pp. Illustrated. £110. ISBN 978-0-470-97118-5. 978-1-118-01343-4.

AIRCRAFT DESIGN AND CONSTRUCTION



Aircraft Engineering Principles — Second edition. L Dingle and M Tooley. Routledge, Taylor & Francis Group, 2 Park Square, Milton Park, Abingdon OX14 4RN, UK. 612pp. Illustrated. £39.99. [20% discount available to RAeS members via www.crcpress.com using AKN14 promotion code]. ISBN 978-0-08-097084-4.

AVIONICS AND SYSTEMS

Radar Systems Analysis and Design using MATLAB

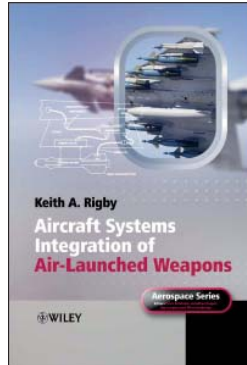
— Third edition. B R Mahafza. CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL, 33487-2742, USA. 2013. Distributed by Taylor & Francis Group, 2 Park Square, Milton Park, Abingdon OX14 4RN, UK. 749pp. Illustrated. £82. [20% discount available to RAeS members via www.crcpress.com using AKN14 promotion code]. ISBN 978-1-4398-8495-9.

Bayesian Multiple Target Tracking —

Second edition. L D Stone *et al.* Artech House, 16 Sussex Street, London SW1V 4RW, UK. 2014.

293pp. £119. [20% discount available to RAeS members via www.artechhouse.com using RAES2014 promotion code]. ISBN 978-1-608-07553-9.

GUIDED FLIGHT



Aircraft Systems Integration of Air-Launched Weapons. K A Rigby. John Wiley and Sons, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, UK. 2013. 248pp. Illustrated. £84.50. ISBN 978-0-470-97118-5.

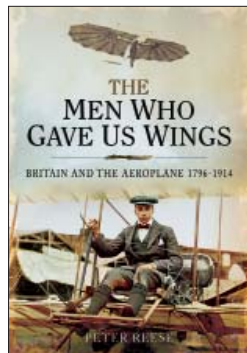
HISTORICAL

Gloster Aircraft Company.

D N James. Fonthill Media Limited, Millview House, Toadsmoor Road, Stroud GL5 2TB, UK. 2014. 186pp. Illustrated. £16.99. ISBN 978-1-78155-259-9.

British Aircraft Manufacturers since 1909.

P G Dancy. Fonthill Media Limited, Millview House, Toadsmoor Road, Stroud GL5 2TB, UK. 2014. 252pp. Illustrated. £20. ISBN 978-1-78155-229-2.



The Men who Gave Us Wings: Britain and the Aeroplane 1796-1914.

P Reese. Pen & Sword Aviation, Pen & Sword Books, 47 Church Street, Barnsley, S Yorkshire S70 2AS, UK. 2014. 252pp. Illustrated. £25. ISBN 978-1-84884-848-1.

MANAGEMENT

Critical Chain

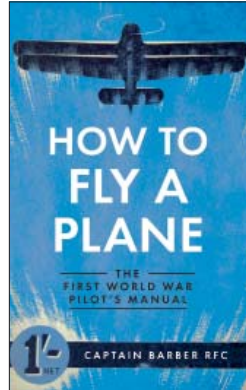
Management — Third edition. L P Leach. Artech House, 16 Sussex Street, London SW1V 4RW, UK. 2014. 326pp. £59. [20% discount available to RAeS members via www.artechhouse.com using RAES2014 promotion code]. ISBN 978-1-60807-734-2.

MATHEMATICS AND DYNAMICS

Modeling and Simulation of Aerospace Vehicle Dynamics —

Third edition. P H Zipfel. American Institute of Aeronautics and Astronautics, 1801 Alexander Bell Drive, Suite 500, Reston, VA 20191-4344, USA. 2014. Distributed by Transatlantic Publishers Group, 97 Greenham Road, London N10 1LN, UK (T +44 (0)20 8815 5994; E mark.chaloner@tpgltd.co.uk). 661pp. Illustrated. £80 [20% discount available to RAeS members on request]. ISBN 978-1-62410-250-9.

PILOTING



How to Fly a Plane: the First World War Pilot's Manual.

Captain Barber. Amberley Publishing, The Hill, Merrywalks, Stroud, Gloucestershire GL5 4EP, UK. 2014. 160pp. Illustrated. £8.99. ISBN 978-1-4456-3583-5.

A welcome new edition of Horatio Barber's *The Aeroplane Speaks* — originally published in 1917 — an early piloting manual which discussed basic flying principles, cross-country flying, stability and control, rigging, propellers and maintenance and concludes with a glossary of terms.

PROPULSION

Powered Flight: the Engineering of Aerospace Propulsion.

D R Greatrix. Springer. 2012. 519pp.

Illustrated. £63.99. ISBN 978-1-4471-2484-9.

Deep Space Propulsion: a Roadmap to Interstellar Flight.

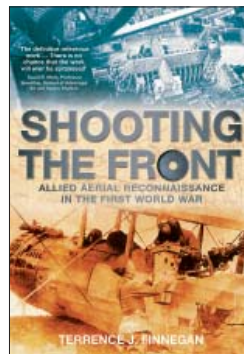
K F Long. Springer. 2012. 367pp. Illustrated. £31.99. ISBN 978-1-46140606-8.

A Young Engineer's Guide to Combustion Engines.

E M Goodger. Published by the author, Limes, 78 Church Road, Woburn Sands, Bedfordshire MK17 8TA, UK. 2011. 28pp. Illustrated. £10. ISBN 978-0-9520186-6-7.

A basic well-illustrated introductory guide to the science and technology of various engine types and how they work, the fuels they use and the problem of combustion knock within piston engines.

SERVICE AVIATION



Shooting the Front: Allied Aerial Reconnaissance in the First World War.

T J Finnegan. Spellmount, The History Press, The Mill, Brimscombe Port, Stroud, Gloucestershire GL5 2QG, UK. 2014. 424pp. Illustrated. £19.99. ISBN 978-0-7524-9954-3.

We Were Eagles Volume 1: the Eighth Air Force at War July 1942 to November 1943.

M W Bowman. Amberley Publishing, The Hill, Merrywalks, Stroud, Gloucestershire GL5 4EP, UK. 2014. 256pp. Illustrated. £20. ISBN 978-1-4456-3363-3.

Incorporating the recollections of many who were involved, this book vividly describes the WW2 air operations of the US Eighth Air Force using the B-17 Flying Fortress and B-24 Liberator.

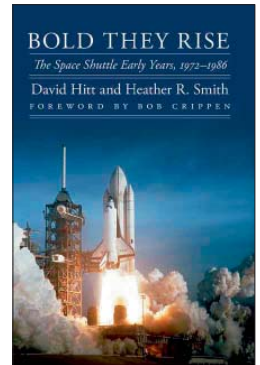
SPACE

Aerodynamic Data of Space Vehicles.

C Weiland. Springer. 2014. 355pp. Illustrated. £93.50. ISBN 978-3-6425-4167-4.

Spacecraft Dynamics and Control: an Introduction.

A H J de Ruiter *et al.* John Wiley and Sons, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, UK. 2013. 569pp. Illustrated. £62.95. ISBN 978-1-118-34236-7.



Bold They Rise: the Space Shuttle Early Years 1972-1986.

D Hitt and H R Smith. University of Nebraska Press, 1111 Lincoln Mall, Lincoln NE 68588-0630, USA. 2014. Distributed by Combined Academic Publishers Ltd, Windsor House, Cornwall Road, Harrogate HG1 2PW, UK. 326pp. Illustrated. £23.99. [25% discount available to RAeS members via www.combinedacademic.co.uk using CS314FLIGHT promotion code]. ISBN 978-0-8032-2648-7.

SYMPOSIA

Preparing the Aircraft Commander for the 21st Century: Monitoring — What Are We Doing About It?

Proceedings of Royal Aeronautical Society Flight Operations Group two-day conference, London, 19-20 March 2013 [Held on CD-ROM]. Royal Aeronautical Society, London. 2013. £105 (members); £135 (non-members). ISBN 1-85768-345-5.

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

NATIONAL AEROSPACE LIBRARY

Conservation of The Cuthbert- Hodgson Collection

The National Aerospace Library at Farnborough holds an extensive early ballooning collection, the Cuthbert-Hodgson Collection, which is probably one of the finest of its kind in the world.

Funded through a combination of the Foyle Foundation, the Royal Aeronautical Society Foundation, proceedings from the National Aerospace Library's stand at its Aerospace and Aviation Book Fairs and the sponsorship of J R Thirkettle CEng MRAeS, over the past five years almost the entire collection of 18th and 19th century ballooning lithographs, posters and fabrics has been archivally conserved.

This major conservation project has involved the lithographs and posters being carefully separated by the conservators Riley, Dunn and Wilson Ltd of Falkirk from their old board mountings, archivally repaired and individually encapsulated in a polyester laminate (and housed in made-to-measure archival storage boxes) which means that they can be handled and studied without damaging the originals.

As described in *The Aerospace Professional* in January 2011 (p 15) the Cuthbert-Hodgson Collection also includes a number of original fabrics from notable balloons. A detailed conservation project of these surviving fabrics and other associated ballooning ephemera has now been undertaken by Zenzie Tinker Textile Conservation (www.zenzietinker.co.uk; T +44 (0)1273 685222). As with the lithographs and posters, each fabric sample and other ephemera held in the collection had to be very carefully removed from its old card mounts prior to conservation treatment and cleaning. Those samples that were damaged or extremely fragile were supported with a fine Japanese paper, using wheat starch paste as the adhesive. Both the paper and the textile samples were treated in this way, except for the two larger textile samples which were supported with a reversible, conservation adhesive treated silk crepe line applied to the back of the sample and further supported with some laid stitching for extra strength.

Annotations and labels, if written on or attached to the previous mount, were removed and tipped in to the new mount using wheat starch paste. The windows were attached to the back boards using a



Conservator Camilla Close-Brooks attaching samples to new mount board using Japanese paper hinges.

Zenzie Tinker Conservation Ltd.
Below: Portrait engraving of the pioneering balloonist Vincenzo Lunardi (1759-1806).
Bottom: Representation of Jean-Pierre Blanchard's ascent from Frankfurt 3 October 1785.
RAeS (NAL).

hinge of linen tape running down the left hand side and Melinex sheets were hinged from the top edge of the back boards, over the samples, to protect them while also enabling future access to the samples which are now housed in two new made-to-measure solander boxes.

The fabrics collection includes among others fragments from the hot air balloon in which Pilatre de Rozier and the Marquis d'Arlandes made the world's first aerial voyage on 21 November 1783; Chevalier de Moret's hot air balloon destroyed by fire at Chelsea, 10 August 1784; Cocking's parachute; Garnerin's balloon c.1803-1804; Dean's Rarefied Air Balloon 1819; Graham Coronation Balloon, 1824; J W Hoar's Immense Hot Air Balloon 'destroyed by the crowd, May 1838'; Mrs Graham's Gas Balloon of August 1830 and from her wrecked balloon of 1851; samples of silk used in Charles Green's Victoria and Nassau balloons, 1831-37; John Hamptons' balloon, 1838; Comte de Lennox's cylindrical airship 'The Eagle' 1835 and fragments of contemporary printed chintz with intricate ballooning designs among other artefacts and ephemera.

The origins of the collection can be traced to the Cuthbert Aeronautical Collection of John Cuthbert — who started collecting early aeronautica pre-1820s and over time his collection was bought by J E Hodgson, a bibliophile and aviation historian who was the Royal Aeronautical Society's Honorary Librarian during c.1920s-1930s, who added to the collection which was purchased in its entirety in 1948 by Sir Frederick Handley Page and presented to the Royal Aeronautical Society in order to preserve the collection for the nation.



Funded by a major bequest to the Library from the estate of the former NASA scientist Dr Charles E Billings FRAeS, many 'highlights' from the collection were digitally photographed in 2011 and a wide selection (238 images) of the 18th and 19th century ballooning lithographs and posters can be viewed via the website:

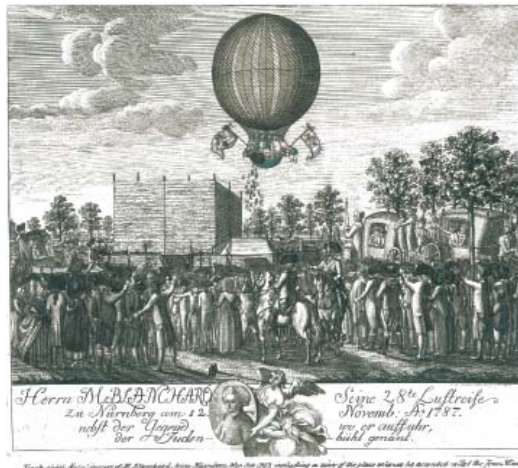
www.aerosociety.com/printsandposters

Now this collection — which contains many items of historic interest which are older than, for example, the American Constitution and pre-date the French Revolution — has been preserved for current and future generations to view and research, detailed catalogue records of the individual ballooning lithographs, posters and fabrics (765 items) having been compiled on behalf of the Library staff by retired volunteer and Society member Mike Stanbery MRAeS.

The Cuthbert-Hodgson Collection also incorporates one of the world's finest collections of early aeronautical and aviation books recording the development of aerial flight — and representations of it — through the ages.

Adopt-a-Book

An archival conservation study has been undertaken of these older volumes, identifying those particular titles which, due to a combination of age and use,



Representation of Jean-Pierre Blanchard's ascent from Nuremberg 12 November 1787 — his 28th ascent. RAeS (NAL).

Below: Handbill advertising Charles Green's ascent in the 'Nassau' balloon from the Royal Gardens, Vauxhall, 31 July 1838 — the pioneering British balloonist Charles Green (1785-1870) made over 500 ascents in his lifetime, of which the National Aerospace Library holds records as original handbills/posters of 241 separate flights. RAeS (NAL).

are in need of archival conservation. The average cost for those books needing attention to be conserved in their original bindings (with the cloth rebaked and spines remounted and/or made-to-measure archival solander boxes produced to house the material) is about £110 plus VAT per volume.

If any individual member, company or organisation would like to contribute to the cost of conserving these historic volumes please contact under the Library's 'Adopt-a-Book' conservation programme, Brian Riddle, Chief Librarian (+44 (0)1252 701060; E brian.riddle@aerosociety.com).



Photographic Archive Online

The National Aerospace Library holds a very extensive photographic collection of aviation images (well over 100,000) dating from the early days of ballooning through to the modern technology aircraft, missiles and rockets of today. It also includes numerous aviation personalities across the same period. Assembled over the decades through numerous donations from aircraft companies, organisations and individuals, the photographic archive is a major visual record of the development of aviation through the ages.

Over 8,000 images from the collection (more to follow) can now be viewed online at:

www.aerosociety.com/printsandposters

alongside over 440 vintage colour aviation posters/magazine covers/air show programmes/airline timetables/decorative book covers/ballooning lithographs, etc. from the Library's



archives. Reproductions can be ordered as posters, prints and a wide range of gifts.

The website has been produced in collaboration with the Mary Evans Picture Library (www.maryevans.com) through whom these images can be licensed for reproduction in books, magazines, advertising and other media.

For any enquiries regarding this material, please contact the Librarians at Farnborough: T +44 (0)1252 701038/701060 or E hublibrary@aerosociety.com



Top: C S Grace on his Short Biplane.
Bottom: Westland Sikorsky S-51, G-AKCU, of BEA.

EDUCATION & SKILLS COMMITTEE

UPDATE ON THE RAeS EDUCATION & SKILLS COMMITTEE

In January's *AEROSPACE* magazine the Society's Education & Skills Committee (ESC) reported on the successful Conference held last October, and committed to develop a work programme based upon the industry's input at the Conference. At the Conference there was a wide recognition of the shortage, both current and forecast, of sufficient personnel with the right skills, and of the need to build more effective links between the education sector (universities, colleges and schools) and the aviation and aerospace industries. The ESC's programme to address these issues has now been formulated and agreed and detailed work has begun in earnest.

The main objective to be secured is to develop and implement sustainable means to deliver the education and training strategies needed to provide industry with personnel that have the right skills, knowledge and attitudes. This is described in the Society's Discussion Paper 'Towards a UK Aviation Skills Plan' (available via the Society's website: http://www.aerosociety.com/Assets/Docs/Publications/DiscussionPapers/Towards_A_UK_Aviation_Skills_Plan.pdf). There is also an objective to professionalise the industry across a broader spectrum. This is entirely consistent with the direction of travel of the Regulators, which require more people within the industry to be 'suitable qualified'.

The ESC's work programme includes projects in each of the four areas described in the previous article. These are: Operators — skills for successful operation of a flight, e.g. pilots, cabin crew; Facilitators — skills to enable operations, e.g. Engineering, ATC, airport, ground operations; Originators — product, equipment and aircraft research, design, development, manufacture and aftermarket organisations, and; Enablers — Training organisations, universities, colleges, schools, Air Cadets, Honourable Company of Air Pilots, Air League, etc.

Examples of the work being undertaken include: For Operators, continuing to support opening access such as the development of apprenticeships for pilots, and similar schemes for cabin crew; for Facilitators, contributing to the development of apprenticeships for engineers, air traffic controllers and ground operations staff; for Originators, co-ordinating the work of different groups and helping to identify and promote career paths, and; for Enablers, developing and distributing careers information, guidance and advice, supporting

careers events, and providing employability and recruitment activities to support young people, parents, teachers and careers advisors in schools, colleges and universities.

The programme also includes work strands that cut across all four of these areas. For example, one key aspect of the programme will be to identify and catalogue any initiatives being undertaken by other groups, such as those being led by People 1st, ADS Group, Education 4 Engineering (E4E) and the British Business and General Aviation Association (BBGA), among others. The aim is to capitalise on the Society's position as the pre-eminent aviation and aerospace organisation in the UK, recognising its impartiality and international reach, and ensure both that all areas of the aviation and aerospace sectors are covered without there being any duplication of effort, and that all work is co-ordinated.

Another example is the way in which the programme covers the co-ordinated provision of support for various RAeS-led and external careers and educational events across the UK, such as the Ballantyne Lecture, Careers in Aerospace Live, Cool Aeronautics, the Farnborough Futures Day and Innovation Zone, and, of course, the Annual E&S Skills Conference on 1 October. Other examples include a recognition of the need to address issues such as women in aviation and management, both of which cut across all four of the work streams.

In addition, it is clear that the provision of careers advice and the associated development of careers pathways needs to reflect local needs. Therefore the Committee is looking at the global aspects of this important subject (e.g. the ICAO Next Generation initiative (NGAP)) and the European picture, as well as engaging with the regional RAeS Branches both home and abroad.

The work programme was formally launched at a special seminar on 30 April at the Society's Headquarters at No.4 Hamilton Place. The ESC will host another conference in October 2014 to review progress on the work programme and to ensure that the industry's skills needs have been adequately identified and addressed.

It remains the ambition of the committee to ensure that we place the skills agenda at the heart of all that we do nationally and internationally, so that the industry has a sustainable supply of suitably trained and qualified personnel that enables the aviation and aerospace sectors to continue to flourish.



The main objective to be secured is to develop and implement sustainable means to deliver the education and training strategies needed to provide industry with personnel that have the right skills, knowledge and attitudes

Contact

For details about the Education and Skills Committee, the Work Programme, ESC Seminar on 30 April or Autumn conference please contact:
E careers@aerosociety.com
T +44 (0)20 7670 4325/6

No.4

Hamilton
Place



Summer on the roof terrace at No.4 Hamilton Place

Home to the Royal Aeronautical Society, No.4 Hamilton Place is an elegant venue in the heart of London. The No.4 roof terrace looks out over Hyde Park and is ideal for summer parties and receptions.

- Capacity: 50-200
- Bespoke summer menus
- West facing terrace

For more information visit www.4hp.org.uk or contact the Venue Team on **020 7670 4314** or email hello@4hp.org.uk

No.4 Hamilton Place, London W1J 7BQ

EVENTS www.aerosociety/events



Crown copy/right

3 June

A Short Tour in the Hindu Kush — Air Power, Counterinsurgency and the Afghans
Air Cdre (Rtd) David Best
Air Power Group Lecture

4-5 June

Keeping Flight Simulators Current and Capable
Flight Simulation Group Conference

4 June

Edwin A Link Lecture: Simulation — Before, During and After Flight Test
Capt Randall L Neville, 787 Chief Test Pilot, Boeing
Flight Simulation Group Named Lecture

9 June

The Introduction of the RAF Jet Aircraft: Engineering and Supply Issues
AVM Graham Skinner
Historical Group Lecture

10-12 June

RPAS Today — Opportunities and Challenges
UAS Group Conference

16 June

Rosetta: Europe's Comet Chaser
Paolo Ferri, Head, Mission Operations Department, European Space Operations Centre, European Space Agency
Space Group Lecture

18 June

Aerospace Golf Day

2 July

New EU Framework for Consumer Complaints: Time for a New Air Ombudsman?
Professor Christopher Hodges
Air Law Lecture and Summer Reception

3-4 July

Technology: Friend or Foe? The Introduction of Automation to Offshore Operations
Rotorcraft Group Conference

7 July

Sopwith Lecture
Sir Brian Burridge, VP Strategic Marketing, Finmeccanica
Named Lecture

22-24 July

Advanced Aero Concepts, Design and Operations
Aerodynamics Group Conference
University of Bristol, Bristol, UK

22 July

Lanchester Lecture
Chris Lee, Aerodynamics Engineering Lead, Future Combat Air Systems, BAE Systems Military Air & Information
Aerodynamics Group Named Lecture
University of Bristol, Bristol, UK

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

LECTURES www.aerosociety/events

Gloster Meteor F8, A77-851, during a handling display at the Centenary of Military Aviation Air Show. Operating the Gloster Meteor will be discussed by Air Cdre Alan Clements at Canberra on 10 June.



© Commonwealth of Australia, Department of Defence

BIRMINGHAM, WOLVERHAMPTON AND COSFORD

RAF Museum Cosford. 7 pm.
Chris Hughs, T +44 (0)1902 844523.

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

BRISTOL

UWE Conference Centre.
Alessandra Badino T +44 (0)751 529 7787.

2 July — Barnwell Lecture. Lightning II and bringing it into service. Cdre Rick Thompson RN, IPT lead Lightning II.

CANBERRA

Military Theatre ADFA. 6 pm.
Jon Pike,
E jonpike@grapevine.net.au
10 June — Operating the Gloster Meteor. Air Cdre Alan Clements.

CRANWELL

Tedder Room, Whittle Hall, RAF Cranwell. 7 pm.
2 June — Op Taxable.
7 July — Flying the Phantom F-4 with 892NAS/HMS Ark Royal. Andy Lister-Tomlinson.

FARNBOROUGH

Park Centre, BAE Systems, Farnborough. 7.30 pm. Dr Mike Philpot, T +44 (0)1252 614618.

17 June — Unmanned K-MAX lift and shift in the battlefield. Andrew Horier, Lockheed Martin UK, and Dr Richard Markiewicz, Dstl.

HAMBURG

Hochschule für Angewandte Wissenschaften Hamburg, Berliner Tor 5 (Neubau), Hörsaal 01.12, 20099 Hamburg. 6 pm. Richard Sanderson, T +49 (0)4167 92012.

5 June — Multicopters — a practical view on unmanned aerial vehicles. Jon Verbeke, Lecturer, KU Leuven University, Belgium. Joint lecture with

DGLR and VDI.

12 June — Mitigating the Climate Impact of Aviation — Is Technology Enough? Dr Antony Evans Lecturer in Energy and Air Transport, UCL Energy Institute, University College London. Joint lecture with HAW, DGLR and VDI.

1 July — Inaugural Gerhard Sedlmayr Lecture. Pioneer aviator and his commitment to safety and rescue. Andreas Sedlmayr, Managing Director, Autoflug GmbH. *Airbus Conference Center (ACC), Kreetzslag 10, 21129 Hamburg. 6.30 pm.*

HIGHLAND

The Gallery, Elgin Library. 7.30 pm. Alex Gray, T +44 (0)1224 319464.

18 June — Space talk. Dr Robin Catchpole.

OXFORD

The Magdalen Centre, Oxford Science Park, Oxford. 7 pm. Nigel Randell, E oaktree.cottage@btinternet.com
15 July — Talking to the Taliban. Gp Capt Mark Manwaring.

PRESTON

Personnel and Conference Centre, BAE Systems, Warton. 7.30 pm. Alan Matthews, T +44 (0)1995 61470.

11 June — History of the Hawk. John Newton, Head of UK Hawk & T-45 Engineering, BAE Systems, Brough.

SHEFFIELD

Knowledge Transfer Centre, University of Sheffield, Brunel Way, Catcliffe, Rotherham. 7 pm.

24 June — Airbus: How Europe nearly missed the 'bus'. Prof Keith Hayward, RAeS Head of Research.

SYDNEY

E adkins@bigpond.net.au
25 June — New Singapore ATC Centre. Thales.

TOULOUSE

Le Chateau de Lâroque, Route de Toulouse, 3200 Gimont, France, 40km west of Toulouse airport towards Auch. 7 pm.

27 June — Informal Annual Dinner.

YEOVIL

Dallas Conference Room 1A, AgustaWestland, Yeovil. 6 pm. David McCallum, E david.mccallum@agustawestland.com

19 June — *From Lysander to Lightning: Teddy Petter, Aircraft Designer* — book launch. Glyn Davies.

YEOVILTON

Nuffield Bar, Little Yeovilton, RNAS Yeovilton. 6 pm.

24 June — Airfix models. Simon Owen.

29 July — Inaugural Eric Brown Lecture. Eric Brown.



Simon Owen will discuss Airfix models at Yeovilton on 24 June.
Airfix.

2014 ALAN BRISTOW LECTURE

UK SAR Capability 2015 and Beyond

The fifth Alan Bristow Memorial Lecture was held at No.4 Hamilton Place on 9 April 2014 and featured presentations by Bristow Helicopters Ltd and the Maritime and Coastguard Agency (MCA).

Alan Bristow was at the forefront of commercial SAR development and his global legacy goes back to the late 1940s when, after serving as a helicopter pilot in the Royal Navy, he first ventured into developing the use of helicopters for a wide variety of roles, particularly in the marine environment.

It was therefore fitting that the speakers Damien Oliver, MCA Change Manager for the UK Search and Rescue (UK SAR) Helicopters Programme and Chris Bond, Bristow Group's Technical Lead for the successful UKSAR bid and responsible globally within the Bristow Group for Rearcrew SAR Standards & Quality Assurance; should initially focus on capturing the 70-year history of our nation's brave men and women who have conducted military search and rescue. And, importantly, for the past 30 years, Bristow Helicopters Ltd and the Maritime and Coastguard Agency (MCA) have accumulated a long and successful history of working alongside the military in conducting UK search and rescue services.

Damien Oliver went on to give an interesting insight into how the contract awarded to Bristow Helicopters in 2013, was procured for the UK Government to meet the needs of its users. This ten-year contract will see responsibility for UK Search and Rescue activities transitioning from the military to the MCA with Bristow operating a mix of 22 state-of-the-art Sikorsky S92 and AgustaWestland AW189 helicopters from ten purpose-built bases strategically located around the UK.

Chris Bond then explained how the technology in the new aircraft compares to the ageing RAF and RN Sea Kings. He also emphasised the high level of engagement that is taking place with military personnel and other operational stakeholders; and how both organisations are working together to ensure that the citizens of the UK receive a search and rescue service as good as they experience today.

The audience of well over 100 people showed a lot of interest in the future capability of UK SAR and this was clearly reflected in the questions following the presentations.

Summing up in her closing speech Jenny Body, then President of the Royal Aeronautical Society, drew attention to a highly informative lecture that provided reassurances about the future effective-



AgustaWestland AW189 at the 2013 Paris Air Show. Finmeccanica.

ness of UKSAR as a commercial undertaking. In particular, she noted the use of video to vividly demonstrate incredible feats of bravery by our UK civil SAR crews when they perform rescues in mountainous seas.

The Reception that followed was kindly sponsored by Mrs Heather Bristow, AgustaWestland and Sikorsky.

SOUTHEND BRANCH



Tony Borrett (right) being presented with an engraved tankard (with box set of beer) from Branch Chairman David Roberts. This was given to Tony on behalf of the Southend Branch at the AGM last April. Tony has retired from his position at the Southend Branch after exactly 25 years.

Afterburner

Corporate Partners

NEW PARTNERS

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



DELTA AIR LINES

Plesman House, 2a Cains Lane, East Bedfont, Middlesex TW14 9RL, UK
T +44 (0)871 2211 222
W www.delta.com

Contact

Perry Cantarutti, Senior Vice President, EMEA

Delta Air Lines serves nearly 165 million customers each year. Delta and the Delta Connection carriers offer services to 319 destinations in 57 countries on six continents. Headquartered in Atlanta, Delta employs nearly 80,000 employees worldwide and operates a mainline fleet of more than 700 aircraft. The airline is a founding member of SkyTeam global alliance and participates in the industry's leading transatlantic joint venture with Air France-KLM and Alitalia, as well as a newly formed joint venture with Virgin Atlantic. Including its worldwide alliance partners, Delta offers customers more than 15,000 daily flights. Additional information is available on delta.com.



BIRMINGHAM AIRPORT

Diamond House, Birmingham, West Midlands B26 3QJ, UK
T +44 (0)871 222 0072
E infoline@bhx.co.uk
W www.bhx.co.uk

Contact

Paul Kehoe, Chief Executive

Birmingham Airport is the UK's third largest airport outside London and the UK's seventh largest overall, handling over nine million passengers per year.

Birmingham currently serves 148 direct scheduled and charter routes and offers an additional 279 possible connections worldwide. This gives passengers a choice of 422 direct or one-stop flights.

With over £300 million invested in the airport over the past ten years, Birmingham now boasts world-class facilities and state-of-the-art infrastructure, including a newly extended runway, which means aircraft can fly further, bringing new long-haul destinations within direct range for the first time.

EVENTS

Please note: attendance at Corporate Partner Briefings is strictly exclusive to staff of RAeS Corporate Partners. Both individual and corporate members are welcome at the Aerospace Golf Day.

Unless otherwise advised, registration for Corporate Partner Briefings is at 16.30 hrs.

Wednesday 11 June 2014 / London

Managing the future pilot shortage
Corporate Partner Briefing by Mark Searle, Chairman, BALPA

Wednesday 18 June 2014 / Frilford Heath, Oxfordshire

Aerospace Golf Day

Tuesday 1 July 2014 / London

The New DE&S Entity
Corporate Partner Briefing by Bernard Gray, Chief of Defence Materiel, Ministry of Defence
Sponsored by Boeing UK

www.aerosociety.com/events

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

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



Are Your Recruiting Efforts Effective?

Targeted career websites, such as the Royal Aeronautical Society Jobs Board, deliver the most highly qualified talent and have the best return on investment. Our candidates are made up of the specific professionals you want to reach. If you want the best and brightest candidates, you need to go where they search for jobs — the Royal Aeronautical Society Jobs Board.

In addition to posting your jobs in front of qualified candidates on the Royal Aeronautical Society Jobs Board, you can also search our CV bank for talent. And, as Corporate Partners of the RAeS, we offer you a discounted rate and great value.

Post your vacancies online at www.aerosociety.com/jobs or speak to an expert who can help create a customised recruitment solution to get you great candidates.

Contact:

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

CAPTAIN RICHARD KENNETH JOHN HADLOW



FRAeS
1935–2014

Dick enlisted with the RAF in September 1953 and gained his Commission on the 20 April 1954. He served in various bases in the UK and Middle East and then spent eight years at the Central Flying School at Little Rissington, instructing on the Jet Provost and ended as an A2 Instructor and Flight Commander of #1 Squadron. At this point his career made a change — to avoid flying a desk, he converted to helicopters and was posted to RAF Selatar in Singapore in 1966 to 103 Squadron and, after a short period, became the CO of 110 Squadron.

Dick retired from the RAF in 1973 and moved to civil aviation, initially flying business jets and then the Boeing 737 and 757/767 with Britannia Airways.

He was later selected by Britannia as a Line Training Captain on these aircraft. During his free time he flew Chipmunks with the Air Experience Flight. Pleasure flying was an enduring pastime.

In 1965 he won the CFS aerobatic BRABYN staff trophy displaying the Jet Provost. Later he displayed the Venom, Jet Provost and Meteor for Jet Heritage and the Royal Jordanian Air Force's Vampire and Venom on the airshow circuit.

Dick retired from professional flying in 1995. He was a founder member of the RAeS Flight Operations Group, becoming Chairman in 1998. Dick was integral, with other members, in getting the final review of the 1994 RAF Chinook accident. This resulted in the removal of the original pilot error judgement.

Captain P D J Terry FRAeS, Chairman FOG

A full obituary for Dick Hadlow may be found on the Society's website at: www.aerosociety.com/News/

FRANK EDWIN ROE



CBE CEng FRAeS
1925–2014

Frank became the first graduate apprentice to be hired by the company when he joined the English Electric Company in Preston in 1946. Four years later he was appointed head of its wind-tunnel department where he oversaw the rapid expansion of its capabilities, many of which remain today.

Having worked on the aerodynamic design studies of the P1 (Lightning) aircraft and the development of the wind tunnel, Frank rose up the ranks of the company. In 1957, he became Chief Development Engineer for the EE Aircraft Group, rising to Director of Resources, BAC Preston Division in 1968, and Resources Director, BAe Aircraft Group in 1978, before taking on MD of the

British Aerospace (BAe) Warton division in 1981 and held the role as MD of the BAe Military Aircraft Division in 1986 until his retirement in 1987.

He was awarded the CBE for Services to industry in 1985, and appointed a Deputy Lieutenant for Lancashire in the same year. He was also a founding and lifetime member, as well as President, of the RAeS Preston Branch.

Following his retirement, Frank helped with the major expansion of the University of Central Lancashire, as Deputy Chair of the Board of Governors.

He was also a founding and active member of Lytham Hall Trust for many years, and was instrumental in securing a major donation of £1m from British Aerospace, to enable the Trust to acquire Lytham Hall, for the benefit of the community.

A full obituary for Frank may be found on the Society's website at: www.aerosociety.com/News/Society-News/

WILLIAM HALL MCKINLAY



CEng MIET FRAeS FRIN
1924–2014

William McKinlay was born on 8 February 1924. On leaving George Watson's College in 1941 he started an engineering degree at Edinburgh University but a year later was training as an RAF navigator. He served from 1942 to 1946 with Transport Command and India Command, reaching the rank of Flt Lt.

In 1947 he joined BOAC on Short Sunderland flying boats to the Far East and South Africa. He completed his degree studies at Edinburgh where he was in the Air Squadron having learned to fly in 1949. In 1953 he joined Smiths Aircraft Instruments Ltd in Cheltenham where he met Ruth Wickham and they married in 1957. While he was working on

simplex flight control systems in 1958 a son was born; when developing duplex systems in 1960 twins arrived; colleagues advised caution when he became Project Manager of the Trident triplex system.

His talent was not just in systems-integration but people-integration — getting teams to work together. In 1964 the Swedish Society of Aeronautics awarded him the Thulin Medal in Bronze for his personal contribution to the development of automatic landing.

In 1964 he moved to Edinburgh and spent the remainder of his career with Ferranti Ltd, working on inertial and integrated navigation systems. A clear-thinking and articulate man, he was a popular speaker and committee chairman.

R A McKinlay FRAeS

A full obituary for Bill may be found on the Society's website at: www.aerosociety.com/News/Society-News/

Afterburner Elections

FELLOWS

Ian Brimelow
Rhona Flin
Ruth Mallors-Ray
Paul Menner
Andy Patsalides
Keith Rose
James Smart
Simon Spearing
Phillip Spencer
Keith Williams

MEMBERS

Tong Beum Kim
Murray Spoelstra

ASSOCIATES

Wesley Basson
Alexander Bowen-
Rotsaert
James Cole
Adam Harvey
Romans Kirenskis
Anthony Lewis
Thomas Mallin
Ketan Moti
Mitesh Moti
Bernard Ngwenyama
Akhilakur Rahman
Devendran
Sanjeevekumar
Janine Versteegh

E-ASSOCIATES

Alex Brinkmeyer

AFFILIATES

Sarah Booth
Christopher Fletcher
Erick Siu Long Ip
Syed Jafri
Bjoern Jahncke
Millard Kwan
Gert Lauritsen
Roland Wallace
David Wilson

STUDENT AFFILIATES

Werner Jaenisch
Carol Khumalo
Michael Robinson
David Toma

SOCIETY OFFICERS

President: **Air Cdre Bill Tyack**
President-Elect: **Martin Broadhurst**

BOARD CHAIRMEN

Audit and Compliance Chairman:
Prof David Allerton
Learned Society Chairman: **Prof Graham Roe**
Membership Services Chairman:
Martin Broadhurst
Professional Standards Chairman:
Prof Chris Atkin

DIVISION PRESIDENTS

Australia: **Air Cdre Noel G Schmidt**
New Zealand: **Gp Capt Frank Sharp**
Pakistan: **AM Salim Arshad**
South African: **Prof Laurent Dala**

NEW ZEALAND SYMPOSIUM



Left: NZ Division Award recipients.

Below: The Kestrel Award for the most efficient and contributing unit of the RNZAF for 2013 went to Sqn Ldr John Barrack of Ohakea.

The New Zealand Division held its annual symposium on Friday, 11 April. This year's theme for the 29th annual symposium was 'Flying in Formation', looking at how the aviation industry and the government can work together to achieve improvements to the prosperity, security and safety of New Zealand aviation.

The venue was the Civil Aviation Authority's conference facility overlooking Wellington harbour. Opening the conference, CAA Director, Graeme Harris FRAeS, gave an overview of the current projects and endeavours of his

organisation. He addressed the topic of aviation security and how local operations are being studied by other national authorities as, the NZ reputation in this area is high.

The symposium was well supported, both by members and sponsors, and the 91 attendees received some very thought provoking presentations. In the evening the Division held its annual Awards Dinner at the James Cook hotel in Wellington. This was attended by the Chief of Air Force, Director of Civil Aviation, Chief Pilot and Head of Flight Operations AirNZ and many other leading members of the aviation

community. The awards were presented by Divisional President Frank Sharp FRAeS and were made to very deserving people who have all contributed greatly to aviation in New Zealand or, for the younger recipients, have achieved excellent results in their early education/training.



WITH REGRET

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

Prof David Maurice Denison FRAeS 81
William David Dickinson AMRAeS 88
Barrington Clive Foster AMRAeS 74
William Hancock CEng MRAeS 92
Charles Frederick Hughesdon AFC FRAeS 104
Alan Wingate Jones FREng FRAeS 74
Charles William May CEng MRAeS 90
Michael Pinney CEng MRAeS 62
George Kenneth Rhodes MRAeS 79
David Sadler CEng MRAeS 93
Peter Donald Thorne FRAeS 90

ADVERTISING

To advertise in any of the Royal Aeronautical Society's publications, website or e-media please contact:

Emma Bossom
T +44 (0)20 7670 4342
E emma.bossom@aerosociety.com



Piecing together airline training for the region

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



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

halldale.com/apats

Flight Simulation Conference



ROYAL AERONAUTICAL SOCIETY

KEEPING FLIGHT SIMULATORS CURRENT AND CAPABLE

LONDON / 4 - 5 JUNE 2014

The aim of this flight simulation conference is to discuss the challenges associated with keeping flight simulators current and capable from both a concurrency and technological aspect.

This applies to military and civil flight simulators across fixed wing and rotary wing communities.



www.aerosociety.com/events

Sponsors:



Link Simulation & Training

THALES



AEROSPACE GOLF DAY

FOR INDIVIDUAL AND CORPORATE MEMBERS



ROYAL AERONAUTICAL SOCIETY

FRILFORD HEATH GOLF COURSE, OXFORDSHIRE / WEDNESDAY 18 JUNE 2014



18 hole Stableford Points competition

9 hole Texas Scramble competition

Individual and corporate team prizes

Lunch, refreshments and afternoon tea

Optional Social Supper on 17 June 2014

Join us at our 2014 Golf Day for some healthy competition with fellow golfers in the aviation community.

This event is ideal for networking in a relaxed and informal setting.

Enter a corporate 4-ball team or opt to be teamed up with other individual players.

For further details please apply to:

Gail Ward
Events Manager — Corporate and Society
Royal Aeronautical Society
T +44 (0)1491 629912
E gail.ward@aerosociety.com

The Last Word

COMMENTARY FROM

Professor Keith Hayward
RAeS Head of Research



Tea Party economics

In defence of public spending on advanced technology



Robert Scoble

Among other things, touch screens were the result of public investment.



DESPITE A MASSIVE INVESTMENT IN THE ARJ-21 AND C219 PROGRAMMES, CHINA IS STILL SOME WAY FROM A REAL BREAKTHROUGH INTO WORLD MARKETS

Having brought the US government to the edge of default and sent shivers through every innovation stimulating Federal budget holder, the same coalition of conservative Republicans are threatening to cut or to curtail the Exim Bank — the US export credit agency. Over the years, Exim has been a major force in driving the success of US commercial aerospace. European export credit agencies have also helped the likes of Airbus and Rolls-Royce. While some US airlines feel that it has funded their competitors' purchases, they too might have benefited from equivalent European support if buying Airbus or European aero-engines.

To the critics of export financing, export credit support smacks of 'corporate welfare', another subsidy to a privileged group of companies — a line of attack that the Tea Party, as well as some left-wing commentators on both sides of the Atlantic, roll out on a regular basis. In the case of the Exim Bank, it has actually made money from its investments — \$1bn last year. In reality, given the extent of the aerospace supply chain, a lot of jobs in a range of companies, big and small, flow from this kind of support; and given the globalised nature of that chain the national benefits tend to even out over time.

Upstream investment is also good for an economy

The type of narrow fiscal vision espoused by

Tea Party economics can be ridiculed but this is never too far from a tendency more widely these days to denigrate the role of state investment in technologies like aerospace. But, as the Sussex University economist Mariana Mazzucato points out in a recent book, *The Entrepreneurial State*, much of the basis for the IT revolution — such as touch screens inherent in Apple products — were the results of public investment in R&D. Earlier still, the semi-conductor revolution was driven and sustained by defence and space requirements and their respective budgets. Private capital may then take a technology forward, but is all too reluctant to assume the risks of an unproven concept.

An obsession with limiting public spending could therefore constrain future competitiveness. Mazzucato points to the risk that at some future date, massive Chinese public commitment to basic research will generate productive innovations that could leave the US and others similarly blinded by ideology behind.

And the case of aerospace

This scenario fuels many apprehensive views of a future populated by a globally effective Chinese aerospace industry. But, in this case, a new RAND report on China's commercial aerospace strategy provides a more comfortable assessment precisely because US and European companies and governments are still investing in R&D and commercial exploitation that still leaves the Chinese chasing a rapidly moving set of targets. Despite a massive investment in the ARJ-21 and C219 programmes, China is still some way from a real breakthrough into world markets.

In short, the crucial link between public and private investment remains in place for aerospace despite Tea Party economics — for now. As the RAND report goes on to note: the real threat may come in the next generation of aerospace technologies if the level of Chinese public investment is sustained and western commitments falter.

Rotorcraft Conference



ROYAL AERONAUTICAL SOCIETY



40TH EUROPEAN ROTORCRAFT FORUM

SOUTHAMPTON / 2-5 SEPTEMBER 2014

The European Rotorcraft Forum is one of the premier events in the rotorcraft community's calendar, bringing together manufacturers, research centres, academia, operators and regulatory agencies to discuss advances in research, development, design, manufacturing, testing and operation of rotorcraft.



www.erf2014.com

Sponsors



Structures & Materials Group Conference



ROYAL AERONAUTICAL SOCIETY

4TH AIRCRAFT STRUCTURAL DESIGN CONFERENCE

Publications Partner



QUEEN'S UNIVERSITY BELFAST / 7-9 OCTOBER 2014

Future aircraft will be complex, requiring multi-disciplinary design approaches and solutions in a distributed design environment. The Royal Aeronautical Society's 4th Aircraft Structural Design Conference will address the challenges facing the designers of the next generation of aircraft.



For more information and to view the full programme please visit our website.

www.aerosociety.com/events

Sponsors



Launch your aerospace career

Cranfield University is a wholly postgraduate university with a global reputation for aerospace education.

- UK's no.1 destination for postgraduate study in aerospace.
- 20+ specialist aerospace MSc courses.

Apply for funding for your Cranfield MSc through the Aerospace MSc Bursary Scheme (up to £9,500).



Cranfield UNIVERSITY

For more information visit
www.cranfield.ac.uk/soe/aeromsc

UAS Conference



RPAS TODAY

OPPORTUNITIES AND CHALLENGES

LONDON / 10 - 12 JUNE 2014

The use of remotely piloted aircraft is growing rapidly across a number of different applications. This conference will provide delegates with essential information on the factors that are supporting the proliferation of civil use of RPAS, as well as providing clear insights into regulatory and other constraints in place to ensure public safety and privacy.



www.aerosociety.com/events

Sponsors



Image copyright: Thales / Richard Seymour Photography

Rotorcraft Group Conference



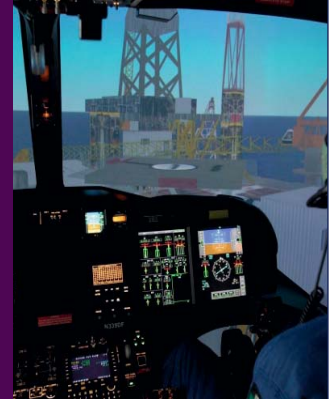
TECHNOLOGY: FRIEND OR FOE?

THE INTRODUCTION OF AUTOMATION TO OFFSHORE OPERATIONS

LONDON / 3 - 4 JULY 2014

This conference will focus on automation in modern complex helicopters engaged in offshore operations world-wide, and the underlying design, operational and training issues.

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



www.aerosociety.com/events

Lead Sponsors



CHC



Sponsors



Aerodynamics Conference



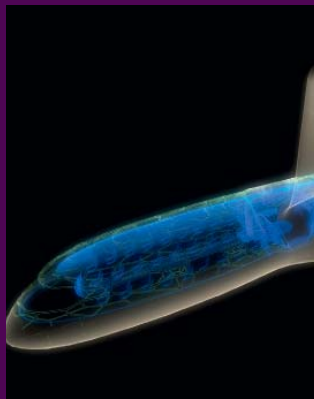
ADVANCED AERO CONCEPTS, DESIGN AND OPERATIONS

Publications Partner



BRISTOL / 22- 24 JULY 2014

The 2014 Royal Aeronautical Society Applied Aerodynamics Research Conference will provide an opportunity to raise the profile of the challenges ahead and highlight the technologies required to ensure cost effective solutions in a global market, with awareness of increasingly demanding environmental considerations.



www.aerosociety.com/events

Sponsors



International Flight Crew Training Conference



THE INTERNATIONAL PILOT TRAINING CONSORTIUM: NEXT STEPS?

Register Before 27 June and Receive a £100 Early Bird Discount (Excludes Baseline Member Rate)

LONDON / 23 - 25 SEPTEMBER 2014

The Annual International Flight Crew Training Conference will examine the work undertaken by the IPTC and will address the issues facing the flight crew training community from the perspectives of aircraft operators; manufacturers; makers, users & providers of training systems; researchers and regulators.



www.aerosociety.com/events

IPTC Partners



Sponsors

