BRIGHT SPARKS

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Best laid plans

It is perhaps no surprise that, once again, UK defence budgets are in crisis. After extensive cost-cutting, the 2015 SDSR seemed to promise a firm plan for equipment procurement. Even during last year’s tumultuous Brexit summer, key commitments for P-8 Poseidon MPAs and AH-64E Apaches were firmed up – a clear win for air power. While UK defence had not left the dark tunnel of the ‘£38bn budget black hole’, it did seem, at last, to be moving towards the light. Unfortunately, someone now seems to have switched the tracks, and the defence procurement train has diverted back into darkness on another line. Costs have already risen by one-fifth and gobbled up the £10.7bn headroom built into the MoD’s budget. Furthermore, equipment acquisition costs are expected to rise 20% over the next decade, with support costs rising 30%. On top of this is extra costs caused by the weak pound, given that US equipment is priced in dollars. While the MoD builds into its costs rising 30%. On top of this is extra costs caused by the weak pound, given that US equipment is priced in dollars. While the MoD builds into its procurement plans hedging against currency fluctuations, this mitigation only given that US equipment is priced in dollars. While the MoD builds into its procurement plans hedging against currency fluctuations, this mitigation only

Tim Robinson

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Flight systems

- Air-to-air refuelling
- On board oxygen generation system
- Enhanced braking system
- Nose wheel steering
- Additional engine thrust
- Full authority digital engine control

Upgraded cockpit

- Large area display
- Digital head-up display
- Ground proximity warning system
- Autopilot
- Traffic collision avoidance system
- Datalink
- Sensor simulation

Stores capability

- Smart weapons enabled
- Laser designation pod
- Centre line dual purpose fuel/baggage pod
Hawk eyes new heights

A jointly developed Anglo-Indian variant of the Hawk, the Advanced Hawk prototype has been unveiled at the AeroIndia exhibition by BAE Systems and Hindustan Aeronautics Ltd (HAL). Aimed at the LIFT and light attack mission, the Advanced Hawk features an active slat wing, extra thrust, AAR probe, defensive aid suite, new single display for the cockpit and smart weapons integration. The result is an expanded higher performance envelope and a light fighter combat capability.
DEFENCE
Argentina gives up hunt for new fighters

After news reports linking the acquisition of IAI Kfirs, MiG-29s, JF-17s and other combat aircraft, Argentina has officially given up looking for a replacement for its 32 A-4AR Fightinghawk fighters due to budget constraints.

AEROSPACE
MRJ EIS slips two years

Japan’s Mitsubishi Heavy Industries (MHI) has revealed that its MRJ regional jet schedule will be delayed a further two years – with entry into service now targeted for mid-2020, rather than 2018.

SPACEFLIGHT
Whitehall announces £10m boost to UK space sector

The UK Government has announced a £10m incentive scheme to stimulate a UK-based commercial launch capability for the UK space sector. The funding, along with a new Spaceflight Bill, is aimed at securing a slice of a commercial spaceflight market expected to be worth £250m over the next 20 years. The goal is to establish a UK-based commercial launch capability by 2020.

AIR TRANSPORT
Trump travel ban causes airport chaos in US

An Executive Order pausing entry for 90 days to the US for citizens from seven designated countries including Iran, Iraq and Yemen, caused widespread chaos at American airports in January. President Donald Trump’s EO, which also halted refugees from Syria and caps annual immigration at 50,000, caused protests at US airports while authorities scrambled to implement the hastily announced EO. Confusion between agencies responsible for immigration was also shared by airlines, some of whom adjusted their crewing schedules to avoid some of their pilots or cabin crews being detained in transit. The ‘Muslim ban’ saw two days of protests erupt at US airports, including New York’s JFK, Philadelphia, Portland, Chicago and Seattle.

NEWS IN BRIEF

After sustaining structural damage during a hard landing last August, the UK’s Hybrid Air Vehicles has revealed that the Airlander hybrid airship has now been fully repaired. With the flight deck structure now complete, the next stage is ground testing, prior to the aircraft restarting its flight test programme.

Singapore Airlines has placed a provisional order for 20 777-9s and 19 787-10s. The £13.8bn order also includes options for six additional aircraft of each type. The first aircraft is scheduled to enter into service in 2018/19.

General Atomics Aeronautical Systems (GA-ASI) has launched a new variant of its Predator B UAV named the SkyGuardian which can operate in non-military airspace. Intended for border-surveillance, maritime patrol and disaster relief missions, SkyGuardian has an endurance of over 35hrs with speeds up to 210kt and a maximum altitude of more than 14,000m.

A Japanese mission to test a way of removing space debris using a 700m electrodynamic tether was unsuccessful when it failed to deploy from a HTV ISS cargo resupply ship on its way back to Earth. Before burning up, it was intended to trail a tether that could potentially allow future satellites and spacecraft to de-orbit without using propellant. However, the tether failed to unfurl, leaving scientists to de-orbit the HTV on 6 February.

Captain Michel Gordillo has become the first pilot to circumnavigate both the North and South Poles in a homebuilt aircraft, a Sky Polaris Vans RV-8, weighing under 1,750kg, as well as the only pilot to fly a single-engine aircraft across Antarctica.

Brazil has complained to the World Trade Organization over the Canadian government’s recent decision to provide Ca$372m in loans to Bombardier for its Global 7000 business jet programme and the CSeries regional jet.

Swedish airline BRA (former Braathens)
Bell 505 certification advances

On 22 January, Bell Helicopters flew its first production 505 Jet RangerX from its facility in Mirabel, Canada. With the Model 505 having been awarded Transport Canada certification in December, FAA certification is expected in the first quarter of this year, says Bell. Meanwhile, Bell has announced a delay to the certification of its 525 Relentless helicopter following the crash of a test aircraft in July in which two test pilots died. The two remaining flight test aircraft have been grounded since the accident while the NTSB investigates the cause.

Air Canada gets makeover

Canadian flag carrier Air Canada has unveiled a new black and white livery to be rolled out across its fleet. The revamp, which also includes new uniforms for crews, sees a return of the red maple leaf and an A350-style ‘bandit mask’ applied near the cockpit windows.

All change amongst T-X contenders

On 1 February Northrop Grumman and BAE Systems announced that they were withdrawing from the $16bn US Air Force T-X advanced jet trainer contest. This follows the earlier announcement that Raytheon was to withdraw as the prime contractor for a bid based on the Leonardo T-100. However, in a twist, on 8 February it was revealed that Italy’s Leonardo group is to bid the T-100 advanced trainer by itself without former US partner Raytheon. Instead, its own US division, Leonardo DRS, will be the prime contractor if selected. In addition to Leonardo, the remaining teams still competing for the contract to supply 300-350 trainers are Boeing/Saab, Lockheed Martin/Korea Aerospace Industries and Sierra Nevada Corporation and TAI.

A380s to museums

Airbus test aircraft, including two A380s, are to be donated to aviation museums, the Museum of Air and Space in Paris-Le Bourget and Aeroscopia in Toulouse. As well as an A320 and A340-600 test aircraft, the museums will get an A380 test aircraft each. A380 MSN4 will be transferred to Le Bourget on 14 February.

Bell 505 certifies, Air Canada unveils new black and white livery, T-X contest sees Leonardo enter on its own, A380s are donated to museums.
Taiwan has announced plans to develop the XT-5 indigenous advanced jet trainer for its air force by 2020. The programme would first develop a prototype trainer followed by 66 production aircraft to begin entering service by 2025.

On 21 January an ULA Atlas V rocket successfully launched a SBIRS GEO F missile detection satellite for the US military. The launch, from Cape Canaveral, put the third Space Based Infrared System Geosynchronous Earth Orbit satellite (SBIRS) into GEO orbit. The satellite joins two other SBIRS as part of a missile early warning system that watches for the hot plumes of a missile launch.

Leonardo is to begin icing trials on its AW609 tiltrotor following a year’s delay to the flight test programme after the fatal crash of the second prototype in October 2015. The icing trials will be conducted on the third AW609 prototype in Marquette in Michigan. Leonardo is aiming for FAA certification in 2018.

Schiebel Camcopter for RAN

The Royal Australian Navy has selected the Schiebel S-100 Camcopter UAV to provide shipborne maritime ISR missions. The contract is for an unspecified number of air vehicles and lasts three years.

Ireland-based CityJet has firm up an order for six Bombardier CRJ900 regional jets. The order, worth $280m at list prices, also includes options for a further four CRJ900s. CityJet will operate the aircraft under contract for SAS.

Germany is to send four Tiger attack and four NH90 transport helicopters and 350 additional soldiers to Mali as part of a UN peacekeeping mission. The aircraft will take over from The Netherlands peacekeeping forces.

The ISS is to be supplemented with a commercially-funded airlock in 2019 which will allow more small satellites to be deployed. The airlock, which will be installed on a port on the ISS Tranquility module, is being funded by a partnership between Boeing and Houston-based NanoRacks.
DEFENCE

US approves $1.8bn in defence exports

The US State Department has officially approved some $1.8bn worth of FMS export arms deals. The list of weapons exports greenlighted include $400m of support services for RAF Boeing C-17s, $400m for sustainment of Kuwaiti Boeing AH-64D attack helicopters, along with $110m in Raytheon AMRAAM air-to-air missiles to the same country. The State Department also approved a $525m deal for ten tethered aerostats for ISR for Saudi Arabia, as well as a $418m deal for 12 Air Tractor AT-802L armed cropdusters for Kenya.

AEROSPACE

Rolls-Royce reveals record £4.6bn loss

Engine manufacturer Rolls-Royce has reported a record loss before tax of £4.6bn – the largest in its 133-year history. Some £4.4bn of this is attributed to a one-off accounting charge due to the 20% fall in the value of sterling against the dollar since the UK’s Brexit referendum. The loss also included £671m to settle corruption cases with the UK and US authorities. Meanwhile, R-R’s profits fell to £813m, down from £1.4bn the previous year.

SPACEFLIGHT

Boeing reveals Starliner spacesuits

Boeing and the David Clark Company have revealed the next generation of spacesuits for the CST-100 Starliner commercial crew capsule, which will transport NASA astronauts to and from the ISS. The spacesuit, for launch, ascent and re-entry, features a soft helmet with zipper, enhanced mobility compared to legacy suits and touchscreen sensitive gloves.

AIR TRANSPORT

INFOGRAPHIC: IATA reports 2016 traffic growth

The International Air Transport Authority (IATA) reports that 2016 saw a 6.3% rise in global demand for air transport with 3.7bn passengers flying with IATA carriers. The fastest-growing regions were Middle East with an 11.2% increase, followed by Asia Pacific (9.2%) and Africa (6.5%).

ON THE MOVE

Elaine Chao has been appointed as the new US Secretary of Transportation.

Airbus Chief Strategist, Marwan Lahoud is to step down at the end of February.

Siemens has appointed Gary Caroll to the position of Head of Aerospace, UK and Ireland.

Matthew F Bromberg is to succeed Bennett Croswell as President of Pratt & Whitney's Military Engines division.

The new VP, Sales and Revenue Management at JetBlue Airlines will be Dave Clark.


Source: IATA
Does the so-called populist vote, combined with what some believe to be a serious electoral backlash against elitism and the old political order, translate to a rebirth of protectionism?

I suspect that if loudly expressed election rhetoric heard throughout the recent US election campaign from the now President Donald Trump is to be believed, then the answer would appear to be yes.

Having already witnessed US car manufacturers abandon plans to increase production of cars abroad, there can be little doubt that the Trump administration is anything less than serious about reversing the long trend of producing goods in low-cost countries and then importing what is produced into the US. It isn’t just Mexico that is on the Trump list – and that could see a sharp increase in taxes on imported products – it is China and other countries as well. Like it or not, this could mark the beginnings of an awkward and very challenging trade war from which no-one will win.

Back to the future for US protectionism

One could, of course, argue that the US has actually maintained protectionist policies for years and that would certainly be true in regard of defence and aerospace equipment and in other areas regarded as being in the national interest. To be fair, the US is far from being the only country that hides behind the national interest excuse, as everyone knows that France has being doing the same for years and not just in defence equipment. Britain, being ill prepared to accept investment risk and being a respectful and law abiding member of the European Union, chose to open its defence requirements to everyone.

For a country such as America that wants to ensure that its defence industry remains relevant, putting in place protectionist policies that ensure almost everything is made in America is hardly surprising. There is nothing illegal in this at all but is it really fair?

While the US sells military aircraft to the rest of the world, the number of times that it has acquired British or European-designed military equipment can almost be counted on one hand. That is not to say that the US doesn’t occasionally admire foreign ‘designed’ defence capability, of course but when it does, the insistence is usually that it must be built in the US. That was certainly true 30 years ago in relation to the BAE Systems Harrier VSTOL aircraft which later emerged refined in US production as the AV-8B and later, with the BAE Systems Hawk trainer aircraft that emerged very successfully as the T-45 Goshawk. Both aircraft were built in the US by McDonnell Douglas, now part of Boeing.

Twenty years later came the AgustaWestland EH101 helicopter which, in its US101 ‘Marine One’ presidential helicopter form was ordered by the DoD in 2005, these were to be built by Lockheed Martin at Owego, New York State. Sadly, in an act that was deemed by most to have been executed primarily on protectionist policy grounds, President Obama cancelled the programme shortly after arriving at the White House in 2009.

The official grounds for cancelling what had begun as the VH-71 programme was that it was now deemed that there was no need for a new presidential helicopter to replace the fleet of ageing Sikorsky-built, Sea King helicopter ‘Marine One’ derivatives built in 1975/6. This was nonsense and the reality was that this was a response to pressure from other US helicopter companies to buy only an all-American design, a fact borne out by a US Navy announcement in 2014 that Sikorsky had been awarded an initial six of an intended 23 new S-92 helicopters to replace the US Presidential helicopter fleet by 2023.

My point I suppose is, that, while the new White House administration appears to be espousing a new era of protectionism it is easy to see that the US has actually been practicing protectionism for years.

While certain exemptions are in place for the UK, Canada and Australia, another interesting way of understanding how the US protects its own in respect of defence equipment acquisition comes in the form of ITAR – International Traffic in Arms Regulations. These in effect control not only import of all defence and military related technologies, equipment and components into the US but also exports from the US as well.

While the original goal of ITAR was to protect US national security and to ensure a tight authorisation process, ITAR has morphed into something very much larger than had originally been intended. Today, for instance, all satellite technology and launch vehicles come under ITAR rules and we may reasonably
expect under President Trump that the overall reach of ITAR could well be even further extended.

Protectionism is nothing new and it is certainly not restricted purely to the US. Members of the EU they may well be, but France never did embrace globalisation in anything like the same manner as others. Neither did it open its doors to allowing a foreign takeover of anything that it considers to be in the national interest. Not even France can claim that all its industries are in the national interest, although the reality is that it does appear to have rather a lot of them.

Just as France has cleverly ensured that it does not get flooded with imports of foreign-made cars, particularly of Japanese built cars, so too has Japan ensured that its doors are most often closed when it comes to foreign imports. China’s distaste for allowing goods that might compete with its own industries has also increased, although it has been clever in ensuring that it opens its doors to all forms of new technology and services that it badly needs in order to develop its own green-field industries. Just as India also does, China requires that foreign companies choosing to operate inside the country must do so in partnership with Chinese companies, this most usually being on a 50/50 ownership basis.

**Shielded airlines**

Protectionism isn’t just about shutting doors to imports from another country of course, as it can also be about pampering specific industries with incentives. Take the airline industry, for example and, remove from your mind any notion that deregulation and ‘open-skies’ policies swept protectionism completely away. Far from it, the airline industry is, today, mainly because it continues to lack a universally agreed global regulatory structure that allows everyone to compete on a level playing field, riddled in protectionism. For evidence look no further than at the ownership structure and speed that airlines such as Emirates, Etihad and Qatar Airway have grown. Owned by their respective governments and because most are based in oil-rich states that are not exactly short of available funds to ‘lend’, each of these particular Gulf State airlines has been pampered. Where else, for instance, other than in the state-owned airline sector would you find an airline agreeing to purchase as many as 150 wide-bodied Boeing 777 aircraft all in one go and breaking all records in the process – as Emirates did in 2013 when it announced this huge aircraft purchase at that year’s Dubai Air Show.

There can be little doubt, according to critics, like the Big Three US airlines, that the reason that Gulf State airlines have been able to expand so rapidly over a relatively very short period is because they have been supported with cheap no-interest loans and subsidised airport charges. Make no mistake, while this is a rather different form of protectionism than just slamming the doors closed to imports, it is no less serious in terms of how it harms those that have tried to play the game fairly based on what should be a level playing field for all.

US and European-based airlines have certainly paid a high price at the expense of Gulf State airlines that have enjoyed interest-free state loans and that have not had to worry about income in far-reaching expansion plans. Of course, Gulf State airlines would argue that for them, having a strong national flag carrier airline with the newest aircraft and having invested in the most modern airports in the world are also matters of national interest and who can blame them? They would also argue that Chapter 11 bankruptcy protection for US airlines, also distorts the market.

I would not be surprised if the US doesn’t attempt to hit back at state-owned airlines but we will see. America has, of course, taken great care not to allow foreign ownership of its own airlines and, while there has been a substantial amount of internal airline consolidation since deregulation, it has protected its own industry as best as it can. Europe has not been so fortunate with troubled airlines, such as the formally state-owned Alitalia now being 49% owned by Etihad Airways and thus being able to exploit this ownership on Alitalia routes.

So, are the decades of shared US and European policies of embracing globalisation about to be reversed? With President Trump threatening to tear up trade agreements, with Britain having voted to leave the EU and with difficult elections due in The Netherlands, France, Germany and probably Italy as well later this year, the answer is that we might just be about to watch the beginnings of the process of globalisation being put into reverse.

**WHILE THE NEW WHITE HOUSE ADMINISTRATION APPEARS TO BE ESPousing A NEW ERA OF PROTECTIONISM, IT IS EASY TO SEE THAT THE US HAS ACTUALLY BEEN PRACTICING PROTECTIONISM FOR YEARS**
Transmission

LETTERS AND ONLINE

Time to rethink UK airspace?

Howard Wheeldon’s pieces for AEROSPACE and elsewhere in the Society are usually thought provoking, often controversial. His February 2017 contribution did not disappoint. Although an article ostensibly about reorganisation of UK airspace, it became a rather strange call to constrain air transport through legislation and restriction, suggestions that might make even Stalinist Russia blush. It says: ‘the UK balance of payments has been adversely affected by the huge growth in air cargo imports and that the UK economy has been damaged by the export of jobs’. No statistics are given and no evidence to back up the assertion presented. Nothing is mentioned about exports. London Heathrow is the UK’s number one port by value but its tonnage is dwarfed by the mass of both imports and vital exports shipped through ports like Felixstowe and Southampton, without which our economy would falter. He fails to mention the fundamental change in production and logistics facilitated by the integrators such as FedEx, UPS, DHL and TNT and their comprehensive night air freight networks that enable just in time production and reduce inventory costs. Bizarrely, he then goes on to say: ‘there has been little impact, or their having been adversely affected is the UK’s number one port by value’. What about the benefi ts air transport contributes to the South East of the UK for 60 years, not 20 as he asserts. Yet we fail to introduce proper land use planning or stop those moving into areas near airports of their own free will then objecting to airport operation or expansion. Air transport accounts for some 3% of global CO2 and has made a binding commitment to get back to 2005 levels of emissions by 2050; it is well on track, Industry, commerce, agriculture, domestic heating and road transport all contribute signifi cantly higher levels of global emissions than air transport. The 57 LeQ contour around airports has reduced by 75% over the past 30 years. Reductions achieved as a result of research, development and massive investment by the air transport industry in modern, fuel effi cient aircraft which lack of adequate runway capacity limits their optimum use. We all wish to be responsible and limit the adverse impact of human activity on the planet. However, just constraining the air transport industry will not achieve that end. Indeed it may worsen it. Remember that 3km of road or rail track takes you 3km; 3km of runway takes you to the world! Modern turboprops are often much better matched to meet market requirements in terms of capacity and frequency, at much lower emissions, than fi xed formation 1,200 seat trains using 1,000s of miles of fi xed track requiring regular, often dispersive and polluting, maintenance.

Laurie Price FRAeS

All Party Parliamentary Group on General Aviation

I recently attended the inaugural meeting of the All Party Parliamentary Group (APPG) on GA set up jointly by Grant Shapps MP and Byron Davies MP, the latter being nominated Chair by the small number of fellow MPs present. Grant has been a force for good for GA and Byron a light aircraft pilot himself (who campaigned hard to stop cuts to Air Cadet gliding), will be an excellent Chair. The most relevant part of the meeting was when participants were given the opportunity to raise issues of concern. It brought into sharp relief that only a few years on from the conclusion of the GA red tape challenge (RTC), there are still pressing issues to discuss and raise with the Government. Put simply the GA community needs to hold the Government’s feet against the fire to ensure they are not only familiar with the GA RTC but that they also work hard to implement it. GA is often with the slightest adverse weather. We have not built new full scale runways in the South East of the UK for 60 years, not 20 as he asserts. Yet we fail to introduce proper land use planning or stop those moving into areas near commercial aircraft in some cases? Or that most of the UK’s major airports are either fully co-ordinated or facilitated, because of slot shortages and have been for 30 years or more? Both Heathrow and Gatwick are operating at virtually 100% of their capacity; if, as he asserts, there are no controls on industry growth, why do slots at Heathrow change hands for £30m or more? Why have many UK regions, such as Teesside, Humberside, Newquay, the Channel Islands and Isle of Man lost services to the Heathrow hub, if industry growth has been unconstrained? All that has happened is that domestic services have been substituted by international operations, despite the adverse economic and social consequences to those UK regions. What about the benefi ts air transport contributes to the economy, to society, social cohesion, well being and global connectivity and understanding; even more important post Brexit? The costs the airlines have borne for years of increased block times (50+ in some cases) as airport operators and Government have failed to provide new runways and push for 100% use of existing runway capacity with no resilience resulting in delays and cancellation.

Scott Pendry MRAeS
**Geoffrey Wardle.** [On Turkey’s F-X fighter](https://www.aerosociety.com/news/turkey-s-tf-x-fighter-throws-a-lifeline-to-uk-military-aerospace/) Looks very much like an F-22A, is this to replace the F-35 programme purchase with a more capable aircraft? I must admit I would have expected something looking more like the FOAS configuration on which so much good work was done.

**Dr Danilo Di Salvo** [On Baby boomers](https://www.aerosociety.com/news/baby-boomers) Informative article. I completed my MBA project on the supersonic market and my research suggested that there is a significant market available for supersonic aircraft. A couple of thoughts: the introduction of a supersonic option may stimulate the market for supersonic flight (much like Tesla did with electric cars) and a massive challenge for Boom is their ability to keep their operating costs down. Finally, something that has struck me after talking with Blake Scholl is his determination to bring the world closer together. Boom is working hard to bring the costs down so that we can all fly at supersonic speeds. Personally, I think that this would be amazing as I have relatives on the other side of the world and I would love to see them more often!

**Peter Hewkin** Is this really the best name for a company? Remember that it was the sonic boom preventing overland flight which was the downfall of Concorde!

**Laszlo Molnar** Interesting article. Thermoset composite require autoclave, thermoplastic polymer for example, unidirectional PEEK composite from TENCATE TC1200--f could be layup with robotics without curing. The engine thrust of 1.6 to relative low create the three engine configuration. I believe two engines are lighter less expensive, lower main costs and the design effort will drop to half.

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**Dr Danilo Di Salvo** [On Baby boomers](https://www.aerosociety.com/news/baby-boomers) Informative article. I completed my MBA project on the supersonic market and my research suggested that there is a significant market available for supersonic aircraft. A couple of thoughts: the introduction of a supersonic option may stimulate the market for supersonic flight (much like Tesla did with electric cars) and a massive challenge for Boom is their ability to keep their operating costs down. Finally, something that has struck me after talking with Blake Scholl is his determination to bring the world closer together. Boom is working hard to bring the costs down so that we can all fly at supersonic speeds. Personally, I think that this would be amazing as I have relatives on the other side of the world and I would love to see them more often!

**Peter Hewkin** Is this really the best name for a company? Remember that it was the sonic boom preventing overland flight which was the downfall of Concorde!
After endurance records, the next goal for electric, zero-emission flight is speed. TIM ROBINSON looks at a proposal for the world’s fastest purpose-built electric racing aircraft.

Until today, any word association game with electric aviation might have picked ‘green’ and sustainable – but ‘high-performance’ or ‘fast’ would not be among the words chosen.

Solar Impulse, for example, which circumnavigated the world in 2015-16, has a cruising speed of only 56mph. Meanwhile, Airbus’ e-Fan demonstrator, has a top speed of 220km/h or just 136mph. The current speed record for a manned electric-powered aircraft is only 220mph – set in 2013 by pilot Chip Yates using a modified Long-EZ.

However, a UK company, Electroflight, is aiming to change all this, by pushing electric propulsion to the limit in the aim of creating a ‘Formula E of the skies’ or even an ‘electric Red Bull Air Race’. Performance and power are the watchwords – with the aim of going 250mph and beyond. Founded around six years ago by Roger Targett, the goal of Electroflight he says is: “To develop high-powered, high-performance electric propulsion systems for use in aerospace and showcasing them through the P1e aircraft initially, then establishing an air race series based on the P1e aircraft, to push the development of batteries, motors and control systems in aerospace.”

Electroflight say the aim is to build the world’s fastest high-performance, full electric sport aircraft.

**The engine**

Key to Electroflight’s plan is a lightweight, electric motor that promises a better than a 1:1 power-to-weight ratio, giving the P1e the kind of face-melting acceleration usually experienced by jet fighter pilots or F1 drivers. (Indeed, this is already being exploited in the motor industry by Elon Musk’s electric car company Tesla – its Model S P100D hit 0-60mph in 2.275 seconds recently in ‘Ludicrous Mode’ – making it the fastest accelerating production car in the world.)

The Electroflight P1e will use axial flux YASA 750R motors. Says Targett: “The motors weigh 37kg and produce 750newton metres of torque at 2,750rpm and can run 200kW (264hp) peak for 60 seconds. Max continuous is half that.”

The first flight of the Electroflight P1e will use a single 750R motor, while the contra-rotating propeller system will be developed and tested on a bespoke test rig, for use in later versions of the P1e or possibly other aircraft. The contra-rotating unit will use two motors in tandem driving two-bladed propellers. In this arrangement, each motor drives a separate shaft and does not require a complicated gearbox. This is a much simpler mechanical arrangement than in the contra-rotating propeller units driven by piston or turbine engines.

Power for these motors will come from lithium batteries and, for the record speed runs, Targett

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**Roger Targett and the P1e.**

**Electroflight P1e**

250+mph maximum level speed (sea level)

9,000ft/min Climb rate

345kg All up weight (excluding pilot)

400+kW Max power

420kg Take-off weight
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FRILFORD HEATH GOLF CLUB, OXFORDSHIRE / WEDNESDAY 5 JULY 2017

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The impressive torque generated also means that, like the ultimate piston engine fighters of WW2 and the souped-up Reno air racers, a contra-rotating propeller also cancels out what might be dangerous yaw swings as power is applied. Contra-rotating, two-bladed propellers also can be a smaller diameter – meaning the airframe as a whole can be smaller and lighter. “The contra-rotating system will give us a huge amount of power/thrust in a small airframe,” says Targett.

The airframe

Built around the power and battery package is a highly sleek, all-composite single seat racing aircraft. The power package is also slimmer than a traditional piston engine, like a Lycoming, reducing the frontal area and promising improved aerodynamics. Maximum all-up weight of the P1e, says Targett, is expected to be 450kg but this will be slimmed down to 420kg for the record attempt. For safety, the pilot will sit in a semi-reclined position for improved G tolerance. They are also inside a constructed impact safety cell that is built into the fuselage structure. In addition, the P1e will be equipped with a whole aircraft ballistic parachute system that works at a low altitude/high speed.

Performance

With a high-power electric motor and lightweight airframe – it is no surprise that the P1e’s performance is expected to be startling for an electric aircraft. Says Targett: “The calculated thrust-to-weight is very close to 1:1 and level flight speed will be in excess of 250mph.” Indeed, the P1e should give Red Bull racers a run for their money. “The power-to-weight of the P1e would be significantly better than the aircraft currently used in the Red Bull Air Race series. We may have to ‘de tune’ the P1e for the typical RBAR race track!” Further development, says Electroflight, could push the P1e past 300mph where it could race in the sport or a dedicated electric class at Reno. Notes Targett: “I feel confident that electric aircraft will be significantly faster than a hydrocarbon powered equivalent.”

The downside, however, of this blistering speed is, of course, endurance. Says Targett: “For the speed run we need a flight time of 3.75 minutes plus 20% reserve. For air racing and air show displays, the P1e will have a flight time of 10 minutes plus 20% reserve.” While the speed of recharging for multiple flights a day is now not an issue, one challenge for the team will be battery temperature management.

Project status

Having built and displayed a full scale mock-up of the P1e at RIAT and Cranfield Festival of Flight, with initial seed funding Electroflight is now on the hunt for sponsors or partners to provide funds to get the P1e into the air and break the electric airspeed record for Britain – as well as potentially backing an aerial ‘Formula E’ to promote green, clean aviation – with associated STEM education spinoffs. This could be sooner rather than later, if a sponsor is found. Targett: “If we had the required funding tomorrow, we could be flying in just under 12 months.”

Summary

It is important to remember that this project is still in its early stages. Yet, just as the round-the-world flight of Solar Impulse sparked excitement about the possibilities of zero-carbon electric flight for endurance, so too could Electroflight for speed – converting die-hard aviation pistonheads into green, zerocarbon evangelists. Intense competition for a “Formula E” of the air could also potentially stimulate new public interest for general aviation and create a whole new airsport. As Roger Targett observes: “We believe that having an electric air race series will help to push the development of electric propulsion in aerospace. History shows that competition drives technology.”
Buying Better for the Aerospace Industry

As a highly regulated industry, airports, aerospace manufacturers and associated businesses are no stranger to complex regulation and demanding business environments. Whilst engineers are building the technologies of the future, facilities and procurement managers have the tough responsibility of making sure the power stays on, the costs are controlled and the operations run smoothly, day after day.

Like the aerospace industry, British Gas has a proud history, institutional expertise and a highly skilled workforce. As a Corporate Partner of the Royal Aeronautical Society, we look forward to working with fellow members. Through forming strong partnerships with leading aviation firms, we are honoured to help support vital employment and internationally renowned production.

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Drone deliveries
A first class service?

BETH STEVENSON looks into recent progress in commercial UAV package deliveries around the world. How far are we away from practical services?

Unmanned aerial vehicles (UAVs) have been a talking point for the general public for some years now but nothing piqued people’s interest more than the potential use of this type of aircraft to deliver parcels to their doorsteps.

The catalyst for a wave of UAV delivery schemes began when Amazon’s CEO Jeff Bezos launched the online retailer’s Prime Air project in 2013, which led to a number of companies and organisations to then consider how the use of the technology could benefit their individual operations.

Since then there appears to be a new UAV delivery project popping up every day and while two of these – namely Amazon and Google – remain at the forefront of the development of a large-scale deployment of this technology, a full-scale roll out of UAVs in this application still seems to be some years away.

At the time Bezos launched Prime Air, Amazon had revealed the first well-publicised plans that would take this technology that was typically reserved for military operations – plus a growing number of commercial uses and the hobbyist market – and present it for an application that would directly impact the everyday person.

However, despite the media focus on the possibilities made available through the introduction of UAV delivery – the idea of having a pizza delivered via an unmanned system caused a particular frenzy and Domino’s has even carried out a trial using a Flirtey UAV – the jury is still out on just how viable the concept is.

Machine class delivery

There have been some significant feats in this area by organisations carrying out deliveries of time-critical wares like medication and aid. However, these tend to be carried out in remote areas where airspace restrictions are less of an issue, or during events when normal rules are no longer followed to the book, such as following a humanitarian disaster.

The first trial delivery of a Prime Air prototype was carried out on 7 December in Cambridgeshire.
in the UK, during which a UAV demonstrated delivering a package to a remote home within 13min.

“We began private trials in the UK last year and the first customer delivery by drone took place on 7 December 2016,” an Amazon spokesperson tells AEROSPACE. “Through this private trial, we will gather data to continue improving the safety and reliability of our systems and operations, bringing us one step closer to realising this amazing innovation for all (of) our customers.”

This achievement drew attention to Amazon’s Prime Air programme after a relatively uneventful two-year period but the timing of it has also drawn cynicism.

Having been carried out so close to the holidays, it has been suggested by e-commerce packaging company Priory Direct that the online retailer could have been looking for a quick marketing hit in order to drive up sales.

Bezo launched Prime Air in December 2013. The company threatened to take the project’s research activities away from the US in December 2014, while the lead up to the end of 2015 saw a new model of UAV unveiled by the company, demonstrating that the end of each year is a key time for Amazon to make an announcement.

Nevertheless, Amazon claims that testing will now continue, which will ultimately lead to customers being able to order seven days a week during daylight hours, depending on the weather.

“We’re starting small for now and, in the coming months, we’ll offer participation to dozens of customers living within the area of our Cambridge, UK facility,” the spokesperson adds.

Amazon revealed images of its first multirotor prototype in 2013 but this has evolved since then, and a video showing the December flight test showed a rather different quadrotor design.

“The drone in the video is just one of the vehicles we will use as part of this trial,” the spokesperson says. “We will continue testing many different vehicle designs and delivery mechanisms to discover how best to deliver packages in a variety of operating environments.”

Amazon’s stream of red tape

The company envisions creating a family of systems suited to different environments and one example shown on the Prime Air website shows a vertical take-off system that then transitions to horizontal flight when airborne. Narrator to the video, British TV presenter Jeremy Clarkson, is heard saying that it will be able to fly out to 15 miles using ‘sense and avoid’ technology to avoid obstacles.

Despite this achievement, Prime Air has not come without its challenges, not least of all getting authorisation to test the concept in its native US.

The constantly evolving designs of the UAV has not helped matters as, in 2015 an experimental airworthiness certification was granted by the US Federal Aviation Administration (FAA) for an out-of-date model. This notably riled the company, and led to Paul Misener, Vice-President for Global Public Policy at the company, telling a US Senate subcommittee on aviation operations safety and security that the model that had been authorised was ‘obsolete’ and it was taking its testing elsewhere.

Misener said that the rules and approvals granted by the FAA were ‘more restrictive’ than other nations including the UK and despite the administration subsequently granting a certification for a newer model, Amazon has continued to test in the UK.

As a result of the frustrations the retailer saw with trying to test its concept in the US, authorisations were then applied for in the UK, where the company has concentrated much of its Prime Air efforts.

“The UK Civil Aviation Authority and the Department for Transport have taken a supportive, forward-looking approach to our pioneering programmes, and have provided Amazon with permissions to embark on these private customer trials,” the spokesperson notes.

The Amazon spokesperson told AEROSPACE that testing could take place in other countries subject to ongoing discussions: “We are working with regulators and policymakers in various countries in order to make Prime Air a reality for our customers around the world and expect to continue to do so,” he says.

To further prove that this is not just a passing phase for the retailer, Amazon has also patented a design for an airborne fulfilment centre for its delivery UAVs, which could be a manned airship that flies at a high altitude and deploys the aircraft to delivery locations. Filed in December 2014 and granted in April 2016, the patent only came to light in December 2016, and describes smaller airship ‘shuttles’ that could replenish the larger ship, and also transport staff to and from it.

The representative noted that the company was reluctant to talk about future plans, and declined to offer any further detail on when Prime Air could be a commercially viable service.

Google’s search for a delivery drone

Hot on the heels of Amazon announcing its plans in 2013, Google entered the competition when, in 2014, it revealed its UAV delivery prototype that had been developed under the company’s Project Wing venture which came under the experimental X division of the company.
A video released in August of that year showed a demonstration that took place in Australia, which involved a flying wing UAV delivering supplies to farmers in a remote area.

Unlike Amazon's Prime Air effort, which is supported by a strong marketing campaign, Project Wing does not claim as many headlines as its competition and was unavailable for comment.

However, the company rather modestly briefly claims on its website that, in September 2016, it began testing the aerial delivery UAV at the Virginia Tech Mid-Atlantic Aviation Partnership FAA test site.

"These tests were designed to generate data for the FAA's ongoing study of unmanned aerial delivery systems," the company's website claims, but few further details are offered, other than to say that refinement of the aircraft and communications systems had continued in California since the first flight in 2014.

"Our aircraft can fly pre-planned routes on demand using sensors and software to detect and avoid one another in real time," it adds. "They fly up to 400ft above the ground, and safely deliver fragile packages to a spot the size of a doorstep."

Project Wing was headed by technology aficionado Dave Vos, who carried his experience and credibility from previous stints at companies such as Athena Technologies – of which he was co-founder – and Rockwell Collins, into the project. However, October 2016 reports claim that he had stepped down from this position, offering further speculation as to the status of the project.

Additionally, Google parent company Alphabet has sold off another UAV project that came under the X guise, namely the high-altitude solar-powered unmanned aircraft system that it acquired when it bought out Titan Aerospace in 2014. The system was acquired with the vision that it could bolster bandwidth in remote areas, akin to the Aquila UAV being developed by Facebook, but the company is now focusing on its Project Loon that looks to do this with the use of balloons.

In 2014 it seemed that Google was at the forefront of UAV utilisation with the Titan acquisition and the Project Wing test flight but the recent closure of the solar-powered development does not bode well for unmanned technology within the company.

Nevertheless, with testing now brought back into the US, the company will have to face airspace regulation issues in-country directly, even if it is using the easier route of using FAA test sites to do this. If the UAV delivery concept is going to survive, commerce and convenience-led cultures like the US will have to be able to adopt it into its regulations, and facing it head-on is key.

Postal Drone

Aside from these two large-scale UAV novices that are taking a significant technological and operational leap into the unmanned aviation domain, other companies are also investing in the utilisation of UAVs for delivery, but on a smaller scale.

France's La Poste announced at the end of 2014 that it had tested the delivery of a 4kg parcel through the postal service's GeoDrone project which kicked off two years of concept and safety testing alongside UAV technology partner Atechsys.

As a result of this, in December 2016 it was announced that the French General Directorate of Civil Aviation had authorised La Poste subsidiary DPDgroup to deliver parcels by UAV on a regular basis in the Var, southeastern France.

This will cover the weekly delivery of packages from Saint-Maximin-La-Sainte-Baume to Pourrières, in the Var which La Poste claims will be the first regular commercial line delivering packages by UAV.

DHL has also been using UAVs to deliver parcels in Bavaria during a three-month trial using its Parcelcopter design.

Carried out in 2016, the Parcelcopter was integrated into the company's delivery chain, delivering parcels in the Alpine region of Reit im Winkl.

Each round trip covered 8km of flight, with the Parcelcopter typically delivering sporting equipment or needed medicines, arriving at the Alm station within eight minutes of take-off, which typically takes 30min by car in winter.
Additionally, customers were invited to test out the Parcelcopter Skyport, into which they could insert their shipments to initiate automated delivery using a Parcelcopter. A total of 130 autonomous loading and offloading cycles were performed during this time, the company says. Results of the trial are being assessed, and another area will be tested for further trialling, DHL says.

**Delivering smooth landings**

Unmanned technology is having its moment in the commercial domain, as it makes a step change from a system that did not directly impact most people’s lives, to promising to be an omnipresent entity that will take the convenience that the western world is so used to, to the next stage.

The leading companies making this promise are still in the throes of development as they race to be the first to make this viable, but are making incremental progress that seems enough to keep people asking when this concept will be available in practice, although this is clearly not without its challenges.

In parallel, smaller companies that base their businesses on parcel deliveries have introduced UAVs into their structures, and while this is a scaled down version of what Amazon and Google hope to achieve, it shows that it can be done, and the requirement to some degree is very much there.

It is now in the hands of the two large organisations to prove that they can deliver on their promises, and no doubt that if they do, UAVs landing in gardens and on doorsteps the world over will become commonplace.
AEROSPACE: You have recently passed your first year as Chief Executive having taken over from Stephen Ball. What has been the greatest challenge in your new role and how will you be building on the success and legacy Stephen leaves behind?

PR: I was fortunate to work closely with Stephen before taking on the role in January 2016 and he was a great mentor to me. That meant I was familiar with 90% of the job, which was a huge bonus and not one that many share when assuming a new responsibility of this nature. Like most roles at this level there’s a lot to do. We introduced a significant amount of change at the same time I took over, including the separation of part of our business to Leidos – so the breadth and depth of work required is a challenge, albeit one I’m relishing. The Lockheed Martin values are simple but powerful and they give an easy focus to the role: respecting others; doing what’s right for our customers; and making sure I and my team perform with excellence. If I can do these things and lead a team that does the same, then I’m confident that we will build on Stephen’s legacy.

SIMON LEVY speaks to PETER RUDDOCK CBE FRAeS, Chief Executive, Lockheed Martin UK, as he gets to grips with replacing Stephen Ball, the acquisition of Sikorsky and the integration of the F-35 into the RAF.

AEROSPACE: Having acquired Sikorsky last year, what changes have you seen and what is on the horizon now that it is a Lockheed Martin company?

PR: I’m really pleased Sikorsky is now a Lockheed Martin company. We have a shared legacy of innovation and performance and have been shaping the history of aviation for more than a century. Together we are even better positioned to provide best value for our customers, our employees and for our shareholders.

The S-92 is a state-of-the-art helicopter and it is doing a superb job; we also have the honour of flying Her Majesty The Queen in a Sikorsky helicopter. I had to eject from a Hunter that was on fire many years ago and ended up in the sea about 20 miles off the coast; the Whirlwind helicopter that picked me up had to dump fuel before it could rescue me but I have never forgotten that moment nor the critical role that our search and rescue helicopters play in the life of our nation. We currently have 14 S-92s supporting HM Coastguard and search and rescue operations and the capability they provide is second to none.
**AEROSPACE**: The F-35 made a huge impact at RIAT and Farnborough International last year. Has it now turned a corner in convincing doubters?

**PR**: There is a tremendous amount of excitement and positivity regarding the F-35 and that has accelerated since RIAT and Farnborough. This momentum is only going to build further as we get closer to the first F-35s flying operationally from RAF Marham and then from the hugely impressive Queen Elizabeth-class carriers.

I think the other point really worth making is how mature the programme is now. There are more than 350 pilots, flying 200 jets, with more than 70,000 flight test hours behind them. This is a jet that’s ready to be deployed in combat for both the US Air Force and the US Marine Corps. In the next five years, more than half the F-35s to be delivered will go to international customers outside the United States.

I’ve flown more than 30 different aircraft types, including a number of the fourth generation fighters, and the thing that impresses me above everything else is the incredible situational awareness the F-35 affords. It is like going from night to day compared to what our pilots have flown previously.

**AEROSPACE**: What opportunities still exist in the UK for British industry to play a part in the programme (avionics support, simulation, training etc)?

**PR**: Well, we’ve seen the announcement that the UK will be a global repair hub for the maintenance, repair, overhaul and upgrade of avionic and aircraft components. This is a huge prize for the UK and will result in a significant amount of additional work taking place here, centred at Sealand in north Wales.

As Lockheed Martin, in concert with other UK industry partners, we’ll be providing UK programme support for training, maintenance, supply and F-35 information systems and there’s also significant opportunities to mature some of the impressive fifth-generation C4ISR capabilities and to integrate these with other UK platforms.

**AEROSPACE**: What discussions have you had with the MoD over the full buy (138) of F-35s. Could these be split between F-35Bs and F-35As?

**PR**: The commitment to 138 aircraft was restated in the 2015 Strategic Defence and Security Review and is great news for the F-35 and really underlined the UK’s position and status in the programme. We are focused on delivering the B-model. However, if there is a desire by the MoD to split the variants in the future, we’ll be able to support that request.

**AEROSPACE**: What type of support will Lockheed Martin offer and supply to the UK’s F-35 fleet once they have entered active service?

**PR**: We’re the industry product support integrator...
to provide sustainment for the F-35 programme and we work in conjunction with the Joint Program Office on this. Here in the UK that means Lockheed Martin working in concert with other industry partners to provide support for training, maintenance, supply and information systems.

**AEROSPACE:** Will UK-specific F-35B weapons (PIV, Meteor, SPEAR 3) be available to other F-35 customers?

**PR:** That's not a question I can answer, I'm afraid.

**AEROSPACE:** The C-130 Hercules has been in production now for over 60 years. Will it ever retire and can it still compete with more modern aircraft now on the market?

**PR:** It's an aircraft that has redefined airlift capabilities for more than 60 years. It's the world's workhorse today and I think that's going to remain the case for the foreseeable future. We're continuing to identify new ways to make the Hercules even more relevant and valuable to our customers in the military and commercial sectors. Both France and Germany are buying the C-130J and there's the new LM-100J commercial version coming along, so the aircraft is going from strength to strength.

A C-130 crew came to my aid in the Falkland Islands many years ago, providing fuel when there was nowhere to land, and the horrendous weather made ejecting unappealing. So I have a special place in my heart for this remarkable aircraft, it's unique. It can tackle missions that other airlifters can't, don't or won't and that's going to be the case for a long while yet.

**AEROSPACE:** Hellfire has been the anti-tank missile of choice for many years. Do you see a big battle between its successor Joint Air-to-Ground Missile (JAGM) and MBDA's Brimstone II to equip UK Apache AH-64Es?

**PR:** It's our air-to-ground missile that's currently fielded on the Apache helicopter and JAGM integration onto the Apache is fully funded and underway as part of the JAGM Engineering and Manufacturing Development phase. This, along with the low recurrent cost, means that our family of weapons – current and future – provide outstanding value when compared to alternative options and this is key to helping achieve true value for the British taxpayer.

**AEROSPACE:** How is Brexit and the activation of Article 50 predicated to shape Lockheed Martin’s footprint in Europe and the UK?

**PR:** I think it's really too early to say at present but we're committed to the UK – and to Europe – and I'm extremely proud of the highly skilled workforce we have here in the UK. We've not seen a direct impact to date but then more than 90% of our supply chain is also UK-based.

**AEROSPACE:** What steps are you planning to take to engage and recruit more apprentices in the next couple of years?

**PR:** I'm really proud of our work to encourage future generations of talent through apprenticeships. We've made a commitment as a member of the 5% Club to see that 5% of our UK workforce over the next five years will be young people on structured training schemes.

**AEROSPACE:** What is being done to encourage recent graduates to seek employment or continue their higher education under the guidance of Lockheed Martin?

**PR:** It's an aircraft that has redefined airlift capabilities for more than 60 years. It's the world's workhorse today and I think that's going to remain the case for the foreseeable future. We're continuing to identify new ways to make the Hercules even more relevant and valuable to our customers in the military and commercial sectors. Both France and Germany are buying the C-130J and there's the new LM-100J commercial version coming along, so the aircraft is going from strength to strength.

A C-130 crew came to my aid in the Falkland Islands many years ago, providing fuel when there was nowhere to land, and the horrendous weather made ejecting unappealing. So I have a special
PR: I recently had the pleasure of spending the morning with our 2016 intake of graduates and I’m really looking forward to seeing how they progress in the next two years. We’re doing everything we can to reach the cream of British graduates – but it’s a competitive field. Where we have an advantage is in the breadth of the work we can offer, the opportunity to work on some truly innovative programmes. It’s encouraging that we consistently score highly with third party assessments, being highly ranked as an ‘Attractive Employer’ by Universum for example.

We know our graduates are good – and so does the Royal Aeronautical Society! One of our graduate engineers, Alex Godfrey, was awarded the Society’s 2016 Young Person Achievement Award. As a Fellow of the Society myself, I’m thrilled for Alex.

AEROSPACE: What’s the next major project for Lockheed Martin in the UK following the delivery of F-35?

PR: We’re not losing sight of the F-35 just yet, this programme will be around for a long time! As one example, we’re responsible for helping get RAF Marham ready for the arrival of the F-35 and the new facilities are developing at pace.

The Government’s prosperity agenda is really important and we’re doing everything we can to support that, whether that’s searching out export opportunities or the potential for creating British jobs on future programmes such as the new Mechanised Infantry Vehicle.

We’re also keen to expand our role in promoting space exploration from the UK and Europe. We’re supporting the UK and European Space Agencies and having a presence at the UK Space Agency ‘Catapult’ in Harwell is exciting.

AEROSPACE: Where do you see the biggest growth areas for LM’s business in the UK (eg, space, cyber, UAVs)?

PR: Every single one of the areas you cite as an example has the potential for growth and we’ve got talented people looking at each of them. On unmanned technology, we took part in the Royal Navy’s Unmanned Warrior exercise and the scale and pace of change that unmanned technology will bring to defence is quite incredible. There’s one area you haven’t mentioned that we also see as having significant potential for growth – and that’s energy. We have a great deal to offer in this area, be it waste-to-energy or micro-grids.

AEROSPACE: LM is obviously well known for its defence products and the F-35 – what’s the most surprising product or unusual area of business that LM UK is involved with?

PR: As I just mentioned, I think a lot of people would find it surprising that we’ve got an interest in energy. However, at its core, the energy challenge is an engineering challenge and that’s what we do best. We have the world’s best engineers and technologists focused on energy innovation.

We’ve just announced a teaming agreement with CoGen to develop energy-from-waste projects in the UK, starting with a new plant in Cardiff, Wales. That’s going to be a facility that will convert waste into up to 15 megawatts (MW) of energy, enough to power about 15,000 homes and businesses in the local area by processing 150,000 tonnes of waste per year.

Alongside energy-from-waste, there’s tremendous potential in UK tidal energy and we’re looking at this too – they’re fascinating areas to be applying expertise to.
Organisations need to be confident that they are hearing all the safety concerns and observations of their workforce. They also need the assurance that their safety decisions are being actioned. The RAeS HUMAN FACTORS GROUP: ENGINEERING (HFG:E)† set out to find out a way to check if organisations are truly listening and learning.

Organisations that aspire to peak safety performance need a heightened awareness of two things: the warning signs of impending threats and their opportunities to improve. They need a reliable organisational ability to ‘listen’ for warning signs and opportunities, analyse their significance, learn and crucially, to promptly act on that learning. To do this effectively they must engage everyone in their organisation, meaning that effective leadership is vital too.

† The HFG:E project team consisted of Stephen Bramfitt-Reid (Rolls-Royce), Colleen Butler (Health and Safety Laboratory), Andy Evans (Aerosurance), Doug Owen (The Schumacher Institute) and Tania Wilson (Virgin Atlantic Airways).
They say ‘safety is no accident’ but, as commercial aviation accidents become rarer, having had no recent accidents does not mean an organisation is ‘safe’. So how can accountable managers and senior executives prove to themselves that they have listening and learning organisations? The RAeS HFG:E set out to answer this question.

The traditional approach would have been to deconstruct the components of ideal SMS (typically from a regulatory requirement or an industry standard for SMS), create a checklist and do an audit. During that audit one might even grade the maturity of the components as present, suitable, operating and effective (for example). While this conventional approach has value, it also has three limitations. Firstly, it is structured around compliance with pre-determined practices. Secondly, it doesn’t actively encourage innovatively creating future best practices. Thirdly, it focuses on processes and procedures yet, as highlighted in the Haddon-Cave Nimrod Review, people make safety, not just processes and paper.

Identifying the warning signs and opportunities:

Q1 How do you know that employees are confident to confide their concerns, report occurrences, reveal human performance issues and suggest improvements?

Q2 How does your organisation react to ‘bad news’?

A strong safety culture is one in which everyone, especially senior executives, are ready and willing to hear bad news. In such an organisation no one denies an ugly or inconvenient truth, shoots the messenger or mistrusts the reporter’s intent. Stay open minded and non-judgemental, listen for understanding and opportunities for improvement. Consider:

- Do you welcome bad news as an opportunity to improve or as a way to identify who is at fault?
- Do managers go to see for themselves and talk to the right people before acting?
Q3 How do you ensure that it is easy for employees to raise concerns, report occurrences, reveal human performance issues and suggest improvements?

Effective reporting and employee engagement are key components of your safety system. Are your processes sufficiently flexible to capture and highlight safety concerns and improvement opportunities in varied situations, in a timely manner? Consider:

- How wide is your range of reporting methods (eg verbal, paper forms, IT network, web or app)? Does everyone have easy access to one or more of these methods?
- In practice, are these simple and easy to use?
- Are you sure your people understand what needs to be reported? How well do you train and promote this? Are they given the time to complete reports?

Analysing the significance of warning signs and suggestions

Q4 How do you ensure that your organisation appropriately analyses its safety data?

You may gather much safety data in many forms but how well do you turn that into actionable ‘intelligence’ to improve your processes and reduce risk? Consider:

- What safety-related data do you gather (or could you gather)?
- How well does your organisation collate that data, analyse it, monitor for changes and share those insights?
- Do you routinely use this data to update your risk assessments and procedures?
- How many of your organisation’s safety decisions are based on solid data and how many times do you lack the critical information you need?
- Are you able to routinely use safety data pre-emptively or are you mostly using data only after occurrences?
- Do you actively search public domain sources and participate in industry safety groups to supplement your internal data?

Q5 How deeply does your organisation consider what prevented ‘near-misses’ from becoming accidents?

Holistically investigating near-misses can help you understand and reinforce what went right, by design or coincidence and how you were protected against a more severe outcome. Consider:

- Are near-miss reports systematically investigated, analysed and risk assessed?
- Do your investigations look for what went right, as well as what went wrong?
- How do you determine ‘how close’ near-misses were to an accident?

Q6 How can your organisation get more safety insight out of the corporate data it collects?

When monitoring your safety performance and making safety decisions, are you relying only on the safety department’s own data or do you look at all corporate data as potential safety data? Consider:

- Are you fully exploiting audit reports, entries in maintenance records, reliability data, parts usage data, planning/production/project management data, supplier performance data, competence assessment records, training feedback forms, overtime records, employee retention data, customer complaints, warranty claims, meetings actions etc?
- Are you combining data from multiple sources or are you limited by how you record and store data (ie by data silos)?

Q7 How well do you monitor your top risks with Safety Performance Indicators (SPIs)?

The use of appropriate leading and lagging metrics can help measure performance, anticipate the future and proactively prevent problems from occurring. Consider:

- Are you able to routinely use safety data pre-emptively or are you mostly using data only after occurrences?
- Do you actively search public domain sources and participate in industry safety groups to supplement your internal data?
How well do your SPIs provide assurance of your safety performance?
Do your SPIs provide you with early warning that critical safeguards are deteriorating so timely interventions can be made?
Do your SPIs cover your top risks and critical controls?

Q8 How confident are you that your organisation has accurately identified its top risks?
To make informed risk-based decisions requires an understanding of the hazards that your organisation is exposed to, their potential severity and the likelihood. How complete and accurate is your organisation’s risk picture? Consider:
- How do you collect information to help you understand and prioritise your organisation’s greatest threats?
- Worst case consequences can be relatively easy to imagine but likelihood can be much more difficult to estimate. Do you have the right data to make confident estimates?
- Has your organisation the appropriate skills and tools to understand risk?
- Do occurrences validate your existing risk assessments or are they sometimes surprises?
- How often do you re-examine all your risks? Do you only look at a narrow sub-set?

Taking action: learning, improving and leadership

Q9 How do you ensure learning and improvement is achieved across your organisation?
A learning culture is one which processes information in a conscientious way and makes changes accordingly. Consider:
- How well do you systematically gather, analyse and review safety data, both internally and from other organisations?
- How well do you learn from both ‘successes’ and ‘failures’ within your organisation and also from outside? Are those lessons widely disseminated?
- How well does your organisation act on and communicate rule-making, risk assessments, procedure changes, new technology and changing circumstances?
- How do you ensure information is communicated and shared effectively both horizontally (across different locations, departments or shifts), vertically (across hierarchical levels within the organisation) but also with customers and subcontractors?


Q10 How can you behave to clearly demonstrate you are an authentic safety leader who promotes trust in your organisation?
The importance of safety leadership cannot be overstated. Humility affects what you are willing to hear and learn about your organisation and its risks. Consider:

- How well do you champion safety? What do you condone by walking past?
- Do you set clear expectations for safety behaviours and objectives for safety improvement?
- Are you prepared to ‘follow’ too, when appropriate?
- Are you aware of how you come across, the messages you send and how you are perceived?
- Do you lead by example and consistently demonstrate those behaviours you expect to see in a healthy safety culture? Encourage and reward engagement in safety, demonstrate that you have an interest in the day to day operations, ‘go look see’, include safety feedback in employee briefings/communications, focus on learning and improvement.

Final word
The RAeS HFG:IE believe that reflecting on these ten questions should give you some insight into how your organisation can become better at listening and learning. Acting on that insight will enhance your safety performance. They recommend revisiting the questions periodically on your journey to peak safety performance. However, it is vital to remain constantly vigilant of the reality of what is happening across your organisation.
Anglo-Italian group Leonardo is banking that a new single entity for its UK business will streamline operations, provide a single voice to customers and boost export potential for its electronics and helicopter capabilities. TIM ROBINSON reports.

revealed by Leonardo CEO and General Manager Mauro Moretti on 12 January, the new entity, Leonardo MW Ltd brings together the group’s UK divisions; AgustaWestland, Selex ES, Finmeccanica UK and DRS Technologies under one roof. The full name Leonardo MW stands for ‘Marconi Westland’ – paying tribute to the famous legacy brands that have designed, manufactured and supported products to the UK armed forces for the past 100 years.

With Norman Bone appointed the new Chairman and MD for Leonardo MW, the company boasts some 7,100 employees in the UK and £2.3bn revenue, with £1.3bn of this in exports. It also supports a supply chain of around 2,300 firms with the bulk being SMEs. This now makes Leonardo MW second only to BAE Systems in the UK defence industry.

As well as helicopters, the new UK entity also covers electronics, sensors and radars, defensive aids, as well as the fast-growing cybersecurity sector. The company provides a healthy chunk of electronics onboard the Eurofighter, including the CAPTOR radar, Pirate IRST and DASS. More than 50% of the company is involved in electronics, with the company currently designing four fire control radars simultaneously – said Bone – an unprecedented level of activity.

He also noted that Leonardo MW is ready for long-term innovative partnerships, highlighting its selection for UK’s Mode 5 IFF (where it partners with Airbus DS) as an example of this. “When you have the breadth of capabilities we have,” says Norman Bone, “companies will want to partner.”

Last year’s ‘Unmanned Warrior’ exercise, which saw Leonardo platforms and sensors (radar and EW) take part, also provided the “single best example of Leonardo working together” says Bone, when a SW-4 Solo optionally piloted helicopter UAV was trialed with SelexES’s Osprey radar.

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In particular, Leonardo stresses that it is the only true UK company able to provide end-to-end capability in military rotorcraft from design to support – with the key IP (intellectual property) kept on-shore in the UK.

Responding to questions about the future of Yeovil post-Wildcat and AW101, Bone pointed out that existing customers will need support and upgrades to AW models in service. Additionally, Yeovil has the potential to become a centre for ‘unmanned opportunities’ in the future. Indeed, the press conference followed an earlier announcement that the company has won a £277m five-year contract to provide support and training to the UK MoD for RN and British Army Wildcat helicopters, having delivered the 62nd and last Wildcat to the UK last month.

Next generation missile threats means Leonardo MW’s BriteCloud is attracting strong international interest.

Export interest

Leonardo believes that the new integrated organisation, with a single voice, will also help drive exports and support the Government’s prosperity agenda. For example, its Osprey AESA radar won a key US Navy contract last year to equip the MQ-8C FireScout UAV – a significant win, given the highly competitive US defence market.

Meanwhile, its BriteCloud next-generation expendable active decoy, set to replace chaff and flares on fast jets, is already being tested by the RAF. Export interest in this system, says Bone, is ‘intense’ with a potential market of up to 4,000 fighters.

Additionally, despite the uncertainty in European circles over the incoming President Trump, CEO Moretti noted that his desire to make European NATO members pay their own way for defence could make for an opportunity for suppliers such as Leonardo.

Investing in skills

Meanwhile, Leonardo says that it will continue to invest in its UK skills base (with over 400 people on its graduate and apprentice schemes) but also that the new organisation will provide an even more attractive employer. For example, in the future, rotorcraft apprentices could switch over to defence electronics, or vice versa as part of their training.

The new Leonardo MW combined entity pays homage to several legacy companies including Marconi and Westland.

Swapping apprentices or graduates to other areas is not just interesting for the workers involved but this cross-fertilisation is also extremely useful for the company itself – particularly in harnessing and exploiting innovation.

**ATR – time for a new airliner?**

Group CEO Moretti also shared his thoughts on Leonardo activities outside the UK – in particular with its turboprop partnership with Airbus under ATR. While the partnership has been a fruitful one, Moretti suggested that ATR needs to launch a new ATR 72 model immediately, or face abandoning customers. Additionally, he said that work needs to start on developing a new 100-seater model. This would not just be a regional passenger aircraft but also have utility as a cargo and even a military multi-role aircraft.

Leonardo is also working on a new attack helicopter for the Italian Army – which will replace the A129 Mangusta. A €487m contract signed on 14 January for a new exploration and escort helicopter (NEES) will see Leonardo develop three prototypes and one production level helicopter by 2015.

**Summary**

This revamp is welcome news for those concerned about the UK aerospace and defence sector, post-Brexit – with a commitment to invest in onshore skills, R&D and protect UK-developed IP. Furthermore, putting electronics and rotorcraft under the same roof gives Leonardo MW the advantage of being able to more closely integrate and optimise sensors and platforms – particularly for the evolving unmanned rotorcraft market. Digital and other upgrades to existing platforms too are also likely to keep Yeovil busy in the future. In addition, if a new US President focuses minds on boosting European defence capabilities – this too represents an opportunity for companies such as Leonardo MW. With electronics (including cyber and sensors) and rotorcraft platforms as its core going forward – Leonardo MW is now one of the UK’s largest high-tech engineering companies.
Manchester’s new signing

In January, Manchester Airport became the first non-London airport to get an Airbus A350-operated service with Singapore Airlines. MARTYN CARTLEDGE reports on this regional airport coup.

At 07:53 GMT on 17 January 2017 there was a double celebration at Manchester Airport and a number of ‘firsts’ with the arrival from Houston of 9V-SMI, an Airbus A350-900 of Singapore Airlines on the relatively new SIN - MAN - IAH service. Not only a first on the route but a first for Manchester, as this aircraft was the first A350 to land at the northern airport which also makes it currently the only non-London airport in the UK to have an A350-operated route.

There was a large welcome for the flight from both Singapore Airlines and Manchester Airport executives, as well as TV, radio and print media, many of whom had, the previous day, visited the Airbus factory, staff from which also making the journey down the M56 for this inaugural A350 service. This was something of a greater North West powerhouse event with the wings being built by a 700-strong workforce at Broughton factory just 40 minutes away. Some were staff only seeing the complete aircraft for the first time.

Speaking to AEROSPACE, Sheldon Hee, General Manager of Singapore Airways UK and Ireland, said that the decision to place the A350 on the route that he described as ‘A key part of our network’ was that it is a good time to invest having seen demand and business grow on the route combined with the aircraft’s economics being well suited. Add to this its unique features and upgraded cabin experience, he feels it will help grow the routes both to Houston and Singapore which, of course is now non-stop having previously operated via Munich. This direct service also provides another interesting alternative for flights into Australia for travellers from this northern city.

Speaking previously about the new service Ken O’Toole, CEO of Manchester Airport said: “This new service to Houston with Singapore Airlines will open up a whole new part of America to business and leisure passengers across the North. Houston and Singapore, along with a wealth of other recent new routes, can only be found at Manchester in the UK outside of London.”

A Mancunian welcome

Stephen Turner, Commercial Director at Manchester Airport was equally positive: “The introduction of Singapore’s A350 is a historic moment for Manchester Airport. We are trailblazing, bringing the aircraft into Manchester over other European cities is fantastic.” He went on to say that
the introduction of the A350 had been a painless process for the airport without the need for any infrastructure changes. Positive news, as the airport will receive its second A350 service later this year when Cathay will also replace the 777 currently operating the four (increasing to five with the A350) weekly flights to Hong Kong.

A quick straw poll of passengers disembarking from Singapore showed the new aircraft was being well received both in comfort as well as features, in particular the new 13in touch screen. Although none of those spoken with had taken this service because of the aircraft type, all were complimentary and many noticed that the cabin did look different from previous flights.

The service does not have a first class cabin, although not deemed an issue, as demand for such a product is not seen as that great outside of London routes.

Passengers taking the onward leg to Houston were treated by the Airport to a small event involving breakfast from both the UK and Singapore which also included SIA and A350-branded cupcakes which added to their bemusement at the heavy media presence.

The aircraft had arrived nearly an hour early which helped an on time departure despite media swarming over the aircraft prior to boarding to view the excellent cabin fixtures introduced on this aircraft. As each passenger boarded, SIA provided a nice touch by handing each passenger a bag containing champagne truffles and an inscribed Parker pen commemorating this first A350 service.

The flight operates five times per week as SQ52/51 with the east and westbound flights crossing paths at Manchester on Wednesdays, Saturdays and Sundays.

From Lancashire to the world

After eight months in service with SIA, the A350, in addition to Manchester, is now serving Amsterdam, Dusseldorf, Moscow, Johannesburg, Cape Town, Tokyo, San Francisco and Houston with SIA seemingly very pleased with the aircraft.

Singapore has big plans for the A350. At the handover ceremony for the first A350 in Toulouse, Singapore Airlines CEO, Mr Goh Choon Phong said: “The A350 is a key element in our overall capacity growth and fleet renewal strategy. Its improved operating efficiency offers us the opportunity to open up even more new routes, providing more travel options to our customers”.

Back in Manchester, Sheldon Hee further commenting on how ‘fantastic the aircraft is for us’ and it being a ‘delight to operate’ with the aircraft so far ‘exceeding our expectations’.

When asked about the next steps for the aircraft Mr Hee talked of the upcoming extension of the Moscow service to Stockholm and the plans for the ULR version serving New York and Los Angeles in 2018. This will re-introduce the longest direct non-stop flight in the world, something eagerly awaited by both airline and passengers alike.

Unfortunately for the rest of the UK’s regional airports there are currently no plans for any further services either being introduced or being switched to the A350, making the coup Manchester secured even better.

On a different note, when asked about the recent decision not to renew the lease on the first A380, Mr Hee said that it is unlikely that this will affect any of the London Heathrow services and that decisions on further leases will be made on an individual basis matching supply and demand.
Creating the world of tomorrow

Self-preserving intelligent aircraft? Detachable fuselages? Space nanobots?

BILL READ FRAeS reports on future predictions for air travel and spaceflight as envisioned by speakers at two recent RAeS conferences.

On 28 November the RAeS hosted a one-day conference on harnessing innovation today for growth tomorrow. This was followed the next day by the one-day President’s Conference on the subject of technology in aerospace. The subjects covered in both events ranged over a wide area from the industry environment needed to encourage innovation growth while managing risk, through to predictions and ideas of how aircraft, spacecraft or manufacturing technology might develop in the future.

Some of the issues covered in both conferences, including future propulsion, 3D printing and new aircraft configurations, have already been described in Plane Speaking with Charles Champion, Executive VP, Engineering of Airbus (AEROSPACE, February 2017 p14) who was one of the speakers at the harnessing innovation conference. This conference also included presentations from the winners of the RAeS ‘Go for Gold’ challenge in which young people presented their ideas as to what engineering concepts or technological advances might shape the next 50 years of aerospace (a description of the competition and the prize winners is given on p 46 in the February 2017 issue of AEROSPACE).

Encouraging innovation

Innovation means taking risks. “There’s no business case for taking risks,” says Michael Christie, Strategy Director and Chief Technologist at BAE Systems Military Air & Information. “Is ‘the right answer’ more important than a quick answer? To innovate, you need a tolerance to failure, diversity rather than conformity.”
From the present to the future. Clockwise from top: military aircraft pilots are already using augmented reality helmets, Embraer automated wing assembly; wind-tunnel testing of model NASA ‘double bubble’ technology demonstrator, concept art for Bee-Plane detachable fuselage aircraft, concept art for future Dassault business jet.

“Long-term commitment and collaboration are the key to successful innovation,” declared Dr Graham Hillier, Director of Strategy and Futures, Centre for Process Innovation Limited (CPI). “Innovators can convert inventions into successful commercial businesses but it is a complex systematic process. If innovation is not focused on a market need (whether perceived or not) then it will fail. Innovation is a cash drain until it gets beyond innovation. To be successful, it needs the right people to come together, in the right place at the right time.”

“Change is the only constant,” said Chris Tarry FRaS, Chief Executive, CTAIRA. He highlighted a number of drivers which he thought would influence the future development of aerospace, including the growth of communication and e-commerce, increased automation, integrated systems and automated decision-taking.

Digital revolution

“Digital technology has been impacting industry in many ways for many years but the accelerating pace of change offers us the opportunity to transform our business,” said Alan Newby, Director, Aerospace Technology and Future Programmes, Rolls-Royce. “Digital technology now extends beyond the IT systems which connect us and is now creating new services for our customers, allowing us to automate our factories ever more effectively, taking us to a point where we can completely design products in a computer and allowing us to track products, spares and tooling and control them remotely. The key is not just the ability to collect and store data but in what we do with that data (the smart analytics) eg: taking preemptive action to avoid potential disruption further down the line and to keep the aircraft flying.”

Increased connectivity is also affecting aerospace manufacturing. "Manufacturing is changing!" declared Dr Rab Scott, Virtual Reality Manager, AMRC, University of Sheffield. "We are now in the fourth Industrial Revolution in which we see the integration of cyber with physical things. We have access to big data and the Internet of Things which enables us to enhance and augment products with new features and services.

Data challenges

However, there are still challenges to be overcome. "The majority of equipment in the supply chain is not connected and investment is needed to retrofit sensors to equipment," said Rab Scott. "Where we are generating data, there is a vast amount of information which needs to be handled and stored. We need to know how quickly the data is changing, what type of data it is (temperature, financial, power etc) and its variability (sample rate, scale and volume). We need to decide whether we store the data locally or on the cloud, what parts of it should be analysed (locally or globally) and how quickly do we analyse it. There is value in immediate data – if I have a sat-nav, I want to know about the traffic jam ahead now – not in ten minutes.

Intelligent aircraft

A number of speakers predicted how aircraft might evolve in the future. Bruno Stoufflet, Chief Technology Officer, Dassault Aviation, explained how future Falcon business jets will be fitted with more autonomous systems. "Automation is to be introduced in the four major pilot activities of aviate, manage, navigate and communicate," he said. The aim is increase levels of automation so that the aircraft can be more resilient and continue to perform in degraded modes.

Dr Donough Wilson, Innovation Lead, VIVID/ futureVision, Coventry University Technocentre, had even more radical proposals. "It is time to move away from 'outmoded legacy thinking' and 'dumb technology', he said. "The modern glass cockpit is just a copy of the old steam gauge cockpit where the instruments just provide information. What we need is active technology in which the aircraft becomes a co-participant in the process of flight with an interest in its own survival. The process of flight is a linear sequential progression and the data for all airline routes are known with defined boundaries and rules. Accidents happen outside those boundaries. Modern aircraft are equipped with navigation requirements, required flight performance, safety limits and optimum terrain clearance, so that the systems know the exact performance the aircraft should be delivering for every phase of the flight. If an accident is about to happen, it is not the pilot but the sensors and systems aboard an aircraft that know what the true position is and its potential fatal consequences. It's the pilot's brain that is the weak point in the control process. Pilots are human and are affected by emotions and fear – it is the pilot that crashes the aircraft."

IT IS TIME TO MOVE AWAY FROM ‘OUTMODED LEGACY THINKING’ AND ‘DUMB TECHNOLOGY’

Donough Wilson
Innovation Lead, VIVID/ futureVision, Coventry University Technocentre
AEROSPACE

RAeS innovation conferences report

Go for Gold speaker Ricardo Ferreira da Silva also had an idea for making flying simpler with the Common Cockpit Project in which pilots would use augmented reality glasses to fly aircraft. By using the special glasses, a pilot could fly different aircraft without any additional type training. The augmented reality glasses would be linked to an avionic hub containing sensors for all essential information flight information and GPS location.

“Cockpits can be made simpler,” agreed Donough Wilson but added the suggestion that: “Information can be displayed straight onto the windscreen which is a more effective method than using night vision goggles.”

Intermodal aircraft

Three of the Go for Gold winners had proposals involving new concepts for loading and unloading aircraft. Chun Hang Cho put forward the idea of the ‘Plane-Ferry’ or ‘Perry’ which would reduce boarding times by loading passengers and all their luggage into three self-driving coaches at the terminal which would then go inside the fuselage of the aircraft. The passengers would then remain on the coaches during flight (similar to vehicles using the Channel Tunnel). Cho suggested that each coach could carry over 100 passengers with their own cabin crew and have virtual windows to provide a view during flight. In the event of an in-flight emergency, the coaches could be ejected from the aircraft and fitted with their own flight data recorders and beacons.

The concept of an ‘intermodal freight transport’ approach to loading and unloading passengers was also explored by Jorge Van Looy and Alvaro Echavarri with their ‘EverPlane’ system. In this case, the passengers would be seated inside a detachable fuselage which would part from the aircraft after landing and then run on rails to the terminal. Meanwhile, a new loaded fuselage (complete with fuel which could be pumped out into the wings later) would come from the terminal and be attached to the aircraft ready to return to the runway for the next flight. Looy and Echavarri estimated that low-cost carriers operating a series of short flights during the day could use the EverPlane system to gain an additional eight hours in the air. They also suggested that the fuselages could be customised for different passenger classes or for cargo.

A third idea for improving airport efficiency came from Sebastiaan Menger with his ‘AirFlow Airport’ concept in which the interior of airports are designed to make it more intuitive for passengers to know which direction to go including inclined floors in passport control and level floors in retail areas. There would also be multi-zone runways and turntable-like aircraft parking stands where aircraft could be turned round so that they are always facing in the direction of travel.

There have been a number of ideas put forward for aircraft with a detachable cabin, one of which comes from Airbus which has filed a patent for a ‘virtual window’ detachable cabin module that could board passengers at an airport docking station and then be attached to the rest of the aircraft.

Several companies are developing augmented reality glasses for civil aircraft, including Aero Glass which produces ‘smart glasses’ for GA pilots which projects additional information to the pilot on terrain, navigation, traffic, instruments, weather and safety procedures.

3D printing in zero-gravity has already been tested aboard the International Space Station. Here, a 3D printer is tested by NASA in a zero-G aircraft prior to being taken to the ISS.
Testing technology

Fay Collier, Associate Director for Flight Strategy, Integrated Aviation Systems Program, NASA Langley Research Center, looked at how NASA was flying or wind-tunnel testing small technology demonstrators to accelerating the introduction of new technology to commercial aircraft. The aims of the demonstrators are to achieve noise, emission and fuel burn reduction targets to further mature technology developed in other projects and to help prepare NASA for potential future X-Plane programmes.

NASA has awarded five contracts to define X-Plane system requirements, consisting of the Double Bubble (Aurora), Tail-less Blended Wing Body (BWB) (Boeing), Transonic Trussed Braced Wing (Boeing), BWB Super Regional Jet (DZYNE) and Hybrid Wing Body (Tail) (Lockheed Martin).

Flying by laser

Go for Gold speakers Arava Anmol Manohar and Ritvik Anand described a future in which aircraft would not require kerosene engines but could be powered by ‘e-viation’ laser beams generated by renewable energy (a technology that has already been proved – see top right image). Each aircraft would be fitted with photo-electric cells which would convert the energy from the lasers into electricity which would drive the aircraft’s motors. “E-viation would have the advantage that aircraft could fly for any distance without the need to carry fuel and thus drastically increase payload,” explained Manohar and Anand. “Lasers could also power a wide range of different-sized aircraft, from electric VTOL taxis to solar airships.”

The power for the laser could be generated from a network of ground-based power stations but Manohar and Anand suggested that the lasers could also be transmitted from space through a constellation of satellites which would generate the electricity from solar energy. They considered that fewer than 100 satellites in multiple altitudes would be needed. This space-based solar power grid, would then transmit the energy to a network of aircraft flying in their vicinity. Each HAV would be travelling endlessly along a set route and could additionally be used to transport cargo or to reroute surplus energy from large cities to remote rural villages. The lasers could also be used to power other forms of transport.

At present, the technology needed to enable such a system does not exist but advances in laser technology which increased their efficiency from 5% at present to their theoretical maximum of 50% could make it possible. There are also a number of other problems which would also need to be resolved, such as the potential harmful effects of the lasers, the effect of cloud, fog or bad weather on transmission and what would happen to the aircraft should the laser power fail – Manohar and Anand suggested that aircraft carry enough onboard energy to enable them to cope with emergency scenarios.

Building in space

Moving beyond Earth orbit, two Go for Gold presenters looked at how engineering and manufacturing for space projects might be developed in zero gravity. Joshua Perkins described his vision for the Robotic Additive Manufacturing Automated Space Station for the Expansion of Science (RAMASSES) which proposed a switch from Earth-based subtractive manufacturing to orbital additive manufacturing. Once established, the robotic additive manufacturing space facilities could use materials from asteroid mining or recycled space junk to construct space ships and drive systems which could be used for missions to other planets within the Solar System and beyond.

Sophie Harker also had a concept based on manufacturing in space, except that her idea was to send nanobots into space which could then work together like termites to create a particular structure. The nanobots would initially be held together with electromagnets but would have a shell which allowed them to lock into different shapes. The structure or shape required would be determined following an algorithm. By transmitting a new algorithm to the nanobots, they could then rebuild into new shapes. This could enable the remote construction of space vehicles, space hotels or even entire space colonies around the Earth and the Moon. Because of their ability to create different shapes, the nanobots could be used to create different configurations for space vehicles depending on circumstances. A planetary rover could be morphed into a heat shield during landing and then change into a shape more suitable for data collection. The nanobots could also conduct in transit repairs if the spacecraft was damaged.

Readers of the future take note – you heard it here first!

Researchers at NASA and the University of Alabama have flown a small-scale aircraft that flies by means of propulsive power from an invisible, ground-based infrared laser.
A year after the introduction of new CAA ‘E Conditions’ designed to encourage the development of experimental light aircraft, the RAeS held a conference to see how well the new rules are working. 

BILL READ FRAeS reports.

In November 2015, the UK Civil Aviation Authority (CAA) launched new simpler requirements for the initial testing of small experimental aircraft. The new ‘E conditions’ allow aircraft designers to flight test new and modified concept aircraft up to a maximum take-off mass of 2,000kg without having to go through the full procedures previously required to get a new design past the initial stage of proof-of-concept prototype. If the design is then thought to be viable, then the aircraft can go through the full certification process.

In November 2016, the RAeS General Aviation Group (GAG) organised a one-day Light Aircraft Design conference to review the experience of the regulations and whether they were benefitting new aircraft projects.

Manufacture and testing

A number of speakers looked at the subject of aircraft design and manufacturing. David Lunn and Ross Campbell from aero and mechanical engineering company FineUnit described the challenges faced when designing fuselages from composites. One of the problems when using composites is that they don't have the same mechanical characteristics in every direction as traditional materials. It also takes time for new composites to be tested and manufacturers aren't always keen on publicising the results of these tests because of protecting intellectual property rights. This results in aircraft manufacturers having to conduct consecutive and costly test programmes.

In an attempt to solve this problem, the US has created the National Centre for Advanced Materials Performance (NCAMP) which maintains a shared database of fully qualified material systems that will be freely available to the public (http://www.niar.wichita.edu/coe/ncamp.asp). Both the Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA) accept composite specification and design values developed using the NCAMP process. “This enables manufacturers to gain certification by using a shorter equivalency test programme, instead of having to conduct a full qualification programme,” said Campbell. “This opens the door for smaller companies which may have been put off using composites because of the costs and time involved.”

David Lunn described how the position of the frames and the skin size for the fuselage could be determined using estimates of shear force and bending movements that the aircraft was likely to...
which was constructing a replica of a Ferguson 1911 Monoplane. “This was an ideal candidate for E Conditions as it was uncertifiable by any other rules,” he said. “For example, the aerofoil was the same shape at the leading edge and the trailing edge which made it very difficult to determine where the centre-of-gravity should be. We had to add 50kg of lead under the engine to balance it out. There were also holes bored in the wing struts for control cables and we had to test whether they were safe. The aircraft was only flown once with the requirement that there were no pilot-induced turns and that it was only flown in straight lines within the airfield boundary.”

Ellin also worked on a re-engined 1939 Aeronca Chief high wing monoplane, commenting: “This modification was probably less appropriate for E Conditions, as there was no doubt that the new engine was going to be an improvement. E Conditions are most useful when you don’t know if what you are testing will be a success.”

experience. Once the frame positions had been determined, then the position of the undercarriage, seats and other components can be decided.

Additional generalised finite element methods (GFEM) are used to determine the density of the frames and skin based on the expected loading of the fuselage allowing for the engine, controls and pilot. GFEM can also determine where certain areas may need to be reinforced to avoid buckling or to support loads both when the aircraft is static or being subjected to additional forces in flight.

Meanwhile, Joshua McGovern from aircraft design and manufacturing specialists Swift Aircraft explained about the stability and control (S&C) characteristics of light aircraft. McGovern explained how Swift designed aircraft using a computational fluid dynamics (CFD) spreadsheet tool and how S&C characteristics were tested using a combination of experimental wind-tunnel tests, semi-empirical and computational methods.

Phil Spiers from the Advanced Manufacturing Research Centre, described how the AMRC had helped with fatigue testing of the UK-designed GB1 Gamebird aerobatic aircraft using a specially built test rig which can be lifted and rotated at different angles.

**Electric potential**

Several speakers focused on the future potential of electric or hybrid-electric light aircraft (see also Bright sparks on p 14). Dr Paul Robertson from the University of Cambridge looked at the design considerations for using such aircraft while Howard Torode from the GA Group and Chairman of the BGA Technical Committee talked about how the aerodynamic efficiency of light aircraft designs could be enhanced through lessons learned from glider designs.

**Europe to ease regulations?**

EASA is working on a GA Roadmap Project to introduce flexibility and simplification in Part-21 certification, details of which were explained by Dominique Roland. “The current rules and culture are only suitable for large organisations and aircraft,” he explained. EASA is proposing a new Part-21L for light aircraft which would require product audits rather than process audits to make the regulations more workable for smaller companies.

**Getting the right E Conditions**

Dr Alex Ellin, Principal Lecturer in Aerospace Engineering at Teesside University described the experience of being the competent person required by the E Conditions regulations to underwrite activities. In 2016 Ellin was asked to be the competent person for BBC Northern Ireland which was constructing a replica of a Ferguson 1911 Monoplane. “This was an ideal candidate for E Conditions as it was uncertifiable by any other rules,” he said. “For example, the aerofoil was the same shape at the leading edge and the trailing edge which made it very difficult to determine where the centre-of-gravity should be. We had to add 50kg of lead under the engine to balance it out. There were also holes bored in the wing struts for control cables and we had to test whether they were safe. The aircraft was only flown once with the requirement that there were no pilot-induced turns and that it was only flown in straight lines within the airfield boundary.”

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Established as a key event in the social calendar of the aviation and aerospace community, the Royal Aeronautical Society Annual Banquet attracts high level industry attendance and offers the ideal opportunity for networking and corporate entertainment.

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

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

Programme
Reception: 7.15pm
Dinner: 8.00pm

What's included?
This black tie event includes a pre-dinner networking reception followed by an exquisite four-course dinner with fine wines and coffee.

Enquiries to:
Gail Ward, Events Manager – Corporate & Society
Royal Aeronautical Society
T: +44 (0)1491 629 912 / E: gail.ward@aerosociety.com

www.aerosociety.com/banquet
Afterburner

www.aerosociety.com

Diary

16 March

Inaugural Nottingham Branch Lecture

Airbus A350 XWB: Achievements of the Modern Digital Age

Gordon McConnell

42 Message from RAeS

- President

“Last month I summarised some of the challenges faced by the Society internationally. Many of these, unsurprisingly, are the same as those faced by UK Branches, and also emerged from the review of membership commissioned by then-President Bill Tyack in 2014.”

- Chief Executive

“Early in the month we will be welcoming some of our newly elected Fellows to the Society, which is always a wonderful opportunity to engage with professionals across the industry and invite active participation in the Society’s activities.”

44 Book Reviews

Upon a Trailing Edge, Oswald Boelcke, Will Sustainability Fly? and Miles Aircraft – The Post-War Years.

47 Pakistan Division

2016 was a busy year for the Pakistan Division, with a number of special events held to increase the profile of the Society in Pakistan.

48 Weybridge Branch

John Gough describes the quest for a flyable spacecraft which started with a German project in 1936.

50 New Corporate Partners

Seven new companies join the Society’s Corporate Partner Scheme.

52 Diary

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

55 Obituaries

Martyn Pressnell, Colin Torkington and a memorial to former astronaut Gene Cernan.
Unsurprisingly, the list of digital opportunities remains long, with support for remote attendance at meetings a priority, followed by assistance to our Branch network to make the most of the Society’s website and social media outlets.

A theme which has been popular in previous membership reviews and questionnaires is the ‘value for money’ question, also known as ‘what’s in it for me?’ I’m going to delight you by opining that this question is meaningless in the context of a professional and learned society: the benefits of joining accrue to the existing membership as much as to the new joiner; likewise, most of the value to a new member lies in the quality of the community he or she is joining. Yes, ‘the Society’ provides (excellent) services to members but in my view this isn’t really the principal selling point, which is about the peer-to-peer value of membership. Worse, focusing too much on the ‘value for money’ question at HQ distracts us from nurturing that peer-to-peer activity, for example in developing the relationships between our Corporate Partners and their local Branches, so that each can provide opportunities and support for the other.

Just before I started this piece, I was reflecting on how different each topic was from month to month. Now, of course, I realise that the upshot of both the membership and the international strategy reviews is that the Society has to innovate in the way it interacts with members and delegates activities to Branches and Divisions/Regions. Of course, this remains long, with support for remote attendance at meetings a priority, followed by assistance to our Branch network to make the most of the Society’s website and social media outlets.

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RAeS Council Elections are now open!

The Society's Elections are being conducted electronically, hosted by mi-voice. All voting members who have an email address registered with the Society should have received an email which contains your unique voting number and instruction on how to cast your votes. If you have not received an email or you do not have a valid email address registered with the Society, please call mi-voice on +44 (0)2380 763 987 or email support@mi-voice.com.

Please note that any member who has not paid their membership subscription by 31 March 2017 will be taken off the membership register and will therefore be unable to vote. The Society encourages you to update your membership to enable you to participate in the voting process and have your say on who is elected to Council.

The Society's Council is responsible for managing the professional, technical and learned affairs of the Society and provides the necessary direction and leadership required to achieve several key objectives, such as increasing and maintaining the influence, respect and reputation of the Society globally. For the Council to successfully carry out this objective it is vital that it is made up of the most suitable individuals – which is why your vote is so important.

As well as its ex officio members, there are 18 elected members on the Council, as a voting member, you really do have the opportunity to influence the way the Society is run through your voting options.

Voting will close at 9am BST on 11 May 2017, the same day as the Annual General Meeting.

If you have any queries or have not received the voting email, please call mi-voice on +44 (0)2380 763 987 or email support@mi-voice.com.

2017 Candidates

Miss Hilary Barton BSc(Hons) CEng FRAeS AFIMA
Mr Martin Broadhurst OBE MA CDir FIoD FRAeS
Mr David Chinn BSc(Hons) CEng MIET MIOD MAPM ACIL FRAeS
Mr Geoffrey Clarkson CEng FRAeS
Mr Chris Daniels MA (Oxon) MBA FRGS
Mr Michael Goulette FRAeS FIMMM FREng
Mr Ian Middleton BA(Hons) MBA FRAeS
Mr Howard Nye FRAeS
Air Commodore (Retd) Peter Round BSc(Hons) MA FRAeS
Mr Philip Spiers BEng(Hons) CEng FRAeS
Dr Robert Winn FRAeS

Thank you for taking the time to vote in the 2017 Council Elections
Risk, the Heart and the Air Pilot
By M Joy


This is an unusual autobiography. It is among other things, a collection of recollections, some relevant to the story line, some completely out of place. I have known the author all the time he was working as a cardiologist and through others about his love of flying.

In some parts the author treats the reader as though they know nothing and he explains all. In other parts, he seems to assume we know as much as he does, which of course we do not. The Bayesian theorem of conditional probability, has got many of us into intellectual trouble in the past, so in places this is not the easiest book to read, or to follow.

The author without doubt and some voracity, lets us know that he is a pilot, that he has owned a number of aircraft and that he is an aviation enthusiast. That does not, however, make him an expert. Because of the unique position he held as the Cardiologist to the UK CAA, he has been privy to much inside information, not always available to the general aviation public. He is of course perfectly entitled to his opinion using this information but he often strays into territory belonging to others, who are far better qualified to comment. Accident analysis, for example, is a very complex field.

I am not sure who the target audience is for this 320-page book, as there is too much of everything by way of information packets, both historical and factual, flying and non-flying, many of which have little if anything to do with, or follow the biographical time line. Just when the author starts to describe something that might be interesting, he deviates and the interest is lost. It is a memoir of stops and starts, it never flows.

He refers to and discusses many people he has met personally, some in considerable depth. There are of course many others, just as important, without whom we could not have arrived rightly or wrongly where we are today, in which ever aviation arena the author discusses. His arguments could therefore be seen as unbalanced, and might be construed by others, as inaccurate but interesting, but sadly not stimulating.

If you make statements, you have to prove them, carry the reader with you, and convince the reader that you really know what you are talking about. I am still waiting to be convinced.

Dr Ian Perry
FRAeS

OSWALD BOELCKE

Germany’s First Fighter Ace and Father of Air Combat
By R G Head


This is the first biography of the originator of fighter combat written in English and the first since the English translation of Johannes Werner’s Knight of Germany: Oswald Boelcke German Ace (John Hamilton Limited. 1933). It has the added bonus of being written by a former fighter pilot.

As well as the usual biographical material, the author covers the early years of air warfare and Boelcke’s influence on its later development. Unfortunately, it is rather a difficult book to read. It does not flow. This is not really the fault of the author but rather of the publisher. Poor editing or no editing is all too common these days. It is divided into chapters which are further subdivided into mini chapters with headings, some of which follow on from one to another, some of which do not. Within the chapters and some sub-chapters some paragraphs relate to the heading, others do not. There is also repetition. For example, there is some technical information on the Albatros in the body of the work as well as an appendix on the same subject. This is surprising as the author thanks his editors in the acknowledgements (printed after the prologue, unusually). Actual errors are few but Albert Ball was not shot down by Lothar von Richthofen, and Arch Whitehouse was not a 16-victory ace. The Pour le Mérite is not the equivalent of the VC or CMO.

If this book had been read through in its entirety and some minor adjustments made it would have been twice as good. Nonetheless, it is a complete, well-researched biography and contains all the available information on Boelcke. As such it will be of interest to all aficionados of Great War aviation.

The book has a number of appendices including Boelcke’s victories and the record of Jasta Boelcke, and four views on aerial tactics including that of Erich Hartmann – ‘See, Decide, Attack, Coffee Break’. It is illustrated throughout with photographs, albeit rather small ones.

The author without doubt and some voracity, lets us know that he is a pilot, that he has owned a number of aircraft and that he is an aviation enthusiast.

Christian Busby
Aviation Fuel Options in a Low-Carbon World

By W J Palmer

Plenty of words have been written about the environmental impact of air transport – especially the noise and pollution that aircraft and airports generate. Increasingly, we are also confronting the effects of air transport on climate and of the immense difficulty of reconciling the enormous economic and social importance of aviation with the equally critical task of avoiding climate chaos.

In the large literature on these subjects, few books take us much closer to a solution to this dilemma. In *Will Sustainability Fly?*, Walter J Palmer, a retired airline pilot, airline manager and climate specialist, does just that: he takes us a few degrees closer to a navigable path through these complex issues. An attractive, clear, knowledgeable and detailed account of ‘low-carbon’ options for aviation fuels and this is a book that has the potential to make a difference to current and future air transport operations. The book’s goal is an ambitious one: to show how jet fuel can be made without using fossil-source materials and to advocate for policies that could make this the norm across the industry. In doing so, the author is attempting to convey ‘a more complete vision of sustainability’ than renewable fuels have traditionally conjured.

The book explains succinctly – and convincingly – why air transport needs to find low-carbon fuel options, and fast. Aviation is a carbon-intensive service; it has evolved in the art of burning kerosene, using now-mature technology, to extraordinarily high levels of safety, utility and efficiency. Kerosene is almost the perfect fuel for aviation – except that its use is now changing the properties of the atmosphere itself in ways that we are only beginning to comprehend. The book examines ways in which the concentrated chemical energy of kerosene can be obtained without damaging the climate system and it also considers the barriers to change that currently stop us from doing so. Covering both technical and political/economic aspects of the problem, the book deals deftly with the possibilities for creating biofuels but also with the practical and ethical issues that arise when we try to trade ‘food for fuel’.

While dealing professionally with the current technologies for generating biofuel, the book also points towards broader, philosophical questions about ecological justice and what we might owe to the future. It is a well-researched and well-written book and it contributes to the important dialogue about how we can fly without changing our planet irrevocably.

Dr Ben Daley
Lecturer in Environmental Management
Centre for Development, Environment and Policy
School of Oriental and African Studies (SOAS)
MILES AIRCRAFT – THE POST-WAR YEARS

Reading and Newtownards 1945-1948
By P Amos


The information in this Volume 3 is poignant as the very sad story of betrayal, political manoeuvring and downright shenanigans is outlined in detail. However, the sheer brilliance of the Miles team shines through. Peter Amos details the story, many stories actually, in a fascinating manner, and the book is illustrated immaculately.

Of a similar size and quality to Volumes 1 and 2 the information contained in all three is invaluable to historians, political writers, engineers, lecturers and aviators, in fact no one can fail to be enthralled. The book covers the period from 1945 to 1948. Not long, one would think, but long enough for the most dramatic, heart-wrenching events to take place.

The types actually designed, constructed and/or flown during these three years included the M.38 Messenger, M.65 Gemini, M.57 Aerovan, the Merchantman, the M.28, M.68 and so on, while designs went ahead, not only aircraft but ancillary equipment and so on. One can hardly believe that this short time could also include the Southern Martlet flying again and the construction of the Miles M.60 Marathon airliner.

In three short years such innovations as self-locking nuts and electric actuators were only two of Miles’ inventions/developments that flooded out of Woodley and such futuristic ideas of anti-gravity, boundary-layer research and even the mundane saving of waste wood, really practical as well as theoretical ideas.

Early in 1945 Walter Capley, one of Miles most advanced thinkers as well as a skilled pilot and engineer, was killed flight testing a Spitfire at Woodley. This, not only a personal tragedy as he was an inspirational thinker and very attractive man, seemed to affect not only the staff but somehow set back a lot of innovation and advanced ideas in which he was involved. It was almost a turning point. However, life went on. George Miles designed and flew the prototype aircraft – Aerovan, the Merchantman, M.28 and M.68 – with great skill.

The Miles Martin Pen company was part of the post-war diversification of the Miles Aircraft Company. The ‘Biro’ ball point pen was a really new invention and the early ones were horribly expensive! The Aerovan flew to Switzerland loaded with them. Like many of Miles’ ideas and inventions, the potential was great but profits were sadly undermined by many factors. I do remember as late as 1947 being given prototype red Biros at Miles Aeronautical School to test and assess, they were horrible all blotches and faint.

It is very difficult to read this book without being astonished at not only futuristic projects, such as advanced supersonic flight and the contrast of the Hogg Report and what really looked like a medieval witch hunt. It is impossible in a few words to describe the scope of this book, there is also a disk included containing appendices. All in all an enlightening and a really interesting, fascinating volume.

Jean M Fostekew
Pakistan Division flies high

2016 was a busy year for the Pakistan Division, with a number of special events held to increase the profile of the Society in Pakistan, including a high-quality lecture programme:

In February, the Chief of the Air Staff of the Pakistan Air Force, ACM Sohail Aman HI(M) FRAeS, was the chief guest at a day-long Aviation Seminar held at the country’s Air War College at Karachi. The seminar, entitled ‘Aeronautics – Historical Perspective, Present and Future’ was well-attended by both young and old, included four papers presented by eminent aviation specialists from Pakistan on current topics of interest and concluded with an hour-long discussion moderated by the Divisional President, AM Salim Arshad FRAeS.

March and April saw two absorbing lectures on Space Technology and its Applications delivered by Air Cdre Arshad Siraj FRAeS, a former Head of R&D at Surface and Upper Atmosphere Research Commission (SUPARCO) of Pakistan.

Three more lectures on Aircraft Accident Investigation, Human Factors and Risk Management were delivered by learned professionals in April, May and August respectively.

The Pakistan Division participated in an Aviation Expo in Karachi in September which drew a large group of young enthusiasts.

In October, a field trip for school children to the PAF Museum was arranged by legendary airline pilot, Capt Johnny Sadiq, and was a great hit.

The Pakistan Division Council also used the sesquicentenary celebrations to launch an ambitious development programme, enrolling two new corporate partners, the Pakistan Air Force (PAF) and the Pakistan Aeronautical Complex (PAC), and launching two new Branches: at Kamra, home to the PAC, in October 2016; and at Islamabad in November 2016.

The latter was officially opened by Prof Chris Atkin, who was warmly welcomed by the Division in the middle of November, along with Richard Meredith-Hardy who amused and enthused a number of audiences with his account of flying a microlight over Mount Everest in 2004. The pair took in a variety of functions aimed at raising the profile of the Society in Pakistan, starting with the 150th Anniversary Dinner in Karachi, during which both the RAeS President and the Chief of the Air Staff, PAF, emphasised the important role of the RAeS in creating a community in Pakistan around aerospace education, knowledge exchange, and standards. The RAeS delegation then moved north to visit the Pakistan Aeronautical Complex at Kamra and the Pakistan Air Force Academy at Risalpur, also taking in the sights of Islamabad and the hospitality offered there by the PAF Officers’ Mess (having earlier enjoyed the wonderful atmosphere of the Sind Club in Karachi). The busy programme ran very smoothly and was a credit to the organising Divisional Council. The UK visitors were admirably looked after, also coming away with numerous mementoes from their visit!

Overall the recent efforts of the Pakistan Divisional Council (www.raes.org.pk/about.html) are to be highly commended. Not content with the achievements of 2016, the Division has a full calendar of events for 2017 while providing guidance for the newly-formed Branches and the newly-registered Corporate Partners. At the same time the Division hopes to launch two further Branches and to bring two more Corporate Partners into the RAeS fold.
WEYBRIDGE BRANCH

The Quest for a Flyable Spacecraft

On 1 February John Gough, formerly, among many other things, an aerodynamicist at Hawker Siddeley Kingston and currently the Weybridge Branch treasurer, talked to the Branch about the development of manned spacecraft. The objective of the programmes was to devise a piloted vehicle that would self-launch into orbit and return safely.

As background, John explained the theory of orbital mechanics covering Kepler’s laws concerning orbit shapes and sizes and planetary movement. Trajectories are described by conic sections from circles to hyperbolae. Moving on to propulsion, liquid-fuel rocket motors were the solution as these were, unlike solid fuel boosters, controllable. Some basic propulsion theory was then explained, including Tsiolkovsky’s equation which related the mass at take-off to the mass at burn-out.

The pioneer of flyable spacecraft was Austrian aerospace engineer Eugen Sanger who, in 1936, under Nazi sponsorship, conceived a rocket powered winged space plane, the ‘Silbervogel’ (Silver Bird). Using a rocket sled the Silbervogel was to be boosted along a 3km launch track to 500mph, after which it would climb out on its own rocket power to sub-orbital altitude. Range would be increased by skipping into and out of the atmosphere. Final re-entry would utilise the flat under-surfaces to slow the craft for a piloted landing. This ‘Amerika bomber’ was to fly from Germany, across the US to drop an 8,800lb bomb then continue across the Pacific to land in Japanese controlled territory after a 19,000-mile journey. The project was cancelled in 1942.

Considering the re-entry problem John compared pointed and blunt noses. Shock waves attach to a pointed nose causing severe local heating whereas the blunt nose creates a detached shock wave where dissociation and ionisation results in much lower local temperatures. This characteristic was the theory behind the blunt heat shields of NASA’s Mercury, Gemini and Apollo vehicles. A shortcoming of these vehicles was that the re-entry was uncontrolled with the final imprecise soft landing in the Pacific achieved using parachutes. This was a very expensive procedure. Mercury needed a flotilla of 23 ships to ensure a successful recovery, so NASA aimed for runway landings for the two-seat Gemini.

Options considered were parachutes, crew ejection, paragliders, parasails, and lifting body wingless capsules. Flight tests were carried out with the Gemini capsule suspended from a self-inflating flexible wing devised in 1948 by NASA engineer Francis Rogallo and his wife Gertrude. However, development problems caused a return to parachute systems for Gemini and Apollo.

The Dyna-Soar reusable spacecraft concept was developed from the Silbervogel in 1950 by Walter Dornberger, ex head of the Nazi experimental establishment at Peenemunde, who was working at the Bell aircraft company. However, the development contract went to Boeing as the X-20. The vehicle was single seat, flat bottomed and delta winged with turned up tip fins. It had its own two-stage rocket system and would be launched into orbit mounted on the nose of a two-stage Titan 3 with two strap-on boosters. In orbit both the X-20’s rocket stages would be utilised and jettisoned before re-entry and glide landing on a runway. Delays with Titan development caused the project to be cancelled in 1963.

In the 1960s and 70s NASA flight tested a number of lifting body vehicles with a view to developing a reusable spacecraft. The M2-F1 single-seat glider, built at NASA Dryden, was flight tested from 1963, initially being towed by a car and then by a C-47. It was a wingless, blunt nosed narrow delta with a flat topped and round bottomed cross section and two ‘tip’ fins. The Northrop M2-F2, similar to the F-1 in configuration but powered by an XLR-11 rocket motor and air launched from a B-52, was flight tested from 1966. However, it crashed on its 16th gliding flight before powered flight had
been achieved. The F-2 was rebuilt as the M2-F3 with a third central fin added which cured stability problems encountered on the F-2. From 1970 the F-3 made 27 B-52 air-launched flights achieving 1.6M and 71,500ft. The Northrop HL-10 was a blunt nosed, single seat, narrow delta, blended wing-body design of elliptical cross section with ‘tip’ and central fins. Again powered by an XLR-11 rocket motor it made 37 flights from 1966 achieving 1.86M and 90,030ft. The Martin X-23 was a small (6ft 9in long), pilot-less test vehicle, not unlike the HL-10 but with two fins. Two examples made three flights launched by Atlas ICBM to investigate re-entry conditions, including manoeuvring, at up to 25M. It was covered in ablative material. The Martin X-24A was similar to the HL-10 and flew from 1970 powered by an XLR-11 and launched from a B-52. In 28 flights it reached 1.6M and 70,950ft. The X-24A was converted to the X-24B with a semi-circular fuselage with a flat under surface, long pointed nose, narrow double delta wings and ‘tip’ fins. Precision runway landings were demonstrated and 1.76M and 74,130ft achieved in 36 flights from 1963. The vehicle was retired in 1975 having paved the way for the Space Shuttle.

The Space Transportation System (STS) which included the reusable Space Shuttle benefited from the availability of CFD software and improved materials. Its $L/D$ of 2 was double that of earlier lifting bodies. Rockwell International was awarded the contract for the Shuttle in 1972 which had a 122ft long rectangular cross section body with a semi-circular top, a blunt nose, thick double delta wings and a single fin. The undersides were clad with thermal tiles for re-entry protection. It was powered by three SRS-25 launch rocket motors and two orbital manoeuvring system engines. For vertical launch it carried a jettisonable fuel tank and two reusable solid booster rockets. Crews varied from five to seven. Dead-stick runway landings were made at Cape Canaveral or Edwards Air Force Base. Initial glide launches were from on top of an adapted Boeing 747 in 1977. The B747 was later used to transport the Shuttles between bases. The six Shuttles flew 135 missions in 30 years of service. One was lost during launch and one during re-entry.

The lecture concluded with the next project, the Rockwell X-30, hypersonic, air breathing, single stage to orbit demonstrator; the National Aero Space Plane. Despite progress in the structural and propulsion (scramjet) fields the project was terminated in 1993.

After a question and answer session the vote of thanks was given by Alan Simmons.

Chris Farara
Weybridge Branch
NEW PARTNERS

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

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Jess Putt, I&C Marketing Manager

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W www.think.aero

**Contact**
Martin Wise, Business Development Manager

Think Research is a successful and independent ATM and Airports consultancy providing expertise and insight to deliver performance improvement through concept development, validation and implementation. Think is based in the UK, with an international customer base. Think staff come from a range of technical and operational backgrounds including engineers, analysts, air traffic controllers and pilots. Think combines its unique skills with industry leading expertise in: validation, concept development, real time simulation, fast time simulation, analytics, safety, modelling and human factors. We have a proven track record and reputation having worked on some of the world’s biggest ATM projects with some of the world’s biggest ATM Stakeholders.

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Traxxall is the most advanced maintenance tracking system available today. We elevate aircraft maintenance tracking to a whole new standard. An innovative system, Traxxall was created to bring new levels of accuracy, efficiency and service to aircraft maintenance tracking. As an aircraft maintenance tracking service, our sole focus is helping aircraft owners and operators keep their aircraft flying safely, reliably and on schedule. Traxxall meets the needs of any make and model of turbofan, turboprop or piston aircraft, both fixed and rotary wing.

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W www.smartskynetworks.com

**Contact**
Bruce Holmes, Vice President and Executive Director

SmartSky Networks is launching the United States’ first airborne 4G air-to-ground (ATG) network later this year with full nationwide coverage slated for 2017. SmartSky’s patented spectrum-reuse technology leverages 60 MHz of spectrum and beamforming to provide more than ten times the typical speed and capacity of the current industry standard ATG network. With system hardware designed for multiple frequencies, SmartSky is positioned to expand internationally in the future where different frequency bands might be required.
EVENTS

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

Wednesday 22 March 2017 / London
Means of Ascent – Securing the Future of the UK Aerospace Industry
Corporate Partner Briefing by Colin Smith CBE HonFRAeS, Chair, Aerospace Growth Partnership (AGP)
Sponsor:

Thursday 11 May 2017 / London
Annual Banquet
Corporate tables and individual tickets available
Lead sponsor:

Tuesday 23 May 2017 / London
Corporate Partner Briefing
Nigel Stein, Chief Executive, GKN plc

Tuesday 6 June 2017 / London
Corporate Partner Parliamentary Reception
House of Commons, Westminster, London SW1A at 18.30 hrs

Wednesday 5 July 2017 / Frilford Heath, Oxfordshire
Aerospace Golf Day

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

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W www.sea.co.uk

Contact
Abi Blanche-Martin, Marketing

SEA Air Systems (formally SCS) provides expert advice and services to public and private sector customers in the defence markets. SEA has considerable expertise across a broad range of delivery areas, including safety and regulatory, training, complex systems and engineering support.

Primarily SEA provides technical support services to the Defence Equipment and Support Organisation, building an extensive corporate knowledge of air platform designs at both the whole aircraft and sub-system level, Continued and Continuing Airworthiness, Production and Sustainment Policy, Process, Procedure, People and Products, delivered by suitably qualified and experienced persons.

The key strengths for SEA Air Systems lie in Independent Technical Evaluation and Aircraft Certification, while the wider SEA portfolio includes air wake modelling, helicopter vibration monitoring and aviation training simulators for flight deck operations.

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Contact
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**EVENTS**

8 March
Fly the Flag, and Tailor the Aircraft – the political history of the VC10 and Trident
Prof Keith Hayward
Historical Group Lecture

15 March
Aviation Safety: Much is Done, Much to Do
Margaret Gilligan, Associate Administrator for Aviation Safety, Federal Aviation Administration

22 March
A Risk-Based Approach to RPAS Operations
UAS Group Seminar

5 April
New Materials, Structures and Manufacturing Methods for Aerospace Use
Structures and Materials Group Conference
Sheffield Advanced Manufacturing Research Centre

20 April
Alan Bristow Lecture: Unmanned Aircraft Systems (UAS) – How Sky-Futures and Bristow are shaping a new era of industrial aviation
Jonathan Bailiff, President and CEO, Bristow Group; James Harrison, Co-founder and CEO, Sky-Futures; Nick Rogers, Co-founder/Chief Regulatory and Training Officer (CROTO), Sky-Futures and Ben Daniel, Training and Development Manager, Bristow Aerial Solutions

Rotorcraft Group Named Lecture

24-25 April
The Architecture of Air Travel – Designing for Human Behaviour
Air Transport Group Conference

25 April
Time to Rethink Business Aviation?
Networking Event

9 May
Staying Alert: Managing Fatigue in Maintenance
Human Factors Group Conference
 Cranfield University

11 May
RAeS AGM and Annual Banquet

16 May
F-35B Initial Ski Jump Testing
Gordon Stewart, Principal Engineer, Flight Physics, QinetiQ

12 June
Sir Sydney Camm Lecture: Multi-Domain Warfare in the 21st Century
General Sir Gordon Messenger, Vice Chief of the Defence Staff Named Lecture

**LECTURES**

ADELAIDE
University of South Australia, Building MM 1-05, Mawson Lakes Boulevard, Mawson Lakes, 5.45pm
8 March — Branch AGM followed by lecture.

BEDFORD
ARA Social Club, Manton Lane, Bedford. 7pm, Marylyn Wood, T +44 (0)1933 353517.
8 March — Sir John Charnley Lecture. E-fan – the new way to fly
Nicholas Fouquet, Airbus Group Innovations.

10 May — The Icarus Project. Dr Angelo Niko Grubišić, University of Southampton, Joint lecture with Cranfield Branch. Room LR29, Building 122, Cranfield. 6pm.

BIRMINGHAM, WOLVERHAMPTON AND COXSFORD
National Cold War Museum, RAF Museum Cosford, Shifnal, Shropshire, 7pm.
Chris Hughes, T +44 (0)1580 844523.


18 May — Branch AGM (6.15pm) followed by The first of the Phabulus Phantoms. Dave Ward, Heritage Department, BAE Systems, Warton.

BOSCOMBE DOWN
Lecture Theatre, MoD Boscombe Down.
Refresments from 5pm. Lecture 5.15pm. Visitors please register at least four days in advance (name and car registration required) E secretary@ BoscombeDownRAeS.org

7 March — Lancaster bail out! Clive Smyth.
11 April — Branch AGM followed by Engineering the A380. John Roberts.

CAMBRIDGE
Lecture Theatre ‘O’, Cambridge University Engineering Department, Trumpington Street, Cambridge, 7.30pm.
Jin-Hyun Yu, T +44 (0)1223 373129.

7 March — Sir Michael Marshall Young Persons Lecture Competition. Cambridge University Engineering Department, Baker Building Board Room.
4pm. Contact: competition@ cambridgeaero.info

9 March — Gliding – soaring with condors in the High Andes. AM Philip Sturley, Cambridge Branch President. 6pm. Followed by Branch 60th Anniversary Dinner. Royal Cambridge Hotel, Trumpington Road, Cambridge, 8pm (booking required).


10 May — Branch AGM followed by ‘I tell my story’ short talks by Branch members.

CHRISTCHURCH
Coham Lecture Theatre, Bournemouth University. 7.30pm. Roger Starling. E rogerstarling593@btinternet.com

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

Airbus Helicopters X3 high-speed compound helicopter demonstrator. Fast helicopters will be discussed by Dr Gary Clark on 21 March at Oxford, Airbus.
23 March — The V-Bomber force and the Cold War. David Head.

COVENTRY
Lecture Theatre ECG26, Engineering & Computing Building, Coventry University, Coventry, 7.30pm. Janet Owen, T +44 (0)2476 464079.

15 March — Lancaster Lecture. The Lancaster interactive project.

19 April — Branch AGM followed by Mini lectures.

CRANFIELD
Room LR05, Building 122, Cranfield, 6pm.

10 May — The Icarus Project. Dr Angelo Niko Grubišić, The Icarus Project.

23 May — The Boeing RC-135W/V Rivet Joint programme. Wg Cdr Gerry Crosby, RAF (Retd), former OC 51 Squadron.

GLOUCESTER AND CHELTENHAM
Safran Landing Systems, Restaurant Conference Room, off Down Hatherley Lane, 7.30pm. Peter Smith, T +44 (0)1452 857205.

3 May — Design of the BAE Systems Regional Aircraft. Wg Cdr Wg Cdr Gerry Crosby, RAF (Retd), former OC 51 Squadron.

HEATHROW
Community Learning Centre, British Airways Waterside, Harmondsworth, 6.15pm. For security passes please contact Dr Ana Pedraz, E secretaryaerelhr@gmail.com or T +44 (0)7936 392799.


27 April — Branch AGM followed by film show.

ISLE OF WIGHT
Conferece Hall, Isle of Wight College, 6.30pm.

16 March — Branch AGM.

LOUGHBOROUGH
Room U202, Brockington Building, Loughborough University, 7.30pm. Colin Moss, T +44 (0)1509 239692.

LEARNING AEROSPACE IN HAMBURG

HAMBURG
Hochschule für angewandte Wissenschaften (HAW), Hörsaal 01.12, Berliner Tor 5 (Neubau), 20099 Hamburg. 6.30pm. Richard Sanderson, T +49 (0)4167 92012.

16 March — Remembering the TSR2. Brian Mann.


HEATHROW
Community Learning Centre, British Airways Waterside, Harmondsworth, 6.15pm. For security passes please contact Dr Ana Pedraz, E secretaryaerelhr@gmail.com or T +44 (0)7936 392799.


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PRESTWICK
The Aviator Suite, 1st Floor, Terminal Building, Prestwick Airport, 7.30pm. John Wragg. T +44 (0)1655 750270.
13 March — David Fowler McIntyre Lecture. Supply chain issues with ever-increasing production rates. Tom Williams.

SEATTLE
Museum of Flight, 9404 East Marginal Way South, Seattle, Washington, 6.30pm.
17 May — Introduction to the KC-46 tanker design. Danny Wright, KC-46 Chief Mechanic.

 SHEFFIELD
AMRC Knowledge Transfer Centre, Brunel Way, Advanced Manufacturing Park, Rotherham, 7pm. E raesenquiries@amrc.co.uk
26 April — Air accident and investigation. Graham Bradlaugh, Professor of Safety and Accident Investigation, Cranfield University.

SOUTHEND
The Royal Naval Association, 79 East Street, Southend-on-Sea, 8pm. Sean Corr, T +44 (0)20 7929 3400.
11 April — Branch AGM.
9 May — Ernest Dove Lecture. Air operations in Afghanistan. Wg Cdr Paul Morris.

SWINDON
The Montgomery Theatre, The Defence Academy of the United Kingdom, Joint Services Command Staff College, Shrieverham, 7.30pm. New attendees must provide details of the vehicle they will be using not later than five days before the event. Photo ID will be required at the gate (Driving Licence/Passport). Arrange attendance preferably via email to raeswindon@gmail.com or Branch Secretary Colin Irvin, T +44 (0)7740 136609.
1 March — Western Front Association, Remembrance Day.
3 May — All-day visit to RNAS Yeovilton.

TOULOUSE
Symposium Room, B01, Airbus
14 March — Branch AGM and ALM Platform, Airbus.
15 March — Progress of Reaction Engines towards space and hypersonic flight. Mark Thomas, CEO and MD Reaction Engines.
11 April — ALM/ additive layer manufacturing (3D printing). Jérôme Rascol, Head of Aeronautics, Airbus.

WASHINGTON DC
The Montgomery Theatre, Brunel Way, Advanced Manufacturing Park, Rotherham. 7pm.
26 April — Electric aeroplanes panel discussion.

WEYBRIDGE
Brooklands Museum, Weybridge, 6.45pm. Ken Davies, T +44 (0)1483 531829.
11 May — Electric aeroplanes panel discussion.

YEBOVILTON
Nuffield Sports Bar, RNAS Yeovilton, Ilchester. 6.30pm.
28 March — Puma 2. Sqn Ldr Birtwistle.

SOUTHEND BRANCH
Southend Branch Members, family and guests celebrated the 60th anniversary of the Southend Branch of the Royal Aeronautical Society with a lunch at La Romantica restaurant in Rayleigh, Essex, on Saturday, 14 January 2017. RAeS staff members Scott Phillips and Ros Azouzi attended from Hamilton Place. The Southend Branch was founded at Southend Airport in January 1957 by the late Sir Freddie Laker who was the first Chairman of the Branch.

Sean Corr
Honorary Secretary
Southend Branch

Southend Branch Committee and guests. From left: Ros Azouzi, RAeS Head of Skills and Careers; Sean Cor, Honorary Secretary; David Roberts, Branch Chairman; Tony Borrett, Committee Member and former Honorary Treasurer and Alan Coleman, Honorary Treasurer.
MARTYN STANLEY PRESSNELL

CEng FRAeS
1936-2017

Born in Southend, Martyn was an aviation enthusiast since childhood. After a degree in aeronautical engineering from London University, he worked in the Handley Page stress office on the Victor programme and other projects. He chaired Hertfordshire Pedal Aeronauts who designed and built the Toucan, spanning 139ft (42.4m) which in 1972 achieved a best flight of 640m. He was later Vice-Chairman of the RAeS Man Powered Aircraft Group.

After the closure of Handley Page in 1970 Martyn joined Hertford Polytechnic (later Hertfordshire University), becoming a Principal Lecturer until his retirement in 1997. He was later involved with hybrid airships, qualifying as a CAA chief stress engineer on airships. While on the design team for the Cargolifter project in the late 1990s he claimed to spot a serious flaw in the project – namely when you have delivered the 75-tonne payload how do you hold the carrying airship down to stop it flying away!

Throughout his career he maintained an interest in free-flight model aircraft and developed different forms of turbulators and invigorators to improve the airflow over model aircraft wings; he also published articles on the performance of rubber-powered models and books on aerofoils.

Martin Dilly

With thanks to John Taylor, Brian Rapier, Michael Campbell, Trevor Breckell and Roger Newman for additional material

COLIN TORKINGTON

CEng FRAeS
1936-2016

Colin Torkington had been a member of RAeS for 60 years and was active in Australian Division and Canberra Branch affairs, including assisting with accreditation of tertiary aeronautical courses.

Colin began his career at 16 as an apprentice with Vickers, when the company was building three Viscount airliners and a Valiant bomber every week. He did research under Sir Barnes Wallis before a Masters course at Cranfield and design responsibility for the fin of the TSR-2.

Colin came to Melbourne in 1961 and worked in structural fatigue at Aeronautical Research Laboratories. A year later he joined Australia’s Department of Civil Aviation as an Airworthiness Engineer specialising in fatigue. By 1982 Colin was Head of Continuing Airworthiness. However, the structural integrity of aging airliners was an increasing concern. In 1985 extensive fatigue cracking was found throughout the front fuselage section (Section 41) of several 747s. Colin played a role in setting the stringent regime of inspection and repairs that kept the 747 fleet operating safely. It was soon apparent that aging aircraft problems were industry-wide; not limited to the 747 or to Boeing. Aviation authorities, manufacturers and airlines began co-operating to overcome the hazards of fatigue, corrosion, brittle electrical wiring, faulty repairs and lax maintenance. The effort and huge cost has virtually eliminated age related airliner accidents. Colin retired in 2001.

Martin Aubury FRAeS

Eugene Andrew ‘Gene’ Cernan

1934-2017

Former astronaut Gene Cernan passed away on 16 January 2017. Cernan travelled into space three times: aboard Gemini 9A, Apollo 10 and Apollo 17, becoming the last person to walk on the Moon on 14 December 1972.

Far left: Gene Cernan checks out the Lunar Roving Vehicle (LRV) during the early part of the first Apollo 17 extravehicular activity (EVA) at the Taurus-Littrow landing site. NASA.

Left: The first and last men on the Moon. Neil Armstrong, left, and Gene Cernan in 2010. NASA.
SOCIETY OFFICERS

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Australia: John Vincent
New Zealand: John MacIrlree
Pakistan: AM Salim Arshad
South African: Dr Glen Snedden

WITH REGRET

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

Peter John Allard FRAeS 82
Francis Avery FRAeS 70
Martyn Stanley Pressnell CEng FRAeS 80
James Mcgough Taylor IEng FRAeS 90
Michael Irwin Thom CEng FRAeS 81
Leonard Leslie Tydeman CEng MRAeS 92
Capt Keith Warburton FRAeS 74

THE RAeS SINGAPORE BRANCH RE-LAUNCHES

The RAeS Singapore Branch has held a re-launch event, very kindly sponsored by Flight Experience Singapore. On Monday, 16 January, 21 current and prospective RAeS members came together at Flight Experience to hear Dr Seamus Phan on ‘Leadership at 30,000ft – Lessons in leadership from Ancient China and Japan’, network with industry colleagues and enjoy the excitement of flying a Boeing 737-800 into Kai Tak Airport. The event was very well received and enabled both aerospace students and seasoned professionals to discuss how we can move the Branch forward and provide mutual support in the region. The next event is scheduled for mid-March and will involve a discussion on the background for Rolls-Royce’s move into Singapore and a tour of the Large Engine Build Facility at Seletar (SATU).
2017 Honours, Medals & Awards

The most prestigious and long-standing awards in global aerospace honouring achievements, innovation and excellence.

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For further information call Scott Phillips on +44 (0)20 7670 4303 or email scott.phillips@aerosociety.com
Imagine: a new President cancels an expensive weapons system that also is the centrepiece of an allied nation's national security. This was the case some 55 years ago when President Kennedy axed the Douglas Skybolt air-launched ballistic missile. Between 1960 and the end of 1962, the UK received assurances from the USAF that all was going well with a missile which it also saw as a means of keeping alive its prized manned bomber force. Sadly, the nuances of the US procurement process were not fully appreciated in London. The MoD and the RAF tended to speak with more or less a unified voice: not so with the USAF and the DoD civilians. Moreover the new Secretary of Defence, Robert McNamara, was a state-of-the-art bean counter determined to curb failing programmes; nor did he much appreciate the existence of small independent nuclear forces that threatened to destabilise the Soviet-American strategic relationship.

To say that the decision to cancel Skybolt on the grounds of technical failings came as a shocking surprise to the MacMillan government in Britain is an understatement. It left the UK without a credible deterrent and a huge political embarrassment. But a happy ending: much arm twisting of President Kennedy and some world-class schmoozing by Lord Mountbatten of Admiral Rickover, the prickly doyen of the Polaris programme got the UK a cheaper and far more effective delivery system.

A nightmare scenario?

Imagine again, a new President with far less understanding of defence procurement, an erratic decision-making style, and little concern for the subtleties of alliance politics. Add to this a Presidential eye firmly fixed on the F-35, especially the F-35C, which he has described as a programme ‘out of control’. The nightmare would be cuts to a very expensive programme that rendered a foreign carrier aircraft-free. Unlike, perhaps, as there is in the final analysis too much riding on the F-35, industrially and militarily, to see it going the same way as the McDonnell Douglas/General Dynamics A-12 naval stealth fighter (the last major US defence programme to be cancelled). But President Trump still got Marillyn Hewson, Lockheed’s chief executive, scrambling to assure him that she shared his views that ‘we need to get the best capability to our men and women in uniform and we need to get it at the lowest possible price’.

There is a backstory here: the F-35 is the most expensive military procurement in American history. The General Accountability Office, the Congressional oversight agency, has consistently criticised its development schedule and cost escalation. Influential Republicans such as Senator John McCain have piled in behind. It may be just as well that the Secretary of Defense is a Marine general and might be inclined to defend the F-35B. However, cost cutting will surely come, and all of LMC’s partners will have to take a hit, which includes a raft of UK suppliers. When push comes to financial shove, expect some fall-out that will impact on the cost to the UK of equipping its two expensive ships. This might in the end imply a saving for all the F-35’s customers, but for the dollar price has already risen and there is a limit to the breathing space afforded by currency hedging.

Still expect some rough water ahead

The real lesson perhaps is that the UK is potentially so dependent on foreign procurement for such an important item. Mrs May thought she had come home from Washington with a renewed ‘Special Relationship’ but rapidly found that this might be a tad unsettling in practice. Cross fingers then about continuing beyond Brexit with the Anglo-French UCAV and other joint projects where we still share in the really clever technology associated with combat aircraft design and development.
UAS Workshop

A RISK BASED APPROACH TO RPAS OPERATIONS

LONDON / 22 MARCH 2017

The aim of this workshop is to build consensus for the use of a risk-based approach (RBA) to RPAS operations to achieve the required level of safety in an economically efficient manner.

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Lecture Series

LECTURES AT RAeS HQ

MARCH 2017

Fly the Flag, and Tailor the Aircraft - The Political History of the VC10 and Trident
Prof Keith Hayward FRaE
8 March

Aviation Safety: Much is done, Much to do
Margaret Gilligan, Associate Administrator for Aviation Safety, FAA
15 March

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Structures and Materials Group

NEW MATERIALS, STRUCTURES AND MANUFACTURING METHODS FOR AEROSPACE

AMRC SHEFFIELD / 5 APRIL 2017

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