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Nothing to Chance: RCAF Fixed-Wing Tactical Air Mobility Capabilities and the Anti-Access/Area Denial Challenge

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NOTHING TO CHANCE: RCAF FIXED-WING TACTICAL AIR MOBILITY CAPABILITIES AND THE ANTI-ACCESS/AREA DENIAL CHALLENGE

By Major Whitney Camm

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ABSTRACT

In order to meet the defence challenges of both today and the future the Canadian Armed Forces (CAF) must have the means to get troops into and out of theatres of operations safely and effectively. Contemporary anti-access area-denial (A2/AD) challenges could make this very difficult, as they prevent forces from gaining entry to an area, and then make it very difficult to maneuver freely within it should the succeed in entering. This combination of warfare methods, used simultaneously and across all domains, could enable the enemy to gain advantage over the CAF in the battlespace of the future.

The Royal Canadian Air Force (RCAF) must adapt its current capabilities to meet all future requirements while continuing to project air power and deploy forces into any theatre of operation demanded by the Government of Canada, whether permissive, contested or denied. The best means to guarantee this is through fixed-wing tactical Air Mobility assets. Currently, the RCAF relies on the CC-130J Hercules to conduct all tactical Air Mobility missions. However, the CC-177 Globemaster III has also been used in this role to great effect in the past.

This study will demonstrate that A2/AD capabilities are the most significant threat to Canadian Air Mobility Operations in future conflict. As a result, Canada must have a heavy fixed-wing tactical Air Mobility capability in order to maximize its ability to project power globally and remain relevant in the battlespace of the future. It will argue that without a sizeable and immediate investment in state-of-the-art electronic warfare capabilities, countermeasure systems, and training, Canadian Tactical Air Mobility assets will not be able to operate in the A2/AD battlefield of the future.

INTRODUCTION

Canada's defence policy document *Strong, Secure, Engaged* (SSE) opens with the promise that Canada must have "an agile, multi-purpose, combat-ready military, operated by highly trained, well-equipped women and men."[1] Yet, those same women and men are not properly protected from emerging weapons systems or equipped to operate on the battlefield of the future. Historically, anti-access and area-denial (A2/AD) has been an operational concept that combatants have used successfully by creating environments that are not permissive for the enemy. It is also an effective way to counter enemy actions and prevent incursions into friendly territory.

NATO Defence College researcher Guillaume Lasconjarias argues that A2/AD has become an all-inclusive defence strategy that considers all possible warfighting tactics.[2] Although the methods have evolved over time, from trenches to sea mines to anti-aircraft weapons, the goal has always been to deny the enemy access to a region, area or specific target and then make it exceptionally difficult for them to stay in the area should they succeed in entering it. The theory is that multiple layers of complementary capabilities in a relatively small area will be nearly impossible to penetrate, which leaves militaries to work out how to break through an impenetrable bubble without risking a rapid and potentially uncontrollable escalation.[3] In the past, the answer has been to simply

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[1] Department of National Defence, *Strong, Secure, Engaged: Canada's Defence Policy* (Ottawa: DND Canada, 2017), 14.

[2] Guillaume Lasconjarias, "NATO's response to Russian A2/AD in the Baltic States: Going Beyond Conventional?," *Scandinavian Journal of Military Studies*, 2 (1), 76.

[3] *Ibid.*, 75.

manoeuvre around the denied area, but that is no longer entirely possible, with some A2/AD bubbles including vast swathes of neighbouring countries, whether allied or not.[4]

This issue is most relevant today when it involves helping allies when they are located within one of the world's A2/AD bubbles, or if they need to confront an enemy who is. For example, Russia's notable infringement on the Baltic countries of Estonia, Latvia and Lithuania, and their prepositioning of extensive A2/AD systems in Kaliningrad, creates a massive A2/AD bubble that sweeps almost to Canada's most northern coast. Alternatively, China's defensive forays into the South China Sea have created an A2/AD bubble that stretches out past Japan and Malaysia. A2/AD capabilities in these two regions, including the anti-aircraft and ballistic missile systems already in use, will define the world's current and future operating environments.

The reality of A2/AD and its sophisticated systems is creating a massive hurdle for conventional forces and their ageing equipment. In Canada, this is a particular challenge for the Royal Canadian Air Force (RCAF)'s fixed-wing Air Mobility fleets. RCAF doctrine defines Air Mobility as "the delivery of personnel or materiel by air, independent of platform type… [and] as a core air power capability, [is] employed across the spectrum of conflict."[5][6] This being the case, Canada's ability both to sustain and

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[4] Keir Giles and Mathieu Boulegue, "Russia's A2/AD Capabilities: Real and Imagined," *The US Army War College Quarterly: Parameters*, 49 (1): 2019, 21-36.

[5] Department of National Defence, *Royal Canadian Air Force Doctrine*, (Ottawa: DND Canada, 2016), 34.

[6] To best frame the argument, this paper will limit the discussion of RCAF Air Mobility capabilities to fixed-wing tactical-capable aircraft only, notably the CC-177 Globemaster and CC-130J Hercules. The CC-150 Polaris, CC-130T and CC-144 Challenger, while important strategic aircraft, will not be discussed as they are not Tactical Air Transport capable. Additionally, while technically transport aircraft, the CC-130H and CC-295 Kingfisher will not be included as their primary role is Search and Rescue; neither will the BE-250 King Air or CC-138 Twin Otter, as they are only operated in domestic roles, and are very unlikely to be called upon to operate in an Expeditionary capacity. For information on these RCAF aircraft, see http://www.rcaf-arc.forces.gc.ca/en/aircraft.page (last accessed 26 April 2021).

project forces by air into these regions could become almost non-existent by 2035 should the RCAF not immediately invest in more sophisticated electronic warfare and countermeasures systems, as well as return to training Air Mobility aircrews in advanced tactical air transport procedures.

Recent Canadian policy, including *SSE*, note the importance of being able to operate militarily in A2/AD environments. In fact, a number of projects specifically outlined in *SSE* are directly related to operations in non-permissive environments, including acquiring a Ground-Based Air Defence (GBAD) capability for the Army, and a modernization of their land-based Command and Control, Intelligence, Surveillance and Reconnaissance (C2ISR) systems. Additionally, the acquisition of airborne ISR platforms for the Special Operations Forces and enhancing naval ISR systems are also on the list.[7] However, despite being specifically listed as a priority, the only investments for the RCAF in *SSE* do not include considerations for airlift into A2/AD environments.

Significant investment is being made to the RCAF in terms of new space-based assets and replacements to existing fleets (CP-140 Aurora, CF-18 Hornet, CC-138 Twin Otter and the new Fixed-Wing Search and Rescue platform).[8] However, all the upgrades in the world will be meaningless without having the ability to get people and equipment into and out of the non-permissive environments in which the rest of the Canadian Armed Forces (CAF) will be operating. *SSE* details three key security trends that will shape the future of conflict: "the evolving balance of power, the changing nature of conflict, and the rapid evolution of technology."[9] However, as will be discussed in this paper, none of

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[7] Department of National Defence, *Strong, Secure, Engaged . . .,* 109.
[8] *Ibid.*, 39.
[9] *Ibid.*, 49.

those elements are actually being addressed in a meaningful way when it comes to Air Mobility modernization. As this paper discusses, the RCAF must focus on these issues related to the A2/AD challenge in order to field a relevant fighting force into the future.

Academic work related to this paper is primarily focused on the challenge of A2/AD in the future operating environment, the expansion of RCAF Air Mobility capabilities, and the ongoing discussion about what constitutes Air Power. Defence researcher Guillaume Lasconjarias writes about A2/AD with a specific focus on the Baltic region and NATO. He argues that NATO must develop a comprehensive counter-A2/AD strategy, which should include expanding reassurance missions in the countries surrounding Russia, as well as improvements to NATO doctrine in order to continue to be seen as a credible deterrent in the region.[10] Dr Andrew Krepinevich Jr. is a retired U.S. Army officer and National Defence and Foreign Policy expert. He is an authority in the field of China's A2/AD bubble and their militarization of the South China Sea and beyond. He argues that Chinese expansion threatens all countries in the region, from Japan down through Taiwan and the Philippines and that without dedicated deterrence in the area, the United States and its allies will not be able to stop China's expansionism. Krepinevich explores the idea of an Archipelagic defensive system that would create an American A2/AD bubble that overlaps with China's, essentially cancelling each other out through effective deterrence.[11] Key to the discussion about the future operating environment, and A2/AD, is retired Naval Captain Dr. Sam Tangredi. His work on deterrence, future warfare and A2/AD are central to this study, as he argues that A2/AD is

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[10] Lasconjarias, "NATO's response to Russian . . ., 75.

[11] Andrew F. Krepinevich Jr., "How to Deter China: The Case for Archipelagic Defense," *Foreign Affairs*, 94 (2): 2015, 78-86.

more of a strategy than an operational concept. This viewpoint significantly changes how the problem of A2/AD could potentially be solved, as it implies that all levels of military and government could work together to use economic, political and defence means to access previously denied areas.[12]

Also discussed throughout this study is work by researcher Robert Dalsjö, whose focus on Baltic security as it pertains to Russia and NATO provides a clear description of the issue. RAND senior policy advisor David Shlapak and Political Scientist Alexander Lanoszka both provide valuable contributions to the discussion surrounding A2/AD and NATO's involvement in the Baltic Region.[13] Finally, Tsuyoshi Kawasaki provides a vital argument about Chinese expansionism, anti-access capabilities, and that country's strategic power competition with the United States.

Recent Canadian policy documents will be studied and will make it clear that significant investment is needed to keep the CAF relevant in the battlespace of the future. *SSE*[14] promises significant spending for all three services, plus Canadian Special Operations Forces Command (CANSOFCOM), to bring assets, personnel and training up to the standard required to continue to operate effectively. The RCAF continues this promise with discussions in its doctrinal *Future Air Operating Concept* (FAOC)[15] and *Air*

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[12] Sam J. Tangredi, "Antiaccess Warfare as Strategy," *Naval War College Review*, Vol 71 (1), 2018.

[13] Robert Dalsjö, Christofer Berglund and Michael Jonsson, "Bursting the Bubble: Russian A2/AD in the Baltic Sea Region: Capabilities, Countermeasures, and Implications," *FOI Defence Policy Studies Report FOI-R-4651-SE*, March 2019.; David A. Shlapak and Michael Johnson, "Reinforcing Deterrence of NATO's Eastern Flank: Wargaming the Defense of the Baltics," *RAND Corporation Research Report*, 2016.; Alexander Lanoszka and Michael A. Hunzeker, "Confronting the Anti-Access/Area Denial and Precision Strike Challenge in the Baltic Region," *The RUSI Journal,* 161 (5).

[14] Department of National Defence, *Strong, Secure, Engaged* . . ., 49.

[15] Department of National Defence, *Future Concepts Direction Part 2: Future Air Operating Concept* (Ottawa: DND Canada, 2016).

Force Vectors.[16] While the *FAOC* addresses the A2/AD threat specifically, *Air Force Vectors* speaks to developing new capabilities and ensuring that that equipment, particularly in the Electronic Warfare, Intelligence, Surveillance and Reconnaissance (ISR) and Command, Control, Communications and Computers (C4) fields are modernized and put in use across all fleets and capabilities. These documents, including the RCAF capstone doctrine documents of "Move"[17] and "Sustain,"[18] plus aircraft Standard Manoeuvre Manuals (SMM) and project descriptions, were used to amplify the discussion and will be discussed at length.

Significantly, meaningful study into the use of tactical Air Mobility in CAF Expeditionary Operations has not been conducted, particularly covering the Afghanistan era. While a few case studies have been written about Canadian airlift in general, namely those from Korea and Rwanda,[19] the focus of academic work has generally been on kinetic missions, such as helicopter tactical aviation and deployed fighter effects. This paper will attempt to fill some of the gaps and will therefore advocate for the fixed-wing tactical Air Mobility community by highlighting the significant threat posed by A2/AD capabilities, as well as the advantages of tactical fixed-wing Air Mobility flying in high threat areas.

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[16] Department of National Defence, *Air Force Vectors,* (Ottawa: DND Canada, 2019).

[17] Department of National Defence, *CF Aerospace Move Doctrine*, (Ottawa: DND Canada, 2011).

[18] Department of National Defence, *Royal Canadian Air Force Doctrine: Force Sustainment*, (Ottawa, DND Canada, 2017).

[19] Hugh A. Halliday, "Operation Hawk: The Korean Airlift," *Legion: Canada's Military History Magazine*, 07 Aug 2013, https://legionmagazine.com/en/2013/08/operation-hawk-the-korean-airlift-2/ (last accessed 01 April 2021); James Pierotti, "A Tactical Silver Lining in a Horrifying Storm: Canadian Airlift in Rwanda, 1994," *RCAF Journal*, Winter 2016, https://www.rcaf-arc.forces.gc.ca/en/cf-aerospace-warfare-centre/elibrary/journal/2016-vol5-iss1-05-a-tactical-silver-lining-in-a-horrifying-storm.page (last accessed 01 April 2021).

A longer discussion of the future definition of Air Power will occur in Chapter three that relies heavily on work from Brad Gladman and Robert Owen. Dr. Robert Owen is a former USAF CC-130 tactical airlift pilot and has taught and written extensively about Air Mobility and Global Airlift in conflict.[20] Meanwhile, Dr. Brad Gladman is a former military pilot, and current strategic analyst for Defence Research and Development Canada. His work was used to develop *SSE*, as well as numerous RCAF publications that will be referenced here.[21] He is widely understood to be an authority on RCAF doctrine and policy.

This study will analyze the information discussed above in four distinct parts. Chapter one will discuss what exactly A2/AD is and analyze the Russian and Chinese examples to illustrate the challenges and current threat. Specifically, Russian weapons systems postured in the Baltic area of operations and China's incursions into the South China Sea will be examined. In both cases, a brief discussion of allied basing and current posturing will demonstrate the severity of the threat. Chapter two will review a brief history of Canadian Air Mobility. This will include several case studies which will demonstrate the importance of tactical Air Mobility efforts and the lessons learned from

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[20] Robert Owen, *Air Mobility: A brief history of the American Experience*, (Washington: Potomac Books, 2013).

[21] Brad W. Gladman, Defence Research and Development Canada, DRDC-RDDC-2017-R166, *The future of allied air power: The Royal Air Force*. (Ottawa: DND Canada, 2017); Brad W. Gladman, Richard Goette, Richard Mayne et al, "Professional Airpower Mastery and the Royal Canadian Air Force: Rethinking Airpower Education and Professional Development," *Royal Canadian Air Force Journal* 5, no. 1 (Winter 2016); Brad W. Gladman, Defence Research and Development Canada, DRDC-RDDC-2014-R82, *The future of allied air power: The United States Air Force*, (Ottawa: DND Canada, 2014); Brad W. Gladman, Defence Research and Development Canada, DRDC-RDDC-2015-L223, *Considerations for defining the future of Canadian military air power*, (Ottawa: DND Canada, 2015); Brad W. Gladman, and Andrew Billyard, Defence Research and Development Canada, DRDC-RDDC-2017-L346, *Royal Canadian Air Force (RCAF) Future Air Operating Concept (FAOC) Functional Concepts*, (Ottawa: DND Canada, 2017).

those events, especially with regards to the limits of strategic airlift alone. Chapter three will present a review of current Canadian Air Mobility assets and capabilities, including their roles in current Operations. The final chapter will discuss future capabilities, including current doctrine and futures studies. Recommendations for the way forward in order to improve Canada's much needed fixed-wing tactical Air Mobility capability will be presented in the conclusion.

Through a qualitative analysis of the works described above, together with a holistic discussion about Canadian Tactical Air Mobility, this study will demonstrate that A2/AD capabilities are the most significant threat to Canadian Air Mobility Operations in future conflict. As a result, Canada must have a heavy fixed-wing tactical Air Mobility capability in order to maximize its ability to project power globally and remain relevant in the battlespace of the future. It will argue specifically that without a sizeable and immediate investment in state-of-the-art electronic warfare capabilities, countermeasure systems, and training, Canadian Tactical Air Mobility assets will not be able to operate in the A2/AD battlefield of the future.

CHAPTER 1 – A2/AD AND THE CURRENT CHALLENGE

Introduction

The RCAF's mission is "to provide the CAF with relevant, responsive and effective air power to meet the defence challenges of today and into the future."[22] An essential means of accomplishing this mission is to ensure that troops can get into and out of theatres of operations safely and effectively. Currently, the United States is the only NATO country with the necessary equipment to operate freely in access-challenged or A2/AD environments. Commandant of the United States Army Air Defense Artillery School, Colonel Mark Holler, asserts in a recent paper that militaries must take a multi-tiered approach to win in an A2/AD environment.[23] He argues that success will be defined first through penetrating A2/AD, disintegrating A2/AD systems, exploiting freedom of manoeuvre, and finally re-competing to consolidate and expand gains. He believes that without these outcomes occurring in synchronicity, enemy defeat will be impossible.[24] Since the basis of the A2/AD concept is a model of complex, layered systems, the same must be developed for the future of countering A2/AD threats. Canada and its allies must focus on all-domain access, with a goal to improve and acquire new cyberspace and electronic warfare capabilities in the short term in order to match Holler's approach.[25]

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[22] Department of National Defence, *Air Force Vectors . . .*, iv.

[23] Mark Holler, "Fighting air defense in multi-domain operations," *Fires*, July-August 2019, 3.

[24] *Ibid.*, 5.

[25] Elinor Sloan, "Op Ed: Strategic Considerations for Canada's Navy," *Canadian Naval Review,* https://www.cgai.ca/opedjune12016d, (last accessed 01 April 2021). Portions of this section were also inspired by W.A. Camm, "Area Defence in the Baltic Region: A2/AD, Russia and NATO," Course Paper, (Joint Command and Staff Program 47: Canadian Forces College, JCSP 47, 2020).

The RCAF's *FAOC* notes that Canadian National Military Strategy has three key roles, including the requirement to contribute to international peace and security.[26] For the RCAF, this contribution occurs through the Expeditionary Air Operating Concept. The RCAF breaks this concept down into eleven RCAF Functional Areas, one of which specifically states that "RCAF Operations in High Intensity, A2/AD Conflicts" is a priority for the force going into the future.[27] While A2/AD is not a new idea, it has undergone a quantitative change from recent counterinsurgency warfare to defending against hybrid challenges in a pan-domain context, and Canada must adapt.[28] This chapter will discuss the exact nature of A2/AD and then analyze the Russian and Chinese examples to illustrate the challenges and current threat to Canada and its alliances. Specifically, this chapter will investigate the Russian weapons systems postured in the Baltic area of operations and China's incursions into the South China Sea. A brief discussion of Canadian basing and current operations will demonstrate the severity of the A2/AD threat in both cases. Together, this discussion will demonstrate that A2/AD capabilities are the most significant threat to Canadian Air Mobility Operations in future conflict.

What is A2/AD?

There has been a healthy discussion recently about A2/AD in a Canadian context. The RCAF's *FAOC* from 2016 defines anti-access and area-denial as the "action intended to slow deployment of friendly forces into a theatre or cause forces to operate from

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[26] Department of National Defence, *Future Concepts Direction Part 2 . . .*, 12. The other two are defending Canada and protecting North America in conjunction with the United States.

[27] Department of National Defence, *Future Concepts Direction Part 2 . . .*, 12.

[28] Department of National Defence, *Advancing with Purpose: The Canadian Army Modernization Strategy 4th Ed*, (Ottawa: DND Canada, 2020), 4.

distances farther from the locus of conflict than they would otherwise prefer."[29] In short, it describes all action used to obstruct friendly operations into areas where an enemy otherwise couldn't block access.[30] In other words, A2/AD is about preventing the enemy from gaining entry to an area, and if they do get in, preventing them from manoeuvring freely within it. In a study conducted by Defence Research and Development Canada (DRDC) for the Commandant of the RCAF's doctrine development unit at the RCAF Aerospace Warfare Centre (RCAF AWC), the challenge of A2/AD is presented starkly, as a choice to either risk losing access to crucial areas by handing over control of them to adversaries, or building the means to address their tactics through investment in necessary capabilities and the development of new ideas.[31]

Canada's *Future Security Environment* document describes the problem from a broader viewpoint, as the idea that the enemy will try to combine conventional, irregular and hybrid warfare methods simultaneously across all environments, including the cyber domain, in order to gain advantage in the battlespace of the future.[32] The document goes on to warn that "contemporary A2/AD challenges have the potential to undermine many current strategic and operational assumptions"[33] through their ability to target military capabilities across all domains. Air power academic Dr Richard Goette notes that the most significant issue to Canada is that traditionally the CAF has "enjoyed the ability to forward deploy to bases and sustain them by means of relatively secure lines of

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[29] Department of National Defence, *Future Concepts Direction Part 2* . . ., 32. – taken from Air-Sea Battle Office, "Air-Sea Battle: Service Collaboration to Address Anti-Access & Area Denial Challenges" (Washington, DC: May 2013).

[30] *Ibid.*

[31] Gladman, "Considerations for defining the future . . ., 4.

[32] Department of National Defence, *The Future Security Environment: 2013-2040,* (Ottawa: DND Canada, 2014), 96.

[33] *Ibid.*, 111.

communication [but] fiscal challenges and growing adversary A2/AD capabilities have placed limits on this freedom."[34] In short, the CAF must maintain both a heavy intra- and inter-theatre airlift capability that will allow it to support logistics for all manner of operations in which Canada might become involved,[35] which it does not currently have.

Retired Naval Captain and scholar Sam Tangredi argues that A2/AD is a strategy that extends beyond being simply military. Rather, he believes that a true anti-access capability must include political, diplomatic, social and legal actions, which must be addressed holistically if true defeat of the enemy is to be achieved.[36] Furthermore, Tangredi argues that A2/AD bubbles should not be treated as "no-go" areas that guarantee defeat, but rather as arcs that represent danger and for which military forces must be properly equipped and prepared to attack.[37] As this extends to Canada, the RCAF must adapt its current capabilities to meet these future requirements and danger areas, while continuing to project air power and be prepared to deploy forces into any theatre of operation demanded by the Government of Canada, whether permissive, contested or denied.[38]

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[34] Richard Goette, *Preparing the RCAF for the Future: Defining Potential Niches for Expeditionary Operations,* (Ottawa: DND Canada, 2020), 8.

[35] Brad W. Gladman, "Considerations for defining the future . . ., 5.; Department of National Defence, *Canadian Forces Aerospace Move* . . ., 15. Inter-theatre airlift is defined as operations which have "the primary objective of carrying and delivering personnel and material, usually between a main operating base and a deployed operating base, but can also provide airlift between two areas of operation or two theatres of operations." Meanwhile, intra-theatre airlift is defined as operations which have "the primary aim of carrying and delivering personnel and materiel within a specific theatre of operations or area of operations."

[36] Tangredi, "Antiaccess Warfare as Strategy . . ., 35.

[37] *Ibid.,* 40.

[38] Department of National Defence, *Future Concepts Direction Part 2* . . ., 20.

China

China's A2/AD capabilities are most relevant to Canada as they apply to Canada's alliances with Pacific nations and the potential loss of access to international shipping routes.[39] Although Chinese A2/AD in the South China Sea is not currently a direct threat to Canada and is not an area that the CAF is currently forward deployed, the RCAF and RCN routinely transit through the area and require that freedom to manoeuvre to access Pacific partner nations and to conduct episodic operations. Recent examples include support to Op NEON, the multinational effort to support the implementation of United Nations Security Council sanctions imposed against North Korea, Op RENAISSANCE 13-01 and 15-01, which provided disaster relief to the Philippines and Nepal, respectively, and Op PROJECTION during which the RCN conducts training, exercises and engagements with foreign navies and other international security partners. The most recent Op PROJECTION was conducted in the Asia-Pacific region from September to December of 2020.[40]

China currently has several A2/AD systems that could present a very credible threat to forces in the South China Sea and beyond, should they choose to use them. In addition to very effective anti-ship capabilities, China also maintains more traditional cruise and ballistic missile systems, as well as having a number of missile systems still in development that will provide even greater range. For example, the CJ-10 cruise missile is the premier cruise missile of the People's Liberation Army (PLA) and has an estimated

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[39] Xiaoxue Jiang Martin, "China's A2/AD Capabilities and American Security Interests in the Asia-Pacific," *Mapping China Journal*, 3: 2019, 122-136.

[40] Government of Canada, "Current Operations List," *Government of Canada*, https://www.canada.ca/en/department-national-defence/services/operations/military-operations/current-operations/list.html (last accessed 01 April 2021).

range of up to 4000-km. In contrast, the YJ-100 anti-ship missile has an estimated range of 800-km and can be both air- and ground-launched.[41]

From an anti-air perspective, the Chinese reversed engineered the extremely effective French Crotale missile defence system into their Hong Qi-7 (HQ-7B/NATO FM-80), with significant upgrades to both its acquisition radar and launch vehicle, which enables target acquisition out to 17-km. The HQ-7B is typically a short-range, low-altitude interceptor used against both low-flying aircraft and tactical ballistic missiles.[42] To add even more capability to their arsenal, the Hong Qi-9 (HQ-9) road-mobile air defence system has a target acquisition range of closer to 120-km and a range of nearly 300-km, and can successfully target low-flying aircraft with a kill probability as high as 90 percent.[43] Together with several other highly capable short- and mid-range air and missile defence systems, these two variants represent the backbone of the Chinese anti-air program, and they are eagerly exporting versions of the systems to countries such as Iraq, Turkey, Pakistan and Algeria.[44] While these other countries are not the focus of this paper and are technically friendly to Canada, they have also been purchasing A2/AD capabilities, ever-expanding the global list of potential access-denied areas. This development further underlines the necessity for Canada's Air Mobility community to

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[41] Stephen Kuper, "The teeth in China's anti-access/area denial defences," *Defence Connect*, https://www.defenceconnect.com.au/key-enablers/3927-the-teeth-in-china-s-anti-access-area-denial-defences (last accessed 01 Apr 2021).

[42] Missile Defense Advocacy Alliance, "HQ-7 information sheet," *Missile Defense Advocacy*, https://missiledefenseadvocacy.org/missile-threat-and-proliferation/todays-missile-threat/china/china-anti-access-area-denial/hq-7/ (last accessed 15 March 2021).

[43] Missile Defense Advocacy Alliance, "HQ-9 information sheet," *Missile Defense Advocacy,* https://missiledefenseadvocacy.org/missile-threat-and-proliferation/todays-missile-threat/china/china-anti-access-area-denial/hq-9/ (last accessed 15 March 2021).

[44] *Ibid.*

develop and maintain the means to operate in and around these non-permissive environments, as they are becoming more common than not.

Meanwhile, from a surface-to-surface perspective, the big gun in the Chinese arsenal is the Dong Feng-16 (DF-16 / NATO CSS-11) short-range ballistic missile (SRBM). Specifically designed to defeat the U.S. Patriot missile defence system, the DF-16 can carry both nuclear and conventional warheads and can easily reach all targets within Japan and the South China Sea with its published range of approximately 1000-km.[45] Combined with the might of the DF-16, the JL-2 (NATO CSS-NX-14) submarine-launched ballistic missile vastly extends the reach of the Chinese A2/AD bubble. With a range of almost 9000-km, and an ability to carry both nuclear or conventional warheads, this intercontinental-range missile presents a credible sea-based nuclear deterrent capability for China.[46] Fortunately, the Jin-class submarine has had a slew of issues, including noise and communications problems, and is not yet used in operations with the JL-2 loaded.[47] Should China fix the issues mentioned above, this weapons system could become a massive deterrent for Western forces wanting to operate in the South China Sea and elsewhere in the Pacific.

To counter maritime targets, the YH-63 (NATO KD-63) is an electro-optical terminal guided system that can conduct precision strikes against targets out to 200-km. Believed to be the first home-grown long-range cruise missile used by China's People's

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[45] Missile Defense Advocacy Alliance, "DF-16 information sheet," *Missile Defense Advocacy*, https://missiledefenseadvocacy.org/missile-threat-and-proliferation/todays-missile-threat/china/dong-feng-16/ (last accessed 15 March 2021).

[46] Missile Defense Advocacy Alliance, "JL-2 information sheet," *Missile Defense Advocacy,* https://missiledefenseadvocacy.org/missile-threat-and-proliferation/todays-missile-threat/china/jl-2/ (last accessed 15 March 2021).

[47] *Ibid.*

Liberation Army Air Force (PLAAF), the YH-63 can hit targets out to 200-km from its deployed H-6K bomber, which itself has a range of approximately 3500-km. This combination of assets easily puts the majority of the western Pacific within striking range.[48] Combined with the YJ-12 Anti-Ship cruise missile, which has a purported range of 400-km and has variants that can be air-, ground- and sea-launched, China's A2/AD bubble seems almost impenetrable. Of all of China's current systems, the YH-63 is "considered the most dangerous anti-ship missile China has produced," as its speed of up to Mach 3 makes it very difficult to counter. For land-based systems, the DF-21 "represents the pinnacle of the nation's anti-ship ballistic missile capabilities [and] is designed specifically to counter advanced area air defence systems like … those used to protect major surface combatants."[49] With a possible range of up to 2150-km, this anti-ship capability easily closes any final gaps in China's A2/AD bubble.

Currently, Canada is not involved in any conflict in the Asia-Pacific region and does not have personnel permanently deployed to that theatre. However, Canada does maintain several military positions in South Korea with the United States Forces Korea Headquarters based in Seoul and routinely conducts maritime operations and training in the area as previously discussed. The South China Sea is a major international shipping lane, and any disruption would necessarily invite international attention and potentially military action.[50] China's recent forays into militarizing the area have gained worldwide attention, particularly with the construction of artificial islands on the Paracel and Spratly

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[48] Missile Defense Advocacy Alliance, "YJ-63 information sheet," *Missile Defense Advocacy,* https://missiledefenseadvocacy.org/missile-threat-and-proliferation/todays-missile-threat/china/yj-63/ (last accessed 15 March 2021).

[49] Kuper, "The teeth in China's anti-access . . ., (last accessed 01 April 2021).

[50] Sloan, "Op Ed: Strategic Considerations . . ., (last accessed 01 April 2021).

island chains. The Chinese have forward-deployed military equipment and Air Force assets onto these islands into some of the most contested areas of the South China Sea.[51] Since China first built the islands around 2013, the United States Navy has been deliberately challenging them in the area by sailing well within the 12-mile Chinese "claimed" area surrounding the islands to ensure Freedom of Navigation Operations and reinforce international frameworks, including the Law of the Sea convention.[52] While China has never made its intentions publicly known, and its A2/AD capabilities could easily be used both offensively and defensively, its expansion in the area has encouraged the United States and other allies to build up their own regional militaries in response.[53] Should Canada's allies respond offensively to China's increased military posturing, allied military actions, including air strikes, naval blockades,[54] and other build-up in the region, could easily occur[55] and would invariably include Canadian military assets.

China's claims in the East Asia region challenge decades of U.S. dominance and freedom of maneuver in the area. While China is looking to re-assert military and political power in the region, they will need to do so while maintaining good standing with the International community in order to maximize their economic and political relationships. This strategic power competition between the United States and China also puts Canada in a precarious position, as the Canadian Government has so far been

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[51] Jerry Hendrix, "China has impressive A2/AD capabilities, but smart positioning can let the Navy avoid them," *The National Interest*, 10 Nov 2018, https://nationalinterest.org/blog/buzz/china-has-impressive-a2ad-capabilities-smart-positioning-can-let-navy-avoid-them-35702 (last accessed 01 April 2021).

[52] Luis Martinez, "Why the US Navy sails past disputed artificial islands claimed by China," *ABC News*, 06 May 2019, https://abcnews.go.com/Politics/us-navy-sails-past-disputed-artificial-islands-claimed/story?id=60993256 (last accessed 01 April 2021).

[53] Martin, "China's A2/AD Capabilities . . ., 132.

[54] Krepinevich Jr., "How to Deter China . . ., 78.

[55] Martin, "China's A2/AD Capabilities . . ., 133.

unwilling to make a political declaration about China. As a result, Political Scientist Tsuyoshi Kawasaki affirms that "Asians do not sense the presence of Canada's fighting capabilities and readiness in much of their neighbourhood"[56] and feel that Canada relies too heavily on political forums such as the Shangri-La Dialogue to attempt to prove their interest in the region, without any real action.[57] Ultimately, China's use of so-called "salami tactics," small steps that are useless by themselves but can add up to significant gains both politically and territorially, challenges U.S. goals in the region and add to their already impressive arsenal of anti-access capabilities.[58]

Tangredi agrees that China's anti-access capabilities extend well beyond military assets and argues that they could be just as effectively implemented through economic or political means. Essentially, this could allow to China to defeat a strategically superior power through entirely non-kinetic means.[59] He specifically discussed the impact that Chinese exporting has on Western manufacturing supply chains, and the intense global disruption that would occur were China to cut off those supply lines.[60] This is likely where Canada stands to lose the most from an anti-access Chinese strategy, as its economy is extremely dependent on Chinese trade. China is currently considered to be Canada's second most important bilateral commercial partner, and machinery and electrical equipment from China account for 45% of Canada's imports of that type.[61]

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[56] Tsuyoshi Kawasaki, "Where does Canada fit in the US-China strategic competition across the Pacific?," *International Journal*, Vol 71 (2), 2016: 216.

[57] *Ibid.,* 218.

[58] *Ibid.,* 224.

[59] Tangredi, "Antiaccess Warfare as Strategy . . ., 42.

[60] *Ibid.,* 41.

[61] Government of Canada, "The Canada-China Global Commerce Picture and Supply Chain Links," https://www.international.gc.ca/trade-commerce/economist-economiste/analysis-analyse/china-canada-2020-commerce-chine.aspx?lang=eng, (Last accessed 30 April 2021).

Additionally, China is the dominant world supplier for most electrical products, inorganic chemicals and textiles.[62] Should they cut off that supply in retaliation for U.S. or other Western incursion in the South China Sea, the impact could be economically devastating on a global level.

Russia

Russia's A2/AD capabilities impact Canada most significantly when it comes to the regime's recent annexation of Crimea and infringement on the Baltic countries of Estonia, Latvia and Lithuania. Although the latter three countries all have small armies of their own, NATO augmented them in 2016 through the U.S. European Reassurance Initiative (ERI) and NATO's enhanced Foreign Presence (eFP) deployments to provide the region with greater security.[63] The recently published *NATO 2030: United for a New Era* document states that these additional troops were necessary to maintain security in the region, and its reflection group notes that "Russia has placed anti-access/area-denial (A2AD) capabilities, expanded hybrid warfare, and threatened energy and critical infrastructure"[64] in the Baltics.

The region's current and future operating environment will be characterized by Russian A2/AD capabilities, including anti-aircraft and ballistic missile systems ready for use in the border regions. Russia has two primary A2/AD systems that, if used correctly and jointly with each other, could create a credible threat to operations against forces in the Baltics. The S-400 anti-aircraft weapon is the Russian A2/AD arsenal's piece-de-

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[62] *Ibid.*

[63] Dalsjö, Berglund and Jonsson, "Bursting the Bubble . . ., 22.

[64] NATO, *NATO 2030: United for a New Era*, 25 Nov 2020, 16. https://www.nato.int/nato_static_fl2014/assets/pdf/2020/12/pdf/201201-Reflection-Group-Final-Report-Uni.pdf (last accessed 01 April 2021).

resistance and claims to have a range of 400 km. It is reportedly capable of intercepting an extensive range of targets, including transport and fighter aircraft and even ballistic missiles. The S-400 system is a threat primary to the largest aircraft, such as transports, at medium to high altitudes, out to a range of 200-250 km.[65] Comparatively, the Iskander ballistic missile system is considered a significant danger to non-mobile ground targets, out to 500-km and perhaps even as far as 700-km.[66]

Usually, an S-400 anti-aircraft battalion consists of two batteries, each with a command centre, a target acquisition radar, a fire control radar, and four launch vehicles, each holding, depending on size, four to sixteen missiles. These battalions are highly customizable and can be connected to extra sensors and command functions.[67] *Stratfor Worldview*, a geopolitical intelligence platform, calls the S-300/400 "one of the best all-around strategic SAM systems in operation today, [with] particular strengths [being] their extended reach, their flexible ability to strike at different targets… and their sophisticated sensors."[68] Tactical Air Mobility flying, including in the RCAF, uses geographical features to trick a weapons system and render it less effective, which is especially useful against the S-300/400. In particular, mountainous features can obstruct the sensors of the device as they function through line-of-sight technology, which means that aircraft flying low to the ground or through valleys "can take advantage of… the curvature of the earth to avoid an S-400 interception for far longer than a high-flying target."[69]

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[65] Dalsjö, Berglund and Jonsson, "Bursting the Bubble . . ., 10.
[66] *Ibid.,* 11.
[67] *Ibid.,* 28.
[68] "Why the S-400 is Highly Effective – If Used Correctly," *Stratfor Worldview*, 12 Jul 2019, 1.
[69] *Ibid.*, 2.

Regarding their anti-land capabilities, the Russian Iskander-M (NATO SS-26 Stone) is an advanced, truck-mounted, ballistic missile system typically deployed in brigades. Additionally, there are three battalions per brigade, each with between eight and 24 missiles ready to fire in salvo.[70] Russia currently has Iskander brigades deployed to Kaliningrad and Luga, which could be used very effectively by Russia to cut off Estonia, Latvia and Lithuania from the rest of NATO. While the anti-air and anti-land capabilities are impressive, they alone cannot complete the A2/AD bubble without the addition of the very capable Bastion-P (NATO SS-C-5 Stooge) anti-ship cruise missile and the KALIBR sea-launched cruise missile. Russia most recently demonstrated the KALIBR capability in Syria, where it was used to great effect and revealed a "quantum leap in the precision long-range land-attack firepower of the Russian Navy…[giving] it a capability hitherto only possessed by the U.S. Navy."[71] In all of these cases, "the missile systems are integrated into very dense and sophisticated IADS [Integrated Air Defence System] that are also backed up by large numbers of fighter interceptors."[72] As overlapping systems provide the best protection against air, sea, and land attacks while simultaneously spreading power out into those same domains, this fully integrated system is crucial to Russian objectives in the region.

The geographical position of the Russian enclave of Kaliningrad, which is situated firmly between Europe and the Baltic states, is of particular concern. Because of its port access into the Baltic Sea and its connection to the very narrow, 60-mile land boundary between Poland and Lithuania known as the Suwalki Gap, Kaliningrad is a massive

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[70] Dalsjö, Berglund and Jonsson, "Bursting the Bubble . . ., 36.
[71] *Ibid.,* 39-40.
[72] "Why the S-400 is Highly Effective . . ., 3.

strategic problem for NATO. Most of the Russian Navy in the Baltics is based in Kaliningrad, including several types of A2/AD assets. Namely, the Bastion-P coastal defence system, Oniks anti-ship missiles, Iskander-M and K, the S-300/400 surface-to-air missiles and the KALIBR cruise missile.[73] Using this exact same weapon positioning, the RAND corporation ran a series of war games in 2016 to determine how much of a threat Russia truly posed in the region. They concluded that "the longest it [took] Russian forces to reach the outskirts of the Estonian and/or Latvian capitals of Tallinn and Riga, respectively, [was] 60 hours. Such a rapid defeat would leave NATO with a limited number of options, all bad."[74]

Kaliningrad is a primary strategic concern for NATO since it will have to be isolated immediately in the event of a declared conflict, in order to weaken Russia sufficiently to prevent them from carrying out further military operations. At the same time, however, the bulk of Russia's A2/AD capabilities are based in and around the enclave, providing a massive deterrence factor to the Alliance. The assumption from academics is that Russia will use these pre-positioned A2/AD capabilities to prevent forces from entering the Baltic region. [75] *NATO 2030* suggests that "Russia will most likely remain the main military threat to the Alliance [over the next ten years]. It confronts NATO with the risk of a fait accompli or with sustained and paralyzing pressure in a crisis situation."[76] In 2014, General Philip Breedlove, then NATO Supreme Allied Commander Europe (SACEUR) and the Commander of U.S. European Command,

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[73] Dalsjö, Berglund and Jonsson, "Bursting the Bubble . . ., 26.

[74] David A. Shlapak and Michael Johnson, "Reinforcing Deterrence of NATO's Eastern Flank: Wargaming the Defense of the Baltics," *RAND Corporation Research Report*, 2016, 1.

[75] Lanoszka and Hunzeker, "Confronting the Anti-Access . . ., 12.

[76] NATO, *NATO 2030* . . ., (last accessed 01 April 2021).

argued that for most of history, NATO has made decisions about the way it approaches basing and force posture in Europe as if Russia were an alliance member or a friend and that it is becoming more critical than ever to focus "on how to enter anti-access area-denial areas [like] NATO saw built on the Eastern side of Ukraine, where Russia layered tactical and strategic surface-to-air missiles."[77] Though its most recent *2030* document, it finally seems as though NATO is heeding this recommendation.

In 2018, with the creation of the eFP, NATO expanded its presence in the Baltic region with a focus on deterrence. The eFP established four multinational battlegroups, located one each in Estonia, Latvia, Lithuania and Poland with the goal to rotate combat-ready forces through strategically important locations in order to deter Russian movement in the region.[78] These battlegroups are led by the United Kingdom, Canada, Germany and the United States, respectively, and are made up of between 800-1400 troops each, depending on the country in charge and their rotational requirements. Each battlegroup is comprised of some combination of Infantry, Artillery and support units. However, no country has provided a published Electronic Warfare component, and only the United States battlegroup has a Ground-Based Air Defense system. In addition, NATO has increased air patrols in the area, including semi-regular deployments from locations in Lithuania and Estonia, conducted joint military exercises, and pre-positioned heavy equipment throughout the region.[79] Unfortunately, many academics believe that this will not be enough. As political scientists Alexander Lanoszka and Michael Hunzeker

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[77] Ann Roosevelt, "Air superiority must be earned, not inherited, Breedlove says," *Defense Daily*, 17 Sept 2014: 2, 3.

[78] NATO, "NATO's enhanced forward presence. Fact sheet," https://www.nato.int/nato_static_fl2014/assets/pdf/pdf_2018_12/20181205_1812-factsheet_efp_en.pdf (last accessed 20 March 2021).

[79] Lanoszka and Hunzeker, "Confronting the Anti-Access . . ., 12.

observe, the existence of "A2/AD and precision weapons undermine efforts to extend deterrence in the Baltic States… [where] long-range precision weapons enable Russian forces to disrupt, neutralize and destroy (or simply threaten) NATO's small forward-deployed presence and its pre-positioned military equipment."[80]

NATO 2030 argues that the Alliance "should remain open to discussing peaceful co-existence and to reacting positively to constructive changes in Russia's posture and attitude… [in addition to] raising the costs for Russian aggression."[81] Ideally, NATO's strategic goal must be to prevent the use of Kaliningrad for the forward deployment of A2/AD forces. As it stands, the alliance could effectively hold Kaliningrad hostage should it want to, with the eFP battlegroups appropriately positioned in Estonia, Latvia, Lithuania and Poland, naval forces deployed in the Baltic Sea, and air policing assets already in the region.[82] Strategically, Russia is unlikely to start aggressive action if it feels that it might lose its positioning in Kaliningrad or any of its military assets. Whatever path it wishes to take, NATO, and Canada as a result, will need to make additional investments in ISR and precision munitions in order to stay relevant in this area of operations.[83]

Summary

This chapter has provided a brief overview of what precisely the term A2/AD means and why it is crucial to future warfare and to the RCAF specifically. Examination of Russian and Chinese A2/AD capabilities and posturing demonstrate that A2/AD is a

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[80] *Ibid.*
[81] NATO, *NATO 2030* . . ., (last accessed 01 April 2021).
[82] Dalsjö, Berglund and Jonsson, "Bursting the Bubble . . ., 64.
[83] Roosevelt, "Air superiority must be earned . . ., 3.

current and future threat to Canada and its alliances. China and Russia have become near-peer adversaries to Canada through their increased investment in sophisticated weaponry and advanced A2/AD strategies. This means that maintaining control of the air in the event of a conflict will be something that needs to be established, rather than something already assured.[84] Given that conflict in any corner of the world could undoubtedly affect life in Canada, the threat that these systems pose, as well as those countries who may use them against Canada, must be addressed,[85] and the RCAF must remain ready.

The following chapter will demonstrate that the RCAF has been the cornerstone of Canadian military power and reach for almost 100 years and must continue to be the government's "first-choice to deliver air effects with speed and power in reply to aggressive actions that threaten Canada or Canadian interests."[86] Several historical case studies will illustrate this reality, and the severity of being unable to operate in the A2/AD environments will become evident. Consequently, this discussion will further demonstrate that A2/AD capabilities are the most significant threat to Canadian Air Mobility Operations in future conflict. As a result, Canada must have a heavy fixed-wing tactical Air Mobility capability in order to maximize its ability to project power globally and remain relevant in the battlespace of the future.

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[84] Gladman, "The Future of Allied Air Power: The Royal Air Force . . ., 32.
[85] Department of National Defence, *Air Force Vectors* . . ., 14.
[86] Gladman, "Considerations for defining the future . . ., 1.

CHAPTER 2 – RCAF FIXED-WING TACTICAL AIR MOBILITY

Introduction

Doctrine declares that the RCAF is "a shield to real and current threats aimed at our freedoms and safety"[87] and that it will be called upon every time Canada's key national interests need to be protected through a military response.[88] Depending on the situation, this response may be kinetic or non-kinetic. However, in all cases, Air Force assets will be required in some manner as the very essence of air and space power make them the most attractive option in cases where precision and speed are required.[89] In short, the RCAF will be necessarily leading the way anywhere that the CAF needs to go by transporting personnel and equipment into theatre onboard fixed-wing Air Mobility assets. Historically, such as during Canadian Operations in Afghanistan, this meant a strategic airlift flight into a staging base followed by a tactical air transport flight into the theatre of operations. With its current assets, this combination of strategic and tactical airlift will be accomplished by the CC-150 Polaris, followed by one of the RCAF's two Air Mobility fleets capable of tactical air transport operations: the CC-130J Super Hercules or the CC-177 Globemaster III.

The previous chapter provided a brief overview of A2/AD and discussed why the increased usage of A2/AD capabilities by adversaries is problematic, both as it affects the battlespace of the future and the RCAF in particular. Specifically, the threat currently

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[87] Jean-Christopher Boucher, Pierre-Gerlier Forest and Louis Bélanger eds. *Defending Canadian Sovereignty: New Threats, New Challenges*, 2019, 111.

[88] M.J. Hood, "Foreword," in Jean-Christopher Boucher, Pierre-Gerlier Forest and Louis Bélanger eds. *Defending Canadian Sovereignty: New Threats, New Challenges*, 2019, vi.

[89] *Ibid.*

posed to Canada and its allies from both Russia and China cannot be minimized. Increased adversary investment in A2/AD capabilities means that unless Canada can develop the means to dismantle these systems, it must instead establish the strategies necessary to operate in and around the access-challenged environments they create. This will necessarily be through improved tactical Air Mobility capabilities with upgraded countermeasures, electronic warfare systems and advanced aircrew training.

This chapter will provide a brief history of Canadian fixed-wing tactical Air Mobility, followed by a discussion of the RCAF's current capabilities. The examination of several historical case studies will further this argument, and it will be evident that tactical air transport remains a crucial enabler for the CAF. So long as A2/AD capabilities are the most significant threat to operations in future conflict, the RCAF must have the tactical air transport capability to operate in and around those environments. Together, this will demonstrate that Canada must have a heavy fixed-wing tactical air mobility capability in order to maximize its ability to project power globally and remain relevant in the battlespace of the future.

Case Study 1 – Korea: Strategic Airlift Isn't Enough

In June of 1951, when North Korea invaded South Korea and the United Nations responded to intervene, Canada was among the earliest participants. The first transport aircraft, the Canadair North Star, left Canada just two weeks after the initial invasion, and 426 (T) Squadron started extreme long-haul flights into Japan shortly thereafter while integrated with the USAF's Military Air Transport Service.[90] In order to participate

[90] Government of Canada, "The RCAF in the Korean War," 25 June 2020, http://www.rcaf-arc.forces.gc.ca/en/article-template-standard.page?doc=the-rcaf-in-the-korean-war/kbtm6g43, (Last accessed 01 April 2021).

effectively in the mission to Korea, the RCAF cancelled all other transport missions with the exception of previously scheduled northern resupply into Resolute Bay, which was deemed essential.[91]

The initial tasking was to provide six aircraft and twelve crews to sustain airlift operations to the Korean theatre for the period of one year.[92] Ultimately, 426 (T) Squadron conducted airlift in support of troops in Korea for nearly four years and completed 599 round trip missions between McChord Air Force Base and Haneda airfield in Tokyo.[93] While the missions were extraordinarily long and intense due to challenging distances, multiple fuel stops and often inclement weather, the Squadron never flew further inland than Japan. Essentially, and using today's terminology, Haneda airfield was the hub of the logistical sustainment for the conflict in Korea, while the RCAF unfortunately never got to travel down the "spokes" into theatre.

All tactical air transport missions to resupply Canadian and UN troops in Korea itself were conducted by other nations. In fact, the RCAF crews were limited to flying the same basic flight profile as trans-pacific flights offered by Canadian Pacific Airlines, which remained the primary method of travel for both Canadian and American service members heading to the conflict area the aircraft was significantly more comfortable.[94] The primary difference between the two was the passenger airline's inability to transport

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[91] Hugh A. Halliday, "Operation Hawk: The Korean Airlift . . ., (last accessed 01 April 2021).

[92] Laurence Motiuk, *Thunderbirds for Peace: Diary of a Transport Squadron*, Ottawa: 2004, 181.; This author's grandfather, Leading Aircraftsman (LAC) H.R. MacDonald (air traffic assistant) was a crew member on the Squadron's notable first flight from McChord to Japan on 27 July, along with Flying Officer (F/O) A.L. Quickfall (first officer), F/O B.L. Ray (navigator), F/O J.W. Santarelli (radio officer), and Sergeant (Sgt) F.S. Bowman (flight engineer).

[93] Government of Canada, "Canadian airmen and airwomen in Korea," http://www.rcaf-arc.forces.gc.ca/en/history-heritage/korean-war/airmen-airwomen-in-korea.page (last accessed 01 April 2021).

[94] *Ibid.*

freight, which remained the primary purview of the RCAF. However, all cargo still needed to be cross-loaded in Tokyo for further transport into theatre. While the RCAF had C-47 Dakotas at the time and used them quite capably for tactical air transport missions, most notably with 436 (T) Squadron in Burma,[95] they did not have a sufficient number to re-position overseas to conduct intra-theatre tactical airlift missions into Korea, which limited the RCAF to strategic airlift missions only.

There was certainly a requirement for tactical air transport capability in the Korean theatre, which the Americans were providing for the entire coalition. The newly formed United States Combat Cargo Command[96] was flying daily tactical air transport missions into Korea and dropping necessary troops, equipment and other urgently needed supplies to forces on the ground. Accounts of airdrops and combat landings describe enemy sniper and artillery fire, as well anti-aircraft and harassing small arms fire which impeded air operations daily.[97] Lieutenant Colonel Edward H. Nigro, Commander of the 1st Troop Carrier Group asserted that "to say the operation was hazardous would not be an exaggeration."[98] Most notably, Canadians endured this ongoing threat on 25 April 1951, during the Battle of Kapyong. When 2 PPCLI realized that their ammunition reserves and emergency rations were nearly depleted, they requested an airdrop to replenish themselves and allow them to continue fighting. The result was four C-119 Flying Boxcars, who dropped ammunition and rations on their position not quite six hours after

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[95] Royal Canadian Air Force, "CC-129 Douglas Dakota," http://www.rcaf-arc.forces.gc.ca/en/aircraft-historical/cc-129.page (last accessed 01 April 2021).

[96] National Museum of the United States Air Force, "Airlift: Combat Cargo," https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/195983/airlift-combat-cargo/. (Last accessed 30 April 2021).

[97] William M. Leary, *Anything, Anywhere, Any Time: Combat Cargo in the Korean War*, (Washington: The Pentagon, 2000), 9, 15.

[98] *Ibid.*, 10.

the initial request was made.[99] Sadly, the first airdrop from a Canadian aircraft to Canadian troops in combat would not occur until Afghanistan in 2007, when a CC-130H dropped nearly seven tonnes of food, water, fuel and ammunition to R22R troops near Ghorak.[100]

Case Study 2 – Rwanda: Tactical Airlift or Nothing

Starting in 1993, the United Nations authorized missions into Rwanda to respond to the ongoing genocide in the country and promote reconciliation between the Hutu and Tutsi peoples. The largest of these was the United Nations Assistance Mission for Rwanda (UNAMIR), which had the mandate of "contributing to the establishment and maintenance of a climate conducive to the secure installation and subsequent operation of the transitional government,"[101] in which Canada played a leading role.[102] Deployed in 1994, the Canadian CC-130H detachment was an essential force multiplier. Retired Lieutenant General Romeo Dallaire describes the joy he felt every time he heard the aircraft's four mighty engines landing to bring them essential supplies and remembers thinking that "the aircrew risked their lives to save ours."[103] At one point, the Canadian CC-130H was the only tactical air transport asset in theatre and was providing the entirety of the logistics support to UNAMIR in the country.[104] The crews routinely took ground

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[99] Herbert Fairlie Wood, *Strange Battleground: The Operations in Korea and their effects on the defence policy of Canada*, Ottawa: 1966, 88.

[100] Matthew Fisher, "Canadian Air Drops save lives, avoid risky Afghan roads," *National Post*, 30 Sept 2007, http://www.canada.com/nationalpost/afghanistan/story.html?id=adebf893-dc1c-4d03-bd86-d527568e0876&k=31755 (last accessed 01 April 2021).

[101] United Nations, "Rwanda UNAMIR Backgrounder," https://peacekeeping.un.org/sites/default/files/past/unamirFT.htm (last accessed 01 April 2021).

[102] Canadians at Arms, "Rwanda," https://canadiansatarms.ca/rwanda/ (last accessed 01 April 2021).

[103] Romeo Dallaire, "Foreword," in Walter A. Dorn, ed. *Air Power in UN Operations: Wings for Peace*, Surrey: Ashgate Publishing Limited: 2014, xxi.

[104] Pierotti, "A Tactical Silver Lining in a Horrifying Storm . . ., (last accessed 01 April 2021).

fire and became adept at landing on unsecured and otherwise hazardous airfields throughout the country.[105]

After conducting the initial air evacuations, which lasted for approximately two weeks, the remainder of the international community determined that the air threat was too significant, and they would no longer conduct airlift missions into Rwanda. This decision was made in early April after the Rwandan Hutu President, along with the President of Burundi, were killed when their aircraft was shot down on approach to Kigali airport.[106] The discovery of Surface to Air Missiles (SAMs) in the vicinity of the airport, as well as the proliferate use of small arms by all factions, was very much a deterrent to Air Mobility operations.[107] Fortunately, the RCAF had recently procured its first countermeasures systems for the CC-130[108]and were confident that the crew and equipment would be capable of reacting appropriately should the aircraft be fired upon. Additionally, the crew were trained to conduct tactical low-level flying in threat environments and had recent experience operating similarly in the former Yugoslavia. This training and recent experience made Canada the only tactical air transport capable fixed-wing asset within UNAMIR.[109] The United States did not participate in the mission,

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[105] Dallaire, "Foreword," in *Air Power in UN Operations* . . ., xxi.

[106] "The Mutsinzi Report: The Committee of Experts Investigation of the April 6, 1994 Crash of President Habyarimana's Dassault Falcon-50 Aircraft," http://mutsinzireport.com/?page_id=47 (last accessed 01 April 2021).

[107] Pierotti, "A Tactical Silver Lining in a Horrifying Storm . . ., (last accessed 01 April 2021).

[108] Spar, "Systems Upgrades – Missions: Electronic Warfare Self Protection Suite (EWSPS) Integration and Installation," http://www.dougalco.com/spar/apmil04.htm (last accessed 01 April 2021).

[109] Government of Canada, "Operation SCOTCH," https://www.canada.ca/en/department-national-defence/services/military-history/history-heritage/past-operations/africa/scotch.html (last accessed 01 April 2021).

and none of the other contributing nations possessed a countermeasure-equipped tactical air transport platform.

Without Canada, personnel evacuation and troop resupply into Kigali would likely have been impossible, particularly in the early months of UNAMIR. Looking back, military officers believe that the tactical airlift that Canada provided was "a critical component of the continued ability of UNAMIR to operate in Rwanda [and that]… without the airlift, UNAMIR would have had to withdraw."[110] Interestingly, this same situation of being the best-equipped air force in the fight may occur again in the future, as Canada supports its allies potentially without United States involvement. NATO's recent *NATO 2030* document notes that American participation in global conflict is no longer guaranteed, as that country has become more reluctant to lead or even participate in coalition missions.[111] The concern that the United States is no longer committed to the defence of the European continent specifically, or even to NATO itself,[112] cannot be overlooked and needs to be planned for. Should this divisiveness indeed occur, the RCAF must remain ready with advanced equipment and tactics to best support any situation in which it is called to serve.

Case Study 3 – Afghanistan: An Immediate Need for Heavy Airlift

In 2005, Canada renewed its commitment to the International Security Assistance Force (ISAF) and the international campaign against terrorism. In Afghanistan, Operation APOLLO became Operation ARCHER, and there was an immediate requirement to move personnel from their small outpost at Camp Julian near Kabul down

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[110] Pierotti, "A Tactical Silver Lining in a Horrifying Storm . . ., (last accessed 01 April 2021).
[111] NATO, *NATO 2030* . . ., (last accessed 01 April 2021).
[112] *Ibid.*

to the new operations area in Kandahar province.[113] Furthermore, approximately 2300 Canadian Forces personnel were tasked to deploy for ROTO 1 shortly thereafter, with their associated engineering equipment, artillery pieces and tanks.[114] Until this point, the RCAF had been primarily supporting the counter-terrorism mission in the Arabian Gulf region, where it moved approximately 3,700 personnel and 4.5 million pounds of cargo in the first half of 2002 in support of coalition forces deployed on Operation APOLLO. In 2003, 429 (T) Squadron, then a dedicated Hercules squadron, flew the first Canadian tactical air transport mission into Kandahar proper, effectively starting Canada's airlift mission in that country, which would last for the next 11 years.[115]

In 2005, when the mission changed, Canada did not possess a heavy-lift capability and was required to contract out the movement of all equipment that did not fit into the back of a CC-130H Hercules, including both artillery pieces and tanks. Additionally, the only fixed-wing tactical air transport capability in RCAF inventory was that same CC-130H aircraft, which meant that all personnel and equipment had to be strategically airlifted first to a staging base outside of Afghanistan by either civilian contracted lift or CC-150 before being cross-loaded into a CC-130H for the tactical flight into Kandahar.[116]

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[113] Government of Canada, "Independent Panel on Canada's Future Role in Afghanistan," (Ottawa: 2008), 23. http://publications.gc.ca/collections/collection_2008/dfait-maeci/FR5-20-1-2008E.pdf (last accessed 01 April 2021).

[114] Government of Canada, "Operation ENDURING FREEDOM – ARCHER," https://www.canada.ca/en/department-national-defence/services/military-history/history-heritage/past-operations/asia-pacific/archer.html (last accessed 01 April 2021).

[115] Ken Pole, "Canadian mission in Afghanistan ends," *Skies Magazine*, 18 Mar 2014, https://skiesmag.com/news/canadianmissioninafghanistanends/ (last accessed 01 April 2021); on Operation APOLLO, see also Richard Gimblett, *Operation Apollo: The Golden Age of the Canadian Navy in the War Against Terrorism* (Ottawa: Magic Light Publishing and DND Canada, 2004).

[116] Personal conversation with Canadian Forces Traffic Technician/CC-130H Loadmaster who was deployed to both Camp Mirage and Kandahar four times between 2007-2010. For details about how flights were managed through Camp Mirage, see also Government of Canada, *Royal Canadian Air Force Flight Operations Manual*, (Ottawa: DND Canada, 2020), Appendix 2.5.6.5.B.1.

Due to these shortcomings, after less than a year of operations into Kandahar, RCAF leadership, with support from civilian organizations such as the RCAF Association[117], made a push up the Chain Command to the Government of Canada to procure a tactical fixed-wing heavy airlift capability for the RCAF. The CC-177 project was approved on 22 June 2006 for the initial purchase of four aircraft, with an amendment for a fifth made in 2014.[118] The first CC-177 was delivered to Trenton on 08 August 2007[119] and flew its first mission into Kandahar shortly thereafter. In total, the CC-177 flew 746 missions into theatre, totalling nearly 17,000 flight hours and successfully delivering 32,000 troops and 65 million pounds of freight to Kabul, Kandahar and Bagram airfields.[120]

This total is in addition to the personnel and freight that the CC-130H and J Hercules flew in support of the entire coalition on their famous ISAF 88 missions to airfields across Afghanistan. Crew members that served on Operations ARCHER and ATHENA describe round-robin flights to such diverse Afghani airfields as Bastion, Faizabad, Herat and Farah, to name a few, which serves to prove that intra-theatre airlift is critical during sustained combat operations.[121]

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[117] Airpower Advocacy Committee, *AFAC Position Paper 1/2012: Acquisition of an additional CC-177 (C-17) Aircraft*, 13 Jan 2013, https://www.rcafassociation.ca/advocacy/position-papers/2012-%202/afac-position-paper-12012/ (last accessed 05 February 2021).

[118] Government of Canada, "CC-177 Globemaster procurement project," http://www.canada.ca/en/department-national-defence/services/procurement/cc-177-globemaster.html. (last accessed 05 February 2021).

[119] *Ibid.*

[120] Government of Canada, "The Canadian Armed Forces Legacy in Afghanistan," http://www.dnd.ca/en/operations-abroad-past/cafla.page (last accessed 20 February 2021).

[121] Author's personal recollection from flying over 50 ISAF 88 missions in Afghanistan between 2008-2011 as a CC-130H ACSO.

While these three case studies discuss very different situations and present different reasons for why a tactical air transport capability is required in the RCAF, none of them occurred in truly non-permissive environments. That being said, there were still significant threats to aircraft in all three theatres, and tactical airlift was the only way to mitigate them in a manner that made flights into the areas feasible. In Rwanda, the threat of MANPADs and other easy to carry weapons was so significant that one aircraft had already been shot down. As previously mentioned, that one event made every other ally send their air resources back home, as none had countermeasures systems or tactics sufficient to counter a threat that serious.[122]

Meanwhile, in Afghanistan, allied aircraft were being shot at on a daily basis, in some cases catastrophically. On 07 May 2009, a Canadian C-130H encountered effective enemy ground fire during its take-off from an austere runway in South West Afghanistan, earning the Aircraft Commander a Mention in Dispatches for his exceptional airmanship, which likely prevented the loss of the aircraft.[123] The following year, on 05 Aug 2010, a CH-147D Chinook was brought down by heavy enemy fire near Ma'sum Ghar and burst into flames upon impact.[124] Fortunately, all crew and passengers survived, unlike Buffalo 115461, which had been, until then, the last Canadian aircraft to be brought down by enemy fire. Employed in support of a United Nations mission, the aircraft was destroyed

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[122] "The Mutsinzi Report . . ., (Last accessed 01 April 2021).

[123] Department of National Defence, *The Mention in Dispatches: 1991-2016*, A-AD-3000-000/JD-005, 2016, 189. https://www.canada.ca/content/dam/themes/defence/caf/militaryhistory/dhh/honours/mention-in-dispatches.pdf (last accessed 01 April 2021).

[124] Craig Mantle, "The Loss of a Canadian Chinook in Afghanistan: The Pilot's Recollection of 5 August 2010," *Canadian Military History*, 24 (2): 2015, 270. https://scholars.wlu.ca/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1787&context=cmh (last accessed 01 April 2021).

by Syrian SAMs during the peacekeeping mission monitoring the end of the Yom Kippur War, and remains the single greatest loss of life in Canada's peacekeeping history.[125]

While it is impossible to get an accurate number of aircraft shot down by the enemy in Afghanistan for security reasons, there were a recorded 131 aircraft lost between 2001 and 2014 while Canadian airlift assets were in theatre. Many of these remain unattributed and prove the real danger that air mobility aircraft faced while operating in the relatively permissive Afghani theatre.[126] This number would undoubtedly be significantly higher in a non-permissive, A2/AD environment – if the aircraft could access the area, and war, at all.

Current Capabilities[127]

The speed and flexibility of Air Mobility assets is key to air power and its ability to deliver personnel and equipment globally.[128] Limited aircraft resources demand that air forces use those resources as efficiently as possible while maximizing capabilities. In the case of the RCAF, flexibility and efficiency can be achieved by maximizing the number of roles that one aircraft type can conduct during any given mission. For example, during Afghanistan, after the CC-177 procurement, flights were able to go directly from Canada

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[125] James Griffith, "Remembering the "Buffalo Nine"," Royal Canadian Air Force, 09 August 2019. http://www.rcaf-arc.forces.gc.ca/en/article-template-standard.page?doc=remembering-the-buffalo-nine/j5wlhz33 (last accessed 01 April 2021).

[126] "List of aviation accidents and incidents in the war in Afghanistan," https://en.wikipedia.org/wiki/List_of_aviation_accidents_and_incidents_in_the_war_in_Afghanistan; The author reviewed and searched for other documents to provide as a reference for this information, but Wikipedia remains the most complete and most informative.

[127] Portions of this section were inspired by W.A. Camm, "RCAF Tactical Airlift in the Future Operating Environment," Course Paper, (Joint Command and Staff Program 47: Canadian Forces College, 2021).

[128] Jacob D. Maywald, Adan D. Reiman, Alan W. Johnson et al, "The Myth of Strategic and Tactical Airlift," *Air and Space Power Journal*, Spring 2017, 61. https://www.airuniversity.af.edu/Portals/10/ASPJ/journals/Volume-31_Issue-1/V-Maywald_et_al.pdf (last accessed 01 April 2021).

into Kandahar without cross loading to a CC-130H in Camp Mirage,[129] which saved both time and resources. Today, RCAF Air Mobility assets have varying levels of capabilities which could allow them to operate in contested environments, but crews must be trained to conduct those mission, and that training varies between aircraft type.

The current iterations of the RCAF CC-130J and CC-177 are both equipped with countermeasure systems, which allow them to operate in up to Threat System Category (TSC) 1 environments. This TSC includes threats such as small-arms, anti-aircraft artillery, infrared-guided missiles and laser-guided threats, but assumes that air superiority in theatre is assured.[130] Per their respective Standard Manoeuvre Manuals (SMM), both aircraft can conduct Container Delivery Systems (CDS) airdrops, Heavy Equipment (HE) airdrops, and Personnel (Pers) airdrops in addition to low-level tactical flying in TSC 1 environments. The CC-177 can drop 40 CDS containers at 2,200 pounds each,[131] 102 combat-rigged paratroopers, [132] and HE up to 110,000 total pounds.[133] Comparatively, the CC-130J can drop 24 CDS containers at 2,200 pounds each,[134] 40 combat-rigged paratroopers,[135] and HE up to 42,000 total pounds.[136] Conversely, the RCAF's only dedicated passenger or long-haul air-to-air refuelling aircraft, the CC-150 Polaris, is not equipped with any form of countermeasure system and cannot be retrofitted

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[129] A. Ghanmi and RHAD Shaw, "Modelling and analysis of Canadian Forces strategic lift and pre-positioning options," *Journal of the Operational Research Society*, 59: 2008.

[130] Department of National Defence, SMM 60-177-1000, *Air Mobility Standard Manoeuvre Manual: CC177 Globemaster III Operations* (Ottawa: DND Canada, 2016), 11-38.

[131] *Ibid.,* 19-37.

[132] *Ibid.,* 19-34.

[133] Boeing, "C-17 Globemaster Technical Specifications," https://www.boeing.com/defense/c-17-globemaster-iii/#/technical-specifications.(last accessed 06 February 2021).

[134] Department of National Defence, SMM 60-130J-1000, *Air Mobility Standard Manoeuvre Manual: CC130J Hercules Operations* (Ottawa: DND Canada, 2020), 18-34.

[135] *Ibid.,* 18-39.

[136] *Ibid.,* 18-27.

with one.[137] Thus, it is not capable of operating in any level of threat environment, but can very capably provide strategic passenger airlift or air-to-air refuelling outside of any weapons engagement zone, high threat, or A2/AD environment.

CC-177 Globemaster III

The current designated use of the CC-177 is to "transport troops, cargo and oversized combat equipment… fly long distances and land in remote airfields."[138] When Canada first purchased the planes in 2007, the plan was for them also to be used for low-level tactical flying and airdrop operations, which would allow the RCAF to reach wherever it wanted to and into almost every threat area. However, by the time the project reached Initial Operational Capability (IOC)[139] upon the arrival of the fifth and final aircraft on 30 March 2015,[140] the project's scope had shifted dramatically. The acquisition project's summary was amended to read that the aircraft would be used only to "rapidly transport oversized cargo over long distances between continents…[and] operate from remote, unpaved runways,"[141] which negated the requirement for tactical capabilities or advanced crew training packages.

On 13 August 2014, 429 (T) Squadron, the only RCAF Squadron that flies the CC-177, was ordered by Commander 1 Canadian Air Division (Comd 1 CAD) to cease

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[137] Government of Canada, "CC-144/150 Missile Warning and Infrared Countermeasures Project," http://www.forces.gc.ca/en/business-defence-acquisition-guide-2015/aerospace-systems-8.page (last accessed 01 April 2021).

[138] Royal Canadian Air Force, "CC-177 Globemaster III Fact Sheet," http://www.rcaf-arc.forces.gc.ca/en/aircraft-current/cc-177.page. (last accessed 05 February 2021).

[139] Department of National Defence, *Project Approval Directive* (Ottawa: 2019), 367. Initial Operational Capability is defined as "the first attainment during Implementation of the minimum ability to effectively employ a new or improved capability for which adequate infrastructure, training, staffing and support is in place, both for the new capability and the organization that is employing it."

[140] Government of Canada, "CC-177 Globemaster procurement project," . . ., (last accessed 05 February 2021).

[141] *Ibid.*

all airdrop training effective immediately. After fewer than seven years in service, the aircraft's capability was cut in half in a bid to save money and flying hours (YFR) on an already overstretched fleet.[142] After receiving a significant YFR increase the following fiscal year, 429 (T) Squadron lobbied to restart airdrop training before their aircrew qualifications expired but were ultimately denied. The flying hours were immediately re-apportioned to strategic airlift requirements for current operations.[143] Ultimately, the RCAF lost all airdrop capability on the platform, as well as planned capability upgrades, which included Major Air Disaster (MAJAID) and 25,000 MSL High Altitude-Low Opening/High Altitude-High Opening (HALO/HAHO) Pers drop projects. The net gain for the RCAF ended up being approximately $1.62M annually in cost savings between YFR and crew training bills over a projected 120 flying hours.[144]

After the airdrop program was cancelled in 2014, the decision was quickly made to cancel the Squadron's low-level flying program the following year. Although the primary purpose of conducting a low-level tactical mission is "to gain the element of surprise, to minimize the effectiveness of anti-aircraft defences; and to avoid detection and interception,"[145] the decision was made to prioritize strategic lift over all other training requiring dedicated YFR. Since most air defence systems are restricted to line-of-sight operations, tactical air assets flying low level are able to reduce their exposure to air defence threats by employing terrain-masking techniques as discussed in chapter one,

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[142] Briefing Note, *Restoration of CC177 Airdrop Capability*, provided to Commander 8 Wing by 429 (T) Squadron Commanding Officer, 24 Mar 2015.

[143] For more information about the CC-177 project, see Maj B.M. Graham, "Canada's Strategic Airlift Capability: An Erosion of Operational Effectiveness," Exercise Solo Flight Paper, (Joint Command and Staff Program 43: Canadian Forces College, 2017).

[144] Briefing Note, *Restoration of CC177 Airdrop Capability . . .,* 24 Mar 2015.

[145] Department of National Defence, SMM 60-177-1000, *Air Mobility Standard Manoeuvre Manual: CC177 Globemaster III Operations . . .*, 4-8.

which makes them more difficult to track accurately.[146] However, this type of threat simply did not exist anywhere that the RCAF was operating in 2014 and 2015, which admittedly made the decision to cancel the program easier. Nevertheless, should the nature of conflict and the future operating environment continue to evolve in the manner predicted by the *FAOC*,[147] the loss of such an important capability could quickly become a regret.

A significant advantage to low-level tactical flying is its unpredictability. Airdrop, in particular, allows forces to maximize the amount of personnel and equipment that can be delivered at once to a single location in the shortest amount of time possible, which allows for an element of surprise against the enemy.[148] Additionally, "objective area ground support, material handling equipment (MHE), and site preparation requirements can be minimal to nonexistent"[149] at landing and drop sites, which is fundamental when trying to insert personnel or equipment into a combat zone covertly. Additionally, tactical low-level arrivals and departures are particularly useful, as they allow the aircraft to minimize time spent within the threat environment,[150] thus decreasing the likelihood that the enemy will spot the aircraft. Beyond these combat roles, airdrop can also be used to deliver aid to crash survivors during Search and Rescue or MAJAID missions, resupply Canada's northernmost peoples if ice roads are melted from Climate Change or drop food and water to otherwise unreachable survivors of humanitarian

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[146] Department of National Defence, SMM 60-177-1000, *Air Mobility Standard Manoeuvre Manual: CC177 Globemaster III* Operations . . ., 11-6.

[147] Department of National Defence, *Future Concepts Direction Part 2* . . ., 19.

[148] Department of National Defence, SMM 60-177-1000, *Air Mobility Standard Manoeuvre Manual: CC177 Globemaster III Operations* . . ., 19-1.

[149] *Ibid.*

[150] *Ibid.,* 9-15.

disasters like earthquakes and floods. The CC-177 *Concept of Airdrop Operations* argues that "the ability to airdrop personnel and equipment from transport aircraft will continue to play a crucial role" within the spectrum of aerospace applications and "the introduction into service of the CC177 has provided the CF with a new opportunity to expand the airdrop role."[151] This is a statement that remains true today and will become even more critical in the expected future operating environment.

CC-130J Hercules

The CC-130J procurement project summary identifies the Super Hercules as "the workhorse of the CAF's transport fleet [that] provides support to joint operations at home and overseas. CC-130J Hercules aircraft quickly and safely carry passengers, heavy equipment and supplies over long distances to support operations."[152] Additionally, 436 (T) Squadron, the RCAF unit that exclusively flies the CC-130J, is fully qualified to conduct all manner of previously mentioned airdrops, including in formations of two,[153] effectively doubling their available offload to 48 CDS containers at 2,200 pounds each,[154] 80 combat-rigged paratroopers,[155] and HE up to 84,000 total pounds. While this formation capability allows for approximately 20% greater CDS load total weight to be dropped than from the CC-177, it remains nearly 25% short for both PERS, and HE loads.

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[151] Briefing Note, *Concept of Operations: CC177 Airdrop Operations*, provided to Commander 1 Canadian Air Division by A3 Transport Readiness, Jan 2011.

[152] Government of Canada, "CC-130J Hercules tactical airlift procurement project," https://www.canada.ca/en/department-national-defence/services/procurement/cc-130j-hercules.html (last accessed 05 February 2021).

[153] Department of National Defence, *Royal Canadian Air Force Flight Operations Manual*, (Ottawa: DND Canada, 2020). Formations of up to four aircraft will be authorized in certain situations with higher headquarters pre-approval.

[154] Department of National Defence, SMM 60-130J-1000, *Air Mobility Standard Manoeuvre Manual: CC130J Hercules Operations . . .*, 18-34.

[155] *Ibid.,* 18-39.

There is currently no risk of the CC-130J tactical air transport capabilities being reduced. The aircraft remains the only fixed-wing tactical airlift asset in RCAF inventory, and Full Operational Capability (FOC)[156] was only declared in February 2019, with an expected project close-out scheduled to occur in September 2022.[157] 436 (T) Squadron trains to formation low-level flying and airdrops on a daily basis and all crews are qualified on multiple types of airdrops, with most of them also holding formation currencies. Additionally, the Squadron continues to be deployed to Op IMPACT in Kuwait, where it has been since 2014. There, the Squadron is tasked with conducting routine tactical air transport missions and so far has conducted 4452 sorties, where they have moved 14.6 million pounds of cargo and 8,488 passengers.[158]

To increase the capabilities of the platform even further, Textron Systems recently delivered the brand-new CC-130J electronic warfare threat simulator. This capability will significantly increase the proficiency of the CC-130J crews to operate in all types of threat environments. According to the project approval, "this simulator will increase the performance of the CC-130J self-defence system [which] detects the launch of hostile anti-aircraft missiles and dispenses chaff and flares to defeat the missile."[159] The CC-130J SMM states that since "it is likely that some missions will occur in theatres of operation

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[156] Department of National Defence, *Project Approval Directive* (Ottawa: 2019), 364. Full Operational Capability is defined as "the ability to effectively employ a delivered capability for which the required infrastructure, training, staffing and support are fully in place as detailed in the Statement of Requirements (SOR)."

[157] Government of Canada, "CC-130J Hercules tactical airlift procurement project," https://www.canada.ca/en/department-national-defence/services/procurement/cc-130j-hercules.html (last accessed 05 February 2021).

[158] Government of Canada, "Operation IMPACT, "https://www.canada.ca/en/department-national-defence/services/operations/military-operations/current-operations/operation-impact.html (last accessed 05 Feb 2021).

[159] Government of Canada, "CC-130J Hercules tactical airlift procurement project," . . ., (last accessed 05 February 2021).

where potential ground and air threats exist… all missions operating in an EW environment should be backed by pre-and post-flight Electronic Warfare Support."[160]

Considering Air Mobility within the spectrum of RCAF air power, the core tenet of centralized control and decentralized execution cannot be overstressed. As missions matured and complexity increased, crews needed to be given more and more autonomy to make decisions on the fly in order to maximize limited Air Mobility resources.[161] This freedom also allows crews to manage situations as they encounter them, including things like effecting airborne re-routings to avoid denied airspace if required. Likewise, crews can adapt to evolving security or intelligence situations by using all manners of tactics, provided they've been properly trained and are qualified to use them. This can include low-level flying and tactical arrivals or departures as the situation requires. Salmi talks at length about the idea of reducing mission vulnerability as much as possible in all cases and about different ways to accomplish that.[162] In all cases, the most effective way is to train and equip crews to combat any situation that they may encounter. With A2/AD and denied airspace becoming much more common globally, as discussed in Chapter 1, the RCAF's best chance at preserving tactical air transport capabilities remains in maximizing the use of all available assets and crews, both CC-177 and CC-130J alike.

Summary

This chapter has provided a brief history of Canada's fixed-wing tactical air transport capabilities, as well as a discussion of the RCAF's current capabilities. It has

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[160] Department of National Defence, SMM 60-130J-1000, *Air Mobility Standard Manoeuvre Manual: CC130J Hercules Operations . . .*, 4-7.

[161] Derek Salmi, *Behind the Light Switch: Towards a Theory of Air Mobility*, (Montgomery: Air University Press, 2020), 10.

[162] *Ibid.,* 176.

illustrated that a fixed-wing tactical air transport capability is essential for force projection and force employment in the operating environments of the future through the use of three historical case studies. The recent conflict in Afghanistan proved that heavy air mobility assets provide key effects to expeditionary operations and are a must-have capability for any combat-ready military. Canadian participation in Korea demonstrated the RCAF's reliance on other countries, and specifically the United States, for both sustainment and support to Canadian ground forces when Canada does not itself have mission capable assets. Conversely, Rwanda showed how the RCAF has not always been able to count on Air Mobility assets from other countries and may have to complete the mission alone. Ideally, Canada should have the means to be self-sufficient, and troops should have the confidence that the RCAF will support them with or without allied tactical air transport support.

The next chapter will delve further into current Canadian Air Mobility resources and capabilities and will show that a lack of technical superiority will negatively affect the RCAF's ability to support allies and participate in coalitions in the future. Additionally, a discussion of Air Mobility as a function of air power will tie back to the doctrinal sustain and move functions and will demonstrate that without fixed-wing tactical Air Mobility expertise, the CAF will not be able to adequately execute the expeditionary Hub and Spoke logistics concept for future operations. Consequently, this discussion will demonstrate that A2/AD capabilities are the most significant threat to Canadian Air Mobility Operations in future conflict. Thus, Canada must have a heavy fixed-wing tactical air mobility capability in order to maximize its ability to project power globally and remain relevant in the battlespace of the future.

CHAPTER 3 – AIR MOBILITY IS AIR POWER

Introduction

The RCAF doctrinal Sustain function is defined as "the function that regenerates and maintains capabilities in support of operations."[163] In short, Sustain as a function allows the RCAF the means to achieve the effects they wish through their ability to maintain the force.[164] To this end, the RCAF must have the foresight to ensure that any resources they wish to use are correctly positioned in the right place for use at the right time.[165] Often, Air Mobility is a key enabler used to achieve this as it allows the force to project itself quickly wherever and whenever it needs to while remaining self-reliant. Additionally, Air Mobility assets can be used to move troops, equipment and sundries into and out of theatres of operation, which sealift or ground move assets could not necessarily access safely. Doctrine confirms that "as a core air power capability, air-mobility activities are employed across the spectrum of conflict."[166] Necessarily, this includes tactical intra-theatre airlift capabilities, which allows commanders to position their people and equipment right into the theatre of operations no matter the threat level, ensuring that the sustain function is upheld.[167]

The previous chapter provided a brief history of Canada's fixed-wing tactical airlift capabilities, as well as a discussion of the RCAF's current capabilities. It illustrated that a fixed-wing tactical air transport capability is essential for force

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[163] Department of National Defence, *Royal Canadian Air Force Doctrine*, (Ottawa: DND Canada, 2016), 26.

[164] Department of National Defence, *Royal Canadian Air Force Doctrine: Force Sustainment*, (Ottawa: DND Canada, 2017), 7.

[165] Department of National Defence, *Royal Canadian Air Force Doctrine* . . ., 26.

[166] *Ibid.,* 34.

[167] *Ibid.,* 35.

projection and force employment into the operating environments of the future by using three historical case studies, namely Canadian operations in Korea, Rwanda and Afghanistan. Through these examples, it was clear that Canada does not currently have the ability to operate in challenged or non-permissive environments and will not be able to provide meaningful airlift to ourselves or our allies in the battlespace of the future without immediate improvement of our capabilities through the re-creation of a tactical air transport CC-177 qualification.

This chapter will delve further into current Canadian Air Mobility logistical resources and capabilities. It will show that a lack of technical ability will negatively affect the RCAF's ability to support allies and coalition in the future through the doctrinal sustain and move functions. Additionally, this chapter will argue that Air Mobility is a key function of air power and that without heavy tactical fixed-wing Air Mobility expertise, the CAF will not be able to execute the Hub and Spoke sustainment concept for future expeditionary operations adequately, rendering it incapable of projecting power globally and threatening the relevance of the force in the battlespace of the future.

Air Mobility is Key to Air power

Air Power is most commonly defined as "that element of military power applied within or from the air environment to achieve effects above, on, and below the surface of the earth."[168] Historically, the term has been used to signify air elements that aid or directly engage in combat operations, thus providing visible "power" against the enemy, often in the form of fighter aircraft, tactical helicopters or even surveillance through

[168] *Ibid.,* 1.

maritime patrol aircraft or with drones. However, none of the above would be possible without the strategic and tactical airlift required to get those assets and their support equipment and personnel into any theatre of operations, making Air Mobility aircraft a key air power asset and force multiplier.

Doctrinally, there are 11 characteristics of air power, seven applications of air power, and a further seven tenets of air power. Altogether, these 25 points lay out how air power should be categorized and used in order to be most effective. Most notably, the doctrinal function of Reach is likely to play a significant role in the battlespace of the future. The notion that the global reach of air power is strategically significant and contributes to the CAF's ability to project power globally cannot be overemphasized.[169] Air Mobility is so important, in fact, that the Australian Defence Force published an air power note declaring that "the most important air power capability is clearly that which puts our other capabilities where they can be most efficiently used… [and that] without mobility, we are legless."[170] The note went on to discuss how land forces cannot be deployed or sustained globally without a robust mobility network and how the speed, reach and capacity of Air Mobility makes it the most efficient means by which to achieve a global effect.[171] RCAF Move doctrine takes this point one step further and argues that air mobility allows governments to project power rapidly on a global scale, allowing

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[169] *Ibid.,*14.

[170] Government of Australia, "Which Air Power Capability is most important?," *Pathfinder: Air Power Development Centre Bulletin*, 6: 2004, 2. https://airpower.airforce.gov.au/APDC/media/PDF-Files/Pathfinder/PF006-Which-Air-Power-Capability-is-Most-Important.pdf. (last accessed 01 April 2021).

[171] *Ibid.*

almost instantaneous effect over a broad spectrum of objectives at every level of conflict.[172]

Former NATO Supreme Allied Commander Transformation Lieutenant General Denis Mercier also describes the future of air power as being one of airlift missions. He believes that airlift serves to differentiate between air power and having an air force that exists solely for the benefit of a countries land forces,[173] which perfectly describes the Canadian reality. Specifically, without top-of-the-line fighter aircraft, airlift has become the basis on which Canada can demonstrate to the Canadian public that the RCAF is "a shield to real and current threats aimed at our freedoms and safety"[174] and will be the strength through which Canada asserts itself in future global conflict. RCAF capstone doctrine notes that "a strategic goal of CAF today is to achieve seamless operational integration at short notice with our allies… [and] reflects the distinct nature of Canadian air power."[175] This has been proven in recent conflicts where Canadian fighter aircraft were not tasked, including operations into Bosnia (Op AIRBRIDGE) and Mali (Op PRESENCE), as well those in Korea, Rwanda (Op LANCE) and Afghanistan (Op ARCHER/APOLLO/ATHENA) as discussed in the previous chapter.[176]

The concept of strategic and tactical airlift being key to air power is particularly evident when comparing the battlespace of the past with that of the future. Air Force

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[172] Department of National Defence, *Canadian Forces Aerospace Move . . .*, 9.

[173] Denis Mercier, "Thinking about Air and Space Power in 2025: Five Guiding Principles," *Air and Space Power Journal*, May-June 2012, 20.

[174] Pierre-Gerlier Forest and Jean-Christophe Boucher, "Conclusion," in Jean-Christophe Boucher, Pierre-Gerlier Forest and Louis Bélanger eds, *Defending Canadian Sovereignty: New Threats, New Challenges*, 2019, 111.

[175] Department of National Defence, *Royal Canadian Air Force Doctrine . . .*, 11.

[176] Government of Canada, "Past Operations," https://www.canada.ca/en/department-national-defence/services/military-history/history-heritage/past-operations.html. (last accessed 01 April 2021).

historian Allan English notes how significant the differences are between how expeditionary operations were conducted even as recently as the Cold War and now. He explains that air forces are now more likely to operate out of austere airfields instead of main operating bases, must often provide their own security, and are often deployed far away from their main supply lines. All of these changes necessarily require a robust and built-in sustainment mechanism through airlift.[177] This change in tactics also displays the need for tactical capabilities that can operate in many different environments.[178] Professor Robert Owen extolls the idea that the future of Air Mobility is unpredictable and that as strategic focus shifts from government to government, the Air Force needs to be prepared to do the job asked of it whether it is in Asia or the Americas.[179] His discussion of Air Mobility as an Operational Art must also be considered, as the ability to gather resources and use speed and manoeuvrability together to project power globally has been key to RCAF success.[180] Owen goes on to note that no strategic plan or regional war can be conducted without a substantial reliability on Air Mobility assets.[181] Notably, aircraft that can conduct operations from makeshift airfields add significant capability to deployed forces. For the RCAF, the CC-130J's ability to land and take off from unprepared runways of all material types[182] is a force enabler, as is the CC-177's ability to land on

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[177] Allan English and John Westrop, *Canadian Air Force Leadership and Command*, D2-211/2007E, 77.

[178] Mercier, "Thinking about Air and Space Power . . ., 23.

[179] Owen, *Air Mobility: A brief history* . . ., 312.

[180] *Ibid.,* xv.

[181] *Ibid.*

[182] Department of National Defence, SMM 60-130J-1000, *Air Mobility Standard Manoeuvre Manual: CC130J Hercules Operations* . . ., 4-7.

prepared gravel strips[183], which greatly increases the strategic effect of both Air Mobility assets.

Equally important in any discussion of air power is the acknowledgement that not every situation requiring Air Mobility will necessarily be one of conflict.[184] Instead, Canadian military action might be required for important missions such as humanitarian assistance, non-combatant evacuation operations or disaster relief, in which speed and precision are key.[185] Retired RCAF Commander Lieutenant General M.J. Hood states that "the RCAF is the guarantor of Canadian sovereignty,"[186] while Air Power strategist Colonel Derek Salmi argues that the power of Air Mobility lies not just in its ability to allow militaries to project themselves, but more importantly through its ability to influence every level of war beyond simply kinetic effects.[187]

This changing understanding of air power is directly related to the also changing global threat environment. There is no longer an expectation that adversaries will only fight one-on-one with similar capabilities, such as tank-to-tank or plane-to-plane. Instead, these "peer/near-peer/VEO competitors… are currently competing and prevailing over us via Irregular Warfare (IW) activities in the competition space and doing so quite successfully."[188] In a Canadian context, the RCAF's ability to force project anywhere in the world in a matter of hours is likely to increase its credibility with its allies, especially if Canada finds itself operating in a multinational coalition in which the United States is

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[183] Department of National Defence, *Royal Canadian Air Force Flight Operations Manual,* (Ottawa: DND Canada, 2020), 2.2.3.11.

[184] Department of National Defence, *Canadian Forces Aerospace Move . . .*, 15.

[185] Hood, "Foreword," in *Defending Canadian Sovereignty . . .*, vi.

[186] *Ibid.*

[187] Salmi, *Behind the Light* Switch . . ., 1.

[188] Reyes Cole, "The Myths of Traditional Warfare: How our Peer and Near-Peer adversaries plan to fight using irregular warfare," *Small Wars Journal*, 28 Mar 2019.

not a member[189] as previously discussed. Indeed, the bread and butter of RCAF operations is quickly becoming its ability to project power through the use of very long-range strategic platforms which offer both reach and omnipresence in a variety of capabilities, including air strikes, reconnaissance, and transport missions.[190]

Additionally, airlift is used by the Canadian Government to support policy through the delivery of strategic effects.[191] A recent operation in the Philippines (Op RENNAISANCE 13) is an excellent example of Canadian humanitarian activities that also demonstrate reach and manoeuvrability. After Typhoon Haiyan hit the Philippines and killed more than 6,300 people, the CAF responded and deployed the Disaster Assistance Response Team (DART)[192] along with associated heavy equipment, arriving in-country a mere seven days after the disaster on 15 November 2013.[193] This quick response would not have been possible without the immediate mobilization of three CC-177s and a CC-150 to transport troops and equipment.

The RCAF's goal to be a truly global player means that it must also extend its area of strategic interest and improve its capability to reach any point in the world as quickly as possible. This objective was perfectly demonstrated during Op RENAISSANCE 13, as well as shortly thereafter for Op RENAISSANCE 15 when an earthquake struck Nepal in April 2015. The RCAF was called upon once again to conduct expeditionary operations

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[189] Allan English and Col John Westrop, *Canadian Air Force Leadership and Command*, D2-211/2007E, 77.

[190] Mercier, "Thinking about Air and Space Power . . ., 22.

[191] Department of National Defence, *Canadian Forces Aerospace Move . . .*, 17.

[192] The DART provides primary medical care, water purification, and engineering support to disaster-stricken areas on order from the government of Canada.

[193] Government of Canada, "Operation RENAISSANCE 13-1," https://www.canada.ca/en/department-national-defence/services/operations/military-operations/recently-completed/operation-renaissance-13-1.html. (last accessed 01 April 2021).

on very short notice, halfway around the globe, thus proving that when considering air power, being both the strongest and fastest matters.[194] In the case of both the Philippines and Nepal, the same deployment concept and schedule was used, which relied on a continuing circuit of aircraft movements, with crews switching out as required at designated hubs. In the case of Op RENAISSANCE 13, these stops were in Comox, Hawaii and Guam. This circuit method allowed cargo and personnel to move continuously to and from theatre while maximizing crew rest periods and allowing for the pre-positioning of equipment by other assets, as the hub locations remained static.[195] This use of the Hub and Spoke sustainment model proved the value of RCAF reach and speed and was key to the success of this mission, as well as many others since.

Mobility and Reach

The Hub and Spoke sustainment model is not a new concept, and Canada's allies around the world are using it more often in both civilian and military contexts. Global logistics distribution models such as FedEx, Amazon and Boeing's global support network ensure the fastest delivery of goods over significant distances.[196] Replicating this in a military concept is a little more complicated, as countries must take conflict zones

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[194] Mercier, "Thinking about Air and Space Power . . ., 24.

[195] The author was involved in planning subject airlift as the 1 Canadian Air Division Air Mobility Division Force Employment Lead Planner for the Operation.

[196] John Paul Andree, "FedEx: The world's largest continuous flow process," *Technology and Operations Management: MBA Student Perspectives*, 03 Dec 2015, https://digital.hbs.edu/platform-rctom/submission/fedex-the-worlds-largest-continuous-flow-process/ ; Tara Johnson, "How the Amazon supply chain strategy works," 19 Feb 2020, https://tinuiti.com/blog/amazon/amazon-supply-chain/ ; Boeing Distribution Services, https://www.boeingdistribution.com/aero/about-us/ ; for more information about supply chain management, see François Rousseau, François Montaville and François Vidalaine, "Challenges and winning models in logistics" for Bain & Company, https://www.bain.com/contentassets/019c03d1a42b43038bc7360c74b7c384/bain_brief_challenges_and_winning_models_in_logistics.pdf (all last accessed 01 April 2021).

and non-permissive environments into account. However, the theory in all cases remains the same.

In Canada, this global logistics model has been rolled out through the creation of several Operational Support Hubs (OSH) which are, simply "facilities in other countries that provide support for Canadian Armed Forces (CAF) operations."[197] They have been created to enable Canada to move key sustainment and personnel closer to the area where the CAF will be operating, whether kinetic or not.[198] Due to Canada's geography, history and national interest, the biggest challenge to Canadian military participation in global affairs remains its ability to both deploy troops across the world and then to sustain them.[199] Retired Lieutenant Colonel Brad "Squid" Wintrup wrote a study on the subject of OFH's that proposed that "operationally, the greatest risk to mission success can occur as a result of delays along the logistics line of communication… ultimately resulting in conditions at the delivery end where users face resource shortages."[200] Essentially, this indicates that the further a shipment has to travel, the more likely it is to encounter delays.

By creating OSHs around the globe, the CAF can pre-position equipment and thus shorten the distances that items must travel to reach the personnel in theatre that need them. Ultimately, this lessens the likelihood of delays and increases the chances of overall mission success.[201] In his 2013 direction for the OSH establishment, then Chief of

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[197] Government of Canada, "Operational Support HUBs," https://www.canada.ca/en/department-national-defence/services/operations/military-operations/conduct/support/hubs.html. (Last accessed 01 April 2021).

[198] D.B. Wintrup, "Operational Support HUB in the Far East: A Strategic Capability Gap," Course Paper, (Joint Command and Staff Program 41: Canadian Forces College, 2015), 23.

[199] Roy C. Bacot, "Global movements and operational support hub concept: Global reach for the Canadian Forces," *The Canadian Air Force Journal*, 2009: Vol 2, 9.

[200] Wintrup, "Operational Support HUB in the Far East . . ., 17.

[201] Bacot, "Global Movements and Operational Support . . ., 10-19.

the Defence Staff (CDS) General Walt Natynczyk described intended OSH activities as routine aircraft maintenance and repair, fuel stops for both air and sea transit, temporary storage facilities, cross-loading facilities for both sea and air, as well as overnight stop locations for aircrew.[202] A great example of recent use of this concept was during Canadian operations in Afghanistan (from ARCHER through to ATTENTION), where the CAF negotiated the use of a staging base in the United Arab Emirates (UAE) known as Camp Mirage.[203] Strategic airlift assets like the CC-150 Polaris flew cargo and personnel into the UAE, where it was then cross-loaded onto tactical air transport aircraft for furtherance into Afghanistan. Camp Mirage was an all-encompassing base of operations for both Canadian and allied troops, with multiple strategic and tactical aircraft arriving and departing daily. Spare equipment, including aircraft and vehicle maintenance spares, general supplies, clothing stores and ammunition were all stored at and passed through Camp Mirage, and the hub was fully staffed with operations personnel, cooks, and clerks.[204] It was, essentially, a self-sustained mini base halfway around the world.

The OSH construct is a fully scalable capability and can be developed as wholly as the Camp Mirage example or as minimally as the current hub in Jamaica, which is only activated "on-demand." The CAF takes care to choose OSHs within friendly and secure

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[202] Walter J. Natynczyk, *CDS Directive for the Establishment of Operational Support Hubs*, (NDHQ:13 May 2010), 2.

[203] Steven Chase and Brent Jang, "UAE threatens to kick Canada out of covert military base Camp Mirage," *The Globe and Mail*, 08 Oct 2010, https://www.theglobeandmail.com/news/politics/uae-threatens-to-kick-canada-out-of-covert-military-base-camp-mirage/article4328727/ (last accessed 10 April 2021).

[204] The author of this paper witnessed this firsthand as a Canadian Tactical Airlift Unit (TAU) Duty Operations Officer in Camp Mirage in 2006, and later as a CC-130H Hercules ACSO during Op ATHENA over four tours between 2008-2011.

countries only and in locations that have an airport or seaport that is capable of handling the movement of significant amounts of people and materiel.[205] Ideally, these criteria will ensure the CAF's ability to "employ host nations (HN) resources maximally in order to reduce the amount of logistic support resources emanating directly from Canada… [which] offer Canada speed, efficiency and flexibility in projecting and sustaining global power."[206] Of course, the OSHs were not chosen exclusively by the CAF. Instead, a whole-of-government approach is used to select locations with tactical relevance through diplomatic negotiations that ensure that Canada's military presence in the OSH location is fully supported, both diplomatically and logistically, by the Host Nation.[207]

Despite initially intending to create seven OSHs, including ones in Eastern Asia and Africa,[208] the CAF currently only has four, one each in Europe, Kuwait, West Africa and Latin America and the Caribbean (LAC). The European OSH is based at the Koln-Bonn airport in Cologne, Germany and operates on a 24/7 basis. It also has a complete range of transportation capabilities to support all OSH operations. Similarly, the OSHs based at the coalition airfield at Ali Al Salem, Kuwait and the Léopold Sédar Senghor Military Airport in Dakar, Senegal,[209] are both fully functioning and are designed to support all CAF members and coalition assets both in-country and transiting through. Conversely, while considered operationally ready, the LAC OSH in Jamaica is

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[205] Government of Canada, "Operational support hubs," https://www.canada.ca/en/department-national-defence/services/operations/military-operations/conduct/support/hubs.html (last accessed 01 April 2021).

[206] Wintrup, "Operational Support HUB in the Far East . . ., 26.

[207] *Ibid.,* 62.

[208] Stewart Beare, *Letter of Promulgation - CJOC Directive for the Establishment of Operation Support Hubs*, (CJOC: 3350-1 (J5)), 31 May 2013, 1-4.

[209] M.N. Rouleau, *CJOC Directive – Operational Support Hubs,* (CJOC: 3350-1 (DG Sp Plans)), 13 June 2020, 14.

maintained solely in caretaker status. This ensures that contracts, agreements and activation plans are in place, but it is not actively staffed unless required and with advance notice given to the host nation.[210] When a permanent presence somewhere is not possible, a caretaker OSH will be developed to provide the infrastructure to allow the CAF the agility to project power quickly and at range, without incurring the additional costs that would be associated with either a permanent base or last-minute hub development arising from unexpected operations in the area.[211] The remaining three OSHs, with proposed locations in the East Pacific, Africa and South East Asia, are all being developed with this same concept.[212]

As the overarching purpose of a hub is to "maximize efficiencies to mitigate the time, space, force relationship to deliver the right resources, at the right place at the right time," while allowing for logistical global force projection, then the type of airlift assigned to the mission must be considered. In his study, LCol Wintrup states that "mobility operations increase the range, speed, and flexibility of national power projection but this presupposes a level of security and freedom to manoeuvre to operate unmolested."[213] In a non-permissive environment, this manoeuvrability may be impossible, and use of the "spokes" in the Hub and Spoke logistics concept would be unlikely without assets that could operate in that type of environment, which would

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[210] Government of Canada, "Operational Support HUBs," https://www.canada.ca/en/department-national-defence/services/operations/military-operations/conduct/support/hubs.html. (last accessed 01 April 2021).

[211] Hood, "Foreword," in *Defending Canadian Sovereignty* . . ., vi.

[212] Stewart Beare, *Letter of Promulgation - CJOC Directive for the Establishment of Operation Support Hubs* . . ., 1-4.

[213] Wintrup, "Operational Support HUB in the Far East . . ., 14.

negate the usefulness of pre-positioning critical assets at these strategically important locations.

For example, supposing that the Baltic region becomes non-permissive, as postulated in chapter one of this paper, the OSH in Koln-Bonn would become the "hub" with a "spoke" reaching into Canadian units currently based in Latvia. In this context, the requirement is well beyond simple operations support, which directly supports air operations, and moves into much more tactical considerations, including the potential delivery of munitions and heavy equipment into theatre.[214] Of course, as distance increases, effect decreases, and range is significantly affected by payload weight. To this end, the CC-177 has a range of 5,550 nm[215] when empty, compared to the CC-130J's range of 3,700 nm[216]. Considering that the distance between Koln-Bonn and Latvia's main airport at Riga is 697 nm, the maximum payload into theatre would be approximately 121,000lbs more on the CC-177,[217] making it the obvious choice for moving the most equipment and personnel into theatre in the quickest amount of time. However, without immediate improvements in CC-177 tactics and the Squadron's continued inability to fly into non-permissive environments due to expired crew qualifications, the point is moot. Additionally, as the RCAF cannot contract civilian airliners, flown by civilian pilots, to operate tactically into these same non-permissive

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[214] Department of National Defence, *Royal Canadian Air Force Doctrine*, (Ottawa: DND Canada, 2016), 39.

[215] Government of Canada, "CC-177 Fact Sheet . . ., last accessed 01 April 2021).

[216] Government of Canada, "CC-130J Fact Sheet," http://www.rcaf-arc.forces.gc.ca/en/aircraft-current/cc-130j.page (last accessed 01 April 2021).

[217] CC-177 and CC-130J calculations made on CAF-used flight planning software www.milplanner.com show that the distance between EDDK (Koln-Bonn) and EVRA (Riga) is 697 nm, allowing for max payload on both aircraft types, with standard crew numbers. Per previously referenced SMM information, CC-177 max payload is 165,000lbs and CC-130J max payload is 44,000lbs. In both cases, freight would likely bulk out the cargo compartment before maximum weight was achieved.

environments, the CAF must have an internal, capable system greater than what it currently has.

Consider also the initial deployment of the CAF into Afghanistan, which was comprised of 350 vehicles and 300 sea containers of equipment. Before the fighting started in earnest, the CAF was able to contract both sea- and air- lift into the civilian International Airport in Kabul. The plan initially used two Roll-On Roll-Off (RORO) type ships into Derince, Turkey, followed by two Antonov-124 (AN-124) and three Ilyushin-76 (IL-76) cargo aircraft from Turkey into Kabul.[218] Without these contracted assets, which would likely not have been available had the airspace been contested or non-permissive, the deployment of this amount of Canadian equipment into theatre would have been impossible without a fixed-wing heavy tactical air transport capability. Indeed, in a study conducted by the Operational Research Society in 2008, the conclusion was made that the historical fleet of two AN-124s and three IL-76s would be strategically equal to a fleet of five CC-177's conducting the same mission with the same equipment.[219]

Given this significant capability difference between the CC-177 and the CC-130J, CAF support to its own troops as well as to its allies and coalitions is greatly affected by not having a fixed-wing heavy tactical air transport capability. In 2008 alone, the United States was able to airdrop nearly 15 million pounds of supplies to troops on the ground in Iraq and Afghanistan,[220] proving the absolutely necessity of fixed-wing tactical airlift assets in war. As previously mentioned, the RCAF remains dependent on the USAF and

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[218] Ghanmi and Shaw, "Modelling and analysis . . ., 1593.
[219] *Ibid.*, 1601.
[220] Tim Johnson, "Air Mobility maintains the fight in Afghanistan," *Department of Defense U.S. Air Force Releases*, 05 June 2009, 2.

other allies to transport heavy equipment into non-permissive theatres of operation and would be unlikely to capably participate in a coalition that did not include the Americans at this point in time.

Summary

Air Mobility assets provide a key fundamental of air power, and the Hub and Spoke sustainment model does not function without robust strategic and tactical airlift capabilities. A fixed-wing tactical air transport capability is essential for force projection, as shown by a discussion of the doctrinal sustain and move functions. Given that the operating environments of the future are likely to be global, having an airlift capability that can operate in both permissive and non-permissive environments will be required.

The final chapter will delve further into future RCAF capabilities, including a deep dive into current doctrine and the RCAF vision for the future, including a discussion of the recently published *RCAF 2035* doctrine manual and how it applies to Air Mobility and A2/AD. A discussion of how Air Mobility assets could operate in a contested environment will be overlayed with current challenges and provide a number of recommendations for the future. Consequently, this discussion will demonstrate that A2/AD capabilities are the most significant threat to Canadian Air Mobility Operations in future conflict. As a result, Canada must have a heavy fixed-wing tactical air mobility capability in order to maximize its ability to project power globally and remain relevant in the battlespace of the future.

CHAPTER 4: FUTURE CAPABILITIES

Introduction

LGen Rouleau's *How We Fight* memo promises detail and substance to aid the CAF in mapping the future operating environment. In particular, Rouleau argues that the CAF must "spend our resources as carefully as possible in order to build the most coherent and jointly capable CAF that we can."[221] Necessarily, such resource management must extend not only to what assets the CAF and RCAF have in their arsenal but, most importantly, to how those assets are used. LGen Rouleau goes on to assert that "advanced generations of weapons systems, advanced algorithms, machine learning/enabled C2 etc. will simply see CAF incapable of plugging into tomorrow's coalition-of-the-willing,"[222] with A2/AD capabilities leading the way in preventing forces such as the RCAF from successfully engaging in these coalition led conflicts in any meaningful way. In a recent letter, DRDC confirmed this hypothesis by asserting that militaries who are unable to link into their coalition partners and whose assets cannot cope with the A2/AD environment will likely find themselves to be a liability in any future alliance.[223] This final chapter will delve further into future RCAF capabilities, including a deeper discussion of current doctrine and the RCAF vision for the future as it applies to Air Mobility Operations and A2/AD.

Using the doctrinal sustain and move functions, the previous chapter discussed how Air Mobility is fundamental to air power. It discussed how the Hub and Spoke sustainment model does not function without robust strategic and tactical airlift

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[221] M.R. Rouleau, *How We Fight: Commander CJOC's Thoughts*, 10 Feb 2019, 5.
[222] *Ibid.*
[223] Gladman, "Considerations for defining the future . . ., 6.

capabilities and illustrated that a heavy fixed-wing tactical air transport capability is essential for RCAF force projection. Chapter three also noted how the operating environments of the future are likely to be global, which will require an airlift capability that can operate in both permissive and non-permissive environments if the CAF wants to remain a relevant participant in the global community.

This chapter will culminate the discussion and prove that A2/AD capabilities are the most significant threat to Canadian Air Mobility operations in future conflict. As a result, Canada must have a heavy fixed-wing tactical air mobility capability in order to maximize its ability to project power globally and remain relevant in the battlespace of the future.

Learning from the Past

In 2011, a group of senior officers and academics got together to write *Project Laminar Strike: Canada's Air Force post Op ATHENA*. This first-of-its-kind in the RCAF publication discusses the creation of Canada's first deployed Air Wing, from its Intelligence Support to Operations, through to A6 Communications and Information Systems challenges, to the use of Tactical and Strategic aviation in conflict. The goal of the project was to create a detailed lessons-learned document, as well as to present a way forward for the RCAF, including its possible role in future conflicts.[224]

Following the positive reactions to *Project Laminar Strike*, a similar document was released in 2018 to discuss the lessons learned during Op MOBILE, Canada's support to the 2011 Libyan conflict. While the Joint Task Force -Afghanistan (JTF-Afg)

[224] J.H. Christian Drouin, "Foreword," in D.W. Lowthian and S.R. Harrison Eds., *Project Laminar Strike, Canada's Air Force: Post Op ATHENA*, (Ottawa: DND Canada, 2011), vi.

Air Wing demonstrated the creation and deployment of a tactical air wing, and the concept was further developed through the *Air Force Expeditionary Capability Concept of Operations* document written in 2009,[225] the Libyan conflict became the trial run for the updated and improved version: The Air Expeditionary Wing (AEW). The AEW was finally declared operational in 2013, well after the conclusion of the Libyan conflict, with the design "for rapidly deploying Canadian airpower and delivering strategic effects around the world without causing major disruptions to the air force's existing capabilities."[226]

Replacing the existing Tactical Airlift Unit (TAU) in 2008, the JTF-Afg Air Wing amalgamated a number of existing units under one command, which was based at Kandahar Air Field (KAF) in Afghanistan. Following the *Manley Report,* released in 2008, the addition of Chinooks and UAVs to the existing RCAF force package in Kandahar made it too big for either the small TAU or the bigger army-centric headquarters to manage alone.[227] Ultimately, JTF-Afg was stood up and christened Task Force (TF) Silver Dart. The TF commanded operations for TF Canuck (3 x CC130H/J Hercules), TF Erebus (3 x CU-170 Heron Unmanned Aerial Vehicles), TF Freedom and TF Faucon (6 x CH-147D Chinook and 8 x Ch-146B Griffon Helicopters), as well as contracted support options and a dedicated Tactical Air Intelligence Section.[228]

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[225] "Air Force Expeditionary Capability Concept of Operations," 3031-1 (AFEC Rdns), 22 Sept 2009, http://winnipeg.mil.ca/msnspcoord/documents/DMCS-13667.pdf (last accessed 01 April 2021).

[226] Richard Oliver Mayne and William March, "Introduction," in Richard Mayne and William March Eds. *Air Wing: RCAF Commanders' Perspectives During the 2011 Libyan Conflict,* (Ottawa: DND Canada, 2018), *1*.

[227] Government of Canada, "Independent Panel on Canada's Future Role in Afghanistan," (Ottawa: DND Canada, 2008), 23.

[228] W.A. March, "Impact of a Combat Air Wing – Canadian Air Power in ISAF," *Joint Air Power Competence Centre Journal*, Ed 13, Spring 2011, 19.

All of these individual Task Forces were supported by the aforementioned TF Canuck for the sustainment of necessary equipment and personnel into and out of Afghanistan. The CC-177 was a particularly important enabler, as the Air Wing viewed it as "a state-of-the-art "stractical" airlifter"[229] that was able to merge both strategic and tactical airlift capabilities. While obviously not an official term, the concept of an aircraft being "stractical" works very well for the RCAF as it pertains to the CC-177 in particular. With the proper crew training, the airframe can be used successfully for strategic missions such as hauling heavy equipment and personnel into a logistical HUB but can then also continue tactically with the mission along the spokes, into the area of operations.

The Command Team and planners for Op MOBILE took the lessons learned from Afghanistan and applied them directly to their new tasking. As a result, Op MOBILE became an outstanding recent example of the flexibility of the RCAF's Air Mobility fleets, as the rapid deployment of forces led directly to mission success. When the Government of Canada made the decision to support the coalition in the Libyan conflict, a CC-177 that was already enroute to Kandahar with supplies for Op ATHENA was redirected mid-mission first to Rome for cross-loading, then onwards to Malta to begin operations.[230] Combined with other aircraft movements, this quick about-face enabled the CAF to have all combat-ready assets in place within 72 hours of the government's decision to participate in coalition operations.[231] As the mission progressed, the message

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[229] D.W. Lowthian and S.R. Harrison Eds., *Project Laminar Strike, Canada's Air Force: Post Op ATHENA*, (Ottawa: DND Canada, 2011), 3.

[230] Mayne and March, "Introduction," in *Air Wing: RCAF Commanders' Perspectives . . .*, 2.

[231] Alain Pelletier, "RCAF Air Power over Libya: Making a Strategic Difference," in Richard Mayne and William March Eds. *Air Wing: RCAF Commanders' Perspectives During the 2011 Libyan Conflict*, (Ottawa: DND Canada, 2018), 37.

coming out of NATO was that the Canadian CC-130H/J Hercules and CC-177 Globemasters were helping to ensure that the mission's logistical and support requirements were met and that the RCAF was continually punching above its weight.[232] While it is important to note that from a CAF perspective, Op MOBILE was distinctly a Fighter, AAR and ISR war, none of these capabilities would have been deployable or sustainable without complementary Air Mobility taskings.

Laminar Strike concludes by noting that in the future, all missions on which the CAF embarks will be considered Expeditionary, whether to Africa, South America or even Canada's North.[233] The authors contend that all operations are certain to be conducted in concert with the CAF's civilian and military partners from the International community and that the RCAF will play an especially important role. This will be particularly important as the capabilities of existing platforms expand and the mission sets that they are able to accept become broader. The document argues that the excellent response times of both strategic and tactical airlifters, coupled with aircrews that had been seasoned in battle alongside their joint partners,[234] will be key to engaging in the conflict of the future. Meanwhile, *Air Wing* explains that the addition of Air Mobility assets, and in particular the CC-177, were key force multipliers and strategic enablers and that these assets will allow the RCAF to continue to provide the Canadian government and NATO

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[232] Richard Oliver Mayne, "The Canadian Experience: Operation Mobile," in Richard Mayne and William March Eds. *Air Wing: RCAF Commanders' Perspectives During the 2011 Libyan Conflict*, (Ottawa: DND Canada, 2018), 18.

[233] For further information about Air Mobility Operations in Canada's North, see Darwin Ziprick. "Leveraging Air Mobility to Support Canadian Arctic Sovereignty," Course Paper, (Joint Command and Staff Program: Canadian Forces College, 2014), and Daniel Heidt and Richard Goette, "This is no 'milk run': An Historical and Contemporary Examination of Operation BOXTOP, 1956-2015," in Whitney Lackenbauer and Adam Lajeunesse, eds., *Canadian Arctic Operations, 1945-2015: Lessons Learned, Lost, and Relearned*, (Fredericton: The Gregg Centre for War & Society, 2017), 270-306.

[234] Lowthian and Harrison Eds., *Project Laminar Strike* . . ., 102.

with responsive, flexible expeditionary effects in the future.[235] The authors conclude that without having the right tools to provide operational support, the CAF will not be able to "provide the right support at the right time to optimize the capabilities to air operations."[236] In all Expeditionary operations, and as proven in Afghanistan post-2007, this must include a heavy fixed-wing tactical air transport capability, such as the exceedingly capable CC-177.

Looking Ahead

Now that hybrid or unconventional warfare is becoming more common, and with air superiority not always guaranteed, the RCAF must contribute to future conflict in a realistic way, no matter the composition of the force package. Simply, Canada can make its most vital contribution through sustainment. The *FAOC* states that "in order to have a decisive effect and a leading role in low-intensity conflict, the future RCAF needs to project rapidly and sustain forces globally in austere and partially denied environments."[237] In short, Air Mobility assets will always be needed to get people and equipment into and out of theatres of operation, no matter where in the world those happen to be. At the moment, the most likely future conflicts appear to be with Russia and China as discussed in Chapter One, though smaller or more regional disputes may certainly occur and take priority. In all of these cases, access to the conflict area will be the first concern of any commander. The *FAOC* provides an idea of what air power capabilities the RCAF leadership believes will be needed in the near future to provide the

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[235] Mayne, "The Canadian Experience: Operation Mobile," in *Air Wing: RCAF Commanders' Perspectives* . . .,18.

[236] Lowthian and Harrison Eds., *Project Laminar Strike* . . ., 89.

[237] Department of National Defence, *Future Concepts Direction Part 2* . . ., 19.

most relevant and responsive capabilities that will maximize air power and ensure the reach and power necessary to support CAF operations globally.[238]

The document discusses RCAF operations in what it terms "high-intensity, A2/AD conflicts" and clearly states that the RCAF "must be capable of deploying rapidly and participating in a meaningful way as part of a broader coalition in support of higher levels of conflict."[239] Moreover, according to the *FAOC,* all RCAF assets are expected to be able to operate in a contested environment, and the capabilities must be developed to allow the freedom to manoeuvre in the air domain.[240] Clearly, this statement is intended to include all types of aircraft that may be deployed to the theatre of operations, including Air Mobility. However, the definition of "meaningful" is never specified and leaves future planners the freedom to interpret what they believe a meaningful contribution to be with the assets that the RCAF has available at the time of the conflict. Unfortunately, with fixed-wing tactical air transport capability currently limited to the CC-130J, meaningful could mean as little as the one CC-130J conducting approximately eight serials a year in support of Op PRESENCE in Uganda,[241] or as much as the three CC-130H/Js and multiple on-order CC-177s that were deployed continually for 13 years (2001-2014) to Operations in Afghanistan.[242] In both cases, the airlift is vitally important, but the example presents a stark contrast in the level of support and of perceived

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[238] Department of National Defence, *Future Concepts Direction Part 2 . . .*, iii.
[239] *Ibid.*, 20.
[240] *Ibid.*
[241] Government of Canada, "Operation PRESENCE," https://www.canada.ca/en/department-national-defence/services/operations/military-operations/current-operations/op-presence.html (last accessed 01 April 2021).
[242] Government of Canada, "International Security Assistance Force (ISAF)," https://www.canada.ca/en/department-national-defence/services/military-history/history-heritage/past-operations/asia-pacific/athena.html (last accessed 01 April 2021).

Canadian commitment to the mission by the International community. Air Power Academic Dr Richard Goette describes these smaller commitments as "micro-engagements" and argues that they allow the RCAF to free up capabilities quicker than with much larger counter-insurgency (COIN) missions while still giving Canada the ability to prove themselves on the international stage through "concrete, achievable, and well-scoped objectives."[243]

Considering that the RCAF will likely have to operate in contested or degraded environments in future operations,[244] it is easy to assume that access will only be an issue in kinetic missions. However, that is likely untrue as the technological ability to achieve air supremacy is lying more and more exclusively with tier 1, or "large" air forces like the United States.[245] Canada's role as a tier 2, or smaller, air force, means that it can really only employ air power assertively if it maintains a wide array of capabilities[246] and maximizes the role of existing assets. Depending on where the Government of Canada wishes to send the RCAF, missions may occur in or near existing A2/AD environments or in the vicinity of adversaries.

Op RENAISSANCE 15-1 is a great example of a DART mission that occurred right in the backyard of a potential adversary. CAF members first deployed to Nepal on 26 Apr 2015 and stayed for just over a month to conduct humanitarian and disaster support after two earthquakes hit the country in short succession. The very first aircraft

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[243] Goette, *Preparing the RCAF for the* future . . ., 6.
[244] *Ibid.,* 9.
[245] Mathew Preston, "Air Power Theory and Force Classification," *RCAF Journal*, 5 (3): 2016, http://www.rcaf-arc.forces.gc.ca/en/cf-aerospace-warfare-centre/elibrary/journal/2016-vol5-iss3-05-air-power-theory-and-force-classification.page (last accessed 01 April 2021).
[246] *Ibid.*

into theatre at the time was a CC-177 carrying the Humanitarian Assistance Reconnaissance Team (HART)[247], plus Engineers, Medical Personnel and a member of the Red Cross. Shortly thereafter, the CC-117 began regular missions into the country, bringing water and other rations, communications equipment and Red Cross humanitarian aid equipment.[248] Given the proximity to China, should that country have wanted to prevent aid from reaching Nepal, they could easily have denied access to the airspace, and the Canadian CC-177s and non-tactically trained crews would have been unable to provide the assistance required. The same argument can be made for the RCAF standard resupply missions into Op IMPACT in Kuwait.[249] Should Iran, which is getting more capable and agile A2/AD capabilities daily,[250] want to prevent allied access into that theatre of operations, it could, and the RCAF could do very little to operate within or around it from a heavy fixed-wing sustainment perspective.

The concept of smaller air forces is also mentioned several times in the *FAOC* and often identifies the federal budget as being the main reason why the RCAF may be unable to achieve certain mission sets. Indeed, the idea that "the costs of developing the ideal RCAF to meet all of the challenges ahead are likely beyond what defence budgets can

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[247] The Humanitarian Assistance Reconnaissance Team (HART) is available at 12 hours' notice to move and deploys prior to the DART to assess the conditions on the ground. The HART is integrated into the Government of Canada's Interdepartmental Strategic Support Team (ISST) and is used to assess the appropriate DART capabilities to deploy based on the humanitarian needs in location. See also: C.K. Bramma, "Directing the DART towards climate change," Course Paper, (Joint Command and Staff Program 41: Canadian Forces College), 33. https://www.cfc.forces.gc.ca/259/290/317/286/bramma.pdf (last accessed 10 April 2021).

[248] Government of Canada, "Operation RENAISSANCE 15-1: CAF contribution to humanitarian relief efforts in Nepal," https://www.canada.ca/en/department-national-defence/services/operations/military-operations/recently-completed/nepal.html (last accessed 01 April 2021).

[249] Government of Canada, "Operation IMPACT," https://www.canada.ca/en/department-national-defence/services/operations/military-operations/current-operations/operation-impact.html (last accessed 01 April 2021).

[250] Gladman, "The future of allied air power: The United States . . ., 18.

afford"[251] is extremely realistic and is often mentioned when discussing the concept of the smaller air force. In a working paper written for the Royal Australian Air Force, retired Wing Commander Sanu Kainikara defines smaller air forces as being those with a balanced force but limited depth and from Countries with limited or no industrial capability. Forces of this size and capability fall right between those niche air forces with few roles and limited capabilities and the extraordinary mass of the United States Air Force (USAF).[252] Kainikara argues that smaller air forces have the challenge of needing to produce capabilities that are able to operate in difficult environments from within a finite allocation of resources,[253] which is why it is vital that current assets be employed in ways that make the most of their capabilities. The CC-177 provides a great example of Kainikara's concept, as it allows the RCAF to operate more independently than the CC-130J does[254] with its extended reach and cargo capacity.

To this end, the CC-177 could be maximized by utilizing it in both the tactical and strategic roles that the airframe is capable of, vice using it simply as a strategic airlifter. This point is further reinforced by Kainikara, who argues that since smaller air forces cannot rely on sheer size to meet the demands of concurrent operations, and they do not have the flexibility to simply "scale-up" every time there is a conflict, they must instead "plan to fight and win with the force-in-being, partnered with other Services, support agencies, allies and coalition partners."[255] Simply, this means that air forces such as the

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[251] Department of National Defence, *Future Concepts Direction Part 2* . . ., 21.

[252] Sanu Kainikara, Royal Australian Air Force Air Power Development Centre, "The Future Relevance of Smaller Air Forces," Working Paper 29, 2009, 4.

[253] *Ibid.,* 2.

[254] Preston, "Air Power Theory . . ., (last accessed 01 April 2021).

[255] Kainikara, "The Future Relevance . . ., 12.

RCAF, who do not have the budget, personnel numbers, or assets to function on par with allies such as the United States, must use every available resource and maximize every capability they have in order to remain relevant and effective.

The *FAOC* lays out a number of Core Functions based upon each of the RCAF's 11 functional areas that it will need in order to be relevant in the battlespace of the future. Key among these are the tasks to deliver military effects globally, including personnel and equipment, often to regions in crisis, while responding quickly in any capacity required, expeditionary or domestic.[256] Furthermore, the RCAF must maintain or create "capabilities that enable the establishment of and concurrent operation from expeditionary airfields – including those in austere environments."[257] Considering that A2/AD capabilities are aimed directly at other countries' abilities to project power,[258] actually achieving these two core functions may be nearly impossible within current RCAF capabilities.

The *FAOC* maintains that "while the chances of a sustained conflict in an A2/AD environment remain low, the costs of being unprepared should it occur are so severe that preparations to counter them effectively should influence the force structure and capability investment of the RCAF."[259] Indeed, this cost could result in the RCAF sustaining significant losses without proper training or investment in new crew capabilities. There is always a requirement to get the job done, which often equals waivers being granted for crew competencies, qualifications or expired requirements such

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[256] Department of National Defence, *Future Concepts Direction Part 2 . . .*, 22.
[257] *Ibid.*
[258] Goette, *Preparing the RCAF for the future . . .,* 7.
[259] Department of National Defence, *Future Concepts Direction Part 2 . . .*, 10.

as medical exams. While there is a significant process to mitigate mission risk analysis, particularly for dangerous areas or expired crew competencies, such waivers are granted.[260] The uncertainty of expeditionary operations means that risk is always a key component to planning, and given the extremely limited political appetite for loss, there is a huge burden placed on the RCAF to operate without risk, or with very limited risk, which is exceptionally hard to do in a non-permissive or A2/AD environment.[261] The inherent risk of tactical flying is another concern, but one that must be weighed heavily against the capacity of the aircraft and the level of sustainment required for any given mission.

The RCAF's future planning document, *Projecting Power: Canada's Air Force 2035,* asserts that "expeditionary capable air forces will be the foundation for military relevance in the year 2035"[262] and that having said expeditionary capable force would give Canada the rapid, agile and balanced deployment options that it will need to conduct all matters of missions for the Government of Canada. Beyond that, due to the limited number of assets in the RCAF arsenal, each of them must be agile and able to switch quickly between mission types such as strategic airlift to tactical airlift and back again.[263] Further, the document explains in very clear terms exactly why Air Mobility is the enabler of the future and will continue to be the provider of choice for Canadian government logistical support requirements. Author Andrew Godefroy suggests that due to the increasing use of improvised explosive devices (IEDs), tactical airlift will be

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[260] Department of National Defence, *Royal Canadian Air Force Flight Operations Manual*, (Ottawa: DND Canada, 2020), 3.2.1.10

[261] Goette, *Preparing the RCAF for the future . . .*, 10.

[262] Godefroy, *Projecting Power: Canada's Air Force 2035*, (Ottawa: DND Canada, 2009), 58.

[263] *Ibid.,* 59.

required in theatres of operation to move both personnel and equipment safely. Additionally, he argues that a premium will be placed on the RCAF's ability to "guarantee the reliable and uncompromised delivery of high-value cargo" throughout the world. Combined with the extremely low political appetite for CAF loss of life, this premium should ensure that tactical airlift is used for intra-theatre personnel movements where able.[264]

Summary

This final chapter has discussed current doctrine, including the RCAF vision for the future as it applies to Air Mobility Operations and A2/AD. *Project Laminar Strike* demonstrates the value of the first deployed Air Wing on Canadian deployed sustainment activities, while Op MOBILE's deployment of Canada's first Expeditionary Air Wing, makes it clear that inter- and intra- theatre heavy airlift was a key to Canada's success within the coalition. With the ability to quickly move from one mission to another and to re-task and divert while on the road, the RCAF can be extremely agile and must continue to be used accordingly.

Through both doctrine and actions, the RCAF must continue to plan for operations into contested or non-permissive environments and must maintain the critical capabilities to conduct missions safely, including with robust tactical airlift. Throughout the literature, it is very clear that A2/AD capabilities are the most significant threat to Canadian Air Mobility operations in future conflict. As a result, Canada must have a

[264] *Ibid.,* 62.

heavy fixed-wing air mobility capability to maximize its ability to project power globally and remain relevant in the battlespace of the future.

CONCLUSION AND RECOMMENDATIONS

The rise of A2/AD bubbles, including those surrounding Russia and infringing on the Baltic countries of Estonia, Latvia and Lithuania, will define the world's current and future operating environment. These sophisticated weapons systems are being used to create massive obstacles for conventional forces, including the RCAF and its limited Air Mobility forces. As a core air power capability, Air Mobility aircraft must be able to be employed across the spectrum of conflict, which must also include being able to operate in contested, non-permissive, or access-challenged regions.

Canada's ongoing deployments to Latvia and the Ukraine under Op REASSURANCE demonstrate the government's commitment to those countries as well as to NATO's deterrence mission in the region. Russia's recent incursions into Ukraine, plus its illegal annexation of Crimea, demand coalition action and a continued international presence. Canada will surely remain involved in the area for as long as NATO requires, which demands that the CAF maintain the capabilities required to participate in allied action in a meaningful way.

The RCAF's *FAOC* clearly describes the emerging A2/AD challenges and states that Canada must make required investments in the capabilities that will be needed to meet future requirements head-on. Necessarily, this must include a way to get troops and equipment into and out of theatres of operations in order to preserve the precision and speed necessary to combat the enemy. Situations like Korea, Rwanda and Afghanistan prove the importance of having a robust, dedicated Air Mobility capability and underline the necessity of having flexible units that can respond to developing situations on short notice. The recent conflict in Afghanistan, in particular, proved the importance of heavy

tactical air mobility assets and demonstrated the requirement for them in expeditionary operations.

Rwanda proved that Canada needs to be self-reliant in all aspects of sustainment, as the CAF cannot always count on assets from other countries. When the air threat got too high, partner nations left the country, and Canada remained the only tactical air transport capable asset in theatre. Canadian troops need to have the confidence that they will be supported at all times, and this can be accomplished by maintaining flexible air mobility capabilities. Air Mobility resources that can switch easily from strategic inter-theater airlift to tactical intra-theatre airlift and back again will be key in the battlespace of the future.

Recent policy documents made it clear that air mobility is a key function of air power and that doctrinal Sustain, Move and Reach functions could not be accomplished without this key force enabling capability. Beyond kinetic effects, the ability to force project the RCAF in cases of humanitarian assistance, non-combatant evacuation operations or disaster relief all demonstrate air power. Given that the operating environments of the future are most likely to be global in nature, an airlift capability that can operate swiftly while maximizing the use of assets and crews will be integral to CAF success. Moreover, the Hub and Spoke logistics sustainment model does not function without robust strategic and tactical airlift capabilities, and a heavy fixed-wing tactical air transport capability will be essential for RCAF force projection.

Recommendations

Following the literature review outlined in the Introduction, the main research objective for this study was identified as questioning whether the RCAF Air Mobility community was prepared to operate in the A2/AD environment of the future. While the answer proved to be no, several recommendations became evident as ways to move into the future with a greater understanding of the problem and means to deal with it. In order to maximize RCAF capabilities for the future, as well as meet the needs of the CAF of the future as anticipated by current doctrine, the following four actions are recommended.

Firstly, the RCAF must procure a CC-177 Weapon System Trainer (WST) and immediately invest in the development of an in-house Operational Training Unit, ideally housed at 426 (T) Squadron with the other existing Air Mobility training establishments. Secondly, all personnel currently qualified on the CC-177 must be re-qualified to conduct tactical air transport missions, including both low-level flying and airdrops.

While significant investment is being made within the RCAF for modernization efforts,[265] there is currently no plan to improve or expand the tactical air transport capabilities of the force. Despite that, the CC-130J will remain well-positioned, and the crews well-trained to conduct tactical air transport missions well into the future. With their updated countermeasures systems and the newly procured electronic warfare threat simulator, 436 (T) Squadron remains on track to deliver "On Time, On Target" wherever the Canadian Government asks them to go. However, issues remain with capacity, as the aircraft is unable to drop loads large enough to insert a reasonable amount of equipment

[265] Department of National Defence, *Strong, Secure, Engaged . . .*, 39.

or personnel to a drop zone (DZ) when conducting airdrops as a single ship. Several aircraft, including the use of multiple formations, may be required depending on the mission (a Brigade Combat Team concept or heavy vehicle insertion, for example), which would increase the threat risk significantly to every subsequent aircraft flying into the area.

Conversely, the CC-177 has the capacity of approximately two CC-130Js when conducted airdrops of any kind, but all previously tactical qualified CC-177 aircrew currencies have expired, and the Squadron is no longer allowed to, or capable of, conducting these types of missions. Additionally, since the CC-117 does not have an in-house training system and has always out-sourced their ab-initio Pilot and Loadmaster training to units in the United States and the United Kingdom, any kind of re-qualification program would need to be conducted internationally. Without a local WST, the currency and training bill would simply be too high for current resources.[266] That being said, all low-level tactics, including airdrop, remain nascent in the current CC-177 SMM and RCAF FOM for potential use in the future. The investment in a local WST would reduce the training bill, increase the capability of the airframe and crews, and reduce the required expenses of training RCAF personnel outside of Canada.

Thirdly, a robust Air Mobility Electronic Warfare (EW) training and development unit must be created to include all of the EW subject matter experts (SMEs) from the existing Air Mobility Units to work together to develop TTPs and new doctrine for the future RCAF. While both basic and advanced Electronic Warfare courses are available to

[266] Personal communication with CO 429 (T) Sqn, 05 Feb 2020.

CAF members, and a Tactical Electronic Warfare Instructor Course (TEWIC) exists, the only mandatory training for aircrew is the Basic EW course, which simply will not prepare crews for operations in denied or contested environments. More deliberate, intensive and enduring training is required.

This leads to the final recommendation, which is to develop better A2/AD-mindedness at the Tactical level. While a lot of work has been done at both the Strategic and Operational levels to ensure that the A2/AD threat is well understood and captured both in doctrine and by the most Senior Officers in the RCAF, some formal understanding is missing at the Squadron level. While a basic discussion of ISR and IADS is conducted during the official planning scenario on the Air and Space Power Operations Course (ASPOC) taken by senior Captains, there is relatively little mentioned about it during formal training prior to that.[267] Ideally, in-depth lectures and discussions about A2/AD systems and threats would begin during trade training and continue to occur throughout the Air Force Officer Development (AFOD) program, to include tactical considerations related to specific trades. In 2019, the Royal Canadian Air Force Aerospace Warfare Centre (RCAF AWC) which runs ASPOC, also stood up the Air and Space Integration Program (ASIP). This new program is intended to provide the multidomain knowledge required for aviators to operate in diverse and degraded environments.[268] ASIP is currently being executed on a multi-year trial run and the final

[267] Personal communication with ASPOC Course Director, 28 April 2021.

[268] Royal Canadian Air Force, "Air and Space Integration Program," http://www.rcaf-arc.forces.gc.ca/en/cf-aerospace-warfare-centre/air-and-space-integration-programme.page. (Last accessed 30 April 2021).

composition and mandate of the program is still being developed, however this would likely make an excellent home for a robust A2/AD training and education program.

Understanding that rolling out all four of these recommendations would be both time consuming and potentially expensive, priority should be put on requalifying all CC-177 crews for the tactical air transport role, beginning with low-level/combat arrivals and departures. At the very least, this capability would allow the aircraft to operate in moderate risk environments where they can generally fly above the weapons engagement zone (WEZ) and only need tactical procedures for landing or departing from theatre or more dangerous airfields. Requalifying the crews on tactical arrivals and departures would greatly lower the risk to the aircraft and its crews in these environments and allow the CAF to force project power more widely.

There are several areas for further research that have been highlighted by this study. These include further investigation into the role that Canadian Air Mobility has played in modern conflicts, including Afghanistan. Specifically, would the new mission types discussed in *Laminar Strike* have been worth continuing after Op ATHENA ended, and would they have been useful skills for the future operating environment. Also, a discussion of the value of the CC-130J versus the CC-177 would be very interesting with the recent announcement that the Royal Air Force will be retiring all of their CC-130J's in favour of heavy air mobility capabilities by 2023.[269] Would a bold decision like reducing airframes help the RCAF with serviceability and training, or would it be losing an important capability? These discussions would help to better synthesize the future

[269] UK Ministry of Defence, "Defence Secretary Oral Statement on the Defence Command Paper: 22 March 2021," Last accessed https://www.gov.uk/government/speeches/defence-secretary-oral-statement-on-the-defence-command-paper.

challenges facing the Air Mobility community and the RCAF as a whole, and hopefully provide a pan-RCAF way ahead, that spans every level from tactical to strategic.

In all cases, with hybrid warfare becoming more common and air superiority not always guaranteed, the RCAF must be prepared to operate in contested or degraded environments in future operations. This study has demonstrated that A2/AD capabilities are the most significant threat to Canadian Air Mobility operation in future conflict. As a result, Canada must have a heavy fixed-wing Air Mobility capability to maximize its ability to project power globally and remain relevant in the battlespace of the future.

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