

The future of allied air power

The Royal Air Force

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Defence Research and Development Canada

Scientific Report
DRDC-RDDC-2017-R166
November 2017

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IMPORTANT INFORMATIVE STATEMENTS

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Abstract

The purpose of this Scientific Report is to inform discussions of capability and concept development within both the RCAF and CAF. This is the third in a series of reports written for the Commanding Officer of the Canadian Forces Aerospace Warfare Centre. The method adopted begins with an analysis of the policy and supporting strategy framework of, in this case, the United Kingdom (UK) to develop an understanding of the direction being given to its military on the areas of the world and threats against which it is to prepare. On the basis of this understanding of the key tenets of UK strategic thinking it is possible to identify those concepts and capabilities being developed to prepare the Royal Air Force (RAF) to meet those threats. The findings of this analysis are that the UK will, for its own geostrategic reasons, continue to develop the capabilities necessary to ensure it remains an indispensable ally to the world's dominant naval and air power. The institutional change those capabilities are forcing on the RAF are an example of what the RCAF and CAF need to do to define a meaningful role for air and joint operations moving forward. Thus, this analysis of the UK experience could serve a range of functions within the Department of National Defence and the CAF, from focusing RCAF capability and concept development through to informing joint force development.

Significance to Defence and Security

This Scientific Report is the third in a larger analytical effort whose reports are being used in Canadian Armed Forces (CAF) joint-level Force Development (FD) activities and have been distributed to the Five-Eyes (FVEY) joint FD organizations. When completed, this analytical effort will help to provide a focus to RCAF and CAF concept and force development. Through the development of a more comprehensive understanding of the orientation, threat perception, and capability and concept development efforts of Canada's key allies this analytical effort will identify areas that RCAF and CAF concept and force development communities need to explore to ensure the CAF maintains its position as a trusted and capable ally. Moreover, the general analytical approach developed in this report, of creating and using an understanding of 'future warfare' as the main method for force development across the services, has been gaining momentum within the CAF, and is recommended for wider use.

Résumé

Le présent rapport scientifique est le troisième d'une série destinée au commandant du Centre de guerre aérospatiale des Forces canadiennes. Son but est de rendre compte des discussions sur le développement de capacités et de concepts au sein de l'Aviation royale canadienne (ARC) et des Forces armées canadiennes (FAC). La méthodologie adoptée consistait tout d'abord à procéder dans le présent cas à une analyse de la politique et du cadre de la stratégie d'appui du Royaume-Uni (R.-U.) en vue d'acquérir une compréhension de l'orientation que ce pays donne à ses forces armées quant aux régions de la planète et aux menaces contre lesquelles elles doivent se préparer. En fonction de cette compréhension des principes clés de la pensée stratégique du R.-U., il est possible de définir les concepts et capacités développés en vue de préparer la Royal Air Force (RAF) à faire face à ces menaces. Cette analyse permet de conclure que le R.-U. continuera, pour ses propres raisons géostratégiques, de développer les capacités dont il a besoin pour s'assurer de demeurer un allié indispensable de la puissance navale et aérienne dominante du monde. Le changement institutionnel que ces capacités poussent la RAF à adopter illustre les mesures que l'ARC et les FAC doivent prendre pour définir un rôle significatif et permettre aux opérations aériennes et interarmées d'aller de l'avant. Ainsi, l'analyse de l'expérience du R.-U. pourrait être utile dans le cadre d'un vaste éventail de fonctions au sein du ministère de la Défense nationale et des FAC, qu'il s'agisse simplement d'orienter le développement des capacités et concepts de l'ARC ou même de contribuer au développement des forces interarmées.

Importance pour la défense et la sécurité

Le présent rapport scientifique est le troisième dans le cadre d'un plus vaste travail d'analyse consacré aux activités de développement des forces (DF) au niveau interarmées des FAC et diffusé aux organisations de DF interarmées du Groupe des cinq. Une fois mené à terme, ce travail d'analyse aidera à orienter le développement des forces et des concepts de l'ARC et des FAC. En acquérant une compréhension exhaustive de l'orientation, de la perception des menaces et des efforts de développement de capacités et concepts des alliés clés du Canada, ce travail d'analyse permettra de déterminer les domaines que les communautés responsables du développement des concepts et des forces de l'ARC et des FAC doivent explorer pour que ces dernières conservent leur statut d'allié digne de confiance et compétent. De plus, il est recommandé d'utiliser à plus grande échelle la démarche analytique générale, de plus en plus en vogue, décrite dans le présent rapport, laquelle consiste à acquérir et mettre en pratique une compréhension de la « guerre de l'avenir » comme principale méthodologie de développement des forces dans les trois armées.

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1 Introduction

The primary purpose of this paper, which is part of a larger analytical effort seeking to develop a comprehensive understanding of how Canada's key allies see the evolution in warfare and how they plan to meet it through concept and capability development, is to provide a focus for the Canadian Forces Aerospace Warfare Centre's (CFAWC) Concept Development and Experimentation (CD&E) efforts. The method developed for this project, and used in this analysis, involves looking first at the current driving forces behind the subject nation's strategic thinking in order to set an appropriate context with which to understand the path being charted by its air force in terms of major capability investment and concept development. In this instance, an appreciation of the British approach to the United States (US), its policy regarding the military rise of China and the re-emergence of Russia as potential threats to European and world security, and the Royal Air Force's (RAF) efforts to find a meaningful role in the evolution of American concepts of air and joint warfare will offer useful insights for Royal Canadian Air Force's (RCAF) own capability and concept development. This is not to suggest that the RCAF should follow the path of any of its key allies (including the US) exactly, merely that such an understanding will assist greatly in setting its own course.

This more comprehensive awareness of the direction the UK is taking also could serve as an important input into policy formulation discussions, which form the first crucial step in the preparation of a coherent national response to the threats facing the nation and its interests. How nations conceive of these threats in the context of their unique geostrategic imperatives orients their policy and focuses their strategy, the latter identifying in detail how resources will be applied and, *inter alia*, how military capabilities and concepts will be developed. Put simply, in order to understand the British position, and thus the direction its air force is taking, it is necessary first to have a better understanding of its conception of the threats faced, and of its corresponding policy and strategy formulation.

2 UK Strategic Thinking and Geostrategic Imperatives

Once the greatest empire the world had seen, and one on which at its height the sun never set, the British Empire controlled roughly a quarter of the world's land mass, population, and was the centre of the world economy. Maintaining a tolerable level of control and protection over a disparate empire, while still ensuring the defence of the home islands, was no simple matter.¹ The character of the national policy and concomitant strategies adopted at various times to deal with specific threats changed over time, but their general nature endured. In its early stages, the British sought to prevent the emergence of a dominant power in Europe and used alliances and limited military power to check the rise of those who would upset the balance of power in Europe. For example, during much of the period between 1688 and 1714 while England's naval power was growing, it remained a minor power with minimal influence in Europe. It had only a limited ability to project power into Europe's nearly continuous wars, but needed to maintain a balance in Europe so no single country or coalition could rise and challenge English security. In its wars against France in this period, the English goal was simply to check France's advances and maintain an acceptable balance, rather than to engage in a war of annihilation. With the expense and risk of war, this was a sensible approach. Armies and navies were costly to raise, equip, and supply, and using them tore at the social fabric at home and abroad, and risked the survival of the state. As such, wars of annihilation were not a practical means of attaining desired ends. England's (and later Britain's) approach, therefore, was to seek to put multiple pressures on an adversary to restrain it and maintain the balance of power in Europe. Where possible, it would use naval power to blockade the enemy and threaten its economic prosperity. At the same time, the English used diplomacy to forge alliances to threaten adversaries from as many sides as possible, forcing them to mobilize, equip, and supply large and expensive land forces to further strain their resources. The ultimate objective of the use of English and coalition power was to

reduce her enemies to the point at which they were so short of money that their armies were melting away because their troops were unpaid and their ships and crews were rotting at their moorings because there was no money to victual or repair them. When they were reduced to that position they could either continue the war and face total collapse or they could negotiate peace before calamity overtook them. As long as the English were ready to offer them even half reasonable terms, they chose the second course.²

Again, until the First World War the intent was not to crush adversaries, creating a power vacuum from which another adversary might benefit, but rather to limit their power and thus safeguard

¹ J. Clarke, *British Diplomacy and Foreign Policy, 1782–1865: The National Interest* (London: 1989); K. Bourne, *The Foreign Policy of Victorian England, 1830–1902* (Oxford: Oxford University Press, 1970); H. W. V. Temperley, *The Foreign Policy of Canning, 1822–1827; England, the Neo-Holy Alliance, and the New World*, 2nd edition (London: Frank Cass & Co. Ltd., 1966); C. K. Webster, *The Foreign Policy of Castlereagh, 1812–1815. Britain and the Reconstruction of Europe*, 2nd edition (London: Bell & Sons, 1950); S. Mahajan, *British Foreign Policy, 1874–1914: The Role of India* (London: Routledge, 2002), B.J.C. McKercher, “National Security and Imperial Defence: British Grand Strategy and Appeasement, 1930-1939,” *Diplomacy and Statecraft*, 19 (2008): 391–442.

² David French, *The British Way In Warfare 1688-2000* (London: Unwin Hyman, 1990), 2.

English commercial and other interests as cheaply and easily as possible.³ In general, this strategy worked quite well. For example, in the War of the Spanish Succession (1701–1714) the diplomatic efforts pulled together the broadly parallel interests of the Grand Alliance (England, the United Provinces, Prussia and Austria), something equally important to the ground campaigns led by the Duke of Marlborough in attaining English goals. In the end, that war saw Bourbon France economically stressed, physically exhausted, and forced to recognise both Protestant succession in England and also the separation of the French and Spanish crowns.⁴ A side benefit saw the yielding of territories in Newfoundland and the Hudson’s Bay to England and its emergence as the dominant naval power in the North Atlantic and the Mediterranean.

This strategy, and its later use in other circumstances, served some of England’s (and later Great Britain’s) geostrategic imperatives—those things that a nation, regardless of political proclivities, must do.⁵ Unity in the British Isles to prevent hostile powers from developing on its doorstep, or using those islands as a base from which to operate against England, is the first of these imperatives. For this reason England could not tolerate an independent Wales or Scotland, and has moved on numerous occasions to unify its own island. Second in importance is preventing the establishment of a safe harbour for hostile naval forces near England. This has “led to English domination of Ireland and of the southern English Channel coast, along with the Norwegian coast.”⁶ The final geostrategic imperative was the domination of the seas to construct an empire that would provide the flow of raw materials for British manufacturing needed for economic prosperity and independence from Europe. For all these reasons, the British had to take an active interest in preventing the rise of a competitor on the continent that could challenge or threaten these imperatives.

It was primarily in defence of those imperatives that Britain engaged so heavily in the wars against Napoleon. The rampaging of French armies across Europe and the threat of its naval power was something the British could not tolerate. Not only did it threaten the establishment of French dominance of most of Europe and the resulting power that would bring, but its gaze would inevitably turn to Britain, and indeed for a time it did.⁷ French naval and land strength offered the possibility of invasion that was intolerable to Britain. Indeed, France under Napoleon threatened all three British geostrategic imperatives, and until the Battle of Trafalgar in 1805 when Admiral Horatio Nelson led a force that destroyed French naval power for the better part of the next century, invasion seemed a distinct possibility.⁸ The Allied victory at Waterloo in 1815,

³ Winston S. Churchill, *Marlborough: His Life and Times* (London: George G Harrap & Co, 1934), and Gerald Nicholson, *Marlborough and the War of the Spanish Succession* (Ottawa: Queen’s University, 1955).

⁴ J. F. Boshier, “The Franco-Catholic Danger, 1660-1715,” *History*, 79, 255, (1994): 5–30.

⁵ George Friedman, “How British Elections Represent the State of Europe,” Stratfor, 5 May 2015, <https://www.stratfor.com/weekly/how-british-elections-represent-state-europe> (accessed 14 June 2016). Friedman calls these Britain’s geopolitical imperatives, but this ignores their endurance despite political inclinations. Thus, the author of this paper refers to them as geostrategic imperatives.

⁶ *Ibid.*

⁷ Mark Philip, ed., *Resisting Napoleon: The British Response to the Threat of Invasion, 1797–1815* (London: Ashgate Publishing, Ltd., 2006); Margaret Bradley, “Bonaparte’s Plans to Invade England in 1801: The Fortunes of Pierre Forfait,” *Annals of Science*, 51 (1994): 453–475.

⁸ Julian Stafford Corbett, *The Campaign of Trafalgar* (London: Longmans, 1910); J. Hayward, *For God and Glory: Lord Nelson and His Way of War* (Annapolis MD: Naval Institute Press, 2003); Marianne Czisnik, “Admiral Nelson’s Tactics at the Battle of Trafalgar,” *History*, 89, 296 (2004): 549–559; Jon Robb-Webb, “Corbett and The Campaign of Trafalgar: Naval Operations in their Strategic Context,” *Defence Studies*, 8, 2 (June 2008): 157–179.

according to Wellington “the nearest-run thing you ever saw in your life,” had fortunate consequences for Britain.⁹ Not only did it re-establish the balance of power in Europe, but it eliminated France as a rival naval power for much of the 19th century. What resulted has commonly been referred to as the Concert of Europe where powers sought to avoid further wars through the maintenance of a balance of power,¹⁰ one where Britain ensured its own security through its naval supremacy.

It was not until the late 19th century when this favourable situation began to deteriorate. When Germany unified in 1871, its dynamic economy and efficient production methods challenged British economic prosperity by producing and selling goods more cheaply on the continent than could Britain.¹¹ Across the Atlantic, the United States was emerging as an economic power that, by the beginning of the 20th century, was beginning to develop its own powerful navy. While not a direct challenge to the Royal Navy, the German and American navies could pose problems for the British should they have ever united in purpose.

Britain’s fortunes declined rapidly in and after World War I, that calamity for Britain and its Empire, and for Europe and the world. Not only was an entire generation devastated by the meat grinder of the Western Front, but the war’s costs damaged the British economic base and the aftermath prevented it righting itself. Equally importantly, it damaged the image of invincibility that had characterised the British Empire since the end of the Napoleonic wars. Economically, Britain no longer dominated its empire, but rather became its dependant. Germany might have been forced to accept what it viewed as an unendurable peace embodied in the Treaty of Versailles, but it did not view itself as vanquished.¹² Indeed, historians typically view the First and Second World Wars as one continuous war broken by a fairly short peace. The end of the Second World War decisively destroyed British supremacy on the seas and over its empire. The world order it had created, and over which it stood watch, was gone, replaced first by the bi-polar Soviet Union/United States rivalry in the Cold War, followed by the unipolar world dominated by the US after the fall of the Soviet Union.

Naturally, this was a bitter pill for the British to swallow, but its post-World War Two strategy evolved rapidly to remain aligned with the US in countering the Soviet Union in the early stages of what would become the Cold War. The so-called ‘special relationship’ hinged on the sizeable and capable British military and nuclear forces, and its willingness to operate in step with

⁹ Thomas Dwight Veve, *The Duke of Wellington and the British Army of Occupation in France, 1815–1818* (Westport CT: Greenwood Publishing Group, 1992), 39.

¹⁰ Branislav L. Slantchev, “Territory and Commitment: The Concert of Europe as Self-Enforcing Equilibrium,” *Security Studies*, 14, 4 (October–December 2005): 565–606.

¹¹ Richard Lachmann, “Elite Self-Interest and Economic Decline in Early Modern Europe,” *American Sociological Review*, 68, 3 (2003): 346–372, 367.

¹² In truth, the Versailles Treaty was less harsh than the Treaty of Brest-Litovsk that ended the First World War between Russia and Germany. A debate still rages amongst historians about the effect of the treaty, and in particular French Prime Minister Georges Clemenceau’s insistence on the so-called ‘war guilt clause’, and the rise of Hitler. For examples of this debate see Margaret MacMillan, *Paris 1919: Six Months that Changed the World* (New York: Random House, 2001), John Kershaw, *Hitler 1889-1936* (London: W.W. Norton and Company, 2000), Klaus Schwabe, “World War I and the Rise of Hitler,” *Diplomatic History*, 38, 4 (2014): 864-879.

US strategy, which ultimately has and continues to define the parameters of British strategy.¹³ While unable to match the United States militarily, the British did outstrip other American allies both in the quantity of their military resources and in their willingness to use them at the behest of the Americans. This might be called a “lieutenant strategy”¹⁴ where Britain maintained a full-spectrum military force, including nuclear strike options, which was smaller than the US military but more capable than those of other US allies. It accepted the reality of a subordinate position to the US, but retained value by avoiding being just another ally. In so doing, its ‘special relationship’ has allowed it to retain some ability to influence US policy in support of its own ends. Two examples of this were US intelligence support to Britain during the ‘troubles’ in Northern Ireland, and its ability to generate US support for the war against Argentina in the Falkland Islands in 1982. The latter was a conflict in which the US had no stake, but it was willing to provide its support for the British position.¹⁵ In the recent conflict in Libya, in which the RCAF provided a capable component under the Canadian Expeditionary Forces Command (CEFCOM) for its operation MOBILE, the British and French were able to draw a reluctant US into the coalition.

Britain has also continued to try and prevent the rise of a united power in Europe capable of threatening its security. It participated in the European Union (EU), but only in a limited way. It did not join the Eurozone, and thus maintained flexibility with its currency with which to deal more effectively with the 2008 financial crisis. Some have speculated, tongue-in-cheek, that the reason for British participation in Europe was to continue its foreign policy objective of the last half-millennium of a disunited Europe by working from within. To quote Sir Humphrey Appleby, a character from the popular British television series ‘Yes Minister’, on the British approach to the EU, “Now that we’re inside we can make a complete pig’s breakfast of the whole thing: set the Germans against the French, the French against the Italians, the Italians against the Dutch. The Foreign Office is terribly pleased; it’s just like old times.”¹⁶ The truth of the matter is that while the US remains the largest single country for British exports, it is only so if the whole of the EU is not counted as an entity.¹⁷ Europe is very clearly central to Britain’s world view and economic strength. Despite the recent and very close referendum to leave an EU that might well be in the initial stages of disintegration, that close integration will remain.¹⁸

Its position regarding Europe does assist it with another facet of its strategy. In addition to being the most capable and willing of US allies, as evidenced through its participation in the Iraq war while Canada, Germany, and France (and others) did not, Britain has shifted its strategy from maintaining the balance of power on the continent to maintaining a balance between the US and Europe. From a US perspective, this was an entirely useful role, and one that allowed Britain to

¹³ Tim Street, “SDSR 2015: Continuity, Control and Crisis in UK Defence Policy,” *Oxford Research Group* (January 2016), 2.

¹⁴ George Friedman, “How British Elections Represent the State of Europe.”

¹⁵ *Ibid.*

¹⁶ “Yes Minister: The Writing on the Wall” <http://www.imdb.com/character/ch0030014/quotes> (accessed 16 June 2016).

¹⁷ Tim Oliver, “To be or not to be in Europe: is that the question? Britain’s European question and an in/out referendum,” *Chatham House The Royal Institute of International Affairs*, https://www.chathamhouse.org/sites/files/chathamhouse/field/field_publication_docs/INTA91_1_05_Olive_r.pdf (accessed 16 June 2016); “If it ain’t broke, don’t Brexit” *The Economist* (30 April 2016).

¹⁸ Robert Cooper, “Britain and Europe,” *International Affairs* 88:6 (2012): 1191–1203.

be not only the most capable militarily of US allies and an essential partner in dealing with Europe, but also enabled Britain to leverage that relationship to its own ends.

The end result of Britain's strategy should see it well positioned regardless of what happens with the US and the EU. Should the EU remain, that relationship will be more difficult to maintain because of animosity following the British exit, but should the EU disintegrate Britain will be well-placed to assist the US in dealing with the fallout. Moreover, if US presidents continue the policy of relying on allies to shoulder more of the burden in regional conflicts, the British will be well-placed to play a lead role and to continue to use the relationship to its own benefit. Conversely, should the current or a future US president seek to re-establish a more prominent role in world security, it will still need key allies with which to partner and the British have a long history of doing so in support of US and their own interests. Their strong economic ties to both the US and Europe will allow them to serve as a mediator between the US and Europe even should the EU fail and Europe fragment back into individual nations, exploiting the situation to their own advantage. Moreover, the US is likely to support them in doing so. To some, the "British strategy represents a classic case of a nation accepting reversal, retaining autonomy, and accommodating itself to its environment while manipulating it."¹⁹ It will maintain its options while watching how things play out, and will position itself "to take maximum advantage of its shifts in the environment."²⁰ This argument perhaps reaches too far and may not account sufficiently for a degree of lethargy that seems to have crept into British strategic thinking, something outlined below. But in general it does capture the British approach to the world in which it finds itself.

¹⁹ George Friedman, "Britain's Strategy," <https://www.stratfor.com/weekly/britains-strategy> (accessed 23 June 2016).

²⁰ *Ibid.*

3 UK Strategic Guidance

There seems to be a disturbing trend amongst Western powers, all of whom suffer from what some prominent scholars have suggested is “a serious strategy deficit” brought about by the imprecision with which the word ‘strategy’ has been used, conflating ‘strategy’ with ‘policy’.²¹ While some may see this as taking a purist attitude, this imprecision matters when fighting wars of national survival against adversaries capable of targeting such weaknesses to seek political and military confusion.²² The wars Western nations, Britain included, have fought in recent times have not been wars of national survival, and thus some concerning imprecision has crept into the terms ‘policy’ and ‘strategy’ are understood and used. One example of how far this conflation has progressed can be seen in a speech of former US President George Bush when he said that the “forward strategy of freedom must also apply to the Arab-Israeli conflict.”²³ Strategy refers to a way of mobilising resources towards a desired end. In this case, former President Bush had mixed the ‘ways and means’ with the ‘ends’. In order to maintain clarity in purpose and coherence in planning, a nation’s policy must set the target towards which the strategy can be developed.²⁴ Those policy goals, ideally tied to national interests, endure while strategies change to deal with unanticipated developments, sometimes evolving rapidly.²⁵ They are very different and must be treated accordingly. To do otherwise is to diminish both.

The British may realise this problem as in May 2010 a National Security Council (NSC) was established, and chaired by the Prime Minister (PM) with a mandate to establish a “forum for collective discussion of the government’s objectives for national security and about how best to deliver them in the current financial climate.”²⁶ The government’s National Security Advisor (NSA) chairs the Permanent Secretaries Group that supports the NSC and also serves as the secretary to the NSC.²⁷ The responsibilities of the NSA are, *inter alia*, to coordinate the publication of the National Security Strategy (NSS) and the Strategic Defence and Security Review (SDSR), which “set out in detail how the UK Government intended to approach national security issues. At the end of November 2015, the 2015 National Security Strategy and SDSR were published, this time in a single document” showing an incomplete comprehension of the

²¹ Colin Gray, “The Airpower Advantage in Future Warfare: The Need for Strategy,” *Airpower Research Institute Papers 2007-02* (Maxwell AFB: Airpower Research Institute, 2007), 2–4; Hew Strachan, “The Lost Meaning of Strategy,” *Survival*, 47, (2005), 37.

²² Hew Strachan, *The Direction of War: contemporary Strategy in Historical Perspective* (Cambridge: Cambridge University Press, 2013), 16.

²³ Bruce Anderson, “Mr. Bush’s speech in London showed the thinking of a great world leader,” *Independent* 23 November 2003, <http://www.independent.co.uk/voices/commentators/bruce-anderson/mr-bushs-speech-in-london-showed-the-thinking-of-a-great-world-leader-79703.html> (accessed 15 July 2016).

²⁴ Edward Luttwak, *Grand Strategy of the Byzantine Empire* (Cambridge CT: Harvard University Press, 2009), 409.

²⁵ Hal Brands, *The Promise and Pitfalls of Grand Strategy* (Carlisle PA: US Army War College Strategic Studies Institute, 2012), 8; Williamson Murray, Richard Hart Sinnreich, and James Lacey, eds., *The Shaping of Grand Strategy: Policy, Diplomacy, and War* (New York: Cambridge University Press, 2011), 7.

²⁶ “National Security Council,” <https://www.gov.uk/government/groups/national-security-council> (accessed 4 January 2017).

²⁷ *Ibid.*

difference between a national security strategy and a defence policy.²⁸ From there, a new committee of the NSC, chaired by the Chancellor of the Duchy of Lancaster, currently Patrick McLoughlin, will oversee the implementation of the strategy through its component parts.²⁹ And yet the tendency to conflate two linked but different aspects of UK national security—its defence policy and national security strategy—has continued in its latest SDSR.

3.1 UK National Security Strategy and Strategic Defence and Security Review

In November 2015, the UK government released its latest SDSR, which set out its NSS, articulated much of its defence policy, and detailed its strategic and budgetary priorities.³⁰ It is not yet clear what the decision to leave the European Union will have on the UK government's plans, but it is possible that its spending estimates may have to be revisited if its projected Gross Domestic Product (GDP) growth fails to materialise as a result of the Brexit decision.³¹ Some authors argue that once the UK leaves the EU its representation in European foreign policy discussions will be minimal, and its influence over European affairs much diminished. This, in turn may deepen what they see as an “inward-looking UK approach to the problems of the wider world.”³² The end of EU membership may also lead to calls from the US for the UK to redevelop a global defence posture, and may result in pressure on the UK to reinvest in European defence through NATO as one of its few bargaining chips in the negotiations on its economic future in Europe.³³ After the June 8 election in the UK that saw British Prime Minister Theresa May lose her parliamentary majority, an informal process is underway to refresh the SDSR, but that process will be informed by the enduring geostrategic imperatives outlined earlier.³⁴ As yet, however, no official plan for a reassessment of the 2015 SDSR has been signalled by the UK government. Many in the UK defence establishment have applauded the 2015 SDSR's commitment to increased defence funding, something that will both halt and reverse the trend established in the previous SDSR in 2010.

Following the 2010 SDSR, which began a five year period of substantial reduction in defence spending, service personnel, and what some have called a ‘Treasury-led’ approach to national defence policy, the 2015 SDSR seems to have provided a welcome sense of stability.³⁵ Unlike its

²⁸ Jon Lunn, Louisa Brooke-Holland, and Claire Mills, “The UK National Security Council,” *House of Commons Library Briefing Paper* Number 7456, (11 January 2016), 5–6.
<http://researchbriefings.files.parliament.uk/documents/CBP-7456/CBP-7456.pdf> (accessed 4 January 2017).

²⁹ *Ibid.*

³⁰ Her Majesty's Government, *National Security Strategy and Strategic Defence and Security Review, 2015: A Secure and Prosperous United Kingdom* (London: Her Majesty's Stationery Office, 2015), 15.

³¹ Malcolm Chalmers, “Would a New SDSR Be Needed After a Brexit Vote?” *Royal United Services Institute Briefing Paper* (June 2016), 1.

³² Malcolm Chalmers, “The UK and the North Atlantic After Brexit,” in John Andreas Olsen, ed., *NATO and the North Atlantic: Revitalising Collective Defence* (London: Whitehall Papers 87 (1), 2016).

³³ Malcolm Chalmers, “Would a New SDSR Be Needed After a Brexit Vote?”

³⁴ John Louth, Trevor Taylor, and Andrew Tyler, “Defence Innovation and the UK: Responding to the Risks Identified by the US Third Offset Strategy,” *Royal United Services Institute Occasional Paper* (July 2017), 2.

³⁵ Andrew M. Dorman, “Crises and reviews in British defence policy,” in Stuart Croft, Andrew Dorman, Wyn Rees and Matthew Uttley, eds., *Britain and defence 1945–2000: a policy re-evaluation* (Harlow: Longman, 2001), 9–28; Paul Cornish and Andrew M. Dorman, “Fifty shades of purple? A risk-sharing approach to the 2015 Strategic Defence and Security Review,” *International Affairs* 89:5 (2013): 1183–1202; Malcolm

2010 version which, according to a former Secretary of State for Defence and NATO Secretary General, Lord Robertson, was anything but a strategic review of British defence. He argued that:

My Lords, having done, with honourable colleagues, a strategic defence review that was consultative, inclusive, policy-led and convincing, perhaps I can say to the Leader of the House that I know a strategic review, I have done a strategic review, and this is not a strategic review...Instead, will it not be seen by the country as a cobbled-together exercise on the back of a letter from the Treasury calling for deep and random cuts in the defence budget?³⁶

Lord Robertson went on to say that this policy review “will have aircraft carriers without aircraft, an army that is at war reduced by 7,000 operational troops, and really nothing at all said about how we will blend in and mix with our NATO allies to meet the challenges of the future.”³⁷ The 2010 SDSR instituted cuts of eight percent in real-terms since 2010, and numbers of service personnel have fallen from 178,000 to around 145,000.³⁸ The 2015 SDSR will reverse many of these cuts, but its broad policy guidance is still couched within an overall NSS aimed to provide the level of direction needed for the component parts of the UK defence and security communities to develop their own plans to achieve its aims. Sharp cuts to front-line aircraft and ships, as well as the loss of a maritime patrol capability will be arrested, and defence spending is expected to rise by around five percent by 2020–2021.

3.2 Ministry of Defence (MoD) Departmental Plan: 2015–2020

Following the guidance delivered in the 2015 SDSR, the Ministry of Defence issued its own departmental plan outlining how it intends to deliver on the SDSR. In addition to committing to a defence spending target of 2% of GDP on defence for the rest of the decade, the plan includes a “stronger defence with more ships, more planes, more troops at readiness, better equipment for special forces, and more for cyber.”³⁹ More specifically, the plan calls for a new Joint Force 2025, able to deploy a force of 50,000. Moreover, the plan commits the UK to the pursuit of a comprehensive political and military strategy to defeat Daesh, retaining the Trident nuclear deterrent and building the new fleet of four Successor Ballistic Missile Submarines, bringing the two new aircraft carriers HMS Prince of Wales and HMS Queen Elizabeth into service so one is always available, developing proposals to ensure the UK armed forces can operate overseas free from persistent legal claims that undermine their ability to do their jobs, continuing to invest in cyber defence capabilities, maintaining the size of the regular armed forces and keep the army above 82,000, and increasing the reserve forces to 35,000.⁴⁰

Chalmers, “Steady as She Goes: The Outcome of the 2015 SDSR,” *Royal United Services Institute Commentary* (23 November 2015), 1.

³⁶ Hansard House of Lords Debates, 19 October 2010 c784, <https://www.publications.parliament.uk/pa/ld201011/ldhansrd/text/101019-0001.htm#10101930000474> (accessed 23 May 2017).

³⁷ *Ibid.*

³⁸ Malcolm Chalmers, “Steady as She Goes: The Outcome of the 2015 SDSR,” 1.

³⁹ Government of the United Kingdom, “Single department plan: 2015-2020,” <https://www.gov.uk/government/publications/mod-single-departmental-plan-2015-to-2020/single-departmental-plan-2015-to-2020> (accessed 17 January 2017).

⁴⁰ *Ibid.*

The RAF is receiving new capabilities, but its size will only grow by 500 Regular Force and 120 Reserves.⁴¹ Therein lies the rub. It is a source of concern for some within the RAF that the manpower requirements for these new platforms have not kept pace and, while it is expected that the aircraft will show up on the ramp as scheduled, that the personnel and supporting systems required to operate them to their full potential may not be available.⁴² Despite this, the RAF senior leadership seems confident in public that those essential elements of a capability will be delivered as part of a world-class RAF.

3.3 RAF Strategy

In response to the SDSR and other Defence Strategic Guidance, the RAF has developed its own strategy for how it will contribute to the attainment of the policy goals outlined in the NSS and SDSR.⁴³ The three aims of the strategy are to commit resources behind RAF personnel, deliver on the ongoing and anticipated operations, and to increase its front-line strength.⁴⁴ How it will operate is a matter for its force employment and future air and space operating concepts (FASOC). The FASOC receives its guidance from the RAF strategy and from the 2015 SDSR. Indeed, a new iteration of the FASOC is being written not as a stand-alone document, but rather as part of the Future Force Concept (FFC), along with land, maritime and joint parts.⁴⁵

In a common, but nonetheless true, argument the RAF has acknowledged that “the successful delivery of air power relies on [its] people.”⁴⁶ The challenge for the next-generation RAF will be in retaining its highly-trained personnel in the context of a perceived increasing demand for their skills in the civilian world. Moreover, recruiting the people with the requisite skill-sets to deal more easily with the advanced technologies being brought into the RAF will be a challenge to existing recruiting strategies. Most air forces realise this and realise that finding a solution to this common problem is critical to the success of the future RAF against adversaries willing to fight in different ways and with their own advanced technologies to counter its advantages. There is a distinct acknowledgement in the RAF strategy and capability investment plan that the RAF needs to invest in both technology and the people able to use it to good effect.⁴⁷

In any major transformative effort, including the introduction of a step-change technology, there is a risk that major changes will reduce an organisation’s ability to deliver on its core mandate. No military force can afford to lose the confidence of its government and citizenry, lest the funding diminish. As the RAF takes delivery on the platforms that will deliver its capability, there will be a need to ensure at least a consistent, and ultimately an increased, ability to deliver on the

⁴¹ Ministry of Defence, “SDSR 2015 Defence Key Facts,” https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/494895/SDSR_2015_Booklet_vers_15.pdf (accessed 9 March 2017), 8.

⁴² This perspective is drawn from discussions with the Operational Research Section of the RAF Air Warfare Centre in December 2016.

⁴³ Royal Air Force, “Royal Air Force Strategy: Delivering a World-Class Air Force,” http://www.raf.mod.uk/rafcms/mediafiles/B9FB695F_5056_A318_A8BC2CA5A1362C13.pdf (accessed 9 March 2017), 6.

⁴⁴ *Ibid.*

⁴⁵ Email to the author from Mr. Sam Mason, an analyst from RAF High Wycombe, 7 June 2017.

⁴⁶ Royal Air Force, “Royal Air Force Strategy: Delivering a World-Class Air Force,” 15.

⁴⁷ *Ibid.*

expectation of the UK Government and its people. Doing so with the significant leap in technology that these aircraft represent, and enabling them to exchange information and even communicate with legacy platforms, will stress the entire RAF system—from its training and recruitment, to its infrastructure and networks, to its support and maintenance systems. Lessons from this experience will be of distinct value as the RCAF begins to adopt its own next-generation aircraft and systems.

One of the stated ambitions in the RAF strategy is to sustain, retain, attract, and recruit motivated and capable people, be a world-class air force that delivers on operations in accordance with UK Government and popular expectation, all while managing its resources and operating safely. To do this, it must broaden its appeal to all parts of UK society to become an employer of choice, transform its structures and processes by removing unnecessary constraints, transform its training to make it relevant and effective, regain control of its infrastructure, and grow its capability, capacity, and resilience.⁴⁸ These are tall orders common to all air forces for the 21st century, and importantly for the RAF they seem to be more than just words.⁴⁹ To ensure the development of the strategy's themes, "the Chief of Air Staff and members of the Air Force Board Executive have established a plan of work, which will form part of the Royal Air Force Command Plan" and which details how its strategic objectives will be taken forward."⁵⁰ The entrenching of the RAF strategy in its Command Plan will "bring together all existing and planned programmes of work and help ensure the Royal Air Force achieves its ambition of building the Next Generation Air Force [NGAF]."⁵¹

One would expect that the operating environment anticipated for the NGAF would be drawn from the threats identified in the SDSR. While there are elements in common, there are some notable differences. The SDSR points to four specific challenges driving UK priorities: the increasing threat from terrorism, extremism, and instability; the resurgence of state-based threats and the intensification of state competition; the impact of technology, especially cyber threats, along with other technological challenges; and the erosion of the existing international order, which may make it more difficult to build consensus in dealing with global threats.⁵² The RAF strategy simply outlines an environment more contested by able adversaries fighting ambiguous and 'hybrid' warfare, and who are more able to challenge RAF strengths and exploit its vulnerabilities than has been seen since the end of the Cold War.⁵³ Those adversaries will be less constrained by the rule of law and the expectations imposed by British society, but no detail is provided on the specifics of those threats. From this somewhat vague context a series of functional requirements are outlined, including the need to control the air and space against capable air-defence systems and offensive cyber capability. Those unspecified adversaries will be able to contest and degrade the operating environment using unspecified technological and asymmetric means, and RAF systems must be hardened against that prospect. Success in this environment requires the support of allies, and it will be essential to train with and work more closely with international partners before and during operations. It will be essential to integrate seamlessly RAF capabilities into

⁴⁸ *Ibid.*, 20–21.

⁴⁹ For examples of how these are tall orders to all air forces in the 21st century see Brad W. Gladman, *The future of allied air power: The Royal Australian Air Force* (Ottawa: DRDC-RDDC-2015-R212); Brad W. Gladman, *The future of allied air power: The United States Air Force* (Ottawa: DRDC-RDDC-2014-R82).

⁵⁰ *Royal Air Force*, "Royal Air Force Strategy: Delivering a World-Class Air Force," 24.

⁵¹ *Ibid.*

⁵² *National Security Strategy and Strategic Defence and Security Review, 2015*, 15.

⁵³ *RAF Strategy*, 28.

coalition networks “to allow the swift transfer and exploitation of information, rapid decision-making and timely delivery of effects.” Moreover, information connectivity and command and control will continue to be central to success, requiring the exploitation of space-based and cyber capabilities to enable rapid understanding and swift joint action. This, in turn, will require the integration of capabilities across the UK armed forces, through more realistic training scenarios.⁵⁴

The RAF strategy concludes by restating its purpose of delivering air and space power for the UK through harnessing the full potential of its personnel, aircraft, and systems. Its immediate strategic goals are to succeed on operations, to build its workforce to meet future challenges, grow its capacity and resilience, and to deliver the NGAF capability.⁵⁵ Despite considerable pressure brought about by the ongoing global financial crisis, and the decision to withdraw from the European Union, the UK government has committed to deliver the technology, people, and aircraft for the NGAF.⁵⁶ As well, and similar to the Royal Australian Air Force’s ‘Plan Jericho,’ the RAF strategy discussed earlier has recognised the challenges in getting the most out of fifth-generation fighters and the other advanced capabilities to which it is committed. This strategy will influence each of the major pillars of future RAF capability. The RAF plan for capability development, while expensive at a time of fiscal restraint, will give the RAF the credibility it needs to assist in the attainment of British geostrategic imperatives, and will give the UK government the ability to maintain the ‘special relationship’ with the US that is so central to its strategic thinking.

⁵⁴ *Ibid.*, 28–30.

⁵⁵ *Ibid.*, 38.

⁵⁶ *Ibid.*, 15.

4 Capability Development for the Next Generation Air Force

Central to the RAF's conception of future air warfare are the four key roles it has defined for itself, "enabled by specialist air command and control."⁵⁷ The roles are control of the air and space, mobility and lift, intelligence and situational awareness, and attack.⁵⁸ These roles will be used to outline the main areas of RAF capability investment.

4.1 Capability Investment: Control of the Air and Attack

Always an essential capability for deployed operations, and one which has been defined by the coalition air component of operation INHERENT RESOLVE over Iraq and Syria as having 'skin in the game,' a strike capability will remain a key foundation of RAF air power. Many of the same platforms that provide a strike capability are those that contribute to domestic and coalition air defence. In this regard, the RAF has chosen to expand its fleet of fighter jets by two additional FGR4 Typhoon squadrons that will bring the total to seven. By increasing the number of its front-line Typhoon squadrons from five to seven, the RAF has not increased the number of these aircraft. Instead, each squadron will have twelve combat aircraft instead of the current 20–24 now in each squadron. At the same time, the RAF is increasing its reliance on synthetic training to complement live-flying training, which should allow each squadron to maintain comparable numbers of personnel per squadron and actually increase the overall numbers of trained operators. This, in turn, increases the overall readiness of the fleet.⁵⁹ That the Typhoon has also been extended by ten years to 2040 will add a complication to the maintenance of both strike and air defence capabilities. There has been no decision taken to date on whether the earliest Typhoon aircraft will be extended to 2040, and that may mean the overall Typhoon numbers might drop from 156 to 108 in 2019, coinciding with the expected retiring of the Tornado fleet of seventy-six aircraft. This represents the potential of a fifty-percent reduction in numbers, but not necessarily capability, as the Typhoon's strike capability will be developed more fully.⁶⁰ Typhoon is being enhanced under the Typhoon Future Capability Programme to provide an air-to-surface capability, as it was originally brought into service as an air-defence aircraft. Improvements will include a radar upgrade to a new Active Electronically Scanned Array (AESA) radar. In addition, the Typhoon will see the integration of the Meteor air-to-air missile, Paveway IV air-to-surface precision bomb, as well as the Storm Shadow and Brimstone ground attack missiles. Something noted during operation INHERENT RESOLVE is the need for a consistent supply of small diameter bombs, and these weapons will be integrated into Typhoon and F-35B.⁶¹ A key

⁵⁷ Ministry of Defence, *Joint Concept Note 3/12: Future Air and Space Operating Concept* (Shrivenham: The Development, Concepts and Doctrine Centre, 2012), 3–1.

⁵⁸ Air Staff, *AP 3000 British Air and Space Power Doctrine 4th Edition* (London: Ministry of Defence, 2009), 37–56. It is interesting to note that while most Western air forces use the term Intelligence, Surveillance, and Reconnaissance (ISR), the RAF uses Intelligence and Situational Awareness.

⁵⁹ RAF Strategy, 15.

⁶⁰ Quintana, "A Step in the Right Direction."

⁶¹ Royal Air Force, "Typhoon FGR4," <http://www.raf.mod.uk/equipment/typhoon.cfm> (accessed 20 April 2017); Royal Air Force, "Paveway IV," <http://www.raf.mod.uk/equipment/paveway-iv.cfm> (accessed 20 April 2017); Royal Air Force, "Storm Shadow," <http://www.raf.mod.uk/equipment/stormshadow.cfm> (accessed

feature of the NGAF is the F-35 Lightning II, of which the UK government has committed to purchase 138 over the life of the programme.⁶² It has also accelerated the plan for delivery, expecting forty-two aircraft in service by 2023 with twelve Fleet Air Arm aircraft on each of its two Queen Elizabeth class aircraft carriers.⁶³ It will thus maintain a considerable number of fourth-generation fighters in service until 2040 instead of 2030, operating alongside its fifth-generation F-35B fighters now coming into service.⁶⁴

As discussed, in bringing these aircraft into service, the RAF will be confronted with the problem of operating these 5th generation fighter aircraft alongside its 4th generation Typhoon and other aircraft, as well as those of coalition partners. This problem has been identified by the USAF and other European air forces, and solutions are currently being sought.⁶⁵ Indeed, senior RAF leadership views the F-35 as a catalyst for changing the entire RAF training, support, and employment construct, and for good reason. The integration of 4th and 5th generation fighters is a factor confronting the air component of operation INHERENT RESOLVE over Iraq and Syria, so those solutions are timely and important.⁶⁶ Given the possibility of the Canadian government's purchase of 4th generation F-18E Super Hornet fighters as an interim measure to the acquisition of a replacement fighter for the CF-188, this integration problem will be something with which the RCAF will have to deal to avoid its aircraft being unable to make a meaningful contribution to a coalition air operation at the higher level of the conflict spectrum—either in defence of North America through NORAD, as the USAF is moving towards 5th generation fleets, or as part of an expeditionary operation abroad.

4.2 Future Combat Air System

In 2014, the UK and France conducted a £120 million joint feasibility study on a Future Combat Air System (FCAS), leading to a £1.54 billion project to build a prototype. This ambitious programme will see French and British national designs developed, followed by a joint design that will be more fully developed. In the end, the aim is to have “a UCAS capability that can perform sustained surveillance, target designation, intelligence gathering and strike missions in

20 April 2017); Royal Air Force, “Brimstone,” <http://www.raf.mod.uk/equipment/Brimstone.cfm> (accessed 20 April 2017).

⁶² Elizabeth Quintana, “A Step in the Right Direction: The RAF and the SDSR, 17 November 2015,” <https://rusi.org/commentary/step-right-direction-raf-and-sdsr> (accessed 29 November 2016).

⁶³ *Ibid.*

⁶⁴ It is not certain whether all RAF F-35 aircraft will be the short take-off and vertical landing F-35Bs. See Elizabeth Quintana, “A Step in the Right Direction: The RAF and the SDSR,”

<https://rusi.org/commentary/step-right-direction-raf-and-sdsr> (accessed 13 March 2017).

⁶⁵ European Air Group, “4th/5th Gen Aircraft Integration Initiative,”

<http://www.euroairgroup.org/project/4th5th-gen-aircraft-integration-initiative/> (accessed 20 April 2017);

“Northrop Grumman and Royal Air Force Demonstrate Enhanced Airborne Communications Interoperability Between 5th and 4th Generation Fast-Jet Aircraft,”

<http://news.northropgrumman.com/news/releases/northrop-grumman-and-royal-air-force-demonstrate-enhanced-airborne-communications-interoperability-between-5th-and-4th-generation-fast-jet-aircraft>

(accessed 20 April 2017); “Northrop Grumman Develops Link Across 5th, 4th Generation Fighters,” *Defense Daily* (28 May 2014); “Data Link Solutions Testing Enhanced Communications Capabilities Between 5th and 4th Generation Fighter Jets,” *Business Wire* (20 November 2015).

⁶⁶ Group Captain Paul Godfrey, “F-35 as a Catalyst for Change: The UK Perspective,”

<http://cms.polsci.ku.dk/events/integratingairpower/Godfrey.pdf> (accessed 20 April 2017).

hostile territories.”⁶⁷ The full scale development of the prototypes will begin in 2017, centred on a versatile Unmanned Combat Air System (UCAS) “that could serve as a basis for a future operational capability beyond 2030” after Typhoon is retired from service.⁶⁸ From a UK perspective, the project is being undertaken to “help the UK MoD and Royal Air Force make decisions on the future mix of manned and unmanned fast jet aircraft and how they will operate together in a safe and effective manner for the UK’s defences.”⁶⁹

British Aerospace Engineering (BAE) Systems is leading the UK effort, building on lessons learned from the recent successful Taranis (named after a Celtic God worshipped in Gaul and the British Isles) stealthy unmanned combat aerial vehicle technology demonstrator project.⁷⁰ This programme demonstrated that the UK has a significant lead in UCAV that can strike unseen over a long-range, and demonstrates the UK government and RAF commitment to future Unmanned Aerial Vehicle (UAV) systems. How the FCAS develops and the lessons it holds for small and medium-sized air forces in nations with capable aerospace industries will be of particular value to Canada and the RCAF.

4.3 Advanced Weapons

The RAF is adopting a series of new platforms to continue to deliver essential capability. At the same time, it is maintaining, upgrading, and acquiring new advanced weapon systems that deliver desired effects from the air.⁷¹ This aspect of capability development is of particular value, as supplies of advanced weapons have been strained by recent conflicts—a reality likely to continue in future conflicts of similar or higher intensity.⁷² By developing its own source of precision munitions, instead of relying on the US supply like many of its allies, the RAF will be more valuable in a coalition context, further enhancing the ‘special relationship’ between Britain and the United States; it also allows for more freedom in pursuit of the UK’s own interests.

4.3.1 Brimstone

Developed by MBDA, a company that resulted from the merger of the main missile system companies in the United Kingdom, Italy, and France (Matra Bae Dynamics, Alenia Marconi Systems, and EADS Aerospatiale Matra Missiles), Brimstone is one of the key new precision

⁶⁷ *Ibid.*

⁶⁸ “Future Combat Air System: UK and France move ahead,” <http://www.airforce-technology.com/features/featurefuture-combat-air-system-uk-and-france-move-ahead-4893221/> (accessed 28 April 2017).

⁶⁹ *Ibid.*

⁷⁰ BAE Systems, “Taranis” <http://www.baesystems.com/en/product/taranis> (accessed 28 April 2017).

⁷¹ The discussion that follows will not capture all advanced weapon systems. It will focus on those RAF systems noted in the SDSR.

⁷² David Barno and Nora Bensahel, “Mirages of War: Six Illusions From Our Recent Conflicts,” *War on the Rocks* (11 April 2017), <https://warontherocks.com/2017/04/mirages-of-war-six-illusions-from-our-recent-conflicts/> (accessed 26 April 2017); Marcus Weisgerber, “The US is Raiding its Global Bomb Stockpiles to Fight ISIS,” *Defense One* 26 May 2016, <http://www.defenseone.com/threats/2016/05/us-raiding-its-global-bomb-stockpiles-fight-isis/128646/> (accessed 26 April 2017).

air-to-surface missile systems being fielded by the RAF.⁷³ Based on the US Army's AGM-114F Hellfire missile, Brimstone is a 'fire and forget' weapon capable of engaging fixed and moving surface targets, from fast-attack and other naval vessels, to main battle tanks, armored and other fast-moving vehicles, and bunker systems.⁷⁴ Originally entering service in 2004, the missile has undergone upgrades to produce the Dual Mode Brimstone (DMB). MBDA received "the Selective Precision Effects At Range (SPEAR) Capability 2, Block 1 demonstration and manufacturing contract from the UK MoD in March 2010."⁷⁵ Under the contract, the missile was upgraded with an Insensitive Munition (IM) warhead, IM motor, modular airframe, and increased performance.⁷⁶ It can be carried by a range of RAF aircraft, from Tornado and Typhoon, to the F-35 and a range of unmanned aerial vehicles (UAV).⁷⁷ It is equipped with a millimetre wave radar for target recognition, and features a lock-on-after-launch capability and advanced resistance to enemy countermeasures. Moreover, Brimstone "can be programmed to search targets in assigned areas to minimise the risk to friendly forces," with its radar being used to differentiate between valid and invalid targets.⁷⁸ In an era where most operations require a minimisation of collateral damage, this munition's accuracy against static and moving/manoeuvring targets, and its "Human-in-The-Loop capability to meet restrictive rules of engagement" will be useful in dealing with the UK government's anticipated threat environment.⁷⁹

4.3.2 Storm Shadow

Another missile, this one a cruise-missile, developed and manufactured by MBDA missile systems is the Storm Shadow, also known as the Scalp EG in the French Air Force.⁸⁰ Its development has a long history beginning in 1982 with feasibility studies on a long-range stand-off missile that were incorporated into "the NATO seven-nation Modular Stand-Off Weapon programme."⁸¹ Following the Cold War, the requirement for such a missile re-emerged in the UK Conventionally Armed Stand-Off Missile (CASOM) requirement. MBDA won the contract to develop Storm Shadow in 1997 and the missile entered full service in 2004.⁸²

The advantages of Storm Shadow are that it can be operated in extreme conditions to provide a highly flexible, deep-strike capability based around a sophisticated mission planning system. It is launched from the air, following which it descends to a low cruising altitude and is guided to its target precisely using its inertial navigation, Global Positioning System (GPS), and terrain reference navigation systems. Its imaging infrared seeker is activated during the final approach to the target, and automatic target recognition algorithms compare the image to the target impact

⁷³ "History," *MBDA Missile Systems*, <http://www.mbda-systems.com/about-us/history/> (accessed 26 April 2017); "Brimstone Air-to-Ground Missile, United Kingdom," *Airforce Technology*, <http://www.airforce-technology.com/projects/brimstone-air-ground-missile/> (accessed 26 April 2017).

⁷⁴ "Brimstone Air-to-Ground Missile, United Kingdom."

⁷⁵ *Ibid.*

⁷⁶ *Ibid.*

⁷⁷ *Ibid.*

⁷⁸ *Ibid.*

⁷⁹ "Brimstone," <http://www.mbda-systems.com/air-dominance/brimstone/> (accessed 26 April 2017).

⁸⁰ Royal Air Force, "Storm Shadow."

⁸¹ *Ibid.*

⁸² *Ibid.*

point programmed in during the mission planning phase.⁸³ It is designed to attack hardened targets and infrastructure such as buried and protected command centres, and its combination of features makes it “arguably the most advanced weapon of its kind in the world.”⁸⁴ A recent agreement between the UK and France Ministries of Defence to upgrade the missile will “prolong the operational superiority of the weapon against the anticipated evolving threat well into the next decade.”⁸⁵

The development of these and other weapon systems is an essential element in preserving the ‘special relationship’ with the US in pursuit of the UK’s geostrategic imperatives described earlier. By maintaining itself as the ally of first choice and first importance to the US in most conflicts, the UK serves its own interests by ensuring the long-term support of the world’s most powerful and influential nation. This lesson is of key importance to Canada, and should be a central consideration in the development of the future RCAF and the CAF overall. While Canada’s geostrategic imperatives are different from those of the UK, central to those of both nations is maintaining the important strategic defence relationship with the US, and each other.

4.4 Air Mobility and Lift

One of the key uses of air power has been moving supplies, troops, casualties in and out of operational areas. From early examples in the First World War, to more frequent use of aircraft in an air ambulance role in the Air Control operations in the inter-war period, the RAF has a long experience with air mobility. Indeed, most air forces now view it as a core capability, a critical component of a balanced air force. It enables the global deployment of military power, and with its characteristics of speed and responsiveness it is a fundamental enabler for surface manoeuvre. Indeed, it is often a capability of first choice by political leadership in a time of crisis, as demonstrated repeatedly in recent years.⁸⁶ The RAF, as do many air forces, includes aerial refuelling as part of this role, although the RCAF does not. Another essential capability to a balanced air force, aerial refuelling greatly enhances strategic and operational level mobility, while increasing the persistence of combat and surveillance aircraft.⁸⁷ Both air mobility and aerial refuelling are capabilities always in short supply, and are normally delivered using the same basic platform.

In response to the fiscal austerity stemming from the 2010 SDSR, the RAF restructured itself and planned to form seven subordinate forces, one of which was the Air Mobility Force (AMF). Officially regarded as a “logical evolution,” the force comprises the bases at RAF Northolt and

⁸³ MBDA, “Storm Shadow Data Sheet,” <http://www.mbda-systems.com/air-dominance/storm-shadow-scalp/> (accessed 26 April 2017).

⁸⁴ Royal Air Force, “Storm Shadow.”

⁸⁵ Ryan Mass, “U.K., France to upgrade long-range Storm Shadow missiles,” *UPI Defense News* (23 February 2017) <http://www.upi.com/Defense-News/2017/02/23/UK-France-to-upgrade-long-range-Storm-Shadow-missiles/8641487868224/> (accessed 26 April 2017); “MBDA To Lead The Mid-Life Refurbishment of Storm Shadow/SCALP,” *MBDA Press Release* (27 February 2017).

⁸⁶ One example is the Canadian government’s provision of airlift support from France to Bamako, Mali from January to March 2013. In support of France’s operation SERVAL, a military intervention in Mali to combat an Islamic insurgency, the RCAF contributed one CC-177 Globemaster III aircraft from 429 Transport Squadron and traffic technicians from 2 Air Movements Squadron. See “Support to French operations in Mali,” <http://www.forces.gc.ca/en/operations-abroad/support-mali.page> (accessed 14 August 2017).

⁸⁷ *Air Staff, AP 3000 British Air and Space Power Doctrine 4th Edition*, 41.

Brize Norton and delivers the full range of air mobility, air-to-air refuelling, and Command Support Air Transport (CSAT) capabilities.⁸⁸

The RAF's air mobility fleet includes its eight C17 Globemaster and twenty-two A400M Atlas strategic airlifters, supplemented by its twenty-five C-130J Hercules aircraft which will be upgraded and have their in-service life extended until 2030. This move defies a previous UK government decision to remove the C-130J from service when sufficient A400M Atlas were available, representing an appreciation of the value of the air mobility capability on the ability of a military to project power swiftly.⁸⁹ This is a common feature amongst all of Canada's key allies, and a capability of immense value to both national domestic operations and to any potential coalition.

Contributing to air mobility and also providing the RAF's aerial refuelling capability is the fleet of fourteen 'Voyager' aerial refuelling tankers based on the Airbus A330-200 commercial aircraft. The aircraft are owned and maintained by Air Tanker, something that resulted from the use of a Private Finance Initiative (PFI) rather than outright purchase. This somewhat controversial decision sees the RAF paying for the refuelling and transport missions as needed, and the company owning and maintaining the aircraft, and free to use it for other missions for European air forces when not needed by the RAF. The RAF retains the right of 'first call' on the aircraft, to which it provides its own crews, for unforeseen emergencies.⁹⁰ It seems that the RAF may have paid far too much for this service, one in which the RAF has allegedly paid £150 million instead of £50 million per aircraft.⁹¹ The UK National Audit Office (NAO) has argued that affordability rather than value for money led the UK MoD to this deal. Indeed, the report criticises the MoD for not carrying out a sound evaluation of alternative procurement options, and that a MoD assumption that the PFI should be used wherever possible to keep the arrangement "off [the] balance sheet."⁹² In other words, the capital value of the assets would not be included in the MoD's accounts, "and that the Department would not bear the Treasury's cost of capital charge on the aircraft."⁹³ Moreover, the failure to envisage the aircraft being used in war zones has led to delays while flight deck armour and protective equipment was retro-fitted to the aircraft to allow it to operate in Afghanistan.⁹⁴ Should the Canadian government seek a similar solution, the experience of the RAF should inform any investigation into the notion of leasing aircraft as the RCAF looks into its own aerial refuelling tanker and ISR fleet replacements directed by the recently released Defence Policy, *Strong, Secure, Engaged* (SSE).⁹⁵

⁸⁸ Royal Air Force, "Air Mobility," <https://www.raf.mod.uk/role/air-mobility.cfm> (accessed 17 May 2017).

⁸⁹ Brooke-Holland and Mills, "The 2015 Strategic Defence and Security Review," 18.

⁹⁰ Ministry of Defence, "Future Strategic Tanker Aircraft (FSTA)," <http://webarchive.nationalarchives.gov.uk/20121019103242/http://www.mod.uk/DefenceInternet/FactSheets/ProjectFactsheets/FutureStrategicTankerAircraftfsta.htm> (accessed 29 August 2017).

⁹¹ The British Broadcasting Corporation, "RAF accused over multi-billion pound Voyager contract," <http://www.bbc.com/news/uk-18020809> (accessed 29 August 2017).

⁹² Ministry of Defence, "Delivering multi-role tanker aircraft capability," *National Audit Office Report by the Comptroller and Auditor General*, 30 March 2010.

⁹³ *Ibid.*

⁹⁴ Richard Norton-Taylor, "Audit office slams MoD's PFI nightmare," *the guardian*, (30 March 2010), <https://www.theguardian.com/business/2010/mar/30/airtanker-air-force-pfi-audit-office> (accessed 30 August 2017).

⁹⁵ Department of National Defence, *Strong, Secure, Engaged: Canada's Defence Policy* (Ottawa, 2017).

Providing an aerial refuelling capability through a ‘hose and drogue’ system, the Voyager comes in two varieties. The first (KC2) has two under-wing pods, and the second (KC3) is “a three-point tanker with an additional centre line hose for larger aircraft.”⁹⁶ In an interesting decision, the RAF did not insist that its Voyager aerial refuelling tankers be equipped with a ‘boom and receptacle’ system, only with the hose and drogue system. With the expected delivery of additional Rivet Joint and P-8 Poseidon, and its current fleet of E3-D Sentry and C-17 Globemaster, this decision seems an odd oversight and something that might speak more to the decision to deliver this capability through contract. It is clear that the RAF would like to correct this oversight, and since the contract with Air Tanker requires the company to maintain a specified level of service, there may be a way to do so. The fuel for the Voyager is carried in the existing wing and fuselage tanks, leaving the cabin free for transporting up to 291 personnel, or in an aeromedical configuration able to carry up to forty stretchers and three critical care patients.⁹⁷ Moreover, the cargo hold will be available for freight “on either military or civil pallets.”⁹⁸ One of these fourteen Voyager aircraft will be adapted to provide secure transport for the Royal Family and senior UK Ministers. It is felt that the demand justifies the use of one of these valuable aircraft, and that its use will deliver “better value for money than the current use of charter aircraft.”⁹⁹

4.5 Intelligence, Surveillance, and Reconnaissance (ISR)

According to RAF doctrine, surveillance and reconnaissance “are the means by which air and space power provides intelligence and situational awareness” to decision-makers.¹⁰⁰ The RAF’s identified role of intelligence and situational awareness is provided by its ISR fleet, and the developments and commitment to that fleet over time will be discussed in this section—both manned and unmanned varieties even though many provide attack and other capabilities. The ability to see over the next hill or across the electromagnetic spectrum has long been a central feature of warfare. With the volume of information collected by the various national and coalition ISR systems, making sense of it and acting on the relevant pieces requires a robust capability to direct, collect, process and assess, and finally disseminate intelligence to commanders at all levels becomes a challenge. Yet its importance in modern warfare is difficult to exaggerate.

Something noted in recent interviews of senior officers serving in operation INHERENT RESOLVE (OIR) was an intense reliance on ISR. Indeed, it is estimated that in early 2016 somewhere between 74 and 90 percent of the United States Air Force’s (USAF) ISR assets were operating “in direct support of combat operations.”¹⁰¹ One interviewee argued that this operation “...was all about ISR.”¹⁰² Given the global demand of these forces it is important to use them in a

⁹⁶ Royal Air Force, “Air Mobility.”

⁹⁷ *Ibid.*

⁹⁸ *Ibid.*

⁹⁹ Brooke-Holland and Mills, “The 2015 Strategic Defence and Security Review,” 18.

¹⁰⁰ *Air Staff, AP 3000 British Air and Space Power Doctrine 4th Edition*, 46.

¹⁰¹ The figure of 74% comes from General David L. Goldfein, “Department of the Air Force Presentation to the Subcommittee on Readiness United States House of Representatives,”

<http://docs.house.gov/meetings/AS/AS03/20160212/104347/HHRG-114-AS03-Wstate-GoldfeinD-20160212.pdf> (accessed 2 November 2016), 11. The figure of 90% comes from CFAWC Air Power

Employment Project Interview 1, 10. The identity of the interviewees are not included in the paper, and the interviews are referred to by an assigned number. The author holds the list of names and assigned numbers.

¹⁰² CFAWC Air Power Employment Project Interview 4, 17.

rational and tolerably efficient way. While it is easy to understand the desire to feed full motion and high definition video feeds to senior leadership, doing so with potentially unassessed and unfused intelligence can lead senior leaders to think they know how to act without any advice from intelligence or air commanders. As John Ferris has written:

The video imagery from R[emotely] P[iloted] A[ircraft] has been crack cocaine for national military and political leaders, convinced they can direct a strike within seconds against targets 10,000 miles away; and then take another hit, and deliver a further blow. The combination of these sources and strike leads those folk to imagine themselves political surgeons wielding a military scalpel. In war, alas, one operates with a battleaxe and without a medical licence on a patient who is trying to amputate your arm, while some of your colleagues pull at your hand, in the dark.¹⁰³

The assumption that this level of situational awareness will always be possible, something stemming from decades of operational experience since the end of the Cold War, is untenable against capable adversaries and should not drive reassessments of air command and control (C2) towards over-centralisation of the C2 of air power. Doing so would risk the fundamental principles upon which air power is best employed—most notably decentralised execution.¹⁰⁴

The RAF's ISR fleet was heavily cut in the 2010 SDSR, despite it being one of the UK military's, and RAF's in particular, greatest contributors to both national and coalition operations. Many platforms scheduled to be withdrawn from service after the 2010 SDSR saw those dates slip in response to demand for their capability in operations in Afghanistan, Libya, Mali, Nigeria, and most recently in Iraq and Syria. The 2015 SDSR's commitment to long-term investment in the ISR fleet was no doubt welcome to the RAF and its Joint Forces Command, a testament to their determined support of these critical capabilities.

4.5.1 Unmanned ISR

It should be no surprise that Unmanned Aerial Vehicles (UAV) and their supporting systems, collectively known as Unmanned Aerial Systems (UAS), have proven to be of enormous value, delivering both ISR and attack effects. This will not diminish in the future, and nations wishing to avoid a credibility gap in terms of capabilities brought to future coalition operations would be wise to include not only a capable UAV able to operate in the anticipated threat environment, but also one whose systems integrate seamlessly and provide valued capability. That would include the ability to gather, process, and communicate intelligence in a timely fashion in order to support command decision-making. From the RAF Strategy and the 2015 SDSR, it seems the RAF has demonstrated the value of manned and unmanned intelligence, surveillance, and reconnaissance to the UK government, which has committed to investing in both types of platforms to deliver an essential capability.

¹⁰³ John Ferris, "Targeting, Air Intelligence and Strike Warfare: Theory and Practice," unpublished manuscript (2016), 22.

¹⁰⁴ Brad Gladman, "Air power employment in operation INHERENT RESOLVE: a preliminary assessment," (Ottawa: DRDC-RDDC-2017-L041), 9.

As stated previously, the UK government and RAF have committed to the future of UAV systems, both in an ISR role and at the tactical level in an Intelligence, Surveillance, Target Acquisition, and Reconnaissance (ISTAR) role.¹⁰⁵ Indeed, the 2015 SDSR reflects a strategic choice about the future direction for these systems. The positive experience with UAV in Afghanistan has reinforced the value of the partnership established with the USAF, which includes training opportunities in the US for RAF UAV crews—essential since these aircraft are not certified to fly in UK airspace. But the FCAS programme suggests a possible shift in focus towards a European collaborative effort on UAV systems as a central feature of an RAF contribution to the UK armed forces ISR capability.

4.5.2 Manned ISR

The evolution of technology has seen a blurring of the lines between once very distinct bomber, fighter, airlift, tanker, and ISR platforms. While bombers and fighters have long been very useful and important sensors,¹⁰⁶ some manned and unmanned ISR platforms can now carry very effective and precise munitions. Moreover, tactical and strategic airlift assets and aerial refuelling tankers have been configured recently for an ISR role, and to serve as communication nodes.¹⁰⁷ The need for persistent aerial surveillance, something always desired by Joint force commanders anxious to keep pace with enemy movements and to track mobile targets, has been reinforced in the conflicts of the post-Cold War era. Bringing the sensors from all aircraft types together with those of UAVs that have enhanced persistence and the ability to operate in denied areas, and to combine all this with other land and naval systems to produce a comprehensive picture upon which reasoned decisions can be made is, and should be, the main goal of the ISR programme of any nation. Ensuring those systems can integrate seamlessly into an American or NATO led coalition is equally essential. This section will outline the main platforms being maintained, upgraded, and acquired to deliver the RAF's ISR capability.

4.5.2.1 Protector

Unlike other questionable decisions that emerged from the 2010 SDSR, the continuance and upgrading of the RAF UAV fleet was never really in question in the 2015 SDSR. For one thing, the operations in Afghanistan and Iraq cemented views on the value of UAVs for the future RAF.¹⁰⁸ Aside from a sense of “public disquiet” over their use in military operations, which

¹⁰⁵ There is a recent tendency to refer to ISR and ISTAR as synonymous, despite them being quite different in practice. From an air power perspective, target acquisition is an output from ISR and has little application to air operations planning where ISR provides intelligence central to the overall air campaign plan in accordance with strategic intent. Thus, the focus of this paper will be on ISR. See “What Is ISR? Clarifying ISR and ISTAR in Air Power Terms,” *Pathfinder: Air Power Development Centre Bulletin* Issue 117 (August 2009).

¹⁰⁶ See Brad Gladman, *Intelligence and Anglo-American Air Support in World War Two*.

¹⁰⁷ This is the so-called ‘smart tanker’ concept that is being extended to the next generation tanker. See Sandra I. Erwin, “Air Force Takes Steps Toward ‘Smart’ Tanker” *National Defense* June 2003, http://www.nationaldefensemagazine.org/archive/2003/June/Pages/Air_Force_Takes3840.aspx, (accessed 2 October 2014).

¹⁰⁸ Rob Blackhurst, “The air force men who fly drones in Afghanistan by remote control,” *The Telegraph* (24 September 2012), <http://www.telegraph.co.uk/news/uknews/defence/9552547/The-air-force-men-who-fly-drones-in-Afghanistan-by-remote-control.html> (accessed 3 May 2017); Louisa Brooke-Holland,

amounts to a misunderstanding that the UAV is still human-controlled and operates under rules of engagement just as manned aircraft, it is becoming accepted that all balanced air forces need this kind of capability to deliver vital ISR in contested environments and immediate strike based on the intelligence gathered.¹⁰⁹ This understanding has reached the Canadian government, whose recently released defence policy has directed that the Canadian Armed Forces (CAF) invest in Remotely Piloted Aerial systems (RPA), and that the RCAF invest in a medium altitude RPA for both domestic and deployed operations.¹¹⁰ Dealing with domestic use becomes more problematical, and the lessons from the UK and other allied experience on receiving certification for UAV to operate in domestic airspace will be of value as the RCAF begins to develop its own capability based on the UAV platform. Moreover, the RAF experience with its own version of a medium altitude RPA could provide useful lessons in terms of acquisition, support, and integration with US systems.

In a programme previously known as ‘Scavenger’, but which is now known as ‘Protector’, the RAF will acquire at least 20 RPA or UAV to replace the 10 now in service. The RAF currently operates ten General Atomics Reaper MQ9A Medium Altitude Long Endurance (MALE) UAV designed for ISR and limited ground attack roles.¹¹¹ This fleet of Reaper RPA currently are not certified to fly in UK airspace, limiting their value to deployed operations and preventing their use in domestic operations. The next generation of Protector UAV, expected to be at least 20 General Atomics Certifiable Reaper B able to fly in UK airspace and meet NATO airworthiness standards, will also be configured to carry the Raytheon Paveway IV laser-guided bomb and the MBDA Brimstone air-to-surface missiles. In addition, it will have extended wings and fuel tanks to enhance the endurance to over forty hours.¹¹²

In addition to purchasing more of the next generation of MALE UAV for the RAF, the British are also investing in at least three High-Altitude Pseudo-Satellite aircraft (HAPS) Zephyr 8 UAV manufactured by Airbus industries. The aim is for this aircraft, with its 28 metre wingspan, is to be able to sustain a five kilogram payload at altitudes of roughly 70,000 feet for up to three months using solar panels. The Zephyr 8 picks up from the world record setting capabilities demonstrator Zephyr 7, which, *inter alia*, was the first unmanned aircraft to operate at 70,740 feet and flew for fourteen days and twenty-two minutes.¹¹³ The Zephyr 8 is larger but 30% lighter than its predecessor, allowing it to carry more batteries and other payload, thus increasing its operational flexibility. Other options include a twin-boomed version of the HAPS, which can accommodate even larger payloads and is intended to specialise in maritime surveillance.¹¹⁴ For

“Overview of military drones used by the UK armed forces,” *House of Commons Library Briefing Paper 06493*, (8 October 2015), 23–24.

¹⁰⁹ Air Vice-Marshal Jon Lamonte, “The Future of UAVs: Concepts and Considerations,” *Royal United Services Institute*, <http://www.raf.mod.uk/role/thefutureofuav.cfm> (accessed 3 May 2017).

¹¹⁰ Department of National Defence, *Strong, Secure, Engaged: Canada’s Defence Policy* (Ottawa, 2017), 39.

¹¹¹ Louisa Brooke-Holland and Claire Mills, “The 2015 Strategic Defence and Security Review,” *House of Commons Library Briefing Paper 7462* (22 January 2016), 17.

¹¹² Beth Stevenson, “RAF eyes British weapons for Protector fleet,” <https://www.flightglobal.com/news/articles/raf-eyes-british-weapons-for-protector-fleet-429994/> (accessed 27 April 2017).

¹¹³ Airbus Defence and Space, “Zephyr, the High Altitude Pseudo-Satellite, is taking off,” <https://airbusdefenceandspace.com/newsroom/news-and-features/zephyr-the-high-altitude-pseudo-satellite-is-taking-off-2/> (accessed 17 May 2017).

¹¹⁴ *Ibid.*

the CAF these technologies become more mature and more affordable, they might prove a reasonable option for more persistent domestic surveillance (although operations over the Canadian north would be complicated by a lack of solar power at times); they might also make a desirable contribution to an expeditionary operation where persistent surveillance has proven to be a continual requirement.¹¹⁵ At the very least, the progress made on this system should be monitored and may inform the development of the RCAF of the future.

4.5.2.2 AEW1 (E3D Sentry)

Another example of the blurring of the lines between formerly distinct aircraft types is the E-3D Sentry, operated by the RAF as the AEW1.¹¹⁶ A version of the American E-3 Airborne Warning And Control System (AWACS) that first entered service with the USAF in 1977, these aircraft continue to perform their primary role as “the UK’s contribution to the NATO Airborne Early Warning and Control Force.”¹¹⁷ But the six aircraft operated by No. 8 Squadron RAF, based at RAF Waddington, also form “one arm of the UK Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) triad of Sentinel R1, E-3D and Shadow R1 aircraft.”¹¹⁸ It is based on the Boeing 707-320B commercial aircraft, which has been extensively modified to operate modern mission systems. With an endurance of around eleven hours, something extendable through air-to-air refuelling, the Sentry’s roles have broadened to include air and sea surveillance, airborne command, control, and communications, as well as weapons control.¹¹⁹

The AEW1’s Northrop Grumman AN/APY-2 high-performance, multimode look-down radar can separate airborne and maritime targets from ground and sea clutter, detecting low-flying targets or maritime surface contacts from 30,000 feet within 215 nautical miles, as well as medium-level airborne targets at ranges in excess of 280 nautical miles.¹²⁰ The AN/APY-2’s multi-mode attributes provide “lookdown [sic] surveillance to the radar horizon and an electronic vertical scan of the radar beam provides target elevation and beyond-the-horizon operation for long-range surveillance of medium and high-altitude aircraft” allowing it to determine the location, altitude, course, and speed of large numbers of airborne targets.¹²¹ Recent upgrades to the AWACS radar under the Radar System Improvement Program (RSIP) have enhanced its capabilities. The “RSIP modifications enhance radar performance characteristics, add new capabilities, improve the user interface, and lower the life-cycle cost of the AWACS radar, while improving reliability.”¹²² The E-3D Sentry’s mission systems can manage and display targets within the aircraft, or transmit them via its multiple data-links to forces on the ground, in the air, and at sea. While there is no

¹¹⁵ Brad W. Gladman, “Air Power Employment in Operation INHERENT RESOLVE: A Preliminary Assessment,” (Ottawa: DRDC-RDDC-2017-L041), 9.

¹¹⁶ Royal Air Force, “E-3D Sentry AEW1,” <http://www.raf.mod.uk/equipment/e3d-sentry.cfm> (accessed 3 May 2017).

¹¹⁷ *Ibid*; also see “E-3 Sentry (AWACS),” <http://www.globalsecurity.org/military/systems/aircraft/e-3.htm> (accessed 9 May 2017).

¹¹⁸ Royal Air Force, “E-3D Sentry AEW1.”

¹¹⁹ “E-3 AWACS (Sentry) Airborne Warning and Control System, United States of America,” <http://www.airforce-technology.com/projects/e3awacs/> (accessed 10 May 2017).

¹²⁰ *Ibid*.

¹²¹ *Ibid*.

¹²² Northrop Grumman Electronic Systems, “AWACS Surveillance Radar: The Eyes of the Eagle,” <http://www.northropgrumman.com/Capabilities/AWACSAFY2/Documents/AWACS.pdf> (accessed 10 May 2017).

plan for the RCAF to develop such a capability, it is noteworthy that the Royal Australian Air Force (RAAF), an air force similar in size to the RCAF, has done so with its E-7A ‘Wedgetail’ aircraft. These aircraft and supporting systems deliver a highly advanced airborne early warning and control and an air battlespace management capability, are one of the most advanced pieces of technology in the Australian Defence Force. Indeed, during a recent Red Flag exercise in 2012 the aircraft achieved 100% mission availability, but “provided the best controlling he had ever seen,” according to an F-22 squadron commander.¹²³ Wedgetail is thus a vital capability for the ADF in pursuing its geostrategic imperatives of surveillance and control across Australia’s north, a requirement Canada shares over its own austere northern regions, and “the Wedgetail is the only credible AEW&C system available which can deal with the developing strategic environment.”¹²⁴ Developments with this capability in the RAAF may well prove of value to the future RCAF.

4.5.2.3 Sentinel, Shadow, and Rivet Joint

The Sentinel R1 is a long-range wide area battlefield surveillance asset, based on the Global Express business jet manufactured by Bombardier.¹²⁵ Its roots date back to the first Gulf War in 1990–1991 where ISR played a key role in the success of Operation DESERT STORM—particularly the use of Synthetic Aperture Radar (SAR) and Ground Moving Target Indicator (GMTI) systems in tracking and prosecuting enemy ground forces. This experience “galvanised the UK to acquire its own capability and in 1993 the requirement was endorsed by the MOD,”¹²⁶ something that culminated in the airborne stand-off radar (ASTOR), “in a large ‘canoe’ fairing beneath the fuselage,” which became known as the Sentinel system.¹²⁷ This capability consists of air, land, and support components, with the air segment consisting of five converted Bombardier aircraft with a dual mode radar (DMR). The DMR collects SAR imagery and GMTI data. The land segment “consists of 2 transportable Operational Level Ground Stations (OLGS) and 6 mobile Tactical Ground Stations (TGS).” Data links connect the aircraft to the ground stations, providing near real time intelligence to commanders at various levels.¹²⁸ While originally intended for high-intensity combat operations where tracking armoured formations and conducting strategic reconnaissance, the capability has demonstrated its value to operations in Afghanistan, Libya, and to French operations in Mali in 2013.¹²⁹ The RAF considers it “the most advanced long-range, airborne-surveillance system of its kind in the world.”¹³⁰ It was, according to the 2010 SDSR, to have been withdrawn from service after the end of operations in Afghanistan, but in 2013 the MoD decided to extend its life until 2018. The value of this capability was demonstrated not only in Afghanistan but also in Libya, where Sentinel was shown to be

¹²³ Kym Bergmann, “Wedgetail,” *Asia-Pacific Defence Reporter*, (8 April 2013),

<http://www.asiapacificdefencereporter.com/articles/298/Wedgetail> (accessed 16 August 2017).

¹²⁴ Carlo Kopp, “Wedgetail: Australia’s eagle-eyed sentinel,” (Canberra: Australian Strategic Policy Institute, 2006), 14.

¹²⁵ Royal Air Force, “Sentinel R1,” <http://www.raf.mod.uk/equipment/sentinelr1.cfm> (accessed May 2017).

¹²⁶ *Ibid.*

¹²⁷ Royal Air Force, *Air Power 2016: Inspiration and Innovation* (Billericay, Essex: Global Media Partners, 2016), 73.

¹²⁸ Royal Air Force, “Sentinel R1.”

¹²⁹ *Ibid.*

¹³⁰ *Ibid.*

exceptionally good at directing movement on the ground, with fidelity of imagery that allowed for highly accurate targeting. Sentinels acquired intelligence and imagery that was passed on to fast jets, and without the precise intelligence and situational awareness they provided, strike aircraft would have spent far more time in armed reconnaissance without necessarily finding targets or hitting them with the precision demanded by the [United Nations Security Council Resolution] 1973 remit.¹³¹

The SDSR has extended the service life of Sentinel even further into the next decade, giving a specific retirement date of 2021.¹³²

The Shadow, which is based on the Beechcraft King Air 350ER commercial aircraft, was acquired to complement the extant UK's ISR capabilities in Afghanistan.¹³³ At the time, it was expected that Shadow R1 would be withdrawn when combat operations ended in Afghanistan, but the vital support it provided during that campaign has resulted in the aircraft remaining in service until at least 2030, and the number of aircraft increased from six to eight.¹³⁴ While it is very much a tactical platform, providing forward troops real-time intelligence, that tactical intelligence can be useful in confirming and enhancing operational and strategic intelligence.¹³⁵ The experience of the RAF with Shadow is directly relevant to ongoing discussions regarding the possible acquisition of three Beechcraft King Air 350ER aircraft to provide Medium Altitude ISR (MAISR).¹³⁶ Other options, including the offer by L3 Aerospace Systems of a derivative of L3's "cutting-edge SPYDR II system, which uses the King Air aircraft tailored for the DND's multi-INT missions" would benefit from the RAF experience with this capability.

Until 2011, the RAF had two Nimrod R1 aircraft with which to collect various forms of signals intelligence.¹³⁷ In a decision announced in the 2010 SDSR to retire these aircraft from service, which left the RAF without what it viewed as an important capability, the RAF arranged to 'share' USAF Rivet Joint aircraft until a replacement could be found. Acquired as part of the 'Airseeker' programme, the capability consists of the aircraft, which are based on KC-135 tanker fuselages recovered from storage, and "ground-based data analysis and information dissemination facilities. Ground exploitation equipment has been installed in two UK locations for analysis and dissemination of the information collected."¹³⁸ The first of the three new Rivet Joint surveillance

¹³¹ Karl P. Mueller, *Precision and Purpose: Airpower in the Libyan Civil War* (Santa Monica, CA: RAND Corporation, 2015), 177.

¹³² Brooke-Holland and Mills, "The 2015 Strategic Defence and Security Review," 17.

¹³³ Craig Hoyle, "UK's Shadow R1 'to complement, not duplicate' intelligence, surveillance and reconnaissance assets," *Flight Global* (12 February 2009) <https://www.flightglobal.com/news/articles/uks-shadow-r1-to-complement-not-duplicate-intelligence-surveillance-and-reconnaissance-322442/> (accessed 11 May 2017).

¹³⁴ *National Security Strategy and Strategic Defence and Security Review, 2015*, 32.

¹³⁵ For an understanding of how the various levels of intelligence have interacted in this manner see Brad Gladman, *Intelligence and Anglo-American Air Support in World War Two*.

¹³⁶ L3 Aerospace Systems, "L3 to provide proven solution for Canadian MAISR," <https://www.wingsmagazine.com/news/l3-to-provide-proven-solution-for-canadian-maisr-14290> (accessed 16 October 2017).

¹³⁷ "Nimrod R1 aircraft in final flight for RAF," <http://www.bbc.com/news/uk-13942014> (accessed 10 May 2017).

¹³⁸ *Ibid.*

aircraft entered service in 2014, and are now being used in operation INHERENT RESOLVE against Daesh in Iraq and Syria.¹³⁹ The aircraft possesses sensors and systems to intercept and exploit emissions across the electromagnetic spectrum, providing intelligence from the strategic to the tactical levels, some of it in near real time.¹⁴⁰ The RAF anticipates maintaining them in service through 2035.¹⁴¹

There have been promises made to increase the number of crews for the E-3D Sentry, Shadow R1, and Rivet Joint aircraft, the only way to ensure the RAF gets the most out of these platforms. But as stated earlier, there is concern within the RAF that the personnel and supporting systems may not be provided for in sufficient numbers. In order to deliver a complete capability, all of its elements have to be delivered, something often acknowledged only on paper. In the CAF, for example, any capability is made up of its PRICIE components, which includes far more than just the platform.¹⁴² Without each and every one being addressed appropriately the capability is not optimised. The concern within the RAF over the full delivery of capability has lessons of direct relevance in this for the RCAF as it adopts advanced aircraft and conceives the RCAF of the future.¹⁴³

4.6 Maritime Patrol

For an island nation, a Maritime Patrol Aircraft would seem to be an essential capability, high on the list of those to preserve in times of defence spending reductions. Nonetheless, in 2010 the UK chose not to replace its fleet of ageing Nimrod MR2 aircraft. The plan to rebuild those aircraft into the Nimrod MRA4 fleet, with more fuel efficient Rolls-Royce BR700 engines that would almost double the aircraft range and to install a glass cockpit along with new detection systems and weapons for Anti-Submarine Warfare (ASW), was deemed to be too costly in 2010. Moreover, the upgraded aircraft “would have continued to provide long-range maritime and overland reconnaissance—including over the UK—anti-submarine surveillance, air-sea rescue co-ordination, and perhaps most importantly, reconnaissance support to the navy’s Trident submarines.”¹⁴⁴ It was hoped that the Royal Navy’s Type 23 Frigates and their Merlin anti-submarine warfare helicopters, supplemented by RAF C-130 Hercules aircraft, would make up the capability gap, but a short five years later this has proven insufficient and the decision has been reversed.

¹³⁹ R. Scott, “UK Rivet Joint Starts Operations, Conversion Program Continues,” *World Report* (1 October 2014).

¹⁴⁰ Royal Air Force, “RC-135W Rivet Joint,” <https://www.raf.mod.uk/equipment/rc135wivetjoint.cfm> (accessed 10 May 2017).

¹⁴¹ Brooke-Holland and Mills, “The 2015 Strategic Defence and Security Review,” 17–18; *National Security Strategy and Strategic Defence and Security Review, 2015*, 28.

¹⁴² The somewhat unfortunate PRICIE acronym refers to personnel, research and development, infrastructure and organisation, concepts, doctrine and collective training, information management, and equipment supplies and services. See Defence Terminology Bank Record 42611.

¹⁴³ This perspective is drawn from discussions with the Operational Research Section of the RAF Air Warfare Centre in December 2016. It is supported by Brooke-Holland and Mills, “The 2015 Strategic Defence and Security Review,” 19 where it is noted that the RAF’s numbers will only increase by 700.

¹⁴⁴ “Nimrod loss ‘leaves massive gap’, say former defence chiefs,” <https://www.theguardian.com/politics/2011/jan/27/nimrod-loss-massive-gap-former-defence-chiefs> (accessed 20 April 2017).

The elimination of RAF maritime patrol in 2010 left what a series of retired service and defence chiefs referred to as a massive gap in British security, and one completely at odds with its geostrategic imperatives.¹⁴⁵ In an astute move to preserve maritime patrol skills and knowledge, however, the RAF embedded crews in the maritime patrol forces of allied air forces around the world in something called Project ‘Seedcorn.’¹⁴⁶ Crews were sent to the US, Australia, New Zealand, and Canada in a mutually beneficial process that saw RAF crews serving in front-line roles, as well as “instruction, weapons, tactics, and test and evaluation.”¹⁴⁷ Most importantly, the crews seconded to the US Navy have been operating the P-8A Poseidon since 2012, the exact aircraft selected for the RAF to regenerate their maritime patrol capability.

In a deal announced in July of 2016, the UK MoD has purchased nine Boeing P-8A Maritime Patrol Aircraft for the RAF. These aircraft will be based at RAF Lossiemouth in Scotland, and “will play a vital role in protecting the UK’s nuclear deterrent and the UK’s two new aircraft carriers. There is an expected initial operating capability (IOC) of 2020.”¹⁴⁸ They will also be able to locate and track hostile submarines, and will enhance the UK’s maritime Search and Rescue (SAR) capability.”¹⁴⁹ In an odd way, the admission that retiring the Nimrod was a mistake due to increased threats to the UK reinforces the assumption that the 2010 SDSR was more Treasury-led, and shows the value in a pragmatic look at the threat environment for which defence is force structured and postured—lessons important for Canadian defence policy. Moreover, the admission that a nation with a coastline and territorial waters that pale in comparison to Canada’s must have a modern MPA capability, in order to partner effectively with key allies like the US Navy and Royal Australian Air Force (RAAF), should suggest a similar or greater need for Canada. The recently released Canadian Defence Policy SSE, has committed to a replacement for the CP-140 Aurora maritime patrol aircraft, referred to as a “next generation multi-mission aircraft.”¹⁵⁰ The P-8A is exactly that, with a long unrefueled range and an endurance to carry out both “high and low-level airborne maritime and overland surveillance for extended periods.” Moreover, its wide-area surveillance ability is useful for domestic sovereignty patrols and to assist in a search and rescue capability over long-ranges, and interoperability would be a simple matter since many of Canada’s key allies are adopting it for their own purposes.¹⁵¹

4.7 Rotary Wing Aviation

The RAF has for some time been operating the majority of its helicopter forces under a joint command. Formed in 1999 “to bring together under one command the battlefield helicopters of the Royal Navy (RN), Army and Royal Air Force (RAF),” the Joint Helicopter Command (JHC) “delivers the core effects of LIFT, FIND and ATTACK on the battlefield supporting ground

¹⁴⁵ “Nimrod loss ‘leaves massive gap’, say former defence chiefs.”

¹⁴⁶ Royal Air Force, *Air Power 2016: Inspiration and Innovation*, 48.

¹⁴⁷ *Ibid.*

¹⁴⁸ Brooke-Holland and Mills, “The 2015 Strategic Defence and Security Review,” 17.

¹⁴⁹ Royal Air Force, “MOD seals the deal on nine new Maritime Patrol Aircraft to keep UK safe,”

<http://www.raf.mod.uk/news/archive/mod-seals-the-deal-on-nine-new-maritime-patrol-aircraft-to-keep-uk-safe-11072016> (accessed 20 April 2017).

¹⁵⁰ Department of National Defence, *Strong, Secure, Engaged*, 39.

¹⁵¹ Royal Air Force, “MOD seals the deal on nine new Maritime Patrol Aircraft to keep UK safe;”

Brad W. Gladman, *The future of allied air power: The Royal Australian Air Force* (Ottawa: DRDC-RDDC-2015-R212), 19–20. The US Navy also operates the P-8A Poseidon.

forces in the Land, Littoral and Maritime environments.”¹⁵² Co-located with, and under the Land Command Headquarters in Wiltshire England,¹⁵³ the JHC consists of roughly 130 staff officers and provides the administrative, engineering, operations and capability management to all JHC subordinate units, “and an interface with single Services, MOD and foreign military commands.”¹⁵⁴ Its responsibilities are thus battlefield operations and capability development, adding a wrinkle to RAF force development. Formerly independent RAF Chinook and Puma squadrons based at RAF Benson and Odiham are now under the force employment and force development of the JHC, as are “the Apache, Wildcat, Lynx, Gazelle and Bell 212 helicopters and the Defender fixed wing aircraft of the Army Air Corps and the Watchkeeper operated by the 47th Regiment Royal Artillery.”¹⁵⁵ This command and control relationship, not entirely dissimilar to the close relationship between the RCAF 1 Wing and the Canadian Army in Kingston, adds a different and more complicated force development element for the RAF’s Support Helicopter Force (SHF) which provides battlefield support and mobility to land forces.¹⁵⁶ Still, this does not mean the RAF is neglecting the SHF force and is responding to lessons learned from recent operations in Afghanistan and elsewhere to modernise and increase its heavily used fleet of helicopters. The long-standing need to increase the JHC’s fleet “has been partially fulfilled by the acquisition of six Merlin Mk.512s (as HC.3As) originally destined for Denmark,” which allowed 78 Squadron to replace its Sea Kings with the Merlin.¹⁵⁷ Another augmentation of the JHC will be the modification of eight Chinook HC.3s originally intended for Special Forces operations for the support helicopter role. As well, the Puma has been extended in service to at least 2022 (instead of the original plan to withdraw them in 2010). They are undergoing a modification to install “new turboméca Makila turboshafts, a ‘glass’ cockpit and communication, navigation and defensive systems in the old airframes to upgrade them to Puma 2 aircraft.”¹⁵⁸ With that having been said, it must be noted that neither the RAF FASOC nor the 2015 SDSR mention the JHC, and neither provide much detail on plans to upgrade rotary wing aviation.

The modernisation of the JHC fleets, including the Chinook which is also flown by the RCAF, will be of particular interest to the RCAF FD community. It is recommended that a close look at the sensors and links on the RAF Chinooks be taken to inform similar decisions for the RCAF CH-47. These aircraft are potentially extremely valuable ISR platforms, able to gather battlefield data and relay it in real-time to enable command decision-making. However, this is only true if appropriate sensor packages are procured, complete with the necessary links to enable the real-time data transmission that makes them useful in a modern operation. The RAF and JHC experience with these matters would prove of value to RCAF FD.

Rotary wing search and rescue (RW SAR) is a constant point of discussion within the RAF, and with many air forces around the world. Currently, the RAF maintains a fleet of 25 Westland Sea

¹⁵² British Army, “Joint Helicopter Command,” <http://www.army.mod.uk/structure/32411.aspx> (accessed 17 October 2017).

¹⁵³ Richard Scott, UK Joint Helicopter Command looks for capability beyond numbers in Afghanistan,” *Janes International Defense Review*, 42 (Sept. 2009), 46.

¹⁵⁴ *Ibid.*

¹⁵⁵ *Ibid.*

¹⁵⁶ The exploration of this model of rotary wing force employment should be examined through the RCAF Future Air Operating Concept SAR functional concept.

¹⁵⁷ Royal Air Force, “Helicopters,” <https://www.raf.mod.uk/currentoperations/helicopters.cfm> (accessed 17 October 2017).

¹⁵⁸ *Ibid.*

King HAR.3 and HAR.3As for SAR operations. Six detachments of these aircraft are maintained by 22 and 202 Squadrons, as well as three Bell Griffin HAR.2s are operated in a SAR role by 84 Squadron in Cyprus.¹⁵⁹ Recently, the RAF has decided upon an alternative service delivery (ASD) for rotary wing SAR to private companies—in 2014 Bristow Helicopters received a fleet of 22 Sikorsky S-92 helicopters for RW SAR, eleven of which are equipped with “state-of-the-art technology.”¹⁶⁰ Bristow operates these aircraft from 10 bases across the UK, including Prestwick, Caernarfon, Humberside, Newquay, St. Athan, Lee-on-Solent, Sumburgh, Stornaway, Inverness, and Manston. One option being explored in the RCAF Future Air Operating Concept (FAOC) is the alternate service delivery of SAR in Canada, and the UK experience with doing so would be of value to those discussions.

¹⁵⁹ *Ibid.*

¹⁶⁰ M2 Communications, “Bristow gets first Sikorsky for search and rescue services in UK,” *Airline Industry Information (M2)*, 9 September 2014.

5 Stitching It All Together

The RAF strategy outlines its roadmap to attaining its part of the overarching defence and national security policy direction. It provides broad guidance on how the RAF will incorporate new capabilities with existing ones to give a whole ideally greater than the sum of its parts. However, there is an important difference between strategy formulation and strategic planning often misunderstood or overlooked. While strategy should be the product of a clear and rational dialogue between policy and national power with relation to the existing security and operating environments, strategic planning flows from the strategy, but makes decisions to allocate specific resources with a view to attaining policy goals.¹⁶¹ In the case of the RAAF, for example, the government's policy guidance has led (although not in a linear fashion) to an air force strategy,¹⁶² and then to specific plans like 'Jericho' which started the strategic planning process to develop the RAAF more fully towards an integrated force able to make optimal use of 5th generation fighters and other next generation capabilities.¹⁶³

When talking about capability development, one is essentially talking about the RAF of the future. In a perfect world, that discussion would begin with national security policies which lead to defence policies (or in the case of the UK, both a national security strategy and a defence review which serve the same purpose). From there, the national military strategy leads to specific service strategies and thence, in the case of the RAF, to their Future Air and Space Operating Concept (FASOC) that outlines how that future RAF would function, what functional and enabling concepts are required, and how all of that informs capability and concept development.¹⁶⁴ The real world is never that perfect, and as in the case of the 2015 SDSR and 2017 RAF Strategy, the capability investment decisions have mostly been made. The latest endorsed FASOC is from 2012, although the next iteration of the RAF FASOC will be published shortly as part of the Future Force Concept, along with land, maritime and joint parts.¹⁶⁵ In its absence, direction on the future employment of the various capabilities being acquired and maintained comes from the extant 2012 FASOC.

The RAF FASOC sets out the framework for air and space capability and concept development out to roughly 2035; in contrast, the RCAF Future Air Operating Concept (FAOC) is not tied to a specific date, but instead uses changes to the operating environment as the trigger to rewrite the document. The FASOC states that the fundamental purpose of the RAF during this timeframe is to protect the UK and its territories from attack, and to provide a rapid and responsive means through which UK military power can be projected globally. Central to this ability are two of air power's unique attributes—the ability to contribute to the development of situational awareness, and the ability to hold adversaries continually at risk. Traditionally, air power has been delivered by specific platforms designed for particular roles. However, as discussed earlier, there has been

¹⁶¹ Colin S. Gray, "Inescapable Geography," *Journal of Strategic Studies*, 22, 2/3 (June/September 1999), 169.

¹⁶² Royal Australian Air Force, *Air Force Strategy: 2017-2027* (Canberra: Air Power Development Centre, 2017).

¹⁶³ Brad W. Gladman, *The Future of Allied Air Power: The Royal Australian Air Force* (Ottawa: DRDC-RDDC-2015-R212, 2015).

¹⁶⁴ See Brad Gladman, Bruce Chapman, and Andrew Billyard, *The Development of a Future Air Operating Concept: Proposed Process and Example* (Ottawa: DRDC-RDDC-2017-R043, 2017), Annex 'B'.

¹⁶⁵ Email to the author from Mr. Sam Mason, an analyst from RAF High Wycombe, 7 June 2017.

some blurring of those lines between platforms and roles that is expected to continue. Increasingly, the 2012 FASOC argues, “the trend towards genuinely multi-role capabilities means that air operations will increasingly be defined by the desired effects and the context of employment, not by the type of platform used.”¹⁶⁶ Through more effective integration of legacy and new capabilities across the UK armed forces, and a reconsideration of command and control that takes better advantage of air power’s unique attributes, the RAF FASOC expects to deliver responsive air power able to deliver strategic effect on its own, or as part of a smaller joint force in order to meet the challenges of the future operating environment. It is this context that will shape how the capabilities outlined above will be integrated into a whole greater than the sum of its parts.

To do so, the RAF identifies “four fundamental air and space roles, enabled by specialist air command and control.”¹⁶⁷ Those roles, which have always been conducted concurrently rather than sequentially,¹⁶⁸ are control of the air and space, air mobility and lift, intelligence and situational awareness, and attack.¹⁶⁹ The future development of these roles is considered, as well as their interdependency, alongside a requirement for a more adaptive air command and control system.¹⁷⁰ All of this is brought into further focus by Joint Force 25 (JF25), which takes the direction from the SDSR to counter violent extremism and deter and, if necessary, defeat the state-based threat from Russia and other global challengers.

Joint Force 25 will see the UK armed forces able to deploy and sustain a 50,000 strong expeditionary force. As it attempts to scale up the joint warfighting skills amassed over the past two decades, air power will be central to campaign design and the sustainment effort. As the RAF seeks to become a force that “is agile and adaptive, fully immersed in the information age, and truly joint” it must fuse the various building blocks into true capabilities, ensuring all capability components are accounted for.¹⁷¹ It has begun with the recapitalisation of the majority of its fighting equipment. By the end of the decade the Typhoon will have become the mainstay of the RAF’s air combat capability, incorporating the advanced weaponry discussed earlier. F-35 will have reached “its land-based operating capability in 2018.”¹⁷² Its ISR aircraft will be sustained and augmented by, *inter alia*, the introduction of the P-8A Poseidon, new RPA, upgraded E-3D Sentry, and the extension and increase to the Sentinel and Shadow fleets. Its air mobility fleet is among the most modern in the world, with the introduction of the Voyager tanker-transport and the A400M Atlas being completed before the end of the decade to supplement the C-17 and C-130 fleets.

Even with the promise of increased defence spending, some hard choices have to be made to ensure an air force that is sufficiently balanced—both in terms of breadth of capability, but also in terms of depth—to be able to support the broad range of operations the security environment and the UK government might require. While seeking a balance across the four air power roles, it is

¹⁶⁶ Ministry of Defence, *Joint Concept Note 3/12: Future Air and Space Operating Concept*, 3-1.

¹⁶⁷ *Ibid.*

¹⁶⁸ From the earliest application of air power in war, control of the air was seen as the most important function. However, in contested environments that control need only be obtained locally while other roles are conducted. See Gladman, *Intelligence and Anglo-American Air Support in World War II*, 55.

¹⁶⁹ Ministry of Defence, *Joint Concept Note 3/12: Future Air and Space Operating Concept*, 3-1–3-18.

¹⁷⁰ *Ibid.*, 3-1.

¹⁷¹ *Air Power 2016: Inspiration and Innovation*, 37.

¹⁷² *Ibid.*, 38.

acknowledged that even providing a bare minimum of capability across these roles will absorb all available resources. The RAF FASOC argues that it must “maintain an irreducible core capability across all four air and space roles to underwrite [its] ability to take sovereign military action.”¹⁷³

5.1 Control of the Air and Space

As always, control of the air is stated first, indicating its supremacy. The old adage from Field Marshal Bernard Montgomery “If we lose the war in the air, we lose the war, and we lose it very quickly” is certainly true, but it has been applied as though nothing else can happen until control of the air (and now space) has been achieved. However, in most conflicts against capable adversaries, such control is normally hard fought over a long period. Often, the best that can be hoped for is local control of the air over friendly forces and shielding one’s attacking aircraft. It is a case of *primus inter pares*, and not something that must be attained in order to do anything else.¹⁷⁴ So too is control of space. Indeed, against a comparable adversary such as Russia or China, with their advanced A2/AD strategies, maintaining control of the air and space will be problematical and something to be worked at instead of imposed.

Control of the air will remain a priority task for the RAF, both over the UK and while deployed on operations. Primarily conducted with fighters, other specialised capabilities are needed including radar and advanced weapons discussed earlier. As well, the RAF FASOC calls for the exploration of a mix of technologies, including UAS, cyber and “novel anti-air defences.”¹⁷⁵ Specialised force protection and strategic communication skills are also needed to counter adversaries seeking to exploit the information domain and to use non-specialist weaponry to attack RAF bases as a way to contest control of the air. While control of the air will remain primarily a responsibility of the RAF, the cross-service integration of effects is needed to meet the range of anticipated threats.¹⁷⁶

Within the timeframe of the concept (out to the year 2035), the RAF expects missile defence to be a definite necessity. The FASOC points to the need to enhance a national early warning capability along with “a space situational awareness capability” to contribute to a missile defence capability that likely will be attained through multinational collaboration.¹⁷⁷ Each of these requirements is reflected as a commitment in the 2015 SDSR, including the fighter, advanced missile development projects discussed earlier, as well as continued contribution to the NATO Ballistic Missile Defence (BMD) network and “research and multinational engagement through the UK’s Missile Defence Centre.”¹⁷⁸ Control of space and space operations become a bit more problematical, as the link between the RAF and space systems and responsibilities is somewhat tenuous in both the SDSR and the FASOC. The latter asserts a *de facto* RAF environmental lead for the space environment but acknowledges that “roles and responsibilities must be coordinated with Joint Forces Command for ownership of the space control mission and the delivery of space-enabled command, control, computing, communications, intelligence, surveillance and

¹⁷³ Ministry of Defence, *Joint Concept Note 3/12: Future Air and Space Operating Concept*, 3–25.

¹⁷⁴ See Brad Gladman, *Intelligence and Anglo-American Air Support in World War Two: The Western Desert and Tunisia, 1939–43* (London: Palgrave Macmillan, 2009).

¹⁷⁵ Ministry of Defence, *Joint Concept Note 3/12: Future Air and Space Operating Concept*, 3–8.

¹⁷⁶ *Ibid.*

¹⁷⁷ *Ibid.*

¹⁷⁸ *National Security Strategy and Strategic Defence and Security Review, 2015*, 25.

reconnaissance functions.”¹⁷⁹ The SDSR does not acknowledge the RAF environmental lead. Rather, it emphasises an investment in both cyber and space capabilities under Joint Forces Command leadership.¹⁸⁰ With that said, securing those space-based capabilities has become a *de facto* RAF responsibility dating back to the early 1960s and the establishment of RAF Fylingdales in Yorkshire. One of three Ballistic Missile Early Warning Systems (BMEWS) supporting UK and US requirements to detect Soviet missile launch, Fylingdales quickly developed a space surveillance role as a by-product of the ballistic missile early-warning capability.

Regardless of who leads the effort, the UK and its military are dependent on space-enabled capabilities, something reflected in its establishment of a National Space Agency and the development of its National Space Security Policy.¹⁸¹ Not only are all key elements of the UK’s critical national infrastructure, including energy, food, water, transport, telecommunications, government, public, and emergency services, and health and finance, dependent to some degree on space. Moreover, nearly 90% of UK military capability has a space dependency, especially for expeditionary operations which rely on space-based capabilities for communications, imagery and intelligence, and often weather forecasting. The lessons which emerge from the discussions amongst the UK armed services and its Joint Forces Command over the institutional ownership of the UK’s control of space mission will be of relevance to the RCAF, which only recently assumed such a role for the CAF. The same three fundamental issues will drive this matter going forward. The first of these contradicts Douglas Adams’ assertion in *The Hitchhiker’s Guide to the Galaxy* that “Space,” it says, “is big. Really big.”¹⁸² While certainly true, as more nations on earth become space-faring the task of de-confliction and the proliferation of space debris is becoming problematical in low-earth and even geosynchronous orbits. This has necessitated the development of a more comprehensive space situational awareness capability. The second fundamental issue flows from the first. As more nations seek access to the space commons, adversaries can be expected to seek means to sever access to (or destroy) UK space assets. This can take the form of simple GPS jamming to the “neutralizing the uplinks and downlinks of space-based systems through diverse forms of cyberattack [sic].”¹⁸³ Therefore, for the UK space denial “must therefore be considered as an integral part of campaign planning.”¹⁸⁴ The third is something all Western militaries face, especially those like Canada with a close military-to-military relationship with the US, and that is the reliance most have on the US for access to space capabilities and what comes from them. This reliance requires a formalisation of the relationship to include mechanisms to request US space support for UK operations where the US is not involved, likely a rare occurrence but entirely conceivable in terms of a non-combatant evacuation operation.¹⁸⁵ There is thus a need, especially in the context of the RAF expectation that the UK armed forces deployable headquarters may not have “organic space expertise” and that space “may be ignored in the development of joint campaign objectives,” to develop a degree of redundancy and resilience to ensure access to space through the expansion of the small cadre

¹⁷⁹ Ministry of Defence, *Joint Concept Note 3/12: Future Air and Space Operating Concept*, vii–viii.

¹⁸⁰ *National Security Strategy and Strategic Defence and Security Review, 2015*, 30.

¹⁸¹ Her Majesty’s Government, *National Space Security Policy* (London: Her Majesty’s Stationery Office, 2014).

¹⁸² Douglas Adams, *The Hitch-Hikers Guide to the Galaxy* (London: Pan Books, 1979),

¹⁸³ Larry R. Moore, “China’s Antisatellite Program: Blocking the Assassin’s Mace” *Asian Perspective* 38, 1 (2014), 168.

¹⁸⁴ Ministry of Defence, *Joint Concept Note 3/12: Future Air and Space Operating Concept*, 3–5

¹⁸⁵ *Ibid.*

of space specialists engaged in space situational awareness as a “precursor to any potential acquisition of indigenous space capabilities.”¹⁸⁶ The bottom line is that the UK needs to renew its focus on counter-space operations to deny adversary access to space, and to assure its own freedom of action, although the details of that renewal have not been articulated.¹⁸⁷ That attitude is entirely relevant to the RCAF, and efforts to learn from the UK experience would prove of value in the exploitation of this environment in support of CAF operations.

5.2 Air Mobility and Lift

The RAF FASOC identifies air mobility (including aerial refuelling) as “a fundamental enabler of surface manoeuvre,” and with its characteristics of speed and reach, is often the only means to respond rapidly to provide influence in a developing situation. That reality is expected to continue, and the RAF expects to perform air mobility and lift in the future much as it is done at present.¹⁸⁸ This includes a commitment to upgrading the rotary wing lift capability (light, medium, and heavy) provided to the JHC by the RAF SHF. The few options the RAF is exploring include increased self-protection systems including advanced counter-measures, and unmanned air systems performing lift roles, once legal, airspace regulation, and other obstacles are overcome. The 2012 RAF FASOC suggests that the RAF will follow industry lead in this regard, and that it is unlikely that major developments will take place in the concept timeline. It remains to be seen whether this position will be abandoned in the new FFC.

5.3 Intelligence and Situational Awareness

The RAF FASOC identified role of intelligence and situational awareness is provided by its ISR fleet. The ability to see over the next hill or across the electromagnetic spectrum has long been a central feature of warfare. This helps the joint force at the operational level, and also makes “a vital contribution to the national military task to generate strategic intelligence.”¹⁸⁹ The post-Afghanistan change in UK strategic posture, articulated in the 2015 SDSR, puts an increased emphasis on responsive air and space assets to deliver this capability, potentially in highly contested environments. The sheer volume of information collected by national and coalition ISR systems has for some time threatened to swamp analysts, requiring a robust capability to direct, collect, process and assess, and finally disseminate intelligence to commanders at all levels. Changes in technology will force the RAF to adjust its analysis processes and techniques, and the doctrine that governs them. The RAF’s dependency on networked command and data transmission links are an Achilles heel that will be targeted by adversaries. These links must be protected, and personnel trained and educated in air power theory and history, and in the operational art so that appropriate action can be taken in their absence.

¹⁸⁶ *Ibid.*, 3–9.

¹⁸⁷ *Ibid.*

¹⁸⁸ *Ibid.*, 3–10.

¹⁸⁹ *Ibid.*, 3–11.

5.4 Attack

The ability to deliver a precise, responsive, and long-range attack capability has long been one of the RAF's most useful attributes. This will be all the more so against adversaries and their advanced A2/AD environment. To assure this core capability, the RAF requires a coherent combat system "able to threaten continuously what an adversary values most."¹⁹⁰ This system has several critical attributes. The first is a demonstration of the political will to employ force. The reach, speed, and responsiveness of air power is central to an attack capability, as is its ability to penetrate advanced A2/AD environments. Once through these advanced defences, a sufficient weight of precise and appropriate weapons to deliver the desired effect, something discussed earlier, enabled by "an effective end-to-end targeting process."¹⁹¹ The FASOC envisages something of a transformation of the attack mission as part of a coherent combat air system including offensive cyber operations, electronic attack, and the increasing use of smart munitions using manned fixed and rotary wing, and unmanned air systems. While the 2012 FASOC assumes that a practical airborne directed energy capability is unlikely in the concept timeframe, its recent emphasis in the US Third Offset strategy might see this position change in the FFC.¹⁹² In either case, ensuring its own supply of precision munitions capable of operating in advanced A2/AD environment, something discussed earlier, is seen as "critical to sustaining a credible kinetic attack capability."¹⁹³

5.5 Adaptive Air Command and Control

The future operating environment will make demands on the RAF's system of air command and control, especially against capable adversaries and in advanced A2/AD environments. The requirements for air command and control range from the need to effectively command and control air assets for standing commitments, to integrated command structures within a joint context, and finally to large-scale operations where an air component commander will be needed. In all cases, the FASOC calls for a seamless integration with US and NATO command and control structures.

In an interesting misinterpretation of the principles of air command, the FASOC argues that the traditional model of centralised control, decentralised execution will need modification. Instead of decentralised execution, directed execution will become the norm, where commanders will choose the level of decentralisation depending on the campaign requirements. This model is not new, having been practiced in the Second World War in the North African campaigns.¹⁹⁴ It was determined in the fighting against Germany and Italy in the Libyan deserts that it was necessary to centralise control under an air officer at a higher command level than the doctrine envisaged, where access to intelligence was greater and air power could be used to best effect. Later in the campaign this control was relaxed and one saw, for example, the Western Desert Air Force (WDAF) supporting Eighth Army on a daily basis with little interference from higher command.

¹⁹⁰ *Ibid.*, 3–14.

¹⁹¹ *Ibid.*

¹⁹² Robert Martinage, "Toward a New Offset Strategy: Exploiting U.S. Long-Term Advantages To Restore U.S. Global Power Projection Capability," *Center for Strategic and Budgetary Assessments* (2014).

¹⁹³ Ministry of Defence, *Joint Concept Note 3/12: Future Air and Space Operating Concept*, 3–18.

¹⁹⁴ See Brad W. Gladman, *Air Power Intelligence in the Second World War: The Western Desert and Tunisia, 1939-43* (London: Palgrave Macmillan, 2009).

However, that higher command, the Northwest African Tactical Air Force, could assume control over WDAF aircraft and direct them against the best of available targets. It is this relationship that maintained the inherent flexibility of air power, something long understood. However, this level of flexibility in command arrangements requires air officers who understand the operational art, who are comfortable to act in the presence of uncertainty, and who have studied the evolution of air power theory and its history. In short, being able to apply an adaptive command and control system effectively requires well educated and innovative personnel who possess what 18th Century Prussian military theorist Carl von Clausewitz described as the *coup d'oeil*—a mind that works in a comprehensive fashion to dominate events and not be dominated by them.¹⁹⁵ This, in turn, requires an investment in the third, or conceptual, pillar of military power.

5.6 The Third Pillar of Military Power

The RAF is, for example, proceeding with a recruitment model familiar to most air forces—with a mix of regular force, reserves, contractors, and civilian employees, along with efforts to retain experienced personnel. It is also moving forward with transforming its training systems (particularly its technical training) to modernise them and improve efficiency and effectiveness. Augmenting its investment in training, the RAF is seeking to improve the third component of military air power, with the first two being the moral and the material. Like many Western air forces, the conceptual component has been, arguably, neglected over the past decade or more due to the high operational tempo from recent operations. In an attempt similar to ongoing efforts within the RCAF, the RAF is renewing its focus on the conceptual component because its leadership realises that without professional mastery it risks “not making the most of the equipment [it is] bringing into service and not adjusting to the changing threats” faced.¹⁹⁶ To do so the RAF has embarked on a new programme called “Thinking to Win,” sponsored by the Air Force Board Standing Committee and led personally by the Chief of the Air Staff. Its aim is to reinvigorate the conceptual component and thereby “apply Air Power more effectively today, and more imaginatively tomorrow” by matching the RAF’s high-technology equipment by “the prominence of [its] thinking, leadership skills and decision-making.”¹⁹⁷

Much like the RCAF has recently done, the RAF has acknowledged that its conceptual component is strong at the tactical level, although even there it is mostly reactive, but weak at the operational and strategic levels. This leaves it unable to make compelling cases for its capability needs or to express the value of air power beyond an officer’s own experience. Weakness in the conceptual component makes it less able to advocate for air power across the spectrum, and to explain why political leadership should spend limited resources on expensive air power capabilities. This weakness can largely be overcome by a re-emphasis of professional military education across a career, with a focused study of air power history and theory as a central

¹⁹⁵ Carl von Clausewitz, *On War* (Princeton NJ: Princeton University Press, 1976), 578.

¹⁹⁶ *Ibid.* The RCAF journey to improve its professional mastery began under the direction of LGen Hood, Commander RCAF in 2015. For the first paper that began this effort see Brad Gladman, Richard Goette, Richard Mayne, Shayne Elder, Kelvin Truss, Pux Barnes, and Bill March, “Professional Airpower Mastery and the Royal Canadian Air Force: Rethinking Airpower Education and Professional Development,” *Royal Canadian Air Force Journal* 5, 1 (Winter 2016).

¹⁹⁷ Royal Air Force, “Thinking To Win,”

https://www.raf.mod.uk/rafcms/mediafiles/28DBDA58_5056_A318_A8AA043B147E9F02.pdf (accessed 13 July 2017), 2.

feature. Such a professional military-education programme would provide more utility and ultimately better guidance in preparing RAF personnel to engage more effectively across the continuum from force employment to force generation and force development. In particular, the study of the history of air power can help one understand change or, conversely, continuity in military trends by providing a theoretical or mental framework for looking at change over a time.¹⁹⁸ This kind of knowledge and skills are essential to reinvigorating the conceptual component, and to forging officers capable of campaigning at the operational and strategic levels.

Part of the conceptual component is innovation, something not routinely acknowledged in the discussion of either term.¹⁹⁹ Instead, one sees a tendency to see ‘innovation’ as something that comes from outside the military, instead of fostered from within as well. The RAF intends to change this view, strengthening its innovation culture, capitalising better on education and training to enable its personnel to do so, and rationalising its structures and process to stimulate innovation, all aiming to enable RAF personnel to innovate and ultimately to champion air power more effectively.²⁰⁰ Fostering innovation and strengthening the conceptual component is also important in improving the RAF’s ability to recruit and retain the kinds of personnel able to operate with advanced technology, and have the mental fortitude to operate in degraded environments where that technology might fail and uncertainty may preponderate.

¹⁹⁸ Gladman, *et. al.*, “Professional Airpower Mastery and the Royal Canadian Air Force,” 18.

¹⁹⁹ Captain Nick Veenhof, “Innovation: A Missing Piece of an Improved RCAF!,” *RCAF Inform* 22 (August 2016) <http://w08-ttn-vmweb01/cfawc/en/inform/inform.asp?Form=Y&ID=43> (accessed 19 July 2017).

²⁰⁰ Royal Air Force, “Thinking To Win.” Eight initiatives form the core of this effort: a common vision, training to win, driving innovation and change, supporting ideas, recognising talent, developing diverse thinking and new ways to apply air power, and promoting air power.

6 Conclusions

This detailed analysis into UK strategic thinking and the direction the RAF is taking in terms of capability investment and concept development has direct implications for the RCAF, but also for the joint force development and Canadian policy development communities. That being said, these reports are a series and need to be considered together. Even a comprehensive understanding of the air force of a single Canadian ally is an insufficient base upon which to draw recommendations for Canadian policy and military force development. After all, while Canada shares a close relationship with the UK, only parts of the British experience and approach are directly relevant. It is for this reason that the larger study began with an analysis of the United States and its air force, and this study's conclusions will emphasize developments with that most important ally.²⁰¹ However, given the seeming rediscovery of a traditional US foreign policy pattern of allowing allies to shoulder more of the defence burden, an understanding of the UK approach to operations and its capability and concept development certainly is of significant value to Canadian efforts. Thus, this paper's analysis has the potential to serve as a very useful resource for Canadian policy formulation, as well as joint and RCAF force development. Despite the analysis being incomplete, there are some preliminary and provisional recommendations which can be made.

The comprehensive understanding of the orientation of allies with whom Canada and the CAF likely will partner in deployed operations, in terms of how they view the world, their geostrategic imperatives, and their policy goals and strategies to attain them—will assist in setting the context around which to develop Canadian policies in line with desired outcomes and which align a national approach with that of key allies in areas and regions of interest. The Government of Canada currently is involved in Europe through, *inter alia*, operation 'REASSURANCE' and the leadership of the multinational brigade in Latvia. So too are the UK and the RAF, and an understanding of the UK approach to its region and the protection of its interests, as well as the management of their relationship with the United States is essential when developing a uniquely Canadian approach to these matters. It is equally important to defining a role for the Canadian military in any regional operation. As this series of studies also demonstrates, the development of a comprehensive understanding of UK policy development and orientation is a useful first step in an appreciation of its main thrusts in military concept development and capability investment.

There are some direct implications of the UK's concept and capability investment for the RCAF. Four main capability areas have proven to be of particular value to air forces in current operations. The first is ISR. The ability to gather intelligence, locate targets, and assess effects from air and space systems is critical to success in current and future air operations. Both manned and unmanned ISR platforms are key to a balanced air force, and the recent *SSE* defence policy directs the RCAF to invest in these capabilities. The RAF experience with the redevelopment of a MPA, replacement for its current fleet of UAVs, plans for integrating fifth-generation fighters, and the equipping of transport and aerial refuelling aircraft with sensors to contribute to the ISR system will be of distinct value as the RCAF determines its own set of requirements for both domestic and deployed operations. So too is the RAF's experience with space systems, as the *SSE* policy directs the RCAF to replace the current RADARSAT system to improve situational awareness of Canadian territory, and to develop a space surveillance capability. Both domestic and space surveillance are being pursued by the RAF, and lessons from its experience will be of use.

²⁰¹ Gladman, *The future of allied air power: the United States Air Force*.

ISR enables action, and often that action takes the form of kinetic effects delivered from the air. The second key area of capability for a balanced air force is a form of aerial attack capability. Some of this might be provided through an armed version of the UAV system called for in the *SSE* defence policy, but also directed is the acquisition of 88 advanced fighter aircraft to provide this capability and also North American air defence. The decision on which aircraft will be purchased for these roles has yet to be made, but some lessons from the RAF's experience would be of value. The RAF seems to have determined that its regional geostrategic imperatives require it to maintain its position as the ally of first choice for the United States. In doing so, and making a meaningful contribution to confronting advanced A2/AD environments and air forces with their own fifth-generation capabilities the RAF is committed to purchasing the F-35. As the United States Air Force pursues a range of new fifth-generation capabilities, including the F-35 and Next-Generation Strike Bomber, advanced and stealthy ISR capability, advanced cyberspace defence and attack, and increases its emphasis on stand-off and long-range weapon systems while maintaining stand-in resilience,²⁰² those nations not so equipped may find themselves a liability to future coalitions. The pursuit of so-called 'game-changing technologies' like hypersonic missiles and aircraft, nanotechnologies, directed energy weapons, and the next-generation of unmanned and autonomous systems will only exacerbate this condition.²⁰³ These conditions should form the context around which the decision on which next generation fighter to procure is made. It is clear from the *SSE* defence policy that these issues are understood, and the experience of the RAF in coming to its decision should be exploited.

Another key element of a balanced air force is its air mobility fleet, which in the case of the RAF includes aerial refuelling. It is not in the RCAF, but will be included here. In terms of transport aircraft, the RCAF is in fairly good shape. Its recent purchase of the CC-130J and the CC-177 Globemaster III, although whether the numbers are sufficient to meet government expectation is a matter that should be investigated. The only replacement to the RCAF transport fleet called for in the *SSE* defence policy is the CC-138 Twin Otter. In this regard, very little of the RAF's experience is directly relevant. The demands on this aircraft in remote northern areas find no parallel in the UK, and there are very few aircraft able to do what the Twin Otter does in the Canadian North. The refuelling capability is another matter, and the RAF's experience might well be a point of departure for the RCAF. The RAF acquired a fleet of Voyager tankers equipped only with 'probe and drogue' systems. The RCAF's close interaction with the USAF in the air defence of the continent should suggest the need for both 'probe and drogue' as well as 'boom and receptacle' systems. This was what the Royal Australian Air Force decided on with its fleet of refuelling tankers based on the A-330.

In going from policy direction to RAF strategy and then capability investment, the RAF has used its FASOC as a guide for determining specific capability requirements. The RCAF should follow this model. It has just published its own FAOC, outlining three subordinate air operating concepts (Domestic, Continental, and Expeditionary), and eleven functional concepts.²⁰⁴ In order to define reasoned requirements for specific capabilities flowing from these concept areas, it is

²⁰² United States Air Force, *America's Air Force: A Call to the Future* (Washington DC: Department of the Air Force, 2014), 14–16.

²⁰³ *Ibid.*, 18–19.

²⁰⁴ Royal Canadian Air Force, *Future Concept Directive Part 2: Future Air Operating Concept* (Ottawa, 15 August 2016). This FAOC was drawn almost entirely from Brad Gladman, Bruce Chapman, and Andrew Billyard, *The Development of a Future Air Operating Concept: Proposed Process and Example*, Annex 'B'.

recommended that the RCAF wargame each of these functional areas as realistically as possible. Moreover, it is recommended that concept developers, with the support of operational research and strategic analysis, mine the rich data set of operational experience to supplement information drawn from the wargames and other methods with which to test these concepts. In so doing, the experience of allies will be essential in developing reasonable scenarios, and in exploiting their experience. In the words of one of the author's former flying instructors "you had better learn from the mistakes of others because you'll never live long enough to make them all yourself." Doing so with the context provided by this study will assist with RCAF capability and concept development as it shapes the future RCAF.

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List of Symbols/Abbreviations/Acronyms/Initialisms

A2/AD	Anti-Access/Area Denial
AESA	Active Electronically Scanned Array
AEW&C	Airborne Early Warning and Control
AMF	Air Mobility Force
ASTOR	Airborne Stand-Off Radar
ASW	Anti-Submarine Warfare
AWACS	Airborne Warning and Control System
BAE	British Aerospace Engineering
BMD	Ballistic Missile Defence
BMEWS	Ballistic Missile Early Warning System
CAF	Canadian Armed Forces
CASOM	Conventionally Armed Stand-Off Missile
CD&E	Concept Development and Experimentation
CEFCOM	Canadian Forces Expeditionary Command
CFAWC	Canadian Forces Aerospace Warfare Centre
CSAT	Command Support Air Transport
DMB	Dual Mode Brimstone
DMR	Dual Mode Radar
EU	European Union
FAOC	Future Air Operating Concept
FASOC	Future Air and Space Operating Concept
FCAS	Future Combat Air System
FFC	Future Force Concept
GDP	Gross Domestic Product
GPS	Global Positioning System
HAPS	High Altitude Pseudo Satellite
HMAS	Her Majesty's Australian Ship
HMS	Her Majesty's Ship
IOC	Initial Operational Capability
ISR	Intelligence, Surveillance, and Reconnaissance

ISTAR	Intelligence, Surveillance, Target Acquisition, and Reconnaissance
JF25	Joint Force 25
JHC	Joint Helicopter Command
MALE	Medium Altitude Long Endurance
MoD	Ministry of Defence
NATO	North Atlantic Treaty Organisation
NGAF	Next Generation Air Force
NSA	National Security Advisor
NSC	National Security Council
NSS	National Security Strategy
OIR	Operation Inherent Resolve
OLGS	Operational Level Ground Stations
PFI	Private Finance Initiative
PM	Prime Minister
PRICIE	Personnel, Research and Development, Infrastructure and Organisation, Concepts, Doctrine and Collective Training, Information Management, and Equipment Supplies and Services
RAAF	Royal Australian Air Force
RAF	Royal Air Force
RCAF	Royal Canadian Air Force
RPA	Remotely Piloted Aircraft
RSIP	Radar System Improvement Program
SDSR	Strategic Defence and Security Review
SHF	Support Helicopter Force
SSE	Strong, Secure, Engaged
TGS	Tactical Ground Station
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aerial Vehicle
UCAV	Unmanned Combat Air Vehicle
UK	United Kingdom
US	United States
USAF	United States Air Force
WDAF	Western Desert Air Force

DOCUMENT CONTROL DATA		
(Security markings for the title, abstract and indexing annotation must be entered when the document is Classified or Designated)		
<p>1. ORIGINATOR (The name and address of the organization preparing the document. Organizations for whom the document was prepared, e.g., Centre sponsoring a contractor's report, or tasking agency, are entered in Section 8.)</p> <p>DRDC – Centre for Operational Research and Analysis Defence Research and Development Canada 101 Colonel By Drive Ottawa, Ontario K1A 0K2 Canada</p>	<p>2a. SECURITY MARKING (Overall security marking of the document including special supplemental markings if applicable.)</p> <p>CAN UNCLASSIFIED</p>	
	<p>2b. CONTROLLED GOODS</p> <p>(NON-CONTROLLED GOODS) DMC A REVIEW: GCEC DECEMBER 2013</p>	
<p>3. TITLE (The complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S, C or U) in parentheses after the title.)</p> <p>The future of allied air power : The Royal Air Force</p>		
<p>4. AUTHORS (last name, followed by initials – ranks, titles, etc., not to be used)</p> <p>Gladman, B.W.</p>		
<p>5. DATE OF PUBLICATION (Month and year of publication of document.)</p> <p>November 2017</p>	<p>6a. NO. OF PAGES (Total containing information, including Annexes, Appendices, etc.)</p> <p style="text-align: center;">55</p>	<p>6b. NO. OF REFS (Total cited in document.)</p> <p style="text-align: center;">124</p>
<p>7. DESCRIPTIVE NOTES (The category of the document, e.g., technical report, technical note or memorandum. If appropriate, enter the type of report, e.g., interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.)</p> <p>Scientific Report</p>		
<p>8. SPONSORING ACTIVITY (The name of the department project office or laboratory sponsoring the research and development – include address.)</p> <p>DRDC – Centre for Operational Research and Analysis Defence Research and Development Canada 101 Colonel By Drive Ottawa, Ontario K1A 0K2 Canada</p>		
<p>9a. PROJECT OR GRANT NO. (If appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant.)</p>	<p>9b. CONTRACT NO. (If appropriate, the applicable number under which the document was written.)</p>	
<p>10a. ORIGINATOR'S DOCUMENT NUMBER (The official document number by which the document is identified by the originating activity. This number must be unique to this document.)</p> <p>DRDC-RDDC-2017-R166</p>	<p>10b. OTHER DOCUMENT NO(s). (Any other numbers which may be assigned this document either by the originator or by the sponsor.)</p>	
<p>11. DOCUMENT AVAILABILITY (Any limitations on further dissemination of the document, other than those imposed by security classification.)</p> <p>Unlimited</p>		
<p>12. DOCUMENT ANNOUNCEMENT (Any limitation to the bibliographic announcement of this document. This will normally correspond to the Document Availability (11). However, where further distribution (beyond the audience specified in (11) is possible, a wider announcement audience may be selected.)</p> <p>Unlimited</p>		

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The purpose of this Scientific Report is to inform discussions of capability and concept development within both the RCAF and CAF. This is the third in a series of reports written for the Commanding Officer of the Canadian Forces Aerospace Warfare Centre. The method adopted begins with an analysis of the policy and supporting strategy framework of, in this case, the United Kingdom (UK) to develop an understanding of the direction being given to its military on the areas of the world and threats against which it is to prepare. On the basis of this understanding of the key tenets of UK strategic thinking it is possible to identify those concepts and capabilities being developed to prepare the Royal Air Force (RAF) to meet those threats. The findings of this analysis are that the UK will, for its own geostrategic reasons, continue to develop the capabilities necessary to ensure it remains an indispensable ally to the world's dominant naval and air power. The institutional change those capabilities are forcing on the RAF are an example of what the RCAF and CAF need to do to define a meaningful role for air and joint operations moving forward. Thus, this analysis of the UK experience could serve a range of functions within the Department of National Defence and the CAF, from focusing RCAF capability and concept development through to informing joint force development.

Le présent rapport scientifique est le troisième d'une série destinée au commandant du Centre de guerre aérospatiale des Forces canadiennes. Son but est de rendre compte des discussions sur le développement de capacités et de concepts au sein de l'Aviation royale canadienne (ARC) et des Forces armées canadiennes (FAC). La méthodologie adoptée consistait tout d'abord à procéder dans le présent cas à une analyse de la politique et du cadre de la stratégie d'appui du Royaume-Uni (R.-U.) en vue d'acquiescer une compréhension de l'orientation que ce pays donne à ses forces armées quant aux régions de la planète et aux menaces contre lesquelles elles doivent se préparer. En fonction de cette compréhension des principes clés de la pensée stratégique du R.-U., il est possible de définir les concepts et capacités développés en vue de préparer la Royal Air Force (RAF) à faire face à ces menaces. Cette analyse permet de conclure que le R.-U. continuera, pour ses propres raisons géostratégiques, de développer les capacités dont il a besoin pour s'assurer de demeurer un allié indispensable de la puissance navale et aérienne dominante du monde. Le changement institutionnel que ces capacités poussent la RAF à adopter illustre les mesures que l'ARC et les FAC doivent prendre pour définir un rôle significatif et permettre aux opérations aériennes et interarmées d'aller de l'avant. Ainsi, l'analyse de l'expérience du R.-U. pourrait être utile dans le cadre d'un vaste éventail de fonctions au sein du ministère de la Défense nationale et des FAC, qu'il s'agisse simplement d'orienter le développement des capacités et concepts de l'ARC ou même de contribuer au développement des forces interarmées.

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Royal Air Force; RAF; future warfare; ISR; Intelligence; Surveillance; Reconnaissance; concept development; future air operating concept; National Security Strategy; Strategic Defence and Security Review; RAF Strategy; Future Combat Air System; Brimstone; Storm Shadow; Protector; Sentinel; Shadow; Rivet Joint; Voyager; FASOC; control of the air; air mobility and lift; aerial refuelling; attack; adaptive command and control; professional mastery