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Air Power and the Defence Aerospace Industry in the Whole Force era

President, thank you for your kind introduction and warm welcome.

It is an indisputable fact that this Society has been leading much of the UK...and indeed global...discourse on air power since the birth of aviation. Consequently, I was delighted to accept the Society's invitation to deliver the Sir Sydney Camm Lecture for 2015. Inevitably, not all of my messages will be palatable to everyone in this room, but it is my firm belief that only by promoting a constructive debate on the key issues, which we face together, can we begin to sow the seeds of their resolution. Indeed, that is the strength of this Society. Previous lectures have followed a common approach - they have all been forward looking but been informed by our previous experiences - and mine will be no different in this regard.

The Sir Sydney Camm Lecture for 2015 will critically examine...*Air Power and the Defence Aerospace Industry in the Whole Force era*. As we gather here today just one calendar month after the general election, there is a palpable and perhaps obvious sense of change in the air. It is that sense of imminent, arguably fundamental change which underpins my talk to our Society today.

The UK defence industrial base...and the defence aerospace industry in particular...is economically important to the UK...and vital to our national security.

In 2013 the annual turnover of the UK defence sector was £22Bn delivering exports to the value of £9.8Bn with 85% coming in the defence aerospace area. The average value of defence exports has been £6.5Bn per year over the last decade. In areas where the UK feels that it has a competitive industrial advantage, namely Air Capabilities and Intelligent Systems, the forecast global spend is £82Bn per annum over the next 8 years. To deliver this output the defence sector directly employs around 162,000 people in the UK and indirectly sustains a further 114,200 jobs through the supply chain. The Ministry of Defence, is currently planning to spend an average of £16.4Bn per year over the next 10 years to realise its Equipment Plan.¹ These are large numbers underpinning significant reasons as to why this matter is important to the nation.

¹ *Delivering Growth: Implementing the strategic vision for the UK Defence Sector* (DGP: July 2014). p16-17.

My central hypothesis is that the relationship between UK air power and defence aerospace industry in the Whole Force era is truly symbiotic - put simply, if either 'fails' they will both 'fail' - and with any 'failure' the UK will lose, perhaps irrecoverably, its competitive advantage on many fronts. For the defence aerospace industry it may mean difficult conversations with shareholders. For the UK government it will represent a security and economic challenge. Ensuring that we do not 'fail' is therefore vitally important to each and every one of us as we plan and, critically, act to secure our shared future. It is a subject of particular interest to me of course as the Royal Air Force's Air Member for Personnel and Capability. In this appointment, it is my executive responsibility to deliver 3 things: the equipment; the people; and their foundational training, from which much of the UK air power's capability is derived. I therefore intend to do everything in my power to positively influence a beneficial outcome for UK air power and its defence aerospace industry. This lecture is part of that effort – I want to convince you to help me to deliver.

It is my intention to examine the relationship between UK air power and the defence aerospace industry by considering 3 key questions. First, where are we now and where are we going to? In doing so, I will touch on our proud heritage, review our situation at the end of an unprecedented 12-year period of enduring stabilisation operations, and look at our progress towards Future Force 2020. Next question: what challenges must we overcome if we are to successfully reach our shared goals? In this section, I will explore the future strategic landscape for security and defence before identifying those key themes which represent our collective challenge, and then put this into a Royal Air Force focus through a few illustrative examples. My final question is simply this: how might we overcome those challenges which now face us? This final section will highlight what informed observers feel needs to be done before critically examining the UK's Defence Growth Partnership initiative. Taken together, these 3 parts are intended to detail what has been a successful journey to date, and point to the required direction of travel in the future.

Keeping the inquisitive and well-informed minds of Society members and guests entertained throughout the next hour will, I am sure, be one of my key challenges. My *raison d'être* is simply to give you the Royal Air Force perspective on the matter at hand and I invite you to subsequently challenge me in Q&A.

There might be a temptation for the Royal Air Force, and the defence aerospace industry that has supported it, to consider that what has hitherto brought success in the skies and marketplace respectively remains fit for purpose for the challenges of the 21st Century. Much

will of course remain valid but such an approach, in its broadest sense, would be tantamount to resting on the laurels of the past, forgetting what brought that success in the first place; a path that would, most likely, lead to failure in the future. Of course there is a need to remember our past, draw relevant lessons from it and let its enduring principles guide our future. But we must seek an unrestricted and clear vision of the future, pursue innovation in a determined and timely manner, and underpin this with an 'institutionalised' commitment to the task at hand. This is what drove success then and it must continue to drive it now. So let's explore some of those factors as we consider the Royal Air Force's situation today and where we are heading tomorrow.

Where are we now, and where are we going to?

It is my contention that UK air power and the defence aerospace industry have come a long way together in just over a century but our need to work even closer together in the RAF's second century is now much greater: if we don't, we will both fail.

It was only 27 years between the Wright brothers' first flight in 1903 and Sir Frank Whittle's application for patent of a turbo-jet engine in 1930. It was only 22 years between the first flight of the Heinkel 178 turbo-jet powered aircraft in 1939 and the first manned spaceflight by Yuri Gagarin in 1961. And it was only 12 years between the world's first supersonic flight of a Bell X-1 aircraft piloted by Chuck Yeager in 1949 and the flight of the X-15, by Robert White in 1961. This represents a rapid and significant evolution of defence aerospace technology so we shouldn't be too hard on ourselves in the current context. Indeed, in comparison with our sister Services such periodicity is very short. It was 97 years between the first steam-powered warship in 1815 and the first diesel-powered merchant vessel in 1912. And it was 79 years between the use of the Enfield Pattern bolt-action rifle in the Crimean War and the issue of the M1 Garand semi-automatic rifle to the US Army in 1937. The fact is that air power development is an inherently time-compressed business. The people who deliver the nation's air power exploit technological advancement for competitive advantage; it is what we do, it is difficult to do well, but thus far I think we have been pretty good at it.

I want to briefly consider where the RAF finds itself today almost 6 months after the end of NATO's combat operations in Afghanistan. Some of you may have heard the Chief of the Air Staff use the phrase 'air power delivered Afghanistan' – not surprisingly, it is a statement that I fully agree with. But I'll just unpick that phrase for a few moments by way of explaining the rationale behind it. The most obvious literal sense first - the strategic air bridge. Despite some well-publicised incidents of tactical frustration, the Royal Air Force successfully sustained a

strategic air bridge for 9 years to transport the UK's entire fighting force into a contested theatre of military operations that was over 3,000 miles away...and bring them all home again. The figures² are simply eye watering: 270,000 personnel and 51,000 tonnes of freight moved backwards and forward by RAF Air Transport aircraft. This included 7,384 aero medical evacuation patients. During this period, with just a couple of exceptions, every front-line operational aircraft type, whether fast-jet, multi-engine, rotary or remotely-piloted was committed to Afghanistan at some point. Of those exceptions, the Typhoon was holding Quick Reaction Alert in the UK and Falkland Islands as well as surging to support operations over Libya, all while continuing its incremental development program, while the Puma helicopter, which was central to operations in Iraq is now committed to operations in support of the Afghanistan government. But aircraft are merely platforms; it is the way that they are used and supported by Royal Air Force personnel that makes the difference.

However, it was the Royal Air Force's contribution in a conceptual sense that is the most significant but often the least recognised. UK air power, like that of other nations, made a theatre-wide contribution to the ISAF campaign. One moment it could be operating overhead UK land forces in Helmand Province, and then just 45 minutes later be over US land forces on the eastern border of Afghanistan some 350 miles away. And this simple fact, hints at air power's true contribution and why the Chief says air power 'delivered' Afghanistan. Put simply, it provided the necessary assurance that allowed the Combined Joint force to configure and to execute operations the way it did. As retired US Army General Barry McCaffery commented in 2009: 'Coalition air power is the glue holding together the war effort'.³ He was right.

Coming closer to my main theme, I now want to highlight the success of the Royal Air Force's recapitalisation programme over the last few years. This is an important point in determining the relative health of a force, and one often over-looked when just pure numbers are considered. I touched on the success of the air bridge a moment ago but we should not forget that this was largely achieved with aircraft at the very end of their operational lives and all of the issues that this naturally throws up.

With the introduction of Voyager and latterly the arrival of the Atlas aircraft to complement our Globemaster fleet, the UK now has an air mobility force - transport and air-to-air refuelling - that is one of the most modern and capable in the world, and the envy of many, including the Chief of the United States Air Force.

² Figures provided to the author by HQ Air Command A3 Ops on 1 May 15.

³ [http://en.wikisource.org/wiki/After_Action_Report%E2%80%9494General_Barry_R_McCaffrey_USA_\(Ret\)_2009-11](http://en.wikisource.org/wiki/After_Action_Report%E2%80%9494General_Barry_R_McCaffrey_USA_(Ret)_2009-11) accessed 5 May 15.

For those who follow the defence aerospace media closely, you will have spotted recent commentary that detailed the average age of US Air Force fighter aircraft as being 28 years, and bomber aircraft as 32 years.⁴ So, in contrast, the Royal Air Force recapitalisation sees the Service well-placed to lead UK air power further into the 21st Century. The key question of course is what is the direction of travel for that journey?

Enduring stabilisation operations in Iraq and Afghanistan have been the catalyst to transform the contribution of discrete, arguably niche, Intelligence, Surveillance, Target Acquisition and Reconnaissance, or ISTAR, platforms into a multi-faceted, real or near real-time system of systems. The so-called 'collect' platforms are a key part of this. There are now 2 operational Reaper squadrons, one in UK and one in the US. The Air Seeker system with its Rivet Joint aircraft has already completed its first operational deployment over Iraq. Funding for Reaper, Sentinel and Shadow has been extended until 2018. A decision to reinvest in a wide-area maritime and over-land surveillance capability, in whatever form that may take, will no doubt be considered shortly.

The Royal Air Force, with our Fleet Air Arm partners, is operating the UK's first Lightning aircraft in the US as part of the platform's ongoing test, evaluation and development. This platform will contribute to, and draw from, the ISTAR capability I have just mentioned as well as offer the UK its first 5th generation - low-observable - combat air capability. Meanwhile, the Typhoon⁵ continues its programme of weapons integration and development - Storm Shadow is the latest and plans are advanced to upgrade its radar from a mechanical to electronically scanned variant - a theme to which I will return later. Integrating Lightning and Typhoon operations will be a major focus for UK air power in the years ahead; the use of synthetic facilities such as the Defence Operational Training Capability (Air) will be a major contributor to this work.

Our immediate 'aiming point' is Future Force 2020; the vector was set in the Strategic Defence and Security Review of 2010 and we are now halfway along that path. For the Royal Air Force, the Chief of the Air Staff has identified the headline goals he wishes to achieve in his Command Plan 2014. I will draw on both to highlight what might lie ahead with the caveat that our thinking may be fundamentally altered by the outcome of this year's Review.

⁴ Gunzinger, Mark A and Deptula, David A. *Towards a Balanced Combat Air Force* (Centre for Strategic and Budgetary Assessments: 2014). See also <http://index.heritage.org/militarystrength/chapter/us-power/us-air-force/> accessed 5 May 15, and <http://www.defenseone.com/feature/state-of-defense-2015/> accessed 10 Feb 15.

⁵ See <https://www.rusi.org/analysis/commentary/ref:C52FA1CE451AC6/#.VUiTUzd0yUk> accessed 4 May 15.

Earlier I spoke of our enviable quality in equipment terms but I should like to draw your attention to the matter of quantity. In 1991 at the time of the First Gulf War, the Royal Air Force had 31 fast-jet combat air squadrons. On current plans, this number will reduce to 5 Typhoon front-line squadrons with the Royal Air Force having a share with the Royal Navy in a 6th combat air squadron of Lightning. This is of course a plan but reality often mandates agile adjustment. For example, the decision to amend the Tornado GR4's drawdown profile in late 2014 by delaying the disbandment date for II(AC) Squadron highlighted just this. The reality then was three Tornado GR4 squadrons committed to three operations in three different continents. Today, the Royal Air Force's fast jet combat air squadrons number 8. It is however for the government of the day to decide what represents sufficient combat mass for the demands that are to be placed on Defence and, in particular, the Royal Air Force. I have already touched on the decisions that will be required in respect of the ISTAR force and this will be informed by the outcome of the Air ISTAR Optimisation Study which has recently concluded under the leadership of the Joint Forces Command.

The RAF's regular manpower of our Future Force 2020 will be 31,500, with the current strength residing at 33,000, in line with the requirements of the 2010 Review. However, this does not tell the full story. The number of reserves has increased steadily since 2010 and now rests at a total strength of just over 2,100.⁶ In fact we would like this number to increase much further as Reserves offer the Royal Air Force one way of ensuring that we retain enough organisational agility to meet potential future challenges.

And that brings me to the matter of the Whole Force. Some have called this a concept, others an approach, but I see it fundamentally as the way the UK armed forces deliver their military outputs in support of national policy objectives. It requires all areas of defence aerospace - many represented here today - to think and act differently to what has gone before. And it is a Whole Force era that has already started in earnest, just look at how the Royal Air Force is delivering the UK's air mobility effort today from Brize Norton. Of the 6,600 plus personnel routinely employed at that Station, one-third, approximately 2,200 personnel, is provided by reservists, contractors and civil servants.⁷ That is an indication of what is to come. But not all are yet convinced. The Royal United Services Institute recently described the Whole Force as 'the UK's reform of its military in which the armed forces change from being solely composed of a volunteer, professional army, navy and air force – wholly enwrapped within the governmental sector – to instead become a partnered arrangement of regular military, regular reserves,

⁶ Figures provided to the author by the HQ Air Command Future Reserves 2020 team on 7 May 15.

⁷ Figures provided to the author by RAF Brize Norton on 1 May 15.

volunteer reserves, sponsored reserves and private sector contractors.⁸ This description, while comprehensive and factually correct paints, I believe, a negative connotation of the Whole Force. It is not a view I share although I do acknowledge that there will be challenges in its broader implementation.

In closing my view of 'where we are and where we're going', I should like to highlight just a few of the themes contained within the Royal Air Force Command Plan 2014 which are pertinent to what I will discuss subsequently. They are: People; Output; Equipment; and Reputation.

The comparative advantage of the UK armed forces has been principally defined by the quality of its people and this will not change. The Command Plan aspires to have a 'Whole Force...acting together as one'. In the context, that means new relationships must form and those that already exist be enhanced. And across the Whole Force these relationships must be taken to new and unprecedented levels of cooperation. Mutual dependency and trust will be central to these relationships as we go forward.

This 'new' relationship is reflected in how we wish to deliver our future outputs. We aspire to be 'working alongside industry and researchers to enhance capability and support exports'. Some may consider that we already do that – we do – but what we are considering here is a much more integrated approach from the very outset, recognising that our future is now a shared journey.

If we can get this relationship right then the defence aerospace industry and the Royal Air Force will have set the conditions that maximise our potential to get the right equipment, at the right time, and at the right price. The Command Plan calls for an equipment programme where 'all capabilities [are] relevant to the future operating environment'. Predicting the future is quite difficult – particularly for me as a mere helicopter pilot. But behind this statement is the implicit requirement for us to work more closely together, and in a more agile, responsive way than we have done previously, as we think carefully about how we will identify and procure our future equipment. It is clear to us – the approach of the defence aerospace industry is key to Royal Air Force achievement of this Command Plan goal.

And that brings me to the final area – Reputation. Fundamentally it is people who earn reputations, not equipment. But it is the interaction of the people and their equipment which defines success. In our first century the Royal Air Force and defence aerospace industry have done pretty well together. But operating successfully in the defence aerospace sector is

⁸ Louth, John and Quentin, Pete. *Making the Whole Force Concept a Reality (RUSI Briefing Paper, 2014)*. p1

challenging. That does not mean we cannot forge a new reputation by seizing the moment to reform our approach: to redefine our relationship and create a new paradigm for military-industry cooperation. The Command Plan calls for 'value for money' – that will come naturally if we get this right – but collectively we must want more. We share a mutual goal to lead the way and I believe that we have a unique opportunity to do that.

Some of you may be thinking that what I have said is all very good but, as the UK's armed forces reconfigure for a so-called *Return to Contingency*, the Royal Air Force will be increasingly inactive and its engagement with the defence aerospace sector stagnate or drop off. You could not be more wrong. As the Chief of the Air Staff pointed out last year 'we are not returning to contingency, we've never been away'.⁹ Since 1991 the Royal Air Force has participated in well over 50 operations and arguably it has been the major Service contributor in about 2/3rd of them.¹⁰ That's a mean of 2 to 3 *contingencies* per year but, of course, they have not unfolded in such a convenient uniform pattern over that time period. The graph's gradient is increasing...and sharply...because UK air power increasingly offers the nation credible and affordable political choice in times of national and global crisis.

In giving this lecture in 2011, Simon Bryant talked of the Royal Air Force's need to 'Transition in Contact'. He was of course principally referring to a transition to Future Force 2020 in the context of air operations over Afghanistan. Today, I am reinforcing that message as we conduct air operations over Iraq against the so-called Islamic State and contribute to NATO's air policing mission over the Baltic States in the face of a resurgent Russia. Success on current operations will always be the Royal Air Force's number one priority, but preparing for future operations will inevitably continue to be a very close second. My message to the defence aerospace industry is this. UK air power is highly relevant to UK thinking as evidenced by current events; it is likely to be so in the future. It is a 'product' worth cherishing, nurturing and renewed with conceptual and monetary investment. The Royal Air Force will be on that journey with you.

⁹ ACM Sir Andrew Pulford, Chief of the Air Staff, Royal Air Force, during the Lord Trenchard Memorial Lecture, delivered at RUSI on 18 Sep 14.

¹⁰ These figures are drawn from ongoing analysis being jointly undertaken by the Directorate of Defence Studies (RAF) and the MOD's Air Historical Branch.

What challenges must we overcome if we are to get there successfully?

I will now move onto the second theme in which I will examine the challenges that we must overcome if we are to successfully reach our shared goal of a 'world-leading' deliverer of air power.

The future defence and security environment is going to be more complex, offer less certainty and generate a greater number and diversity of challenges. Changes in the economic climate will be significant as the tectonic-plates of the global defence aerospace industry start to shift and throw up new operating models and players. It is my contention that we would be well advised to prepare together for these challenges, and we must swiftly engage ourselves in that work right now.

I want to start this section by briefly recapping the UK government's thinking about its approach to security and defence because this provides important context for what follows. The National Security Strategy 2010, *A Strong Britain in an Age of Uncertainty*, states that the UK is to: 'use all our national capabilities to build Britain's prosperity, extend our nation's influence in the world and strengthen our security.'¹¹ Collectively, security, prosperity and freedom constitute the UK's national interest,¹² with the UK's strategic objectives defined as ensuring a secure and resilient UK and shaping a stable world.¹³ The Review laid out the integrated UK approach and the military means for their delivery.¹⁴

The Building Stability Overseas Strategy of 2011 focussed on early warning, a rapid crisis prevention and response, and for the medium term, investing in upstream prevention.¹⁵ While the International Defence Engagement Strategy of 2013 set out how all defence activity, short of combat operations, will be prioritised to focus our engagement efforts on those countries which are most important to our national interests, and where we are most likely to achieve the desired effect.¹⁶ Why am I covering this? Because it is my firm belief that UK air power has a central contribution to delivering the outcomes required by these various strategies as part of an integrated approach across government. As the National Security Strategy states 'security and

¹¹ *A Strong Britain in an Age of Uncertainty: The National Security Strategy* (TSO: 2010).

¹² Ibid.

¹³ Ibid.

¹⁴ *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review* (TSO: 2010).

¹⁵ Building Stability Overseas Strategy (Crown copyright: 2011)

¹⁶ See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/73171/defence_engagement_strategy.pdf accessed 1 May 15.

prosperity form a virtuous circle¹⁷..I'm interested in the former and, I suspect, you the latter, hence we have a shared goal.

UK Defence's thinking about the future security and defence landscape is led by the Development, Concepts and Doctrine Centre. They have recently completed work on a series of three documents which will no doubt inform the National Security Strategy and Strategic Defence and Security Review. *Global Strategic Trends* takes a thematic and geographic view on the landscape in 2045. It foresees a more complex and uncertain world with change occurring in many areas at a faster and faster rate as a growing population competes for fewer and fewer resources. In the area of military capabilities for example, it considers the possibility that 'advances in technology are likely to lead to increasingly effective non-lethal capabilities and increase the precision of weapons' suggesting that 'this is likely to alter the nature of conflict'.¹⁸ The second document, the *Future Operating Environment*, looks out to 2035. It seeks to describe the characteristics of the 2035 operating environment in order to provide evidence-based insights that can inform future defence capability development. It too is thematic, not prescriptive, and considers the possibility of an environment where 'the proliferation of defence technology amongst potential adversaries means that our key systems will be vulnerable to technical exploitation or capability overmatch'. It adds that 'technological change will accelerate, serving to highlight inadequacies in less adaptable procurement processes within Defence'...and 'very long-term, inflexible equipment plans will no longer be sustainable'.¹⁹ If these characteristics develop then they are very significant, for both of us. The problem is we can't wait to see if these characteristics develop as postulated because when they do it will already be too late, thus we must both act now to prepare for our likely future.

The third document is a series of Environmental Concept Primers: Air, Maritime and Land plus, for the first time, a view of the UK's Joint Forces, for example, cyber. These Primers will form the starting point for 4 future operating concepts to be published in 2016. What the Primers offer now is a first-look at how the UK's armed forces might be configured to fight in the 2030-2035 timeframe. Each one builds on all of the previous documents I have covered. Although our work is ongoing, for the Air environment you can expect an operating concept which embraces rapid and global delivery of precision effect, that fully exploits all of the basing options available to UK air power, and which is underpinned by a robust adaptive command and control posture. In particular, the probable requirement for air power to fight to win in a fully contested

¹⁷ *A Strong Britain in an Age of Uncertainty: The National Security Strategy* (TSO: 2010).

¹⁸ *Global Strategic Trends out to 2040*, 5th Ed. DCDC (Crown copyright: 2014)

¹⁹ *Future Operating Environment 2035*, 2-star level draft, DCDC. This document is in final draft format and is not yet published.

electromagnetic environment, where physical access may also be contested, is something that will occupy us and, of course, you.

I have offered you the government approach and Defence's view of its most likely future operating environment but what is being said about the global defence industry by independent analysts?

A comprehensive 2014 report by the Centre for New American Security examined the factors that were shaping the global defence industry. Their findings on *Creative Disruption* do not make pleasant reading. The report concludes that: 'no one doubts that globalisation, declining post-war defence budgets and the increased pace of technological change are combining to reshape the defence industry'²⁰...and added that 'the convergence of emerging trends in the technological, geopolitical and business environments threatens to profoundly disrupt the global defence industry'.²¹ This is a stark warning.

Globalisation, catalytically fuelled by advances in information and communications technology, has led to defence industry rationalisation and down-sizing. There are no defence companies in the top 20 industrial research and development spenders worldwide. In fact, if the top 5 US defence contractors added together their combined spend, it would still not put defence in the top 20 list.²² And the market capitalisation of the 'big 5' US defence contractors²³ is approximately half of that of Apple.²⁴

Where military technology once drove the commercial sector, the reverse is now increasingly true and the paradigm is expected to have shifted permanently by 2030. Consider when it last was that key military technologies flowed to the commercial sector - the internet in 1991, the global positioning system in 1995 perhaps? You could make a contemporary case for unmanned air systems but, arguably, the idea was barely born and implemented by the military before the commercial sector grabbed the lead. The Federal Aviation Administration predicts that there will be 30,000 'drones' in the US sky by 2020²⁵, and that 10,000 of these may be directly supporting law enforcement activity.²⁶

²⁰ *Creative Disruption: Technology, Strategy and the future of the Global Defense Industry*, Fitzgerald and Saylor. Center for New American Security. 2014. p6.

²¹ Ibid. p7.

²² Ibid. p. 6.

²³ Boeing, Lockheed Martin, General Dynamics, Raytheon and Northrop Grumman.

²⁴ *Creative Disruption: Technology, Strategy and the future of the Global Defense Industry*, Fitzgerald and Saylor. Center for New American Security. 2014, p. 9.

²⁵ <http://www.businessinsider.com/robert-johnson-bi-30000-drones-by-2020-2012-2?IR=T> accessed 28 Apr 15.

²⁶ <http://www.dailymail.co.uk/news/article-2280484/FAA-says-10-000-law-enforcement-drones-flying-America-2020-despite-fears-privacy-violation.html> accessed 28 Apr 15.

And finally, shrinking defence budgets among Western militaries has reduced the number of platforms and equipment that can be purchased, and the number of people that can be retained to exploit them. If you accept this analysis - and it is the view shared by many other independent analysts - what are the thematic challenges that this emerging global context presents us with? Because in this context, the UK defence aerospace industry is not immune to global trends.

It seems to me that these challenges can be aggregated into three broad themes of: affordability, technology exploitation and human capability management. There is arguably a fourth - culture...but I will return to this aspect in part three when we discuss the 'how'.

Let's start with affordability. The challenge is how to get more from what we've got, and probably for longer than we did before. Technology advances rapidly and procurement programmes take time to deliver. The net result is an increasing risk that platforms and equipment, while perhaps even meeting performance, cost and time goals, are not the best solution to the contemporary security paradigm when they enter operational service. Even global collaboration programmes are expensive to participate in and unit costs remain relatively high. Collaboration does however offer acquisition efficiencies through economies of scale. It is now being reported in the US that the Department of Defense is likely to move away from a fixed cost contract and towards a cost-plus model for the Air Force's Long Range Strike - Bomber programme.²⁷ At the recent launch of the US' Better Buying Power acquisition strategy, Frank Kendal, Pentagon undersecretary for acquisition, announced that regardless of who wins the LRS-B competition, future platform upgradability will be built-in from the outset and the right to provide these upgrades will also be competed.²⁸ This is probably a direct response to the current financial context and recognition of the need to act collegiately in support of the US defence aerospace industry when doing so.

The challenge of technology exploitation is related to affordability. We need to find a smart way where we can collectively maintain military capability over an extended period of time and offer the Royal Air Force maximum value for money for every tax payer's pound it spends while offering the UK defence aerospace industry sufficient potential for a viable and sustainable future. Spiral development paths may be one way we can do this. This can be done on the system, the platform or both. Small platform numbers favour spiral development of the system

²⁷ <http://www.defensenews.com/story/defense/air-space/strike/2015/03/05/lrsb-bomber-cost-plus-contract-air-force/24432697/> accessed 28 Apr 15.

²⁸ See <http://www.defenseone.com/management/2015/04/pentagons-next-bomber-will-be-built-upgrade/109804/> accessed 27 Apr 15. Also, <http://www.govexec.com/contracting/2015/04/pentagons-next-bomber-will-be-built-upgrade/109909/> accessed 4 May 15.

whereas greater overall platform numbers offer the opportunity to do both. But judging when the optimum time to cease spiral development is reached will be key if the approach itself is not to become an artificially limiting constraint on capability growth and driver of increased costs. Evolving existing relationships and developing new relationships with new, non-traditional participants will be important for air forces and the defence aerospace industry alike. These relationships will need to be underpinned by an effective strategy if the community is to act decisively at the right time to exploit technological developments. One way might be for the Royal Air Force to adopt a 'lead, watch and follow' strategy. For some technologies only the military can *lead* primary investment in order to achieve a disruptive effect. However, for the majority of emerging technologies, Research and Development will occur independently and the military can *follow* these technologies in order to adapt and adopt related capabilities. But where there is not a clear exploitation pathway, or such a pathway is unaffordable, the military can continue to *watch* until the situation becomes more favourable.²⁹ Such proactive horizon scanning might then allow the adoption of the philosophy - 'as civil as possible, as military as necessary' - to fully assess the implications of technology developments and improve affordability while retaining an advantage for UK air power.³⁰

The final challenge is one that this audience will recognise well. One needs enough people with the right skills to drive technology developments and to identify their credible exploitation pathways for military purposes in the information age. Whether you subscribe to the STEM - Science, Technology, Engineering and Maths - acronym, or its latest iteration of STEAM, where the A inserts Art and Design into the equation³¹, there is global problem. I won't labour the point but merely turn to the latest *EngineeringUK* analysis to highlight its scale. Their 2015 report suggests that although 5.4M engineers are employed across some 600,000 enterprises, the UK will need a further 1.82M engineers by 2022. The conclusion is very clear. Either the UK must double the number of people undertaking STEM graduate courses or increase by 50% the number of graduates who actually enter the engineering industry if it is to balance demand and supply.

Before I close this section, I wanted to briefly bring some of these themes into a sharp Royal Air Force focus for you. The issues I will highlight are the ones that we are dealing with today, not tomorrow; they span from equipment capability to organisational agility and human capability.

²⁹ UK Prototype Air Technology Matrix, DSTL, 30 Sep 14. This potential implication for UK air power idea is put forward in the current 2* draft of the *Future Air and Space Operational Concept (FASOC) Primer* which is due to be published in Jun 2015.

³⁰ *Future Air and Space Operational Concept (FASOC) Primer*. This document is still undergoing active internal review and is subject to amendment.

³¹ See <http://stemtosteam.org/> accessed 29 Apr 15 for a fuller explanation behind the theory.

I will start with the significant issue of the electromagnetic spectrum. Since 2005, successive governments have been examining how the UK could derive economic and social benefit from a more effective and efficient utilisation of the spectrum. In 2014, it set itself a goal of freeing up 500MHz of the UK's public access to the spectrum below 5GHz, an area in the so-called 'sweet spot' for commercial wireless and broadband use - this is to be the home of '5G'. However, 190MHz of that 500MHz is currently used by the Royal Air Force's E3D Sentry and is to be released for commercial use this year. Although there are safeguards within the process to preserve assured public access, the broad future direction of travel is certain - public and commercial users will need to use the spectrum in a more agile way than we do now. The Royal Air Force is comfortable with this approach; I see it as analogous to the introduction of Managed Danger Areas in the late 1990s, where UK airspace is handed backwards and forwards between military and commercial users as demand requires. This approach is now second nature to us. But the introduction of spectrum pricing, which means that in the future the MOD will need to pay a sensible 'market rate' for its own use of the spectrum, is less clear to us. The driver is unequivocal - the spectrum is hugely valuable. In 2011 it was estimated that the spectrum contributed £52Bn to the UK economy - broadly similar to the UK's aviation sector and almost quadruple its maritime sector. This contribution was up 25% on the 2006 figure and government's vision is that this will be doubled by 2020.³² Thus the challenge for the Royal Air Force is technical and we must understand the detailed issues as we are the biggest spectrum user in MOD and the government has not allocated any proceeds of the spectrum sale as a potential user offset.³³ With global spectrum management and pricing being considered by the UN³⁴, the impact is potentially very significant for a global air force.

Implementing the recommendations of Sir Charles Haddon-Cave's independent enquiry into the loss of Nimrod MR2 XV230 continues to present challenges. Although the required accountability and organisational changes have been fully implemented and the Military Aviation Authority and the Duty Holder process are working well, some issues remain for us to work through. We have created a very good oversight system but one that offers little diversion or interpretation from a UK approach. You will recall for example the media interest surrounding the introduction to service of the first Rivet Joint platform. Demanding appropriate assurance is correct but sometimes providing the necessary evidence trail is difficult. And sometimes, it is protection of Intellectual Property Rights that serves to frustrate. These regulatory challenges consume resource.

³² *The UK Spectrum Strategy* (Department for Culture, Media & Sport: 10 Mar 14).

³³ See MOD letter Fallon/Stewart, ref 4.6.3.1, dated 30 Aug 14 in response to HCDC letter Stewart/Fallon *Release of MOD Radio Spectrum* dated 22 Jul 14. available at <http://www.parliament.uk/business/committees/committees-a-z/commons-select/defence-committee/publications/>

³⁴ See *Exploring the Value and Economic Valuation of Spectrum* (UN, ITU: April 2012).

From a capability perspective, implementing Lord Levene's Defence Reform recommendations, where much of UK Defence's capability planning function was disaggregated from the MOD to the single Services, has been equally challenging. The Royal Air Force was required to grow rapidly its technical and acquisition competence to fulfil the role. It is an ongoing task but one we are now just about on top of; however, it has again taken time and resource to get a fully functioning capability planning system in place and represents more *Transition in Contact*.

Turning briefly to the Royal Air Force's human capability challenges. On the face of it the Service is fully manned - it pretty much is - but the problem we face is twofold: we don't have the right mix of suitably qualified and experienced personnel, or SQEP, that we need for today, nor do we know what particular skill sets we will need for tomorrow. The recently published Royal Air Force Strategy for People is a good start but generating and implementing a clear delivery plan is more difficult. It is a problem across Defence of course but arguably one at its most acute in a technologically focused Service such as ours. And of course we are competing with industry for the brightest and the best from the STEM graduates. A few examples: how do we sustain the aircrew cadre when there are fewer platforms for them to fly and only single-seat cockpits, yet a plethora of staff jobs for them to fill; ...the New Employment Model is being implemented now but what will be the impact on the Service of a peer group serving until 60 years of age; and, ...how do we ensure equity of approach across the Whole Force which promotes the 'fight as one' culture we need to succeed? These are tough questions to answer.

We know that at the heart of answering them is a need to be more agile and innovative in our personnel policies, and perhaps in doing so we can help each other out more than we are currently doing in that regard. While the Royal Air Force is no longer considered by potential recruits as offering a 'job for life', they perhaps should now conceive it as offering a 'career for life'. Indeed, I am already pursuing that theme internally very aggressively. Instead of competing for STEM graduates why can't we cooperate? For example, it should be possible to have a very flexible career profile where the precious commodity of engineers move almost seamlessly between the military and its defence aerospace industry, and vice versa, and perhaps on multiple occasions. We would both gain from such an approach. Indeed, US followers will have noticed that Ashton Carter, the new US Defense Secretary, has directed exactly this approach be pursued by the US military.³⁵ The Royal Air Force offers a very attractive apprenticeship scheme – rated as *Outstanding* by Ofsted in its 2015 Report³⁶ – why wouldn't the defence aerospace industry welcome access to this cadre? Experience in the

³⁵ See <http://www.militarytimes.com/story/military/pentagon/2015/03/30/secdef-promotion/70667178/> accessed 31 Mar 15.

³⁶ See *Further Education and Skills inspection report: MOD (RAF)*. (Inspection Number: 446607) (Ofsted: 19 Jan 2015).

Industry offers a broadened engineer, why wouldn't we welcome that experience in the Service? Such ideas are the real crux of the Whole Force challenge. There is now much work to do on building the required flexibility into the future Terms and Conditions of Service for the UK's Armed Forces. It is clear that what might work for one Service may be inappropriate for another, yet currently our personnel policies are largely derived and set centrally.

In drawing this section to a close, my message is that the Royal Air Force's challenges are complex, diverse, numerous and exist on many levels. But our issues are, by association, largely your issues. To overcome them, my plea to the UK defence aerospace industry is to trust us and work with us as one, sharing our respective ideas about the future without fear or prejudice and, with our government's support, reinvigorate and demonstrate that the UK is a genuine world-leader in this field. A leader, not only for its progressive approach in the cooperation between UK's air power and its defence aerospace industry, but also in the quality of the value for money and capable products it provides, and the skilful way in which they are exploited by the nation's air power. I believe that it is only by taking a shared journey that we can fulfil that 'world-leader' goal. We have a good starting point and now is the time to capitalise on that fact.

How might we do that?

You will have your own perspective on the challenges that I have outlined and may agree or otherwise with the Royal Air Force's view of them. But where I think we have overwhelming consensus - including across government - is that they exist and a viable solution needs to be found. The Defence Growth Partnership, the government-sponsored initiative that is led by the UK-based defence industry is, I believe, an emerging route to providing us with potential solutions. It is therefore in our shared interest to make it work, and work well, for our shared future depends on it. We require a solution that is progressive, inclusive and ambitious, and it is my contention that taken at face-value, the DGP offers us such a solution.

So in the time that remains, let's take a *tour d'horizon* of the Defence Growth Partnership and examine it from all angles. Why do we need it? What is it supposed to do? What can we do to aid its chances of success?

The DGP was launched in Dec 2012 and it is to earlier that year that I want to look first and inwards to the views of this Society, for my starting point. In 2012, the Society published an insightful paper titled *The Future of UK Defence Aerospace*. The issue at hand, the paper

stated, was the failure to recognise the importance of the UK defence aerospace industry to the economy of the UK and to our nation's defence capabilities. Under Professor Hayward's guidance, the Air Power Group concluded there were three areas in which the UK was failing: ...it did not understand the security and economic case for supporting the industry; ...it was not investing in technology thus allowing skills and interest in them to wane; and, ...it did not realise that systems integration for airframe, sensors and propulsion was key to overall success. I do not have time to expand here but I commend it to you as an excellent read and something which offers a ready-made validation framework against which to assess the DGP.

But does the Society's view accord with those of the market analysts'? The 2013 McKinsey report³⁷ on the outlook for the global defence aerospace sector for 2015, which drew on the views of industry executives', was pessimistic. It saw a shrinking market where companies would need to search for new markets to find growth opportunities with Brazil, the Middle East and the US considered to be the most beneficial. Many said their companies were considering a divergence towards the more lucrative commercial aerospace sector. Within their own sector, provision of support services was seen as significantly more profitable than equipment sales. And only unmanned systems and cyber offered potential in this area. Thus defence aerospace industry leaders unanimously concluded that the nature of the industry was changing and that their companies must change the way they do business. Changes in government defence procurement, greater transparency, simplification and faster processes, more dialogue and collaboration were all on their wish-list. I note also that 'pilots as decision-makers' was one of their concerns.

Even as far back as 2009, when Price-Waterhouse-Coopers took a close look at UK manufacturing,³⁸ their messages on the aerospace and defence sector were similar to McKinsey's: ...[UK needs] an affordable plan that allows industry and government to plan for the future; ...[UK] government must continue to invest in R&D and key skills; ...and UK must develop a 'home markets' strategy for UK-based companies. PWC's message was that competition would be tougher in the future and the UK would have to fight hard to retain its historic position in the sector...and so it is proving to be the case. Fortunately for me, I note that PWC didn't cite UK pilot 'decision-makers' as one of their concerns.

KPMG provides the contemporary view looking out to 2017.³⁹ They stress the need for industry players to: ...explore new partnerships and increase collaboration; ...innovate in everything from

³⁷ *Defense Outlook 2015: A global survey of defense-industry executives* (McKinsey & Company: 2013)

³⁸ *The future of UK manufacturing: Sector-by-sector analysis* (PriceWaterhouseCoopers: 2009)

³⁹ *Global Aerospace & Defence Outlook* (KPMG: 2014)

products to operations; ...and, create strategies to cope with 'disruptive complexity'. KPMG's UK expert added that 'UK aerospace players may still have some heavy lifting ahead' as the UK sector transforms its traditional UK-based operating model towards new global markets. Thus the analysts' message has been surprisingly consistent over a number of years and all reinforce the view of this Society. ...And all views arguably point towards something like the Defence Growth Partnership.

For those in the audience not familiar with the DGP, a brief recap on what it is before I examine what it's supposed to do. Its genesis was the Aerospace Growth Partnership established in 2010, described as a strategic partnership between government and industry to secure the future of the UK aerospace industry for the next 20 years and beyond. The aim is to tackle barriers to growth, boost exports and grow the number of high value jobs in the UK. The DGP is a defence-focussed subsidiary to the Aerospace Growth Partnership - which focused on the commercial aerospace sector - and was launched in autumn 2013. The DGP embraces government in the form of BIS, UKTI and MOD with 16 leading industry bodies and many other small and medium enterprises.

The strategic vision document *Securing Prosperity*⁴⁰ articulates DGP's vision as to secure a thriving UK defence sector delivering security, growth and prosperity for the nation. The strategy for its delivery is to take a fresh and ambitious approach through a joint commitment from government and defence industry to work together...to develop new opportunities by building on UK's strengths in air capabilities and intelligent systems, and ...deliver growth through innovative and tailored solutions for customers around the globe. I don't think any of us would disagree with the ambition - it seems to offer a framework to meet the concerns I outlined at the start of this section. Its success however will be defined by its implementation.

Almost a year ago, government told us how this was to be broadly done in its *Delivering Growth* implementation plan.⁴¹ This plan focuses on 5 areas. First, and most prominent, is the establishment of a UK Defence Solutions Centre to create a new collaborative environment within which to identify innovative and tailored solutions. The next 3 establish the approach: the Defence & Security Organisation within UKTI will strengthen its focus on the needs of customers around the globe; ...Industry's capability will be strengthened by developing the value chain, investing in technology and building skills for the future; and, ...the launch of new growth opportunities by building on national strengths of air capabilities and intelligent systems including the launch of a new UK Centre for Maritime Intelligent Systems. The final area is

⁴⁰ *Securing Prosperity: A strategic vision for the UK defence sector* (DGP: Sep 2013).

⁴¹ *Delivering Growth: Implementing the strategic vision for the UK Defence Sector* (DGP: July 2014).

resourcing - financial and manpower equivalent to £30M split 50/50 - to drive forward the DGP towards full operating capability by mid-2015, ie, now, and until 2017. Again, I think we would all agree that the high-level plan seems to be sound. Its success though will undoubtedly be defined by the actions which accompany the words in the years ahead.

Last November, the House of Commons Defence Select Committee announced that it was launching an Inquiry into the DGP and it is on evidence⁴² submitted to that Inquiry which I now briefly draw on for an indication of progress.

Arguably, three main themes emerged from those involved in its delivery today: this is a complex initiative involving multiple complex stakeholders; ...its main benefits will be felt in the long-term; and ...the DGP is a unique approach to collaboration between a government and its defence industry. The implication is that a degree of strategic patience is required as DGP's success will likely be measured in decades, not months. The next milestone will be publication of a detailed version of its implementation plan to coincide with the DSEI exhibition this September. The Defence Solutions Centre has been established at Farnborough and is working hard on that task. The Centre for Maritime Intelligent Systems has been established in the Solent area and was described by Steve Wadey, DGP co-chair, as 'the most mature project we are running in DGP'.⁴³ It was cited as a good example of how a £4M, 12-month project has benefited from the (re)alignment of industry, regional and government investment in S&T, the latter via the Defence Science and Technology Laboratory, or DSTL.

But defence industry observers, while acknowledging the themes and potential benefits of DGP that are being put forward, have asked some demanding questions of their own. This Society's evidence for example highlighted an 'unpromising future' beyond the current generation of the UK's fast-jet platforms - the F35 Lightning being a US aircraft - and questioned whether a sole focus on RPAS could sustain the UK defence aerospace industry in the 2030 timeframe. It also challenged the government to hold defence S&T investment at 1.2% of the MOD's annual budget - approximately £375M.⁴⁴ This message was echoed by *Prospect*, the union for 11,000 professionals in the MOD and defence industry. Academe cautioned that the 'Action Plan' due in September must demonstrate how the DGP will achieve its intended effects, and identify what budget is required to support it, noting that without both the DGP is 'no more than good

⁴² For oral and written evidence see: <http://www.parliament.uk/business/committees/committees-a-z/commons-select/defence-committee/inquiries/parliament-2010/defence-growth-partnership/?type=Written#pnlPublicationFilter> accessed 3 May 15.

⁴³ See HOC Defence Committee Oral Evidence: Defence Growth Partnership (HC 482), 11 Nov 2014.

⁴⁴ See written evidence by RAeS at: <http://www.parliament.uk/business/committees/committees-a-z/commons-select/defence-committee/inquiries/parliament-2010/defence-growth-partnership/?type=Written#pnlPublicationFilter> accessed 3 May 15.

intentions.' They also challenged the ability of MOD and industry to demonstrate that they have compatible knowledge, skills and behaviors to make the DGP a success.

Let me now turn to MOD interaction with the DGP and, more specifically, that of the RAF. In essence, the UK government faces a difficult balancing act because of the unique national security nature of the defence industry and therefore the unique relationship that must exist between the industry and government. In the context of DGP, government is simultaneously a strategic partner through BIS to the UK defence industry and, through the MOD, it is a customer of the defence industry's products and services. The vehicle for MOD and RAF interaction with DGP is one and the same - the Customer Advisory Group, which is part of the Defence Solutions Centre. This Customer Advisory Group allows Head Office, Joint Forces Command and each of the single Services to offer a customer perspective which might influence the work of the DGP. For the RAF this responsibility falls within my Capability area at Headquarters Air Command and any customer views that we put forward will be done in a way that fully respects the principle of fair and open competition outlined in the *National Security Through Technology* White Paper of 2012.⁴⁵ From our experience to date with the Customer Advisory Group, we feel that it is a forum which is working quite well. Fundamentally, I see the RAF's relationship to an industry-led DGP as one of support for its vision of a strong, competitive and vibrant defence industry, which can only be beneficial to the Royal Air Force as a customer.

I think it would be appropriate at this point for me offer my perspective about other forums where government, its military and the defence industry interact. The NITEWorks initiative set up in 2003 was held up as a good example of behavioral maturity by Sir Brian Burridge, Chair of the DGP's Technology and Enterprise work stream, in his evidence to the Committee's Inquiry. His point is that as a collective we have already been developing and practicing the good behaviours and skills that we need to make DGP a success.

It is perhaps important that I cover the distinction between DGP, NITEWorks and DSTL. DSTL is an MOD Trading Fund dedicated to science and technology in the defence and security field and provides specialists services to MOD and other areas of government. NITEWorks describes itself as a 'decision support' mechanism for the MOD. It is a partnership between the MOD, including DSTL, and industry which operates predominantly in the pre-competition stages of capability acquisition. It is perhaps no surprise that the defence industry participants in NITEWorks and DGP are one and the same. The critical difference is that DSTL and NITEWorks directly support the MOD whereas DGP, although formed by many of the same

⁴⁵ *National Security Through Technology*, MOD White Paper (Cm 8278) (Crown Copyright: 2012)

entities as NITEWorks, is an initiative to boost national prosperity based on increased defence exports...and hence its BIS lead within government. Of course there will be synergies between all three as already evidenced by the realignment of DSTL S&T investment in support of the Centre for Maritime Intelligent Systems. My view is that NITEWorks, DSTL and DGP can be entirely complementary, each entity benefiting from the work done by the others. The trick will be to share information in a timely manner and ensure that we do not duplicate activity.

In the time that remains I should like to offer you a few words on areas of existing capability development where the Royal Air Force, as likely primary customer, has an interest in working closely with the DGP for mutual benefit.

The first, and perhaps most obvious, is the field of air-launched weapons. The Team Complex Weapons initiative is, in my view, a good example of where we have got it right. By working collaboratively on a number of weapon projects concurrently it has pursued a modular approach aimed at reducing the number of different weapons in service by migrating to a smaller number of weapon families and variants with optimum modularity and re-use of subsystems and technology to give better value for money.⁴⁶ I think the weapons area is something the UK has demonstrably excelled in, exerting a nuanced sovereign leadership, particularly across European defence markets. This can only be good for the UK defence industry in the medium-to-long term. One area which would definitely be of interest to the Royal Air Force is development of a multi weapon-bearing interface to allow many types of weapons to be hung off just one type of aircraft-weapon interface. The Royal Air Force's success on operations has, in part, been down to the quality of the weapons provided by the UK defence aerospace industry. ASRAAM, StormShadow and Dual-Mode Seeker Brimstone are in-service today and Meteor's entry to service is now on the horizon. UK defence industry weapons are of course showcased globally by the Royal Air Force as this recently declassified video clip demonstrates.

A short video clip was played highlighting the key characteristics of the Dual-Mode Seeker Brimstone (DMSB) weapon, namely its: low-collateral nature when employed in urban environments; utility against manoeuvring ground targets at speed; lethality against armour; and, DMSB's ability to switch seamlessly between laser and radar guidance modes for terminal guidance to defeat concealed targets.

The next area where I assess that the DGP and the Royal Air Force to have a shared interest is in Intelligence Surveillance and Reconnaissance, or ISR. The UK Joint Forces Command has

⁴⁶ Team Complex Weapons Press Release dated 15 July 2008.

recently concluded its Air ISTAR Optimisation Study, and its output will now inform the SDSR process. I touched earlier upon the sort of things it might be considering but to expand briefly I cite former Secretary of State Philip Hammond's letter⁴⁷ to the Chair of the House of Commons Defence Committee in July 2014: ' Air ISTAR Optimisation Study has identified key risks, prioritised capability gaps against a range of policy-driven scenarios, and conducted an initial assessment of potential solutions to those gaps'. He reported that 'the Study has determined...there remain significant capability issues to address in Land and Maritime Surface and Sub-surface wide area surveillance to 2030 and beyond. In addition, we [government] need to consider Air Surveillance and Air Command and Control capabilities as the Sentry aircraft reaches the end of its expected service life.' ...Commenting on the potential future Air ISTAR force mix, Mr Hammond wrote 'there are a number of technologies which will mature around 2025 that could provide more flexible force mix options, possibly at a significant reduced cost', ...adding, 'they include platforms which would provide ultra-persistence in flight, the ability to process data away from the actual aircraft, and the use of space-based technologies.' I was therefore encouraged to read the ISR example cited by Sir Brian Burridge in his evidence to the DGP Inquiry, he said: 'there is some very advanced technology in complex ISR - proving that we can identify gestating technology upstream and pull it across the valley of death, which is the area that exists between something that has been well demonstrated theoretically, possibly in a university research department, and a prototype on the bench, which is the difficult area.'⁴⁸ On this basis alone it would appear that the Royal Air Force will have cause to engage the DGP through its Customer Advisory Group in the near future.

These are just two areas of interest to the Royal Air Force but there are many others. For example, technological developments have brought space conceptually 'closer' to us all. But what is a clear UK lead in niche areas of space capabilities has almost gone unnoticed. This offers many possibilities from exploitative use of small satellites, perhaps deployed from aircraft, to innovative applications involving Space X platforms, to development of UK space ports. Creativity, imagination and innovation await us. I note that in the Society's 2014 paper on UK space policy, the MOD was given credit for 'developing a wider appreciation of space and its functions in a 21st Century defence and security environment' ...but also that the final word on UK space policy over the last 5 years was 'much promise, but could try harder.'⁴⁹ My message to you is that the Royal Air Force is trying harder on space matters and that we do recognise its growing significance.

⁴⁷ Letter: Rt Hon Philip Hammond MP to Rt Hon Rory Stewart MP (MOD 4.5.2.13 dated 1 Jul 2014). See [http://www.parliament.uk/documents/commons-committees/defence/140711-SoS-to-Chair-re-Air-ISTAR-Optimisation-Study-\(AIOS\).pdf](http://www.parliament.uk/documents/commons-committees/defence/140711-SoS-to-Chair-re-Air-ISTAR-Optimisation-Study-(AIOS).pdf) accessed 4 May 15.

⁴⁸ See HOC Defence Committee Oral Evidence: Defence Growth Partnership (HC 482), 11 Nov 2014. p4.

⁴⁹ *UK Space Policy: A 'Hidden Success Story'*. A discussion paper by the RAeS (London: 2014)

Another area in which the DGP and Royal Air Force have shared interests is in the provision of aircrew training and, specifically, the advanced use of simulation and synthetics to deliver that training. The quality of Royal Air Force live flying training has been such that it has been copied on a global scale; it is something that we do very well. However, we are now at a crossroads. In the future, not only will we have fewer platforms in which to undertake live flying training events but the complexity of the future operating environment and the capabilities of the platforms will mean that to train fully, particularly to mission rehearse demanding scenarios, synthetic environments will become the norm and live training flying the new niche. This is an opportunity as well as a threat. The Royal Air Force will require a synthetic training environment which blends the Live and Virtual to provide an enriched training experience. We are already doing it today for advanced flying training courses at RAF Valley. The Royal Navy is doing it to train its Observers. The next step is to take it to the front-line and take it up a notch or two. This will require us to think and act differently, and the defence aerospace industry also. I am pleased to note that synthetic operational training is one of the DGP's immediate interest areas. The Air Battlespace Training Centre at RAF Waddington has given us a glimpse of the 'art of the possible' as far as the front-line is concerned but its successor, the Defence Operational Training Capability (Air) will need to go much further, and it will need to be easily upscalable to connect to Joint, ...and Combined. Some will merely see less live flying as a threat ...but I only see an opportunity for the Royal Air Force and the defence aerospace industry to help to redefine the new global standard in air power training.

Before I conclude, I want to turn to Sir Sydney Camm, the man in whose name I give this lecture today. What would he have made of all this? Would he have recognised the challenge? Would he have approved of the way the UK is trying to solve it? Sir Sydney died in 1966. That year in the UK, the first cross-channel hovercraft service was launched, an Oberon class submarine was the last ever warship launched from Chatham dockyard and British Rail began operating electric passenger train services between London and Liverpool. Elsewhere in 1966, the Vietnam War was raging, NASA's 2nd and 3rd Apollo missions were launched and a former actor called Ronald Regan was elected as governor of California. The overarching context was, of course, the Cold War. The UK's armed forces were then an all-volunteer force - Sir Sydney would simply not have foreseen the Whole Force era of which I talk today. The British aircraft industry had reduced in size and was consolidating itself into fewer, larger companies after the outcome of the 1957 Sandy's Defence Review, so perhaps he would have recognised some of the parallels in today's challenges to those he saw the defence aerospace industry face then.

Sir Sydney would however have fitted right into the DGP. He was the son of a carpenter and hard work, accuracy and quality were very much to the fore in his approach. He was an innovator, helping to design the distinctive Hawker metal tubular construction in 1925; today, he would recognise DSTL's work on advanced manufacturing techniques. He was a shrewd investor, delaying Hawkers move to the new field of jet propulsion until the timing was right, the Sea Hawk and Hunter was the reward; today, he would recognise the value-added of NITEWorks. And he was a perfectionist, his designs evolved logically but effectively over time; today, he would recognise the principle of spiral development that might underpin a future DGP success. I don't know if Sir Sydney Camm would have approved of what we are doing ...but I'm pretty sure that he would have been in the thick of the DGP action and also pushing the Whole Force along.

To conclude,

Air and space power has evolved rapidly in just over a century of aviation. The world's oldest independent air force and its supporting defence aerospace industry has been at the forefront of much of that evolution, and we should not forget that fact as we are considering today what we can do better tomorrow. But standing still is not in our nature, which is instead to constantly look forward and consider how emerging technologies can be exploited for decisive military effect in, and from, the Air environment. That is why air power continues to be a credible military option and attractive political choice.

Today the Royal Air Force is reconfiguring to meet its requirements in support of Future Force 2020. This transition is being done 'in contact' with the Royal Air Force involved in around 57 operations since the end of the Cold War alone. In fact, it is difficult to recall a time when it hasn't been 'in contact' during that period. Recapitalisation of much of the Force's equipment has gone well, although there is still some work to do, particularly in growing combat air mass and replacing airborne ISTAR capabilities. Regular personnel have reduced to 33,000 and will fall to 31,500 by 2020 as the Whole Force era - regulars, reserves, civil servants and contractors - begins to dominate how global UK military operations are delivered. Affordability is both the catalyst and necessity - manpower is an expensive resource, as is equipment, in an austere financial climate. This is naturally impacting on the global defence industry too. Consequently, there is now an urgent imperative for air and space power to work even more closely with its defence aerospace industry in its 2nd Century if both are to continue to prosper as they did in its first.

And what of that future? Security, prosperity and freedom are key areas of the UK's national interest. The MOD and UK armed forces, like all other government departments, will be required to contribute to their delivery. But analysis suggests that the future defence and security landscape will be more complex, with less certainty but provide more diverse challenges. Globalisation is the catalyst and rapid advancement of technology which proliferates widely threatens to leave Western militaries overmatched.

For the defence industry which must react to this shifting landscape, the challenges are arguably threefold: better affordability, improved technology exploitation and securing sufficient human capital to deliver it. A constrained defence budget will inevitably mean fewer numbers of equipment and increased unit costs, and if unchecked, a downward spiral of decline. New technology is increasingly exploited first in the commercial sector before flowing to the military, reversing a long-standing trend. The defence industry must therefore develop new exploitation strategies if the sector is to stay ahead of the technology curve. And it must do all of this facing a global STEM skills shortage - the UK alone is estimated to need an additional 1.82M engineers by 2022. The Royal Air Force is not immune to this human capital challenge as it too must compete for the best STEM graduates, all while it implements a plethora of organisational and technical changes mandated of it. The implication is that the Royal Air Force and defence aerospace industry would be better off if they work together to solve these multiple challenges for the journey each is now on is effectively one and the same. Neither can solve their problems in isolation.

The Defence Growth Partnership, a strategic collaboration between government and industry is a solution on the table. It is an export-led initiative to secure the future of the UK's defence industry and benefit the UK economy. The MOD and UK armed forces will be one of its customers. Two and a half years since its launch, the words of the DGP's vision, strategy and high-level implementation plan are being turned into action. Most notably, the Defence Solutions Centre, the 'engine room' of the DGP is up and running and working on its detailed delivery plans which are to be published this autumn.

Progressive, inclusive and ambitious, the Defence Growth Partnership appears to address the major concerns of this Society and market analysts that pre-date it. But some, including this Society, are worried that the level of investment in science and technology is too low. Others suggest that without a detailed plan in-place and its identified future budget secured, the DGP is no more than 'good intentions'. Some question whether the culture of government and the defence industry can change sufficiently to allow the good behaviours to flourish that the DGP will need for its success. Insiders counter that they are already doing this.

The Royal Air Force supports the DGP initiative. It can see the potentially synergistic benefit of interaction and alignment of activity between the two MOD-facing entities of DSTL and NITEWorks with the BIS-facing DGP. The Royal Air Force will therefore fully commit to the work of the DGP's Customer Advisory Group and we can see some opportunities for mutual benefit, particularly in the areas of weapons, ISR, space and synthetics. But we recognise that the DGP is also a complex, unique and long-term initiative and the 'leap of faith' that it represents for government and the defence aerospace industry alike will need to be underpinned by a dose of strategic patience. Its success will likely be measured over decades, not months, as the DGP is a part of the National Industrial Strategy in action. Many nations are watching us.

This lecture's central thesis was that the relationship between UK air power and its defence aerospace industry in the Whole Force era is now truly symbiotic; if either fails, they both fail, and the UK loses its competitive advantage on many fronts. What therefore might success look like for the DGP?

In evidence to the Defence Committee, most considered success to be defined by markets. BIS saw it as an increased export presence, evidence of greater collaboration and innovation, and, being more competitive through the whole supply chain. Phillip Dunne felt that DGP will have been a tremendous success if in 10 years' time UK continues to have the second largest defence industrial base in the world. The industry DGP co-chair suggested that the ultimate measure of success...is increasing the UK's global market share.

But the MOD's interpretation of DGP's success will of course be viewed through a different lens. It views success in terms of greater affordability, better value for money and greater interoperability with partners and allies. As a potential customer of DGP but also ultimate guarantor of national security, MOD will have a difficult dilemma to ponder. Namely when it must choose to protect UK operational advantage and freedom of action because such decisions always involve a balance of risk and opportunity cost. For the Royal Air Force it will be straightforward. Either we will have the equipment we need to fight and win in contested environments, or we will not - it is that simple. I can personally reassure industry partners that I will do my best to ensure DGP's overall success.

Thus, this matters to the nation for reasons of economic prosperity, growth and security. The market analysis suggests that over the next 8 years, £82Bn of global military spending will occur in areas where the UK defence industrial base considers itself to be particularly strong -

Air capabilities and Intelligent Systems. The UK's share of the global market in 2013 was £9.8Bn and, in the words of the DGP's industry co-chair: 'there is room for improvement'.⁵⁰

President, Society members and guests - thank you for your attention.

⁵⁰ See HOC Defence Committee Oral Evidence: Defence Growth Partnership (HC 482), 11 Nov 2014. p19.