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THE CANADIAN AIR FORCE JOURNAL

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THE CANADIAN AIR FORCE JOURNAL is an official publication of the Chief of the Air Staff and is published quarterly. It is a forum for discussing concepts, issues and ideas that are both crucial and central to aerospace power. The *Journal* is dedicated to disseminating the ideas and opinions of not only Air Force personnel, but also those civilians who have an interest in issues of aerospace power. Articles may cover the scope of Air Force doctrine, training, leadership, lessons learned and Air Force operations: past, present or future. Submissions on related subjects such as ethics, technology and Air Force history are also invited. This *Journal* is therefore dedicated to the expression of mature professional thought on the art and science of air warfare and is central to the intellectual health of the Air Force. It serves as a vehicle for the continuing education and professional development of all ranks and personnel in the Air Force as well as members from other environments, employees of government agencies and academia concerned with Air Force affairs. ■

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THE CANADIAN AIR FORCE JOURNAL

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Item	Word Limit*	Details
Letters to the Editor	50-250	Commentary on any portion of a previous *Journal*.
Articles	3000-5000	Written in academic style.
Book Reviews	500-1000	Written in academic style and must include: • the book's complete title (including sub-title); • the complete names of all authors as presented on the title page; • the book's publisher, including where and when it was published; • the book's ISBN and number of pages; and • a high resolution .jpg file (at least 300 dpi and 5 by 7 inches) of the book's cover.
Points of Interest	250-1000	Information on any topic (including operations, exercises and anniversaries) that is of interest to the broader aerospace audience.
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- Acronyms and abbreviations should be used sparingly:
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    - A list of all abbreviations (and their terms) used in the text will be included at the end of each submission.
- The Senior Editor reserves the right to edit submissions for style, grammar and length, but will not make editorial changes that will affect the integrity of the argument without consulting the author.

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Canadian Forces Aerospace Warfare Centre
8 Wing Trenton
Box 1000 Stn Forces
Astra, Ontario K0K 3W0
Attn: Major William March

William.March@forces.gc.ca

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EDITOR'S MESSAGE

In a few short months, Operation (Op) ATHENA, and the Canadian Forces' (CF) combat mission in Afghanistan, will come to a close. In short order, the CF will commence Op ATTENTION, committing almost 1000 personnel to train and mentor Afghan military and security personnel. This is not really a new mission as CF members have been engaged in supporting the Afghan forces; instead, it should be viewed as a shift in emphasis from direct combat to focusing on providing the Afghans themselves with the necessary skills to ensure their own security.

So what of the Air Force? Certainly, the Air Wing in Afghanistan will draw down along with the other CF elements in theatre, but there will be a strong "light blue" presence in Op ATTENTION. As well, the Air Force will continue to support the training and mentoring of Afghan air power organizations through the NATO Training Mission - Afghanistan (NTM-A). Finally, there will still be a fair number of "blue suiters" scattered throughout Southwest Asia (SWA) supporting coalition air operations. So, in many respects, it will still be business as usual.

In Canada, the draw down of the Air Wing means a ramping up of activity as we strive to bring the experience and capabilities gained in theatre back home. Virtually all of the Air Force communities are engaged in this endeavour. New tactics, techniques and procedures (TTPs) will need to be refined, validated, and tested. Doctrine and concepts will need to be amended and adapted. The list of things to do is not endless, but there are times when it certainly seems as if it is. Fortunately, most of this activity will be championed by an Air Force organization that has a vested interest in the outcome.

However, there is the occasional "orphan" capability that does not safely reside in the warm embrace of an established community. A prime example is the unmanned aerial vehicle (UAV). The Air Force has been operating UAVs in theatre for almost a decade and all evidence points to the benefits of this capability as an outstanding force multiplier—they saved lives and helped get the job done. Yet, when the existing contract leasing Heron UAVs for Afghanistan ends this summer, the Air Force will no longer be able to field this capability for development, training, or operations. It will simply cease to be.

There are plans to capture UAV lessons learned, as well as to seek opportunities to have Canadians participate in allied UAV operations, in order to ensure a modicum of experience remains with the Air Force. The hope is that this will provide the Joint Unmanned Aerial Vehicle Surveillance and Target Acquisition System (JUSTAS) project, the program charged with providing an improved UAV capability for the CF by the middle of the decade, with sufficient knowledge and skills to jump-start the reinstatement of this capability. The optimist in me hopes so, but the historian in me has doubts. Time will tell.

Major William March, CD, MA
Senior Editor

LETTERS TO THE EDITOR

To the Editor:

In the Fall 2010 edition of the *Journal*, Lieutenant-Colonel (LCol) "Mur" Murray wrote an excellent piece on the importance of understanding the limitations associated with having a "full bucket." Entitled "You Have to be Mental to be a Fighter Pilot," it is a well-written and concise summary of how cognition works in the human brain, the effects of stress on performance, and "the ways in which information processing and cognitive performance can be improved through training." There is only one problem with the article, and it is for that reason that I am writing this letter.

In short, the demands placed on the modern aviator as a result of highly integrated cockpits and complex operating environments are not exclusive to the fighter community. The lessons in Mur's article are as applicable to the Sea King community transitioning to a Maritime Helicopter Programme (MHP), to the CC130H crews transitioning to the CC130J, and to the CH113 Labrador crews that transitioned to the CH149 Cormorant. This is a critical lesson observed and reported upon in the 1 Canadian Air Division (1 Cdn Air Div) Automation Policy and Planning Development (APPD) Project conducted in 2007–2008, and which I wrote about in this journal in the Spring of 2009 [Volume 2, Number 2]. What that project uncovered was that truly achieving higher levels of information processing and cognitive performance through training will only be achieved through significant effort and change across the Air Force, particularly as it relates to areas such as orders and regulations, the HPMA program, and the ways in which we train our instructors and evaluators. Out of the APPD Project came the Air Standards, Training, Readiness, and Automation (ASTRA) Project charged with implementing the recommendations contained in the APPD Report. I encourage all those who are intrigued by Mur's article to get involved in ASTRA. Only through our collective efforts will we finally achieve the promised operational effectiveness and safety expected with the introduction of these new platforms.

Sincerely,

LCol Colin Keiver
Commanding Officer
436 Transport Squadron

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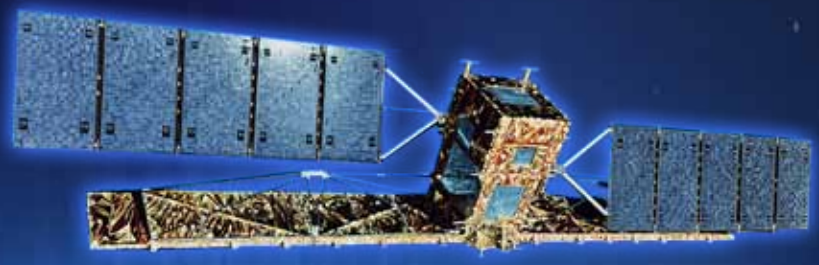
STAR WARS eh.?

A Case Study of Canada's Role in the Militarization of Outer Space

By Raymond Kenneth MacKinnon



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Humankind has recorded only 52 short years in space since the launch of Sputnik 1 on 4 October 1957. More poetically, the late astronomer Carl Sagan claimed, "Man has only waded in the shores of the cosmic ocean."[1] In this brief period, the exploration and exploitation of space revolutionized how both space faring and non-space faring states worked, played, and conducted war. Civilian advancements in the "Final Frontier" proved a remarkably uniting endeavour after the cold war. Communication satellites bolstered notions of a global village, of cultures and economies connected over vast distances. Above, the International Space Station is the most ambitious international collaborative effort human civilization has ever attempted. American space exploration during the Mercury, Gemini, and Apollo programmes inspired a generation of youth to explore the infinite expanses of outer space. The lunar plaque enshrined on the Apollo 11 Lander claimed the United States (US) went to the moon "in peace for all mankind" and stands as a testament to the ostensibly peaceful paradigm of outer space exploration.[2] Yet, the Apollo programme also serves as a reminder of space exploration that emerged from the cold war. For the United States to claim peaceful intentions in a space race born of competition between two superpowers ignores entirely the struggle for international prestige and control of outer space during the conflict between the East and West.[3]

With all the attention garnered by the United States and Soviet Union, it is little known that Canada played a significant role in the exploration of space. In an effort to contribute to this underdeveloped historiography, this paper explores the military initiatives that provided the impetus for Canadian efforts in space, arguing that the cold war was a significant factor in Canada's space exploration. Further, adherence to the popular belief that outer space is a "sanctuary" ignores significant historical evidence to the contrary. The 2007 anti-satellite demonstration by the People's Republic of China and the 2008 response by the United States suggests that failing to acknowledge outer space as a potential arena for war may prove detrimental to military forces that rely on space-based assets in future conflicts.

The cold war fear of exchanging nuclear salvos with the Soviet Union had an important impact on Canada's space exploration and continental defence. Canada adopted a niche role fulfilling both domestic and international goals by focusing on technology that benefited the Canadian public and often synchronized with American research objectives. Canada's Defence Research Board (DRB) worked alongside the US Army and Air Force, providing significant contributions toward ballistic missile research. It was DRB scientist R. J. Sutherland who first articulated the concepts of "first strike" and "second strike," a significant contribution to the cold war strategic lexicon.[4] American initiatives linked to Canadian national defence necessitated collaboration between the two countries. North American Air Defence (NORAD), the strongest example of the Canada-United States (CANUS) relationship, was formalized in 1957–58. As the relationship grew during the post-Second World War era, Canada was not completely subservient to the demands of the United States in regards to continental defence.

Canada-US relations did not ignore Canada's strategic and political objectives. Canada declined full partnership in investments deemed too expensive, or those that proposed to alter the nuclear status quo, namely the space transport system (also known as the STS or space shuttle) in 1972, and President Ronald Reagan's 1983 Strategic Defense Initiative (SDI) respectively.[5] Canadian space research and technology frequently involved projects that resulted in the militarization of outer space, including three shuttle missions that used the Canadarm for placing US military satellites into space. Further, Canadian politicians feared the US might use Reagan's

proposed space station Freedom as a testing lab for SDI research. Considering also the military capabilities of the 1982 search and rescue satellite aided tracking (SARSAT) system and the 1995 radar satellite (RADARSAT-1), these projects offer significant indications that Canada supported the militarization of outer space.[6]

In addition to Canada's partnership with the United States, Canada supported several international treaties regulating military activity. Canada ratified the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (better known as the Outer Space Treaty) and protested the SDI's transgression of the 1972 Anti-Ballistic Missile (ABM) Treaty. Although these documents suggest international agreement on limiting the militarization of outer space, a cursory examination reveals limited adherence to documents with little real coercive power.

The United Nations attempted to regulate the conduct of space-faring nations during the cold war, most notably the United States and Soviet Union. In particular, the Outer Space Treaty prohibited weaponization, yet it had loopholes and inconsistencies that allowed both the United States and Soviet Union to pursue activities directly related to national security during the cold war. Important to note is the clause which "called upon States to refrain from placing in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction."[7] This statement first appeared in the United Nations General Assembly adoption of the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space in October 1963 and eventually formed Article IV of the Outer Space Treaty. Article IV also forbade "the establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies,"[8] but noticeably did not apply these restrictions to outer space itself; the testing and placement was illegal, but not the use of these weapons.[9] The varying interpretation of treaties during the cold war was most notable in US space policy; however, it also affected Canadian cooperation with the US on issues that threatened to move away from the treaty. These are discussed below in relation to their corresponding projects. First, it is crucial to outline Canada's earlier contributions to outer space security and how they benefited both military knowledge and capabilities during the cold war.

The Canadian government formally supported early research efforts in space science and technology through the National Research Council (NRC) and the DRB. The DRB was created in 1947 and led by Chairman Omond Solandt until 1956. The DRB focused on defence research previously conducted by the NRC during the Second World War and focused on aspects at which Canadians excelled and that were directly applicable to Canada.[10] In what became defining characteristics of civilian space policy, it was clear to Solandt that a widely varying climate and vast geography necessitated respective developments in meteorology and communications.[11] These research areas had civilian objectives but also supported military needs, including anti-ballistic missile weapon systems and studies of missile re-entry into the upper atmosphere.

A DRB subsidiary based in Valcartier, Québec, the Canadian Armament Research and Development Establishment (CARDE), actively pursued research in "the counter-[intercontinental ballistic missile] ICBM problem"[12] and focused on developing an understanding of ballistic missile re-entry signatures.[13] In the words of Chief Superintendent, Brigadier D. A. G. Waldock, "The primary problem we are concerned with today is defence against the ballistic missile."[14] CARDE also studied "aerodynamics, ballistics, electronics, physics, chemistry, explosives and mechanical engineering."[15] CARDE did not work in isolation; the United States invested several million dollars per year into CARDE's research. American capital invested in joint CANUS projects

funded collaboration between the DRB and the American Department of Defense (DoD) at CARDE, Fort Churchill, Manitoba, and other installations.[16]

The first stage of the relationship was from 1955 to 1960 when the DRB and United States Air Force (USAF) collaborated on ballistic missile defence research. It was recognized as early as the 1960s that ABM programmes were vulnerable to multiple independent re-entry vehicles. These warheads were designed to fool ABM missiles into destroying decoys and allowing nuclear warheads to slip through defences. Scientists noted that the decoys presented different re-entry wakes compared to actual warheads because of difference in weight. Dr. Gerald Vincent Bull, known for his work on "superguns," headed CARDE's Aerophysics Department and directed the research. At CARDE, he managed the development of experiments designed to simulate missile re-entry and to study the wakes of varying ICBM models.

Termed "gas guns," these experiments used a low-pressure vacuum to mimic atmospheric conditions whilst firing varying miniatures resembling ballistic missiles.[17] They were fired on a range 780 feet (238 metres) long. Ultimately, CARDE tested 25 different ICBM replicas at speeds approaching Mach 5.[18] CARDE excelled in this research, with both experience and infrastructure. From 1964 to 1971, CARDE made "observations of gaseous radiation, ablation and wake phenomena exhibited by projectiles travelling at hypersonic speeds through the controlled atmospheres of the tanks."[19] This research developed an understanding of the characteristics of missile re-entry into the atmosphere because the ability to distinguish between decoy and real warheads was critical in establishing a credible second-strike capability.

The DRB also studied the medium through which the missiles would pass: the aurora borealis. The DRB's Director of Weapons Research Dr. Gordon Watson observed that the newly established Prince Albert Radar Laboratory (PARL) under the jurisdiction of the Defence Research Telecommunications Establishment had the capability to study the aurora borealis and was able to follow rockets launched from Fort Churchill and satellites passing overhead. From its origin, PARL was defence focused. Watson noted, "The unit has been instrumented primarily to obtain extensive data on aurora reflections at high levels and at ranges comparable with those required for the detection of ballistic missiles and satellites."[20] Without a full understanding of the aurora borealis, scientists feared that it could be used to mask or screen incoming missiles.[21]

Defence research was not limited to understanding the variables associated with Soviet missiles; CARDE actively pursued research directly related to anti-ballistic missile defence. CARDE worked closely with the USAF at Fort Churchill while testing the DRB's Black Brant rocketry programme.[22] Although the sounding rockets carried experiments that were often civilian in nature, CARDE's research into solid-state fuel was a crucial military development for northern missile defence. Solid-state fuel was preferred over liquid primarily because "immediate readiness is the keynote in any defence against ballistic missiles. This weighs heavily in favour of solid propellants, which can sit on launchers for long periods of time."[23] In addition, solid-state fuel was more reliable in arctic temperatures.[24]

The military-civilian relationship functioned well. In cooperation with the Bristol Aircraft Company based in the United Kingdom, CARDE developed the rocket propellant while the Bristol plant in Winnipeg manufactured the rockets. Early successes in 1959 led to collaboration with Canadair Limited, redesigning and perfecting the rocket. After years of collaboration, CARDE withdrew from the programme in 1964 and turned over full responsibility to the Canadian branch of Bristol Aerojet Limited, who in turn became Bristol Aerospace Limited and sold rockets to the National Aeronautics

and Space Administration (NASA) and others around the world.[25]

Interestingly, CARDE's research was not limited to defence scientists. Civilian university programmes also assisted defence-related projects. The *Centre de Recherches sur les Atomes et les Molécules* (CRAM) was created in 1967 and allowed CARDE scientists to supervise theses from Université Laval students in Québec. As Alain Gelly noted, military-civilian cooperation had occurred since the DRB's founding and further, "[i]n 1967, DRB delegated responsibility to its defence research laboratories for awarding research grants and contracts to industry and academia."[26] Defence research in Canada was therefore not exclusive to the DRB but extended into both corporations and universities.

In the spirit of defence cooperation, Canadian defence scientists collaborated with the US Advanced Research Projects Agency (ARPA) and made valuable contributions to cold war research that received significant praise south of the Canadian border. The United States acknowledged CARDE's expertise in ballistic missile studies. This fostered a working relationship between Canadian defence scientists and the USAF. As a member of the Tripartite Technical Cooperation Program alongside the United States and United Kingdom, CARDE and the Royal Canadian Air Force (RCAF) collaborated with ARPA in a multi-stage research endeavour called Project Lookout. Lookout I conducted research into radiation given off by ballistic missiles launched from Cape Canaveral, and after the completion of Lookout I, research began on Operation TABSTONE (LOOKOUT II in Canada).

TABSTONE was designed to investigate "measurements of the launch phase characteristics of ballistic missiles"[27] for the US Missile Infrared Decoy and Ship Engagement Model. In the summer of 1961, 28 launches were made from Patrick Air Force Base in Florida. Successes led to collaboration on Lookout III where CARDE and ARPA monitored emissions from the new Atlas and Titan rockets.[28]

In retrospect, Canadian and American rocketry and space science collaboration during the 1950s and 1960s supported many projects relating to defence while simultaneously promoting pure science.

Although rocketry proved immensely successful for both countries, the CANUS defence relationship today has become nearly synonymous with continental defence. Perhaps the most popularized defence relationship between the United States and Canada is the joint effort in North American Air Defence, responsible for safeguarding the sovereign airspace of North America.[29] Eminent political scientist Joseph Jockel noted that prior to NORAD's founding in 1957–58, Canadian and American air defences were becoming "increasingly intertwined, both geographically and operationally."[30] The Pinetree Line (operational in 1954), Distant Early Warning (DEW) Line (operational in 1957), and Mid-Canada Line (operational in 1958) were designed to detect incoming Soviet aircraft, facilitate command and control of CANUS air assets, and monitor North American air space.[31]

US interests did not dominate the air defence of North America. The organization's official mandate was to "provide National Command Authorities (NCAs) in Ottawa and Washington with timely, reliable and unambiguous attack warning and attack assessment."[32] As Joel Sokolsky observed, "It has been a cornerstone of Canadian defence policy that the United States would not undertake the air defence of North America unilaterally."[33] NORAD is a clear example of Canadian military involvement in continental defence, exemplifying both the CANUS relationship and cold war nuclear paradigm.

Canada's position in the northern hemisphere was the primary reason for this agreement: the US anticipated Soviet aircraft and missiles following a trajectory over Arctic territory and passing through Canadian airspace. Moreover, Soviet bombers carrying nuclear weapons over Canada presented a clear risk to Canadian territory.[34] Although the bomber threat was a concern during the 1960s, it never took precedent over the fear of intercontinental ballistic missiles. The Soviet Union deployed less than 200 Bison and Bear bombers, but by 1972 maintained over 2,000 operational missiles pointed towards North America.[35] When the Soviet threat shifted from bombers to ballistic missiles, NORAD's responsibility shifted respectively from airspace to aerospace.

Canada's satellite programmes maintained military use during and after the cold war, exemplifying a duality in civilian and military usage noted by Dr. Andrew Godefroy.[36] Launched in 1982 and declared operational in 1985, SARSAT supports the duality of space assets with the capability of tracking military beacons on 243.00 megahertz.[37] SARSAT is used for aiding downed civilian aircraft and also supports search and rescue operations within the Canadian Forces. Although not referencing the satellite specifically, the 1995 SAR doctrine demonstrates the militarized aspect of Search and Rescue. Section 4.2.1 states: "The primary task of the SAR system in wartime is to support air operations of our own and allied forces with the aim of recovering downed aircrews. In addition, the service is used to recover other armed forces personnel during and after combat activities."[38]

The duality of Canadian space programmes is also evidenced in the civilian and military interests derived from the global positioning system (GPS). While today it is utilized often unknowingly in everyday life, the GPS is a converted military project from the 1980s that was designed to land aircraft in remote areas, assist naval vessels in rendezvous and recovery missions, and assist ground forces in using indirect fire.[39] Despite limited Canadian assets, the Canadian Forces nevertheless occasionally benefit from the dual usage of the SARSAT and GPS satellites. The use of RADARSAT-1 in Afghanistan demonstrated strategic implications for the deployment of space-based assets in the battlefield.[40]

RADARSAT-1 significantly reduced the impact of the "fog and friction of war" by mapping the mountainous terrain.[41]

Closer to home, RADARSAT-1 has also assisted Canada's sovereign claims over the Arctic. In a report presented to parliament in 1987, Member of Parliament (MP) William Tupper suggested that a programme such as RADARSAT-1 would be able to "over-fly the Canadian Arctic every 24 hours, [and provide] detailed information on sea-ice and sea-state conditions, on surface-ship movements in the region, and on the geology of the Arctic land areas."[42] Satellite assets will likely continue to play a crucial role over this contested territory as traffic through the Northwest Passage increases. RADARSAT-1 exemplifies the duality of Canadian space technology by utilizing its capabilities to fulfill both military and civilian objectives. As opposed to "swords into ploughshares," the SARSAT, RADARSAT-1 and GPS satellite programmes with limited budgets maintained civilian and military capabilities simultaneously, and produced relevant, beneficial programmes in both spheres.

Canadian space achievements went beyond satellite programmes. Canada's contribution to the space transport system (STS) included the Canadarm, the robotic arm used on the shuttlecraft that has proven to be a major source of Canadian international recognition and prestige. Heralded as a triumph of peaceful exploration, the shuttle's USAF origins are not often acknowledged. Although no longer used exclusively for military launches, the space shuttle programme initially maintained a working relationship between NASA and DoD.

Missions flown for DoD were referred to as "Designated National Security Missions" and included "space activities peculiar to, or primarily associated with national security programmes, associated research and development activities or space operations involving national security objectives."[43] Of note is the 1980 understanding between NASA and DoD that "the DoD will have priority in mission preparation and operations consistent with established national space policy."[44] This was codified in the 1981 National Security Decision Directive 8 that ordered, "in coordination with NASA, the Department of Defense will assure the Shuttle's utility to defense and integrate national security missions into the Shuttle system."[45] The use of the Canadarm in three of the ten military missions from 1985 until 1992 necessarily associates Canada with the militaristic origins of the shuttle system.[46] Further, primary documentation of the STS programme demonstrates again the military-civilian duality of space exploration and Canada's contribution through niche-role participation.

The United States also looked to Canada for contributions during the research and development phases of President Reagan's proposed space station Freedom. Canada joined this project in 1985, a year before the 1986 Challenger explosion delayed the programme until 1993 when the Russians joined during Bill Clinton's presidency. At that time, the name of the station was changed from Freedom to the International Space Station.[47] The underlying irony of Freedom's political overtones is that the United States also considered the station for military use. During negotiations with participating countries, the US delegation required that "any foreign participants recognize and agree that the United States may use the U.S. elements of the space station and the Canadian-provided Mobile Servicing Center for National Security purposes, consistent with U.S. Law and U.S. international obligations, without their consent or necessarily their review."[48] The Canadian Standing Committee on Research, Science and Technology expressed deep concerns over this position, recommending to the House of Commons that "Canada proceed with its participation in the Space Station project, provided that agreement be reached with the United States on military use of space station. A minimum acceptable agreement would be the exclusion of weapons or weapons prototype testing from [the] space station."[49]

The Tupper Report further stated that "overt military use of the space station is unacceptable to the Committee," and specifically targeted any potential for SDI "experimentation" conducted on the station.[50] The committee delineated between weaponization research, and programmes related more specifically to militarization, finding that "[o]ne such possible use of [the] space station could be for testing of arms-control verification technologies."[51] Canadian support for such a use resonates strongly with the American interpretation of "peaceful purposes" that includes defensive uses and national security interests. In this case, Canada supported militarization that fell under the umbrella of peaceful purposes according to US space policy. Canada confronted the issue of stability rather than to militarize or not, a trend also apparent in the decisions made regarding the SDI in 1983.

Canada officially declined to participate in Reagan's "Star Wars" programme on the basis that it was financially implausible and rendered void the cold war paradigm of nuclear deterrence.[52] The political, strategic, and technical implications of the Strategic Defense Initiative have been catalogued at length and merit only brief treatment here in relation to questions of stability and viability. Specifically, "Canadians… concluded that strategic stability and their national security [were] best to be found in the condition of superpower mutual vulnerability."[53] Nuclear strategy specialist Raymond Garthoff observed that scientists on both sides of the Atlantic believed that "a partially effective defense… might be considered adequate against a ragged retaliatory strike."[54] The fear that the SDI produced a first-strike threat was central to Soviet distrust of the programme. The Soviet Union's General Secretary Yuri Andropov stated that defensive weapons, when paired with offensive weapons, produced a first-strike threat; the SDI violated the ABM Treaty; and, finally, the SDI would lead to a renewed arms race.[55] Union of Concerned Scientists member John Tirman observed that Reagan's Star Wars speech "was questioning not only the previous emphasis of the US ABM programme, but the whole foundation of post-war nuclear strategy."[56]

On these grounds, Prime Minister Brian Mulroney stated, "Canada's own policies and priorities do not warrant a government-to-government effort in support of SDI research";

however, he continued, "private companies and institutions interested in participating in the program will continue to be free to do so."[57] In July 1985, Ronald Purver noted, "Given that most of the work will undoubtedly be done in the US itself, Canada's share of what remains to be distributed among a dozen or more other countries may not be all that great."[58] Purver was correct. The 1990 Report to Congress on the SDI noted that Canada was granted a scarce $3.48 million and was responsible for research into power systems materials, particle accelerators, platforms, and theatre defence architecture.[59]

Questions of legality plagued the SDI research from its onset. The programme called for the development of technology that, depending on one's interpretation, violated Article II of the ABM Treaty. Legitimacy for the SDI hinged on the interpretation of the term "research." In particular, the phrase "currently consisting of" within Article II of the ABM Treaty determined viewpoints of legitimacy or illegitimacy.[60] The so-called broad interpretation noted that the SDI did not call for anti-ballistic missile interceptors or launchers as understood in 1972, but technologies purported to become available through SDI research in 1983.

American disregard for the treaty is notable in Reagan's National Security Decision Directive 192, released on 11 October 1985, which stated, "It is not necessary to authorize the restructuring of the US SDI program towards the boundaries of Treaty interpretation which the US could observe… the issue of where exactly these boundaries should lie is moot even though in my judgment a broader interpretation of our authority in the field is fully justified."[61] Adherence to the broad interpretation meant that the ABM treaty did not restrict *new* research programmes but allowed the SDI to carry on strictly as a research programme.[62] Not surprisingly, the Soviet Union and the North Atlantic Treaty Organization (NATO), including Canada, refused to adopt this interpretation.[63]

Despite the financial, legal, and strategic hurdles, Canada's refusal to offer official participation in the SDI should not be viewed as advocating for the peaceful use of outer space. Distinguishing between the weaponization and militarization of outer space, Canadian political scientist Douglas A. Ross noted, "It is not in Canada's interest to encourage the 'weaponization' of space in any way. The military use of space for surveillance, early warning and communications has been generally considered stabilizing. To oppose SDI is not to oppose any military presence in space."[64] Ross's implication regarding stabilizing initiatives is crucial: Canadian space exploration (including CARDE's ballistic missile re-entry research and limitations on

military uses of the space station) emphasized stability in addition to concerns of militarization and weaponization.

Further complicating matters of stability, President Reagan's SDI is an example of high technology vulnerable to low-technology counters. Dr. Elaine Holoboff noted that in 1986 Soviet scientists "estimated [that] counter-measures to the SDI could be deployed for only [five] per cent of the cost of the SDI."[65] This figure did not include the assumed risks of operating in outer space, including (but not limited to) electronic malfunctions, micrometeorites, harmful radiation, or even collisions with other satellites. Ultimately, debates on the legality or strategic implications pertaining to the SDI became moot with the fall of the Soviet Union in 1991. However, research and discussion on ballistic missile defence remains a realm of ongoing debate within CANUS relations.

The end of the cold war did not transform outer space into a peaceful medium. Although post-cold war developments have been less exuberant, defence research in outer space has continued unabated. Both academic and military literature in the United States and abroad currently debates the question of a fourth service, a space arm to complement the Army, Navy, and Air Force. Deliberation on whether outer space is best understood from an air, naval, or maritime paradigm is ongoing. While acknowledging the interconnectedness of each service relating to outer space, United States Navy Commander John J. Klein noted that, "Since space is a separate and distinct medium of warfare, military operations and strategy in space should be considered a distinct warfare area."[66] His recommendation for the eventual establishment of a Space War College presents several opportunities for CANUS relations: officer education, force development, space-mindedness, and interoperability, to name only a few. In Klein's view, such a programme would include "historical study of strategy and policy, resource allocation, and coalition and joint operations."[67] Should the US pursue Klein's recommendation, the Canadian Forces would benefit immensely from securing academic positions within such an institute.

The 2008 *Canada First Defence Strategy* noted that, "The Canadian Forces will need to be a fully integrated, flexible, multi-role and combat capable military."[68] In support of the difficulties of "the absence of any clear understanding of the way in which outer space is likely… to revolutionize thinking about war and peace, and strategy"[69] (as Dr. James Fergusson pointed out), this case study has argued CANUS cooperation in space research and development has yielded immense benefits in both the military and civilian sectors.[70] Of greater significance is that "the theory, strategic principles, and doctrine of space warfare need to be well understood at all levels within the military before they are actually needed."[71] Although the Canadian Forces maintain institutions devoted to aerospace studies, continued collaboration with the United States would only enhance the exchange of information.

More importantly, the militarization of outer space since the end of the Second World War supports a strong case that ignoring military space technologies and considering space a sanctuary may be harmful to Western security in the future.[72] As with naval and air power before it, space power has become inextricably tied to national security. Echoing Clausewitz, aerospace engineer James Oberg suggested, "Space power is the combination of technology, demographic, economic, industrial, military, national will, and other factors that contribute to the coercive and persuasive ability of a country to politically influence the actions of other states… or to otherwise achieve national goals through space activity."[73] Space power also depends upon a credible deterrent to actions that challenge one's control of outer space, a deterrent that is irreconcilable with the sanctuary school.

Acknowledging the Canadian successes in both military and civilian space exploration is not only an inclusive history but also fosters "space mindedness" towards the inevitability of a challenge to the command of outer space. During the cold war, the control of the air and aerospace theatres was crucial for Canada as a middle power geographically wedged between the United States and Soviet Union. As such, continental defence with the United States was not a corollary of Canada's aerospace expeditions; indeed, this paper has argued it was a prominent characteristic. Canadian efforts fit with American initiatives where fiscal restraints and political policies would allow. Canadian achievements under the watch of the DRB and its subsidiaries made significant advances in the scientific understanding of the ionosphere as well as its relationship with ballistic missiles. The radar satellite, the global positioning system, and the SARSAT system developed valuable dual roles as civilian and military assets. Adherence to international treaties and stable nuclear strategies affected the Canadian response to President Reagan's Strategic Defense Initiative and concerns over the militarization and weaponization of space as manifested in both the space transport system and space station projects.

The cold war thus shaped Canada's space exploration and defence research into outer space security, even after the Soviet Union dissolved in 1991. Academic and military frameworks, together with successful anti-satellite demonstrations, clearly depict outer space not only as a viable, but also as an indispensible medium to conduct war. As Andrew Godefroy observed, "It is also likely that the next weapons race will occur in space as treaties on the non-weaponization of space lapse, are circumvented, or simply ignored."[74] With the American abrogation of the Anti-Ballistic Missile Treaty in 2002, and examples throughout the cold war of political and legal manoeuvrings that breached the spirit of both the ABM and Outer Space Treaties, such a claim appears inevitable. To fall into complacency and assume that modern wars will always square the West against technologically inferior enemies seems the surest way to face defeat. ■

A recent graduate of Queen's University, Raymond MacKinnon is attending York University's Master of Arts programme in Science and Technology Studies. An earlier version of this paper was submitted in Dr. Richard Goette's Canadian Military History class at Queen's University. The author is indebted to Dr. Goette for his guidance and support, without which this paper would not have made it beyond an undergraduate assignment. The opportunity to speak at the 21st Military History Colloquium hosted by the Laurier Centre for Military Strategic and Disarmament Studies allowed Mr. MacKinnon to share this work and receive vital direction from leading scholars. This helped the paper evolve into its current form. Raymond has served in both the Royal Regiment of Canada and Princess of Wales Own Regiment reserve units as a non-commissioned member and is currently considering a career with the Air Force.

List of Abbreviations

ABM	anti ballistic missile
ARPA	Advanced Research Projects Agency
CANUS	Canada-United States
CARDE	Canadian Armament Research and Development Establishment
DoD	American Department of Defense
DRB	Defence Research Board
GPS	global positioning system
ICBM	inter-continental ballistic missile
NASA	National Aeronautics and Space Administration
NORAD	North American Air Defence
NRC	National Research Council
PARL	Prince Albert Radar Laboratory
RADARSAT-1	radar satellite
SARSAT	search and rescue satellite aided tracking system
SDI	Strategic Defense Initiative
STS	space transport system
US	United States
USAF	United States Air Force

Notes

1. Carl Sagan, *Cosmos*, produced and directed by Adriane Malone, et al., Public Broadcasting Service, 1980.
2. The full inscription on the lunar plaque reads, "Here men from the planet earth first set foot upon the moon July 1969, A.D. We came in peace for all mankind." See William E. Burrows, *This New Ocean: The Story of the First Space Age* (Toronto: Random House Inc., 2000), 426.
3. John J. Klein, *Space Warfare: Strategy, Principles and Policy* (New York: Routledge, 2006), 36.
4. Alain Gelly and H. P. Tardif, *Defence Research Establishment Valcartier 1945–1995: 50 Years of History and Scientific Progress* (Ottawa: Minister of Public Works and Government Services Canada, 1995), 114. As Dr. Andrew B. Godefroy recently observed, Canadians often fail to acknowledge their intellectual achievements in defence studies. Andrew B. Godefroy, "Arguing the Unthinkable: Ideas and Debate on Atomic Warfare in the Canadian Army Journal, 1945–1965," paper presented at 21st Military History Colloquium, Laurier Centre for Military, Strategic and Disarmament Studies, May 2010.
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6. The binary opposition of militarization and weaponization appears through this paper, and is understood to mean the following: "Militarization" refers to activities and systems in space used to support military operations. "Weaponization" refers to the placement or basing of weapons in space, whether for offensive or defensive purposes." See Klein, 181n5.
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10. Andrew B. Godefroy, "Defence and Discovery: Science, National Security, and the Origins of the Canadian Rocket and Space Program," PhD. Diss. (Kingston: Royal Military College, 2004), 18.
11. Shepherd and Kruchio, 114.
12. Bill Rawlings, "Turbulent Wakes: Anti-ICBM Research at the Canadian Armament Research and Development Establishment, 1955–1970," Proceedings, 7th Annual Air Force Historical Conference: Canada in NORAD, Colorado Springs, Colorado, United States, June 4–8, 2001, edited by the Office of Air Force Heritage & History, 13.
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14. A. T. Patton, "Canadian Armament Research and Development Establishment," *The Roundel* 10, no. 6 (August 1958), 12.
15. Ibid.
16. Rawlings, 16–17.
17. Gelly and Tardif, 126.
18. Patton, 13–14.
19. Gelly and Tardif, 139–41.
20. Gordon D. Watson, "Canada's Contribution to Space Science," *The Roundel* 11, no. 7 (September 1959), 3.
21. Sheppard and Kruchio, 83.
22. Godefroy, 19.
23. Patton, 14–15.
24. Godefroy, 83.
25. Gelly and Tardif, 153–154.
26. Ibid., 150–151.
27. Ibid., 144–145.
28. Ibid.
29. Renamed in 1981 to North American Aerospace Defense Command. See George Lindsey, "Canada-U.S. Relations During the Cold War," in *Fifty Years of Canada-United States Defense Cooperation: The Road From Ogdensburg,* eds., Joel J. Sokolsky and Joseph T. Jockel (Queenston: The Edwin Mellen Press, 1992), 71. For information on the official mandate, see also J. M. Bourgeois, "Strategic Air Defence of North America: 2000," in *Airwar 2000,* ed., Brian MacDonald (Toronto: The Canadian Institute of Strategic Studies, 1989), 6.
30. Joseph T. Jockel, *Canada in NORAD: A History 1957–2004* (Kingston: McGill-Queen's University Press, 2007), 9.
31. For maps of the radar coverage, see Joseph T. Jockel, *No Boundaries Upstairs: Canada, The United States, and the Origins of North American Air Defence, 1945–1958* (Vancouver: University of British Columbia Press, 1987), xii–xiv. For operational dates, see R. B. Byers, "NORAD, Star Wars, and Strategic Doctrine: The Implications for Canada," in *Aerospace Defence: Canada's Future Role?, eds.,* R. B. Byers, John Hamre, George R. Lindsey (Toronto: Canadian Institute of International Affairs, 1985), 37. See also Gelly and Tardif, 113, for a brief overview of the purpose and responsibilities of the radar systems.
32. Bourgeois, 6.
33. Joel Sokolsky, "The Future of Canadian-American Defence Relations: Trends in U.S. Strategy and the Canadian Defence Posture," Occasional Paper No.10 (Kingston: Centre for International Relations, 1986), 40.
34. Jockel, *No Boundaries Upstairs*, 121.
35. Byers, 38–39.
36. Andrew B. Godefroy, "Is the Sky Falling? Canada's Defence Space Program at the Crossroads" *Canadian Military Journal* 1, no. 2 (summer 2000), 57, http://www.journal.forces.gc.ca/vo1/no2/doc/51-58-eng.pdf (accessed February 17, 2011).
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42. Canada, House of Commons, Report of The Standing Committee on Research, Science and Technology, "Canada's Space Program: A Voyage to the Future," William Tupper, MP (June, 1987), 15.
43. National Aeronautics and Space Administration, NASA/DOD Memorandum of Understanding on Management and Operation of the Space Transportation System (25 February 1980), 3, Digital National Security Archive. Collection: Military Uses of Space, Item Number MS00651.
44. Ibid.
45. For the declassified version of NSDD8, see Simpson, National Security Directives of the Reagan & Bush Administrations, 40, http://www.fas.org/irp/offdocs/nsdd/nsdd-008.htm (accessed February 17, 2011).

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47. Sheppard and Kruchio, 208.

48. United States, Guidance to the U.S. Delegation for Negotiations With Western Europe, Japan, and Canada on their Participation in a Permanently Manned Space Station (3 February 1987), 3, Confidential, National Security Decision Directive 257. Digital National Security Archive. Collection: Presidential Documents, Item Number PD01996, http://www.fas.org/irp/offdocs/nsdd/nsdd-257.htm (accessed February 17, 2011).

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51. Ibid.

52. President Reagan's speech is available online at the University of Texas Archives, http://www.reagan.utexas.edu/archives/speeches/1983/32383d.htm (accessed February 17, 2011).

53. Joseph Jockel, *Security to the North: Canada-U.S. Defense Relations in the 1990s* (Michigan: Michigan State University Press, 1991), 97.

54. Ray Garthoff, *Détente and Confrontation: American-Soviet Relations from Nixon to Reagan* (Washington: The Brookings Institution, 1985), 1027. (Emphasis added)

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56. Richard L. Garwin, Kurt Gottfried, and Henry W. Kendall, *Why Space Weapons Can't Protect Us: The Fallacy of Star Wars*, ed., John Tirman (New York: Vintage Books, 1984), 24.

57. Prime Minister Brian Mulroney, press conference (7 September 1985), quoted in *Perspectives on Strategic Defense*, eds., Steven W. Guerrier and Wayne C. Thompson (Colorado: Westview Press, 1987), 283.

58. Robert Purver, "Ballistic Missile Defence and Canada," in *Canadian Perspectives on the Strategic Defence Initiative* (Ottawa: Canadian Centre for Arms Control and Disarmament, 1985), 16.

59. Strategic Defense Initiative Organization, 1990 Report to the Congress on the Strategic Defense Initiative (May 1990), appendix B, digital security archives, classification unknown, collection: Military Uses of Space, Item Number: MS00705. Cf. contracts given to Israel or the United Kingdom, valued at 184.48 million and 73.04 million respectively.

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61. Ronald Reagan, National Security Decision Directive 192 (11 October 1985), 2, http://www.fas.org/spp/starwars/offdocs/nsdd192.htm (accessed February 17, 2011).

62. Jane Boulden, "Phase I of the Strategic Defense Initiative: Current Issues, Arms Control and Canadian National Security," *Issue Brief* 12 (The Canadian Centre for Arms Control and Disarmament, 1990), 7.

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Arctic Alternative Futures

By Lieutenant-Colonel Daniel Lachance, CD, BA, MDS

CF Photo: Sgt Ron Flynn

Never let the future disturb you. You will meet it, if you have to, with the same weapons of reason which today arm you against the present.

Marcus Aurelius Antonius[2]

INTRODUCTION

Projecting trends[3] into the future can be fraught with flaws, especially the longer the outlook. Inaccuracies in prediction often prove to be the result of forecasters' inability to accurately predict human adaptation to change, and even more frequently, the failure to envision unpredictable events (the so-called wild card[4] events) and revolutionary breakthroughs. Projecting trends in a shorter outlook (10 years or less), however, is also fairly challenging because it is often hard to distinguish meaningful differences between a short-term future and the reality of today, and again, because of the possibility that unpredictable events can completely change the course of a future trend.

In the case of the Canadian Arctic, projecting trends in this dynamic environment is certainly not an easy task. One thing is certain, though, and that is if current future security trends in the Arctic continue to progress as forecasted, the next decade will be challenging to the Air Force, as we may find ourselves to be increasingly present in the Canadian high north. Military planners are currently busy setting the conditions for our future participation based on what we think the future will be, but what if the current predictions were wrong? What if the Arctic was to get far colder or warm up much faster than anticipated? Will we be ready to face these alternative futures?

CF Photo: Sgt Denis Nadeau

This paper is intended to make the reader think about what might come to pass if the current future security trends in the Arctic are displaced by some unforeseen events. By conducting an alternative futures analysis on future Air Force Operations in the Arctic, this paper will point out the implications that a best-case and a worst-case scenario would have on the Air Force.

ALTERNATIVE FUTURES

Examination of the future environment is an important practice for institutions that wish to remain relevant and capable over the long term. This practice is particularly important for the Air Force, as the lead time required to acquire capabilities can be lengthy. Examining future trends and imagining futures scenarios are often employed in order to assist in the identification of future capabilities.

But what is an alternative future? If one were to plot a trend on a timeline, based on what we know, the most likely future would fall in the realm of the Probable (the green zone of Figure 1). Note that the further out one peers into the future, the greater the Probable zone gets. This has to do with the inherent uncertainties that are present in the current trends, and the fact that no matter what, predicting the future is certainly not an exact science.

Alternative futures occur when events displace the trend line outside of the probable zone. If the events all collide to produce good effects,

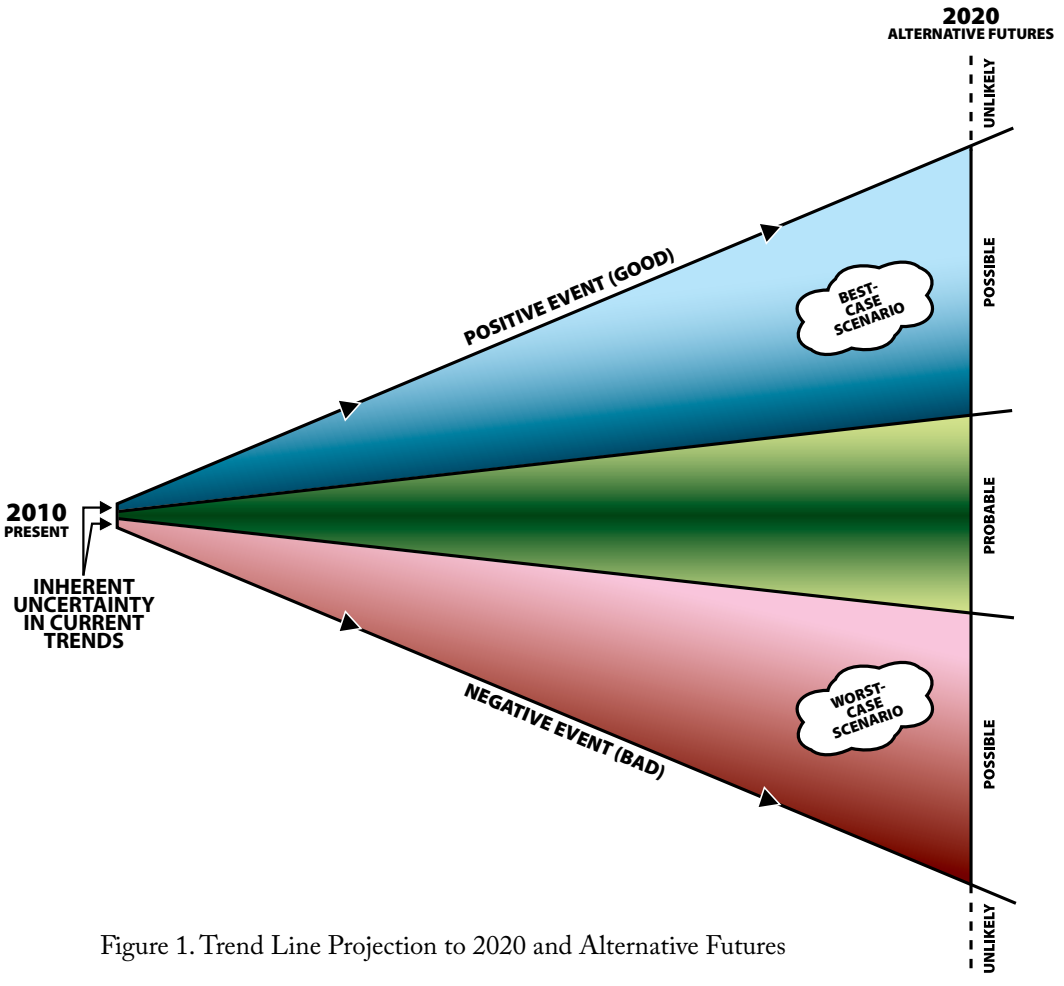


Figure 1. Trend Line Projection to 2020 and Alternative Futures

then the trend line is moved towards a Best-case Scenario (the blue zone of Figure 1). Conversely, events that are all producing negative effects would push the trend line towards a Worst-Case Scenario (the red zone of Figure 1). For the purpose of this paper, the imagined events and their resulting scenarios had to be deemed sufficiently plausible so that the ensuing alternative futures fell within the Possible zones (the blue and red zones of Figure 1) rather than the Unlikely zone (outside the blue and red zones of Figure 1). Consequently, examining alternative futures can be useful to military planners since, theoretically, the majority of all situations that we may reasonably expect to encounter in the near future should fall somewhere within those possible extremities.

KEY FACTORS[5]

Before each scenario is presented, key factors need to be identified. Key factors are thought to be the most important contributing features of the future security trend. There might very well be other factors at play, but in order to keep this exercise manageable, the scenarios will only play with the factors considered key to Arctic futures. To create the scenarios, the key factors were made to have extremely positive or negative effects (while remaining plausible), which created a best (utopian) and a worst-case (dystopian) scenario, or if you wish, the alternative futures. Undoubtedly, how these key factors develop over the next 10 years will shape the future of Air Force operations in the Arctic.[6]

When it comes to future Air Force involvement in the Arctic, it is thought that the following three factors will affect the framework of all possible scenarios. Consequently, the key factors are:

- **Climate.** Not surprisingly, climate is the first key factor. The rate of climate change over the next 10 years is subject to significant debate. See the vignette about "Runaway Global Warming" to get a sense of an alternative future created by a wild card event. In any case, there is considerable scientific evidence that the Arctic climate will continue to follow a warming trend, but notwithstanding the above, it should be noted that there is also a growing body of academic opinion arguing that we are on the verge of a new cooling period. Lastly, there is also a noted correlation between the level of human activity and temperature. The greater the shift towards warmer temperatures, the more we can expect human activity to increase. Conversely, colder temperatures will temper human activity.

- **Governance.** Governing an extremely vast territory with limited fiscal resources, sparse population, and few developed assets can be an extremely daunting endeavour. With the deadlines for the United Nations Convention on the Laws of the Sea (UNCLOS)[7] fast approaching, Nordic states are staking their Arctic claims, many of which are overlapping. Some analysts are warning of potential confrontation while others are seeing signs of increased cooperation.

- **Resources.** The Arctic not only possesses significant reserves of fossil fuels, it is also rich with large coal deposits and strategic minerals. Extracting these resources can be very expensive and is directly related to the market price of these commodities, the harshness of the environment, and the level and quality of governance of the region.

WILD CARD ALTERNATIVE FUTURE: RUNAWAY GLOBAL WARMING

By 2019, following years of record high temperature in the Arctic, most scientists are now predicting that within five years, the current trends in global warming will lead to massive permafrost melting. Aside from considerable infrastructure damages, as most buildings, pipelines, roads, rails, and runways in the Arctic are built on permafrost, the melting of the permafrost will lead to substantial release of methane which is stored in the permafrost. In turn, this methane will cause abrupt and severe global warming as methane is a powerful greenhouse gas which will lead to more permafrost melting and more methane release. In fact, there is enough methane stored in the Arctic permafrost that if only 10 per cent of the stored methane were to be released, it would have an effect equivalent to a factor of 10 increases in atmospheric CO_2 concentrations. Compounding the problem is the fact that methane is 20 times more effective than CO_2 at trapping heat in the atmosphere.

By 2022, global efforts to sequester carbon are proving insufficient and mean global temperatures have increased by an astonishing 3.5° Celsius since 2010. As a consequence of melting Greenland, Arctic, and Antarctic glaciers, sea levels around the globe have risen by an average of 7.5 centimetres in the last 10 years. By 2027, most of New Orleans is lost, joining suburbs of Bangkok and Dhaka which have already been submerged, while many other low-lying cities around the globe remain threatened by rising sea levels[8].

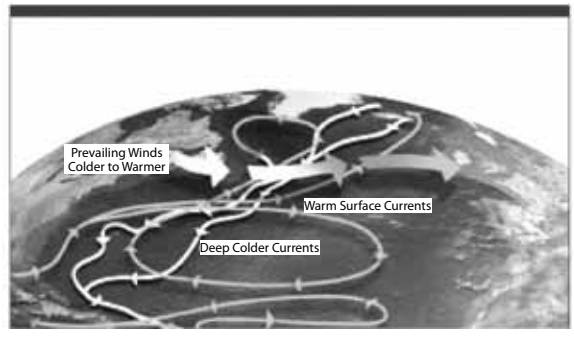
BEST-CASE SCENARIO – THE ARCTIC FROZEN HINTERLAND

General. Because it is predicted that the Canadian Forces (CF) and the Air Force are likely to continue having limited means to operate in the North, the best-case scenario (from an Air Force point of view) would be one where there are few reasons for the Air Force to increase its presence in the North. In such a scenario, the Arctic remains frozen in some sort of economic hinterland where even good governance is not enough to kick-start any sustainable economic development due principally to the harshness of the environment.

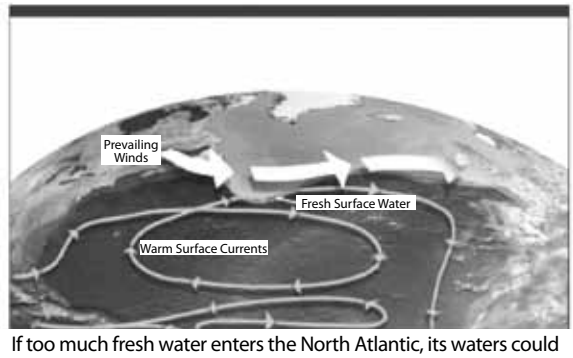
Let us now transport ourselves to the world of 2020 and imagine a future best-case scenario for Air Force operations in the Arctic by considering how the three key factors may have collided in order to produce this alternative future.

Climate. In 2020, global warming continues to be a highly debated topic. Most scientists now believe that climate changes are occurring unevenly around the globe. While the western shores of North America are warmer and drier than 20 years ago, its eastern shores are colder and much wetter. In fact, the Eastern Canada winters of 2017 and 2018 have both produced the largest snowfall seasons ever recorded. Many renowned academics are now theorizing that years of global warming have introduced a large amount of fresh water to the North Atlantic, which has disrupted the thermohaline circulation[9] of the North Atlantic Drift, also known as the Ocean Conveyor (see Figure 2). In 2019, Britain recorded the coldest month of June since 1652. Consequently, many are now forecasting the return to a mini ice-age.[10]

And so, after several years of warming trends, Canada's Arctic mean temperature has stabilized and has actually started to cool down drastically since the record highs of 2012. The Northwest Passage never really became a practical maritime transport route due to the constant presence of icebergs and unpredictable



The Ocean Conveyor is driven by the sinking of cold, salty (and therefore denser) waters in the North Atlantic Ocean (white lines). Warm surface currents (dark lines) give up heat to the atmosphere above the North Atlantic, and prevailing winds (large arrows) carry the heat eastward to warm Europe.



If too much fresh water enters the North Atlantic, its waters could stop sinking. In such a scenario, warm Gulf Stream waters (dark lines) would no longer flow into the northern North Atlantic to release heat to the atmosphere. As a result, European and eastern North American winters would become more severe.

Figure 2. The North Atlantic Ocean-Atmosphere System[11]

ice floes. In fact, most commercial companies have preferred the relatively safer waters of Russia's Northern Sea Route[12] (see Figure 3).

Governance. In this scenario, most surveillance of the Arctic is accomplished by space and near-space assets. Aside from routine fishery patrols and the occasional sovereignty patrols, the Air Force has little requirement to deploy in the Arctic. This is fortunate because the Air Force is facing serious budgetary constraints and had to significantly reduce the yearly flying rate (YFR) of several aircraft fleets. Although the government cancelled its plans to develop the port of Nanisivik in 2013, there are still requirements for the Air Force to support the logistical resupply of Canadian Forces

Station (CFS) Alert and the newly opened Canadian Forces Arctic Training Centre (CFATC) at Resolute Bay.

Due to the resurgence of particularly harsh winters, the Northwest Passage has been essentially impassable since 2016. Consequently, there have been very few challenges to our sovereignty, although there have been rumours of undersea patrols by United States (US), Russian, and Chinese nuclear submarines and unmanned underwater vehicles (UUVs).

But in the end, the Government of Canada has had few reasons to deploy its Air Force north. Cooperation by Arctic states has increased significantly in recent years as they realized that there was much more to gain by cooperating instead of competing when it came to filing their respective UNCLOS claims (See Figure 4).

Lastly, the region as a whole has declined as a priority for the last few federal governments and has gone back to being almost ignored by an Ottawa that has been preoccupied by more urgent matters. The Great Recession of 2008 has left the federal finances in dire straits. In this scenario, pressed to balance budgets, the government has invested little to improve the Canadian Forces and Air Force capabilities to operate in the North. To save money, the government has progressively come to rely on space assets as well as long endurance,

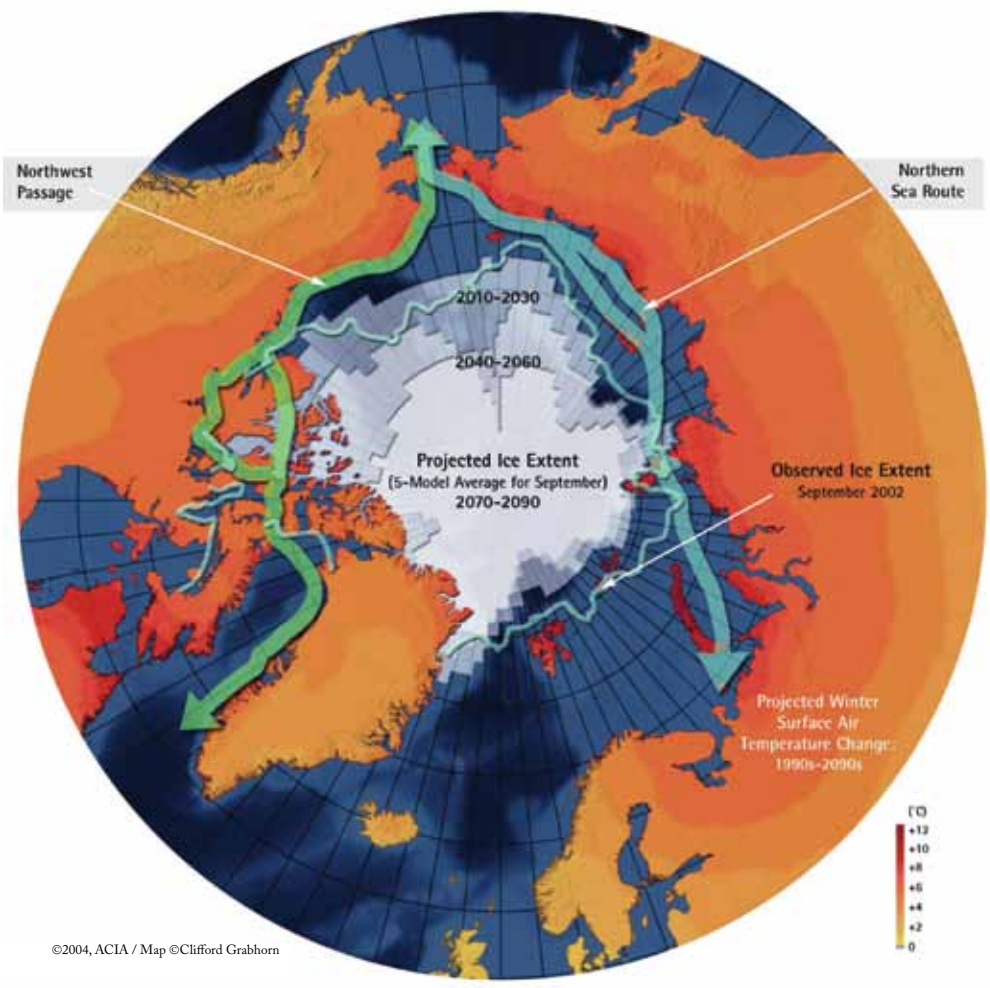


Figure 3. The Northwest Passage and the Northern Sea Route[13]

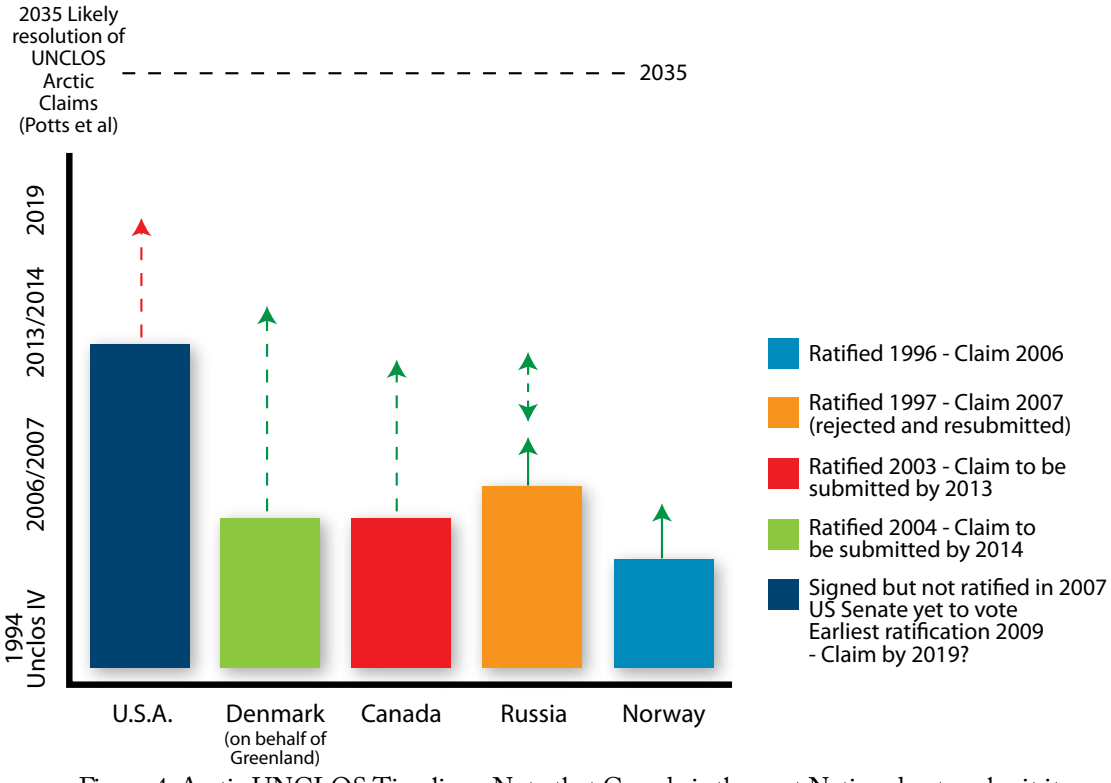


Figure 4. Arctic UNCLOS Timelines. Note that Canada is the next Nation due to submit its claim (2013). Note also that the US has yet to ratify this Agreement.[14]

near-space unmanned systems for surveillance of the Arctic instead of boots on the ground and new aircraft.

Resources. Although the price of commodities has steadily increased since the end of the Great Recession, the costs to extract those resources in the Arctic have continued to make them economically unviable. Aside from diamond, gold, and uranium mines (all located near Yellowknife), there has been little commercial appetite to explore and open new mines much farther away. Despite desperate attempts by provincial, territorial, and municipal governments to promote the region for business, the return of extremely harsh weather conditions has hampered any potential development. Even oil, which recently touched $200 per barrel, is still considered too cheap to warrant the staggering costs and environmental difficulties of extracting it from the Arctic.

Summary. And so, the Arctic remains frozen in some sort of economic hinterland. The Northwest Passage does not become a practical transport route and very few challenges to Canadian sovereignty have occurred. Most Arctic intelligence, surveillance and reconnaissance (ISR) is accomplished by space and near-space assets. And while interest in Northern commodities such as oil and gas is still prevalent, the costs to extract them from a frozen Arctic have made doing so economically unfeasible. Good governance and cooperation prevail, and accordingly, the government has few reasons to deploy the Air Force in the North. This is a good thing because in this scenario, due to budget constraints, the Air Force has limited means to operate in the high north.

But what if the key factors had arranged themselves in such a way that the Air Force was required to constantly deploy in the North? Let

us now turn our attention to this worst-case scenario.

WORST-CASE SCENARIO – ARCTIC GOLD RUSH

General. The worst-case scenario from an Air Force point of view is one in which the Air Force is ill prepared to operate in the Arctic. In this alternative future, global warming is making the region more accessible, and a plethora of human activities, including tourism, mining, and criminal activities, put enormous strain on the infrastructure and to the governance of the region. Furthermore, Arctic states are not cooperating, and various overlapping claims are creating tensions in this gold rush to extract Arctic resources. Let us again imagine the world of 2020 and how the three key factors may have collided in order to produce this alternative future.

Climate. In 2020, the continuous melting of sea ice that started several decades ago is not showing any signs of reversal (see Figure 3[15]). In fact, in September 2019, the extent of the summer Arctic ice cap was at a near-record low, only 6 per cent greater than the record low of 2017, and 47.6 per cent below the average extent of sea ice from 1980 to 2000. As a consequence of melting Greenland and Arctic glaciers, sea levels around the globe have risen by an average of 3.5 centimetres in the last 15 years, significantly affecting weather patterns in unprecedented ways. The most active hurricane season ever recorded was in 2018, with 32 tropical cyclones formed, of which a record 19 became hurricanes (including the massive category 1 Hurricanes *Erika* and *Michael* that both devastated the Yucatan Peninsula only three months apart).

Governance. In this scenario, there is minimum (if any) cooperation amongst the Arctic nations and many territorial disputes[16] are taxing the International Court. In 2016, Russia ceased to participate in Arctic Council[17] affairs to protest against North Atlantic Treaty Organization (NATO) threats of retaliation after the Svalbard[18] Crisis earlier that year. In fact, military analysts are now referring to the current crisis between Russia and the West as "Cold War II." North American Aerospace Defence Command (NORAD) assets (and especially Canadian assets) are constantly being tested by Russian manned and unmanned vehicles. As well, numerous Russian submarines and nuclear powered icebreakers have been violating Canadian and American territorial waters. In 2017, a Canadian Arctic surveillance unmanned vehicle took pictures of an artificial iceberg just north of Inuvik with what appeared to be an encampment of Russian scientists. In the time it took NORAD to despatch several aircraft to investigate, the mysterious iceberg and its occupants had vanished.

Planting flags: Are these early signs of confrontation? In 2002, Denmark erected its flag on Hans Island. In 2005, Canada did the same on the disputed Island. More recently, in 2007, Russia planted its flag at the bottom of the Arctic Ocean, a move that angered many nations.

Virtually ice-free since the summer of 2016, the Northwest Passage is fast becoming a preferred shipping route between Asia and Europe. Even though the Canadian government has declared the Northwest Passage part of our territorial waters, with very little capability to enforce our sovereignty, it is not uncommon to find American, Asian, and European vessels operating within the Canadian Arctic Archipelago. The worst-case scenario from an Air Force point of view is one in which

CF Photo.

the Air Force is ill prepared to operate in the Arctic, and this became quite clear when a Polish tanker hit a small iceberg in the summer of 2016 and spilled millions of litres of crude oil into Baffin Bay. Most of the oil spill washed out onto the western shores of Greenland, and Ottawa was severely criticized by the international press (and especially by Danish politicians) for its inability to respond to the emergency. In 2018, a German tourist died as a result of an accident near Cambridge Bay on board a small cruise ship. Again, the government was embarrassed as search and rescue (SAR) assets took well over 30 hours to respond to the emergency.[19]

Arctic Tourism on the rise: In November 2007 this small (Canadian owned) cruise ship (pictured below) hit a chunk of ice and sank off the coast of Antarctica. All passengers and crew were rescued by a nearby ship, but what if this had happened in our high Arctic? Would we have been able to respond in time?

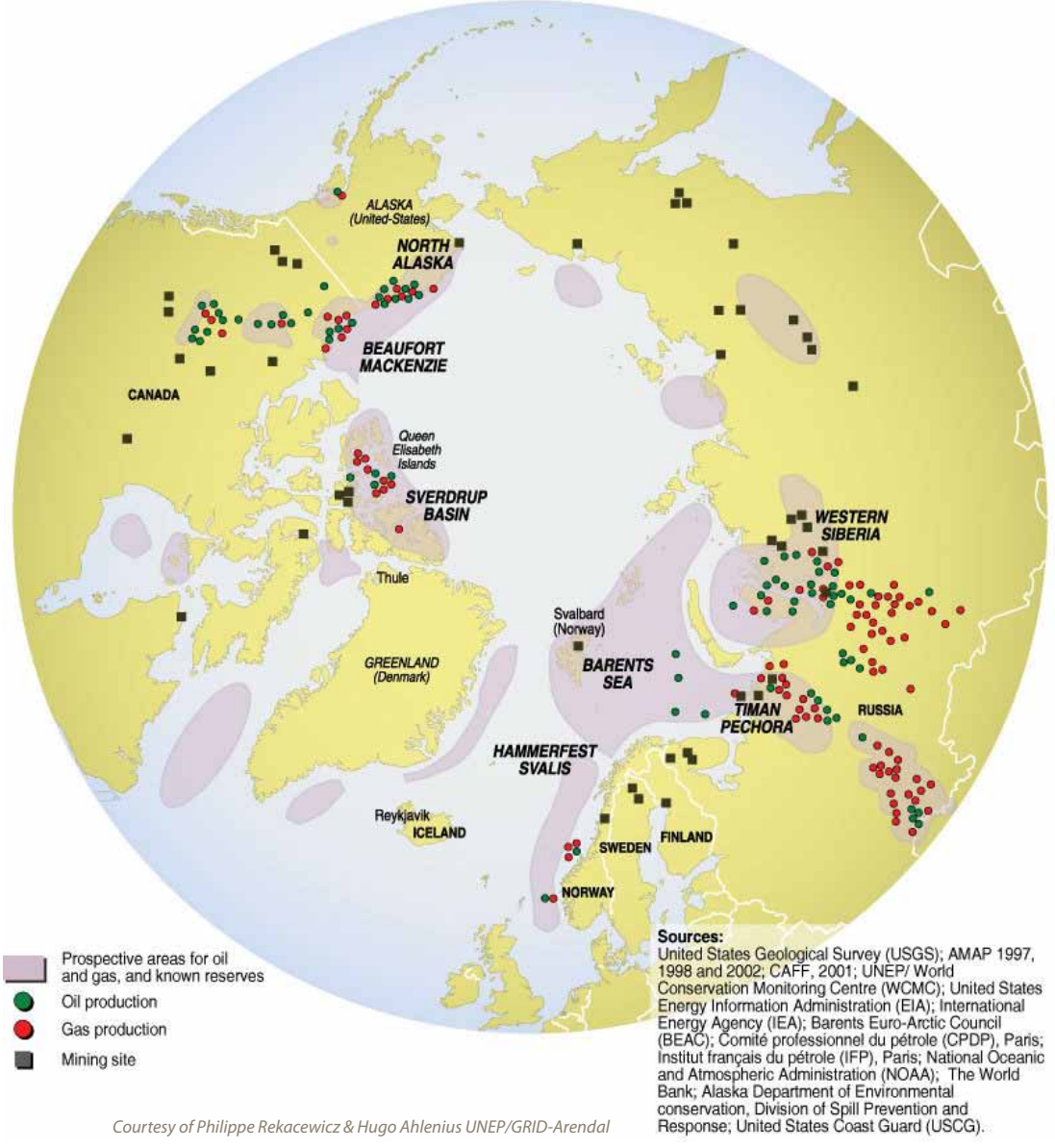
The Russian mafia is also widely rumoured to be trafficking Canadian diamonds using mini-unmanned submarines and aircraft. Organized crime may also be involved in the illegal traffic of oil by tapping into pipelines onshore and offshore in the Beaufort Sea. In 2015, the American government formally called on the Canadian government to do more to stop the flow of illegal immigrants and Russian criminals into Alaska, but again, with very limited means, there were few options available to a cash-strapped government.[20]

Resources. Warmer climates are highly favourable to human activity, and by 2020 the Arctic is booming with activities ranging from exploration and tourism to fishing and mining. Accelerated by the impact of global warming and unprecedented high commodity prices, we are witnessing a "no-holds-barred" rush among nations for oil, fish, diamonds, and access to shipping routes.[21] As peak oil[22] occurred earlier than expected, in 2012, oil companies are now furiously engaged in active competition to secure rights to lucrative petroleum and natural gas reserves below the sea floor (see Figure 5). Unfortunately, in their rush to extract the oil, many have shown a complete disregard for Canadian laws and environmental concerns. Due to its limited capabilities, Canada has been unable to enforce meaningful sanctions. Many

Courtesy of Chilean Air Force

fish stocks are also showing grave signs of stress due to overfishing and resource mismanagement. By 2016, stocks of arctic char have been depleted so much that it is doubtful that the species will be able to support commercial fishing activities again.

In this scenario, UNCLOS has reached an impasse as almost every single Arctic nation filed overlapping and conflicting claims. Note that claims in the Arctic already overlap and many countries have yet to establish their official position on claimed areas (see Figure 6). Furthermore, Canada, Denmark, and Russia have all used the outer edge of ice formations in drawing their Arctic baselines. As ice recedes, revealing new coastal geography, questions over the legitimacy of existing baselines will add further complexity to claims over seaward jurisdiction.[25]



Courtesy of Philippe Rekacewicz & Hugo Ahlenius UNEP/GRID-Arendal

Figure 5. Main Areas of Hydrocarbon Reserves in the Arctic[23]

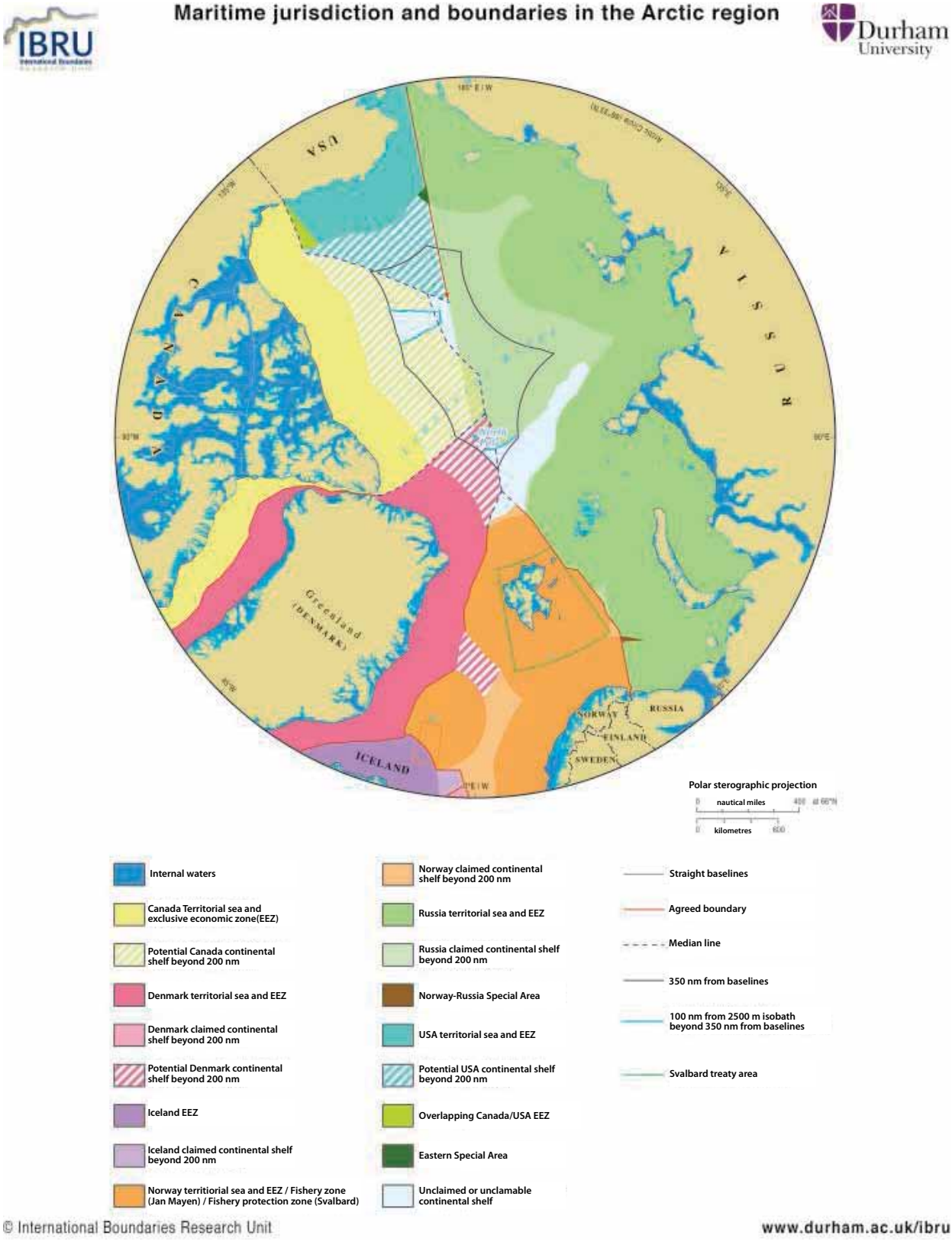


Figure 6. Claims of Ownership Map[24]

By 2020, most nations have filed appeals with the International Court and it will be many years before any rulings are expected. Meanwhile, the Russian Navy and the US Navy have deployed large naval task forces in the contested zone in the Beaufort Sea near the Lomonosov Ridge[26] even though the contested zone straddles mostly Canadian waters.

Summary. In the worst-case scenario, the Air Force is ill prepared for northern operations while the Arctic becomes an area of increased activities. Increased global warming leads to increased human activities ranging from mineral and oil exploration to fishing and tourism as well as illegal activities. In this scenario, the Canadian government has limited capabilities to enforce its sovereignty and environmental laws. There is little, if any, cooperation between Arctic nations and there are increased tensions between Russia and the West over Arctic claims.

TAKE AWAY – AIR FORCE OPERATIONS IN THE ARCTIC

And so, our voyage into the future alternative worlds of 2020 is nearing its end. While these two scenarios are purely fictional, they are based on the current trends and scientific evidence. While the scenarios were taken to the far end of the plausible, they were developed as a think piece in order to assist military planners. Below is a list of "take aways" that are derived from studying both scenarios.

Climate change. On the one hand, climate change will dictate Air Force involvement in the Arctic, as a warmer climate will translate into increased activities in the North. On the other hand, a harsher climate may reduce human activities, but it will increase the difficulties to operate in that region should the Air Force be required to deploy into the Arctic.

Arctic surveillance. Upwards of 50 per cent of the world's undiscovered resources are estimated to lie in the Arctic. Should the Arctic experience an economic boom as a result of resource exploration and extraction, then governance, policing, and surveillance will be challenging given the sheer size of the region. As costly as this task will be, it will remain essential for the Air Force to consider the best possible options from high altitude airships (HAA), to tethered aerostats, unmanned vehicles, and satellites. Note that, should a threat be detected, securing our remote Arctic border will be a monumental task.

SAR requirement. The Air Force will need to develop a more agile and robust response to SAR incidents in the Arctic. At the moment, SAR response time and capabilities in northern regions remain problematic. Clearly, increased permanent presence, tourism, and economic activities in the Arctic as well as expanding trans-polar air routes will ultimately require greater SAR resources in the North and greater Arctic-hardened air mobility support. A permanent SAR capability may even become a future requirement.

Increased requirement for Arctic operations. The government's proposed CFATC in Resolute Bay is expected to house approximately 100 full-time personnel. It is logical to assume that the level of Air Force effort to sustain and support the new CFATC will be more or less on par with that of CFS Alert.[27] Likewise, the deepwater seaport at Nanisivik will require some level of airlift to sustain operations at the new base, albeit at a lesser level.

Potential for conflicts. Mineral extraction and shipping will likely be a source of tension and dispute in the future. New shipping routes may also reshape the global transport system. While these developments offer opportunities for growth, they are also potential sources of competition and conflict for access and natural resources. Currently, the CF has few capabilities to project hard power in our High Arctic. For the Air Force and the Navy, and to a lesser degree the Army, the High Arctic may become a permanent theatre of deployment located at strategic range. ■

Lieutenant-Colonel Daniel J. L. Lachance is a pilot with over 3,800 hours flying helicopters as a SAR pilot and a qualified flying instructor. Lieutenant-Colonel Lachance is in charge of Concept Development at the Canadian Forces Aerospace Warfare Centre. He was also the project director for the recently published report *Projecting Power: Canada's Air Force 2035*, as well as the discussion papers entitled *Trends Shaping Canada's Air Force in the Year 2019* and *Alternative Futures for Canada's Air Force in 2020.* All documents are available at http://trenton.mil.ca/lodger/cfawc/index_e.asp.

List of Abbreviations

CF	Canadian Forces
CFATC	Canadian Forces Arctic Training Centre
CFAWC	Canadian Forces Aerospace Warfare Centre
CFS	Canadian Forces Station
DND	Department of National Defence
NORAD	North American Aerospace Defence Command
SAR	search and rescue
UNCLOS	United Nations Convention on the Laws of the Sea
US	United States

Notes

1. An alternative future is a possible future that occurs when certain events or other influences cause a deviation from the general direction in which a trend is moving. Alternative futures can also be caused by revolutionary breakthroughs or by a strategic shock (a sudden and/or unexpected and often powerful event or driver [an event or human activity that provides impetus or motivation to fuel or sustain a trend] that causes the trajectory of a trend to significantly deviate from its existing course) or a wild card event.

2. Marcus Aurelius Antonius (Roman Emperor A.D. 161-180), *Meditations* (written in 200 A.D.), http://www.quotationspage.com/subjects/the+future/ (accessed February 17, 2011).

3. A trend is a tendency or movement towards something or in a particular direction.

4. A wild card (sometimes also called a black swan) event is a high-impact, low-probability event that would have dramatic consequences if it actually occurred. Wild cards are rare events, beyond the realm of normal expectations, which makes them almost impossible to predict. *9-11* (using commercial aircraft as missiles) is often cited as being a wild card event because of the impact it had on all our lives.

5. Key factors are thought to be the most important contributing features of a future security trend. The key factors are used to create the scenarios. They are made to have either extremely positive or negative effects (while remaining plausible), which create a best (utopian) and a worst-case (dystopian) scenario—the alternative futures.

6. Note that the best- and worst-case scenarios presented in this paper are from the perspective of future Air Force involvement in the Arctic, and not necessarily from the point of view of the local population, the environment, world politics, etc.

7. The United Nations Convention on the Law of the Sea is an international agreement that defines the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources. The Convention, which came into force in 1994, has important ramifications for Arctic states. It allows those states to claim the right to harvest mineral and non-living material in the subsoil of its continental shelf beyond the current 200 nautical miles economic zone. Note that once ratified, states have 10 years to file their claims for access and jurisdiction based on geological and other evidence

8. More than two-thirds of the world's large cities are in areas vulnerable to global warming and rising sea levels, and millions of people are at risk of being affected by flooding and intense storms, according to a recent study published in the journal *Environment and Urbanization*. In all, 634 million people live in the threatened coastal areas worldwide. See "Cities at risk from rising sea levels, scientists say," CBC News, http://www.cbc.ca/technology/story/2007/03/28/tech-flood.html (accessed February 17, 2011).

9. The term thermohaline circulation refers to the part of the large-scale ocean circulation that is driven by global density gradients created by surface heat and freshwater fluxes. The adjective thermohaline derives from *thermo* referring to temperature and *haline* referring to salt content, factors which together determine the density of sea water.

10. This is in reference to the climatological era known as the "Little Ice Age," a period that began about 1350, in which average wintertime temperatures abruptly turned cooler in the North Atlantic region and persisted that way for roughly 500 years.

11. Richard F. Pittenger and Robert B. Gagosian, "Global Warming Could Have a Chilling Effect on the Military," *Defense Horizons*, no. 33, October 2003.

12. Estimates indicate that the Arctic routes could reduce transportation costs by an average of 40 per cent on key Asian-European routes and cut distances by two-thirds. The simple use of economic data indicates that such reductions imply that Arctic open water could attract up to 80 per cent of the global transportation market.

13. ©1994, ACIA, map ©Clifford Grabhorn.

14. Data attributed to United Kingdom, *The DCDC Strategic Trends Programme, the Arctic out to 2040,* 52.

15. Image taken from "What is Climate Change?" http://www.bcca.org/ief/climate/climate_what.html (accessed February 17, 2011).

16. Canada is currently disputing sovereignty over Hans Island with Denmark, the ownership of the undersea Lomonosov Ridge with Russia and Denmark, as well as the location of its maritime boundary in the Beaufort Sea with the US, and the status of the Northwest Passage with the international community. These disputes will not be easily resolved and are expected to continue over the next decade. See also note 22.

17. The Arctic Council is an intergovernmental forum for Arctic governments and people. The member states are: Canada, Denmark, Finland, Iceland, Norway, Sweden, Russia, and the US.

18. The Spitsbergen Treaty (which came into force in 1925) recognizes the full and absolute sovereignty of Norway over the Arctic archipelago of Spitsbergen (now called Svalbard). There has been a long-running dispute, primarily between Norway and the Soviet Union (and now Russia) over fishing rights in the region. Note that Norway also claims that the archipelago is a part of mainland Norway's continental shelf, a position that Russia is also disputing.

19. SAR in the Arctic is a grave concern for the Air Force, as the region is lacking even the most basic infrastructure of road networks, airfields, staging/supply bases, or medical facilities. The potential for SAR in the High Arctic is far more likely now and in the future than at any time in the past. Because a sparse population creates a statistically low risk, it would be inefficient to locate SAR assets in the Arctic. It should be noted, however, that more than 100,000 people fly over the Canadian Arctic each day on high-latitude routes to Europe and Asia. In case of a major air disaster, it would take at least six hours for a Hercules aircraft based in Southern Canada to reach the Arctic, and much longer for helicopters (even if they were shipped by CC177, as some reassembly would be required).

20. The former US ambassador to Canada, Paul Celluci, has warned that terrorists might use an ice-free Northwest Passage to traffic in weapons of mass destruction. See Michael Byers, "Wanted: Mid-sized Icebreakers, Long-range Choppers, Perspective," *Globe and Mail*, 12 June 2009.

21. Unexploited resources in the Arctic account for about 22 per cent of the undiscovered, technically recoverable resources in the world. It accounts for about 13 per cent of the undiscovered oil, 30 per cent of the undiscovered natural gas, and 20 per cent of the undiscovered natural gas liquids in the world. About 84 per cent of the estimated resources are expected to occur offshore. Continued warming of the Arctic implies that the accessibility and profitability of these resources will increase significantly. See US Department of the Interior, "90 Billion Barrels of Oil and 1,670 Trillion Cubic Feet of Natural Gas Assessed in the Arctic," (United States Geological Survey, July 23, 2008), http://www.usgs.gov/newsroom/article.asp?ID=1980 (accessed February 17, 2011).

22. "Peak oil" refers to the point in time when oil production has peaked and only half of proven reserves remain. The significance in this lies in the fact that the remaining known quantity is finite and the laws of supply and demand indicate greater demands for dwindling supplies, which ultimately translates into higher prices. The date when the world reaches global peak oil production cannot be pegged exactly. The projected dates vary between the most pessimistic in 2010 and the most optimistic in 2035.

23. Philippe Rekacewicz and Hugo Ahlenius, UNEP/Grid-Arendal, http://maps.grida.no/go/graphic/fossil-fuel-resources-and-oil-and-gas-production-in-the-arctic (accessed February 17, 2011).

24. Durham University, UK, "Maritime jurisdiction and boundaries in the Arctic region," International Boundaries Research Unit, http://www.dur.ac.uk/ibru/resources/arctic (accessed February 17, 2011).

25. United Kingdom, Ministry of Defence, *The DCDC Global Strategic Trends Programme 2007–2036*, (Development, Concepts and Doctrine Centre, December 2006), 51, http://www.cuttingthroughthematrix.ca/articles/strat_trends_23jan07.pdf (accessed February 17, 2011).

26. The Lomonosov Ridge is an unusual underwater ridge of continental crust in the Arctic Ocean. It spans 1,800 km from the New Siberian Islands over the central part of the ocean to Ellesmere Island of the Canadian Arctic islands. As part of their respective UNCLOS submissions, Russia claims that the Lomonosov Ridge is an extension of the Eurasian continent. Canada asserts that the ridge is an extension of its continental shelf. Danish scientists also hope to prove that the ridge is an extension of Greenland, which would make Denmark another claimant to the area. See also note 13.

27. CFS Alert is the most northern permanently inhabited settlement in the world. It is situated on the northeastern tip of Ellesmere Island in the Canadian Arctic Archipelago. In 2008, CFS Alert housed approximately 70 full-time personnel. Twice a year, the station receives major replenishments. Operation BOXTOP is the name given to the biannual resupply of CFS Alert. Using USAF Base Thule in Greenland as a staging point, for two to three weeks every spring and fall, the Air Force operates day and night to fly fuel and supplies to the station. In the past several years, a typical BOXTOP operation moved over 431,000 kilograms (950,000 pounds) of freight and more than 1,386,558 litres (305,000 imperial gallons) of fuel into CFS Alert. To accomplish this level of activity, four CC130s, one CC150, and one CC177 aircraft flew in total more than 500 hours and moved more than 130 chalks of freight. In addition, CC130 aircraft regularly fly into and out of CFS Alert (approximately every week) to transport perishable supplies. These flights originate from 8 Wing Trenton, and they contain food, medical supplies, and CF personnel rotating through CFS Alert.

CF Photo

BCATP Revisited

THE WARTIME EVOLUTION OF FLIGHT TRAINING IN CANADA

By Matthew Chapman

Originally presented at the 2010 Military and Oral History Conference. Hosted by the University of Victoria, Victoria, BC, 6 May 2010.

Aviation in Canada underwent dramatic changes between 1939 and 1945. This was evident not only in the number of aircraft, airports, and navigational aids spanning the nation, but also in terms of the technical skills and professional culture of Canadian aviators. During the Second World War, pilot training in Canada began following a trend already well established in the United States and parts of Europe. Shifting focus from preparing students primarily for the "stick and rudder" skills required of bush flying and aerial combat reminiscent of the First World War, Canadian flight schools began emphasizing training on instrument flying procedures, thus allowing student pilots to gain the required proficiency to safely and reliably operate highly sophisticated, multi-system, high performance aircraft in increasingly adverse atmospheric conditions. In so doing, this shift in training drove the development of a new professional aviation culture which helped shape and define the rapidly expanding post-war Canadian aviation industry.

This shift in training was driven by a combination of technological developments and political and military pressures which together expanded and complicated the environment in which substantial numbers of aviators were able to operate for the first time. While the growth of major airlines south of the border and across the Atlantic during the late 1920s and early 1930s resulted in increased emphasis placed on teaching instrument procedures in those locations, a similar process had only begun in Canada in the late 1930s with the consolidation of small bush operations around James Richardson and the burgeoning Canadian Airways, and the development of the logistical facilities of the Trans-Canada Air Route and the founding of Trans-Canada Airlines (TCA), the forerunner of Air Canada. What modest advancements that were made in interwar Canadian flight training with respect to teaching instrument flying procedures were, however, for the most part relegated to the isolated world of these larger airlines as well as the relatively small cadre of pilots in the Royal Canadian Air Force (RCAF) who nevertheless retained the moniker of Canada's "bush pilots in uniform."[1]

The broad changes that came to professional aviation during the war were not, of course, unique to Canada. Between 1939 and 1945, pilots of all nations faced similar operational challenges in the air and employed comparable adaptive strategies to cope. Yet given the unique role that Canada played in flight training during the war through the British Commonwealth Air Training Plan (BCATP), the ability of Canadian flight instructors, flight school administrators and civilian and military policy makers to adapt to the challenges faced in the skies both at home and abroad proved to be of vital importance in shaping not only Canadian aviation history, but also that of global aviation more broadly. As such, just how prepared Canada was in 1939 to adapt to the new era of aviation heralded in by the Second World War, and just how rapidly and at what cost those adaptations were made,

CF Photo

are important to consider when studying the history of a technology and a profession that have changed not only the way humans travel, but also how they have come to conceptualize time and space in a continually shrinking world.

Referencing the relatively small body of secondary source academic literature on the topic, a collection of primary source documents from Library and Archives Canada and the Department of National Defence, and, in the spirit of the conference for which this paper was originally written, oral histories, the following will assert that while Canada was well positioned strategically and geographically for training aircrew for the war, it was relatively poorly positioned with respect to the professional experience of Canadian aviators with the type of flying the vast majority of BCATP-trained pilots were expected to perform after

graduation. The following will defend this assertion through an examination of the challenges faced and adaptations made by plan administrators, instructors and, perhaps most importantly, BCATP students.

At the commencement of BCATP training in 1940, few fully operational RCAF pilots were kept in Canada to act as instructors. Rather, the vast majority of fully qualified military pilots were sent overseas to take part in the defence of Britain. As a result, the first instructors in the BCATP were civilians who flew for privately operated, commercially run flying clubs. These men were typically ex-bush pilots or veterans of the First World War who had trained both civilians and military personnel in the methods of flying demanded by interwar Canadian aviation. That is to say, skills associated primarily with bush flying.

The scale of flight training demanded by the war outstripped the capabilities of the civilian run clubs to a significant extent. Pre-war RCAF training plans, which included a civilian instruction component, were built around the expectation that approximately fifty pilots were to be trained annually for the then still fledgling air force.[2] While the civilian clubs had a capacity for producing considerably more pilots than this, they still fell far short of the capabilities required to produce the thousands demanded by the war effort. To make up for the shortfall in instructors the RCAF allowed clubs to nominate student pilots of their choosing to quickly receive a minimum of 150 hours of flight experience and then place them into Central Flying School for instructor training. Upon completing a four-week course in instruction, these students were made sergeants in the RCAF and granted temporary leaves of absence to instruct at the civilian-run BCATP schools.[3] This practice effectively lasted until 1941 when the plan began producing enough pilots to internally staff instructor positions.

Commercial airline pilots from Canadian Airways and TCA, who had perhaps the most experience of any Canadian aviators in 1939 with the type of flying that the vast majority of BCATP recruits would eventually perform overseas, that is, long distance, multi engine, instrument flying in bombers and maritime patrol aircraft, were largely barred from leaving their civilian employment to join the RCAF.[4] Canadian Airways was put to use producing BCATP recruits in the staffing of an Air Observer School where the airline's pilots acted as "air-chauffeurs"[5] to RCAF instructors and their Air Observer (navigator) students. TCA was involved in training pilots for the trans-Atlantic ferry program with Royal Air Force (RAF) Ferry Command,[6] and helped RCAF Eastern Air Command aircrew convert from the twin engine Digbys to the four-engine B24 Liberators; however, no formalized agreement was ever arranged to allow the airline's pilots to instruct directly in the BCATP.

In 1940 and early 1941, in an effort to rapidly produce more pilots to supplement the civilian instructors in the BCATP, instructional time at Elementary Flight Training Schools (EFTS) was reduced from the initial plan of 8 weeks to 7, and Service Flight Training Schools (SFTS) from 16 to 14.[7] This was, as a Department of National Defence post-war historical report noted, a "temporary and dangerous expedient and was abandoned as soon as possible."[8] Nevertheless, the reduction of flight hours for the first classes of BCATP recruits had lasting impacts on both the Plan and operational flying both at home and abroad. Before these impacts are directly addressed, however, it is useful to examine the experiences of the first generation of BCATP trained pilots to understand the role they played in subsequent training.

Upon graduating from SFTS, the vast majority of the first BCATP recruits were, much to their general disappointment, trained as instructors and sent back into the Plan to teach.[9] The practice of recirculating graduates back into the scheme meant that the bulk of instructors who remained in the BCATP during the first critical years of wartime training had themselves been taught in abbreviated fashion. Furthermore, they had been instructed primarily by civilian pilots

whose skills were geared more towards bush flying in rugged simple aircraft rather than long distance, high altitude, poor weather flying in the type of aircraft then being developed for the war.

In 1940, Initial Training School (ITS), the first step along the aviation-oriented path of a pilot's career, was little more than a holding area for uncategorized aircrew. ITS instructors were given general course syllabi to teach, most of which focused on military procedures and protocols as well as academic subjects such as mathematics and physics, but few of those instructors received any educational training for the task.[10] There was, furthermore, little oversight of training both in the classroom and the Link trainer, a pneumatically controlled flight simulator, from any central agency. This resulted in a wide range of instructional quality between schools.[11] It was not until August 1941 that aviation theory began to be taught at ITS, and even longer before instructors with educational training were put to the task.[12] These changes, when they came, extended ITS training from four to ten weeks and represented just one of the myriad of improvements in theory of flight training made in the BCATP throughout the war.

Upon graduating from ITS, candidates selected for pilot training proceeded to EFTS. In 1940, these schools were staffed primarily by the aforementioned civilian instructors who had received abbreviated service instruction at RCAF Central Flying School. The syllabi used to teach students at EFTS, where they were indoctrinated into the basic principles of flying, included teaching emergency procedures, basic aerobatics, navigation, and takeoffs and landings among other fundamental manoeuvres. These were taught using a form of instruction known as "patter," where the instructor memorized a series of verbal commands to give to the student through a primitive intercom system.[13] As Major-General G. J. J. Edwards, who became an EFTS instructor following his own training within the BCATP in 1941, recalls, "you were to become a human tape recorder."[14] Both instructors and students reported that this method of communication "was very poor,"[15] and as such, training was often tedious for the instructor who had simply to repeat memorized instructions, and frustrating for students who were unable to easily ask questions in the air. The monotony of the experience, both for instructors and students, may be one explanation, admittedly among many, for a problem which plagued the BCATP for the duration of the war, though one that was particularly troublesome in its early years.

Unauthorized low flying was the most significant cause of accidents and fatalities in the BCATP.[16] Often explained as the result of pilots' "skill(s) not matching their daring,"[17] the rash of accidents attributed to low flying was in fact more endemic than the result of a few exuberant students pushing their luck. Indeed, such accidents were just as often caused by instructors as by students, particularly in the first years of the war. A 1940 accident investigation branch report noted that more than 50 per cent of low flying accidents occurred while trained pilots, that is, instructors, were in command of the aircraft.[18] Illustrating this problem in a somber vignette, Lewis Duddrige, who trained as a pilot in the BCATP in 1941, recalls an accident where four instructors perished as a result of a breach of regulations:

> When four young men (all instructors) were killed west of Saskatoon in a Cessna Crane, it was utterly ridiculous. They were overstressing the wings. They were cloth covered... (and the pilot in command) put it into a dive and pulled it out, and the wing uncovered and it crashed. Somebody had a stupid idea, they should never, ever have allowed that aircraft to do that. Why somebody else in the crew, the other three, didn't manhandle him is more than I know.[19]

By late 1941 the problem of students and instructors breaking regulations, particularly with respect to low flying, had only increased in parallel with the expansion of training.

Of 170 fatalities in the BCATP that year, 40 were directly attributed to "low aerobatics and low flying."[20] Indeed, memories of unauthorized low flying are common amongst veterans who trained in the BCATP, and particularly so for those who trained early on in the war. Major-General Edwards recalled that shortly after takeoff on his first flight his instructor quickly diverted from the planned orientation exercise and brought the aircraft to treetop level to complete an inspection of a local herd of cattle. "I found that a little nerve racking,"[21] Edwards remembers. Andrew Robert MacKenzie, a pilot trainee in 1940, recalled that it was common for trainees to follow the lead of instructors like the one who trained Edwards. While training plans called for specific manoeuvres to be practiced while recruits went up without an instructor, MacKenzie recalls that, "ninety-nine percent of us went up and did aerobatics... instead of practicing the set sequence… down, kicking the tree tops, flying around just like a high speed car."[22] Even for students at SFTS where unauthorized low flying remained officially prohibited, the official history of the RCAF notes, "as future fighter pilots they were also 'almost encouraged' to experiment with the aircraft." There was "still something of the First World War's adventurism and romanticism in flying, an air of exciting improvisation about the whole experience."[23]

Accidents appear to have played only a limited role as a deterrent to other students and instructors who sought to push the limits of their own skills and abilities. Such was the case given the continuing rash of accidents attributed to both recruits and instructors breaking regulations by performing risky and unauthorized aerobatic manoeuvres throughout 1941 and 1942. Recalling his memory of accidents in the BCATP during training in 1941, Major-General Edwards recounts:

> I forget how many of my classmates killed themselves…. Out of the sixty or seventy students, I think we killed… I think there were killed, eight or ten… we didn't hear much about the accidents, you know, they backed and filled them in immediately (holes caused by the impact of aircraft). They didn't want to panic the balance of the course… we buried quite a few. But you knew it was never going to happen to you.
>
> You suspected all along that the other fellow, as much as you liked him, was not nearly as skilful as you were and he made a nonsense of it somewhere and killed himself.[24]

Asked about the impact of other students' accidents on one's own attitude towards training, Lewis Duddridge recounts, "I would say there was more flippancy about accidents then... I do not think that too many student pilots were afraid of the airplane as they walked towards it."[25]

A sample of accident report summaries from a typical month of BCATP operations from September 1942, a period where the first generation of recruits had already—like Major-General Edwards—been recirculated back into the plan as instructors, tells of tragic consequences of regulations routinely being broken by student and instructor alike:

> A Sergeant instructor with a student flying a Stearman aircraft engaged in unauthorized low flying. Through an error of judgment the aircraft struck the water of the Bow River and both occupants were killed.... A Pilot Officer instructor with a student flying a Harvard aircraft was engaged in (prohibited) mock fighting manoeuvres with an Oxford which was flown by an experienced pilot with a crew of two. The Harvard collided with and destroyed the tail of the Oxford, the crew of which were killed, together with the student in the Harvard. The instructor escaped by parachute. This mock air fighting was pre-arranged by the pilots concerned before leaving their home station.... A Pilot Officer with a student in a Crane aircraft engaged in unauthorized low flying col-

> lided with a straw stack and crashed. Both instructor and student were killed....[26]

In this one non-exceptional month alone, 12 fatal crashes caused the deaths of 24 personnel. In seven of those 12 accidents, instructors were implicated in the accident's cause.[27]

While fatal accidents in the BCATP in 1941 totaled one per 11,156 hours flown, total accident rates were much higher. During the summer training season of 1942 the average accident total was 445 per month.[28] By the last year of the war, in an indication of improvements made in training and the establishment of safety protocols which placed a high value on precision instrument flying, the total number of fatal accidents, in proportion to the total number of students in the system at the time, was halved.[29]

The relatively few BCATP-trained pilots who were sent to Europe rather than recirculated back into the plan as instructors in 1940 and 1941 encountered a new type of flying in England for which many were simply unprepared. Norman L. Magnussun, an air observer who graduated from SFTS in 1941, recalls that the flying experienced at Operational Training Units (OTU) in Britain:

> …was a maturing period for most of the aircrew and pilots who began to realize that war was a pretty serious business. Prior to that time it was a great deal of fun. Learning how to fly, being involved in flying activities was great fun.…We lost a number of crews (at OTUs)… it seems to me that the memories I have of the operational training unit were the difficult flights that we had, the other was carrying coffins to the cemetery. We spent a great deal of time burying our friends.[30]

Fatal accidents at OTUs were alarmingly routine, particularly during the early years of the war. This may have been due to a number of factors, one of which was that preparatory training was likely insufficient for preparing the students for the poor weather, congested airspace, and blackout conditions of wartime England. Another factor was that the length of time required to move a pilot from a Canadian SFTS to an overseas OTU allowed for too

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long a period of flight inactivity for the then still junior pilots to safely make the transition. Whatever the reason, it was clear that many Canadian-trained pilots were unprepared for overseas OTUs and subsequent conversion training. Illustrating this problem, Major-General Edwards recalls the impact of having operationally experienced pilots relate their experiences of OTUs back to him while he was still instructing in the BCATP:

> By the summer of 1942 we were shaking ourselves down. We were getting people back from the European theatre as instructors. That was interesting because a lot of these chaps came back and I recall the long discussions with some of them, and they were saying you are just not teaching them the right way, you are not teaching them the right thing. There is all kinds of bad weather flying over there, they are not getting it back in Canada…. I gather a great many of the graduates that went across wiped themselves out very early in the subsequent conversion training programs in the United Kingdom because of the bad weather conditions…. The more experienced people could handle it easily. Most of the less experienced found out in a hurry and survived. But some, perhaps even many, flew into hills, flew into trees. People getting lost all the time. Flying into balloons… dying.[31]

Reports from the United Kingdom on the quality of pilots that Canadian schools were producing indicated that training at BCATP schools in Canada was deficient in certain areas. One report from as late as the spring of 1943, which was representative of prior assessments, suggested that the skills of Canadian-trained pilots were "low in relation to the flying hours completed." Navigation was "found to be of a low standard," and night flying skills were determined to be "not compatible with the hours of night flying recorded in log books."[32] Such results, although highly contentious as the official history of the RCAF notes,[33] seem to correspond with the relative lack of emphasis placed on instrument training given to Canadian students prior to late 1942. That reports were issued later in the war vindicating Canadian training is likely in no small part due to the presence of experienced operational pilots returning to the training system as instructors, and a realization by plan instructors and administrators that they needed to adapt their instruction to meet the challenges posed by operational flying.

Interviewed for the second volume of the official history of the RCAF, the lead historian for the first volume, S. F. Wise, recalls that as a pilot recruit in late 1943 he was processed through a system that was notably different from that experienced by Edwards and MacKenzie. Beginning even before recruits stepped into the cockpit of an airplane, combat experienced pilots began to play a role in the first stages of BCATP training. At ITS, Wise recalls the experience of having an "all important" fifteen minute interview with combat-experienced pilots for the purpose of selecting recruits for pilot training:

> You were brought before a board which consisted of officers who themselves had had (operational) tours. It was really the first time we had ever been up against what I would refer to as the "real" air force, the real fighting air force, instead of training… they may not have been that old but, my god, they had old faces. It was an extremely serious business… I can remember that I sweated....[34]

Whereas MacKenzie went through 12 weeks of training in 1940 where adventurism and bravado were encouraged among young recruits who attempted to fly their Tiger Moths "like the Canadian Red Baron,"[35] in 1943, Wise endured 21 weeks of intense, precision-oriented flight training. Included in the extended time was more emphasis placed on instrument flying through increased night, hood,[36] and Link Trainer experience. Wise commented that this training encouraged students to fly with precision, and:

> …a sense of professionalism. Not military professionalism, real professionalism as a pilot. The sense that you were training for a highly skilled kind of occupation. That's not a proper thing for a service person to feel, and yet it's true. I think one of the effects of the BCATP was to create that sort of a sense of professionalism, pride in being a pilot. Their indoctrination reinforced that. The indoctrination had less to do with the RCAF as a fighting unit than it had to do with the creation of an aircrew spirit in which there was a high level of professionalism.[37]

By the end of the war, BCATP course structure and syllabi had adapted to the demands of overseas flying considerably. Tour-expired pilots were recirculated back into the training system, educating not only students in the process, but plan administrators as well. By 1945, training at ITS had been extended from four to ten weeks, passing through seven editions of course syllabi along the way.[38] EFTS training syllabi had progressed through eight editions, all of which placed increased emphasis on instrument and night training, with the last appearing as late as February 1945. At SFTS, while training programs early on in the war called for as little as five hours of synthetic, instrument-oriented training on the Link trainer, the final syllabus required no less than 48 hours of synthetic training, most of it on new versions of the Link, and given by instructors with considerably more experience and knowledge of what it was they were

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teaching.[39] Emphasis was likewise increasingly placed on preparing students for poor weather flying with improved instruction offered on instrument and navigational procedures. "Stunting" and low flying had not been eliminated, but associated casualties had dropped.

As the experiences of MacKenzie, Edwards, Duddridge, Magnussun, and Wise help illustrate, the plan evolved as the war progressed. At some level this evolution was administrative and organizational, as there clearly were a number of logistical hurdles to overcome in the development of an undertaking as ambitious as the BCATP. Much of the evolution in flight training, however, was the direct result of Canadian aviators experiencing a new type of flying for the first time and having to adjust their attitudes towards safety and professionalism in the process. It was the successes and failures of those aviators which instructed the next generation on how to handle the challenges posed by a new era in aviation history. To summarize and conclude here, in the words of Lewis Duddridge:

> I think, if you wanted to call flying in Canada in 1939 a vacuum, then the things that happened in 1940 and 1941 were things that were happening if you put an aircraft into service before you had wind-tunnels to test it. Some things had to change because of the trial and error system… this improved our system and what we were putting out. That's what I really believe.[40] ■

Matthew Chapman is currently completing his Master's degree in Canadian military history at the University of Victoria. Graduating from Selkirk College in 2002 with a diploma in professional aviation, he received his BA from the University of Victoria in 2007 before working as a researcher and writer for the West Coast Canadian Forces Auxiliary Fleet at Canadian Forces Base (CFB) Esquimalt. Matthew's MA thesis is combining his professional experiences and academic interest to examine the impact of wartime aviation on the post-war Canadian commercial aviation industry.

List of Abbreviations

BCATP	British Commonwealth Air Training Plan
EFTS	Elementary Flight Training Schools
ITS	Initial Training Schools
OTU	Operational Training Units
RAF	Royal Air Force
RCAF	Royal Canadian Air Force
SFTS	Service Flight Training Schools
TCA	Trans-Canada Airlines

Notes

1. Allan D. English, *The Cream of the Crop: Canadian Aircrew, 1939–1945* (Montreal: McGill University Press, 1996), 11.

2. W. A. B. Douglas, "The Creation of a National Air Force," vol. 2, *The Official History of the Royal Canadian Air Force* (Toronto: University of Toronto Press, 1986), 201.

3. By having these men enlist, the RCAF prevented them from leaving Canada to instruct in the United States where pay was better. Douglas, 230.

4. By an Order In Council, TCA was deemed an essential service provider, thereby preventing the airline's employees from leaving the company to join the RCAF or RAF unless they received permission from both TCA and the government. D. B. Colyer, Vice-President TCA, "Letter to Captain R. Allen, Training Superintendent, British Ministry of Aircraft Production," 18 August 1941, RG70, Vol. 6, File TCA-1-2-8, Library and Archives Canada (hereafter LAC).

5. Douglas, 224.

6. Trans-Canada Airlines Internal Memo, "Re: War Effort in the Form of Air to the Royal Air Force Ferry Command," RG70, Vol. 6, File TCA-1-2-8, LAC.

7. Douglas, 224.

8. "British Commonwealth Air Training Plan - Flight Training" (Historical Narrative) Circa 1950, 181.09(D89)(A) Directorate of History and Heritage (Hereafter DHH), 3.

9. Douglas, 237.

10. "British Commonwealth Air Training Plan - Flight Training," DHH, 17.

11. Ibid., 17–18.

12. Ibid., 16.

13. Known as Gossport Tubes, the intercom was simply a tube running from the mouth of the instructor to the ears of the student and vice-versa.

14. Air Vice-Marshall Gerald J. J. Edwards, interview, Reel 1, Side 2, 13 June 1975, ID 207, UVSC, Canadian Military Oral History Collections, University of Victoria Special Collections, Dr. Reginald H. Roy Collection.

15. Douglas, 242–43.

16. "British Commonwealth Air Training Plan - Flight Training," DHH, 85.

17. Ibid.

18. Ibid.

19. Lewis Duddridge, interview with author, July 2009.

20. F. J. Hatch, Aerodrome of Democracy: *Canada and the British Commonwealth Air Training Plan 1939–1945* (Ottawa: Minister of Supply Services Canada, 1983), 148.

21. Edwards.

22. Douglas, 279.

23. Ibid., 280.

24. Edwards.

25. Duddridge.

26. RCAF, "Accident Investigation Branch Monthly Summary of Accidents, September 1942," August 1942, RG24, Vol. 3278, File H.Q.235-11-1.

27. Ibid.

28. Average monthly accident totals for June-September 1942. "Accident Investigation Branch Monthly Summary of Accidents..." June to September 1942, RG24, Vol. 3278, File H.Q.235-11-1.

29. Hatch, 148.

30. Air Vice-Marshall Norman L. Magnusson, interview, Reel 1, Side I, 13 June 1979, ID 207, UVSC, Canadian Military Oral History Collections, University of Victoria Special Collections, Dr. Reginald H. Roy Collection.

31. Edwards.

32. Douglas, 270.

33. Ibid.

34. Douglas, 282.

35. Ibid., 280.

36. To simulate IFR conditions in flight, instructors used (and continue to use today) a hood which is placed on the head of a student to prevent them from seeing anything but the instrument panel in front of them.

37. Douglas, 284.

38. "British Commonwealth Air Training Plan - Flight Training," DHH, 21.

39. Ibid., 51.

40. Duddridge.

US DRONE STRIKES IN PAKISTAN

evil or necessary?

By Captain Joseph Dumas, USAF

CFAWC composition

Editor's note: In editing this article, the author's American spelling and idiomatic conventions have been maintained.

In the post-2001 world, the United States (US) developed and established the use of unmanned aircraft to target terrorists. This article defines the issues and provides context of the expanding Central Intelligence Agency (CIA) drone strike program in the tribal areas of Pakistan. Critiques of the program are presented in one of three categories, arguing that drone strikes are generally immoral, strategically counterproductive, or outside of international law. In response, the US justifies its actions as a legal tactic in war, necessary for fighting global terrorism, and part of a broader conflict for self-defense. Because drone strikes are the only proven course of action to disrupt the elusive al-Qaeda leadership, the US will ultimately continue and expand this program. September's spike in drone attacks in response to terrorist plots against European nations highlights these issues.

In the latest installment of what has become a fixture of news reporting in southwest Asia, Pakistani officials reported the death of five militants near the Afghan border during the first week of October, an attack suspected to be carried out by American drones,[1] but characteristically unconfirmed by US sources. This most recent article stood out only because its casualties were German nationals. Such stories have become so commonplace over the past several years that they no longer generate much attention or intrigue in the United States. However, the proliferation of unmanned aircraft striking targets outside of combat zones carries serious ethical, strategic and legal issues, which must be intensively and consistently addressed. Though typically not responded to by US officials, these drone strikes inside Pakistan are commonly known to be the work of the CIA and have attracted significant international scrutiny. After a brief look at the history of drone strikes and arguments both for and against their use, this article will show that the US, despite international and domestic outcry, is unlikely to desist from these operations in Pakistan for the foreseeable future because these strikes are the best, if not the only, other option for targeting high-level terrorists.

The use of unmanned aerial vehicles (UAVs) in war is a relatively new phenomenon. Only in 1994 did the US take delivery of its first Predator, a medium-altitude drone, capable of being controlled via data link from the other side of the world, and of providing video feeds and other intelligence data while remaining airborne for up to 40 hours. At that time, these aircraft were used solely for reconnaissance. The post-9/11 counter-terrorism concerns, including war in Afghanistan, Iraq, and elsewhere, have rapidly made this new technology increasingly offensive in nature and greatly broadened in its span of operations. Operation ENDURING FREEDOM (OEF), the US-led invasion of Afghanistan to remove the Taliban and dismantle al-Qaeda in late 2001, first saw the use of armed drones to strike targets in war. In November 2002, the US government announced a Hellfire missile, fired from a Predator drone, had successfully killed an al-Qaeda target in Yemen, marking the first time UAV strikes were used outside of a declared combat zone.

Believing that a large portion of al-Qaeda leadership, the declared target of OEF, had escaped Afghanistan into Pakistan where they had found sanctuary and protection from the government, the US began to seek ways to prosecute these targets. Naturally, UAVs seemed an ideal tool for these cross-border operations because of their low cost, persistent coverage, and lack of risk to US pilots. The first US Predator strikes in Pakistan occurred in 2004. Only a handful of attacks occurred in the first years, but as their usefulness was evaluated, strike numbers quickly rose throughout the end of 2008. Those who thought this tactic might have disappeared with the presidential administration change in 2009 were quickly proven wrong—the first two drone strikes under the Obama administration took place during his third

day in office. In fact, the pace of unmanned missile strikes in Pakistan has exploded during the past two years. During 2009, more aerial strikes took place in Pakistan than during the entirety of the Bush administration, and 2010 has been on pace to nearly double that mark. September alone had more than 20 attacks, the highest monthly total ever.

As noted, the drone strikes in Pakistan are a CIA program, separate from the expansive UAV sorties in Iraq or Afghanistan, which are controlled by the US Air Force (USAF). Because of the secretive nature of the CIA and its operations, almost no details are released concerning these UAVs to include how many drones are used, by whom, and how targets are selected. By contrast, details of the Air Force program are openly published. Reportedly, the director of the CIA or his deputy is the authority for drone strikes; it is also thought that the CIA does not require names for its targets, but will make decisions solely on "pattern of life" assessments.[2]

All of the drone strikes in Pakistan have occurred in border provinces collectively known as the Federally Administered Tribal Areas (FATA), with the lion's share being in North and South Waziristan. The FATA is an area of extremely rugged terrain in which the central government has very limited influence; though the Pakistani army has mounted large-scale ground assaults in this area, the Pashtu tribes remain essentially autonomous. In the past year, there has been rumor of expanding the CIA drone project to other parts of Pakistan, but the main thrust of the program is likely to remain directed at the FATA. As al-Qaeda and Taliban leadership is assessed to be hiding from coalition forces in this sanctuary, the drone strike tactic has quickly become a central part of American strategy. In fact, many in the intelligence community describe the CIA's Predator program as "America's single most effective weapon against al-Qaeda."[3] However, simply because a military tactic is effective does not automatically mean it should be employed.

The policy of using drones to strike targets in Pakistan has aroused many different criticisms from many different sources, including domestic and international figures and organizations. Generally, these criticisms can be grouped into one or more of three broad categories: moral, strategic, and legal. The moral criticisms tend to be very broad and reject the weaponized employment of UAVs worldwide and the targeted killing of individuals. First, many argue there is no real difference between assassination of rival leaders using bullets and knives or precision guided missiles. As recently as the summer of 2001, the US government officially took a similar position, chastising Israel for targeted killing of Palestinian terrorists. That same year, the CIA director argued that it would be "a terrible mistake" for the CIA to "fire a weapon like this."[4] In an equally broad critique, many argue that drone technology allows countries to cheaply pursue war, removing the human tolls and risks of warfare and shrinking the financial burdens of armed conflict. As a result, people are more willing to tolerate their country going to war, not having to risk the lives of their own citizens, or to confront the effects of violence at any level more than blurry images on a screen.

The next category of UAV strike criticism relates to its actual effectiveness in obtaining

desired objectives. These strategic critiques tend to be more focused on the actual technique of using drones to kill terrorists, and to a lesser extent, the specific situation in Pakistan. To begin with, even the perfectly executed drone strike which kills a terrorist and no one else has less than ideal consequences. No further information can be obtained from questioning a dead terrorist, and he can become a glorified martyr, while his family and friends are likely to turn against our cause. According to Daniel Byman, director of Georgetown University's Center for Peace and Security Studies, "It's almost always better to arrest terrorists than to kill them."[5]

Secondly, drone strikes are far from infallible and are prone to killing innocents. The successful killing of Baitullah Mehsud, leader of the Taliban in Pakistan and responsible for hundreds of deaths in Pakistan and Afghanistan, was celebrated by both American and Pakistani officials. However, prior to this successful operation, 16 drone strikes over the course of 14 months had targeted Mehsud, resulting in between 207 and 321 other deaths, a number of whom were certain to have been civilians.[6] In general, numbers of innocents killed by drone attacks vary wildly from source to source; one source lists between 871 and 1,285 killed in Pakistan, one-third of those since 2006.[7] The *News*, a daily Pakistan paper, reports that the 60 air strikes since early 2006 have killed 687 civilians and only 14 al-Qaeda leaders, meaning merely 2 percent of those killed were legitimate targets. Other news sources and websites critical of US policies publish similar civilian to militant ratios.

This brings to bear another shortcoming of UAV strikes against terrorists. The fact that these classified, secret attacks occur in remote areas of Pakistan, often far from government control, where the central government has forbidden journalists to travel, makes official accounts of whom exactly is getting killed by these strikes impossible. This plays right into the hands of al-Qaeda, the Taliban, and the other entities whom North Atlantic Treaty Organization (NATO) allies are trying to defeat, but who are excellent at using these drone strikes for their own propaganda campaigns. Lacking outside reliable sources, the Taliban are able to inflate death tolls and accuse the Americans of being cowards and the Pakistani government of merely being a puppet to Western powers. Even without Islamist spin, any reports of civilian casualties as a result of drone strikes are likely to incite anti-American sentiments in most Pakistanis. In a 2009 Gallup Pakistan poll, only 9 percent of Pakistanis

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supported the drone strikes while 67 percent opposed them.

The final group of criticism against the drone strikes in Pakistan arises in the legal arena. Though these issues range from the legality of pursuing targets in a sovereign nation to the transparency of targets selected by the CIA, they are the most tailored to the situation in Pakistan and offer the most structured forum for dialogue or potential dispute. Beginning with the cross-border issue, the United Nations (UN) has established guidance for pursuing non-state terrorist actors, even differentiating between targeted killing, which can be justified, and assassination, which is always in violation of international law. In general, if a state has permission to operate in the borders of another nation, there is no violation of sovereignty. However, Pakistan has never officially condoned the attacks and has occasionally expressed anger over the drone strikes. Even without permission from the state in which operations occur, most legal frameworks do allow for states to act in their own self-defense. Though many scholars and authorities no longer feel that drone strikes in Pakistan amount to self-defense, the recent discovery of al-Qaeda plots in Western Europe could be used to argue otherwise.[8]

On June 3, 2010, Philip Alston, the UN Special Rapporteur on Extrajudicial, Summary or Arbitrary Executions, released a report specifically addressing the US use of drone strikes in Pakistan. Though non-binding, his report found the CIA program to be contrary to international law and in violation of human rights. Nearly all of the criticisms already explained were in his report, but his main contention was the classified nature by which targets were selected and attacked. Alston notes that killing in an armed conflict by an intelligence agency, such as the CIA, does not itself constitute a violation of international law. However, lacking the transparency and accountability of the military drone program, he argues that such capabilities should be the sole charge of the defense department and not the secretive CIA.[9]

Though the US has not directly responded to Alston's most recent report, or to previous UN criticisms of its drone program in Pakistan, it does have a considered argument for justification which it frequently tries to promote. Officially, the US bases its actions in the area on national self-defense and defends the tactics of drone strikes as being accurate and effective in the war against extremists. Though not officially

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pronounced, there is considerable evidence that the CIA has Pakistan's permission and even cooperation in these strikes. Finally, the reality of the situation is that the US has few other options for pursuing targets in Pakistan, which are still considered to be threats to US interests and personnel.

Since September 11, 2001, the US has considered itself to be in a state of armed conflict. Shortly after 9/11, President Bush declared America to be engaged in a global war on terrorism and received congressional authorization to retaliate against those responsible. Because of the classification of terrorists as enemy combatants rather than merely international criminals, they could be legally targeted within the constructs of international law. Though President Obama has dropped the Global War on Terrorism moniker, his administration has maintained and even expanded this justification. The US State Department Legal Advisor Harold Koh, considered a champion of human rights, has defended the CIA's drone program on the basis of targeting enemy combatants, saying that the US is "in an armed conflict with Al-Qaeda, as well as the Taliban and associated forces."[10] Moreover, Koh has brought in the self-defense argument, which if argued effectively, can be a trump card in international law. By arguing that the US and its interests are at considerable risk from the al-Qaeda and Taliban members hiding in Pakistan, the threshold required to legally target them is significantly lowered. Though many question how direct a threat many of the CIA's targets are, it is undeniable that al-Qaeda and Taliban leaders continue to plan and execute attacks against US forces legally in Afghanistan, and against the homeland of Americans and their NATO allies. The fall discovery of a Mumbai-style terrorist plot (a series of shooting and bombing attacks in India's largest metropolitan city in November of 2008) against Western European nations, planned from the FATA in Pakistan, highlights this intention and is believed to be directly related to the increased drone strikes during September and October.

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Maintaining that the targets inside of Pakistan are legitimate, the US further argues that UAVs are the ideal tool for prosecuting its objectives. Due to their persistent coverage and ability to be flown in hostile terrain or otherwise denied territory, drones allow for a tremendous amount of intelligence to be gathered on any particular target. Drone strikes are credited with eliminating more than half of the CIA's top 20 most wanted targets, including Baitullah Mehsud. In addition to decapitating enemy leadership, the UAV program has additional benefits for the US. Wary of being seen and targeted by the unblinking eyes of the UAVs, al-Qaeda and Taliban leaders must exercise extreme caution and utilize much of their time and resources to force protection, taking away from their abilities to plan and execute attacks on American interests.

More than just being deadly to America's enemies, the US also argues that drone strikes allow for greater precision than other conventional means, thereby reducing collateral damage. The Hellfire missile, the weapon most commonly used in the CIA UAV program, is relatively small and accurate compared to other weapons in the arsenal, certainly much more surgical than the cruise missiles used to strike al-Qaeda training camps in the 1990s. The combination of this small, accurate munition and the persistent intelligence provided by UAVs led one senior US official to call it "the most precise weapon system in the history or warfare."[11] Though each drone strike is usually followed by reports of civilian casualties, US officials dispute these numbers as exaggerated by the Taliban in their propaganda campaign. Due to the lack of outside reporting in the FATA, these numbers are impossible to verify. By their own count, the US believes non-combatant deaths to drone strikes since 2009 to be only about 20; considering the same source believes approximately 650 militants have been killed in Pakistan during that same time frame, drones strikes seem entirely proportionate and precise to US decision makers.[12]

There is even evidence to believe that the tribal Pashtun themselves know the effectiveness of drone strikes. In a 2010 research report released by the Ariana Institute of Islamabad, 80 percent of interviewees in the Pakistani tribal belt felt that drone strike targeting was accurate. Some respondents even voiced a preference for this tactic over ground operations due to the invasiveness of Army maneuvers.

Despite lack of official announcements from either country, there is nearly undeniable proof that the governments of Pakistan and the US have an agreement concerning the CIA drone program in Pakistan. For starters, the fact that Pakistan, which has American-made F-16 fighter jets in its inventory, has neither protested drone strikes more vocally nor taken any measures to stop these flights, suggests implicit toleration, at a minimum. Whatever the status of the arrangement was in the first several years of the CIA's drone program, it has now evolved into cooperation between the two countries. In an attempt to gain support for the UAV strikes, the Obama administration has granted more control to the Pakistan government over whom to target. Today, many of the targets are directly nominated by the Pakistanis, according to Bruce Reidel, a former CIA officer. The killing of Baitullah Mehsud by CIA-fired missiles, after 15 previous attempts on his life had failed, demonstrates the extent to which American operatives are willing to go to gain Pakistani support and eliminate their enemies. Despite enjoying the benefits from the drone strikes and being intimately involved in their operations, the Pakistani government has declined to officially grant approval for fear of appearing like a Western satellite and consequently losing popular domestic support or igniting civic unrest and violence. Pakistani President Zardari already faces low domestic approval and continued rumors of a military coup to replace him; conversely, NATO allies are so reliant upon Pakistan's support for logistics in Afghanistan, as demonstrated by recent border closings, that they cannot take a harder line.

Regardless of international opinion, the US feels that it is justified both in targeting al-Qaeda and Taliban members in Pakistan and in using CIA-operated drone strikes in this pursuit. Just as important but not explicitly stated is the reality that the US has no other viable options for reaching these critical targets in Pakistan. Despite constantly being at war for nearly nine years, many of those responsible for the events of 9/11 still remain at large. The key leaders who orchestrated those attacks and who still represent a threat to US interests escaped out of Afghanistan into the FATA, where they found sanctuary, free from American forces, protected by local tribesmen, and unprosecuted by the Pakistani government. This safe haven is crucial to the Taliban insurgency inside Afghanistan and al-Qaeda activities worldwide. The plotted attacks against Germany, Italy, France, and the United Kingdom show just how serious this threat remains and how difficult preventing and countering these terrorists can be.

Due to the political sensitivities of the region, it is extremely unlikely that the US will mount ground combat operations to clear these areas. Forays by the Pakistani army into the area have been bloody affairs without much success. It is for this reason that in a rare, unguarded moment in May 2009, Leon Panetta, the Director of the CIA, called the predator program "the only game in town."[13]

Seeing no other options, it is unlikely the US government will completely abandon the use of drone strikes in the face of internal dissent and international criticism. But will it modify its program, transferring control to the military as petitioned by parts of the UN, curbing the number of attacks to reduce collateral damage, or bringing more transparency and limits to its targeting process? Though the global use of drone strikes goes beyond the scope of this paper, it is unlikely this tactic will do anything but continue to grow worldwide. Already more than forty countries now have UAVs, with at least nine of these possessing or seeking the ability to launch weapons from these platforms. In the past few years, the US has fielded the Reaper UAV, a much more heavily armed version of the Predator, and more capable and lethal variants are in development.

Specifically with respect to the CIA program in Pakistan, expansion is the most likely course of action. Keeping the program under the control of the CIA—and the secrecy entailed with such a covert program—allows a certain degree of deniability. Such deniability is important for Pakistan, a necessary ally in OEF, and for keeping options open for future use, either in the Southwest Asia Theater, or in other places across the world where al-Qaeda might flee. The election of a more liberal US government, which espouses to be more in tune to international voices, only brought about further use of drone strikes. Especially now, with internal pressure to begin pulling out of Afghanistan in a year and external calls to prevent al-Qaeda-planned attacks in Europe, the Obama administration must impact al-Qaeda and the Taliban as effectively and quickly as possible; certainly, these conflicting constraints weigh on decisions such as whether to continue to use CIA UAVs and to expand their operations outside of the FATA.

Islamic extremism is now viewed as the greatest threat to US interests since the cold war. Determined to prevent another 9/11, this US administration, like the previous one, considers itself to be at war with a foe who has found refuge in an uncontrolled area of Pakistan, just across the border from a nation where we have been on the ground for the past nine years. Feeling that its ends and means are justified, the US government will continue to defend these drone strikes and find supporters for the program rather than modify it. As Bruce Riedel puts it, "The reason the Administration continues to use [the CIA drone program] is obvious: it doesn't really have anything else."[14] ■

Joseph Dumas is a captain in the USAF. He graduated from the USAF Academy in 2006 and is currently working towards completion of his Master's of Arts with an Emphasis in International Relations from Oklahoma University. Stationed at Hurlburt Field, Florida, Captain Dumas is a pilot with more than 1,000 hours.

List of Abbreviations

CIA	Central Intelligence Agency
FATA	Federally Administered Tribal Area
NATO	North Atlantic Treaty Organization
OEF	Operation ENDURING FREEDOM
UAV	unmanned aerial vehicle
UN	United Nations
US	United States

Notes

1. The military has used many different names to describe unmanned aircraft, including unmanned aerial vehicle (UAV), unmanned aerial system (UAS), and remotely piloted vehicle (RPV). The term "drone" likely arises from the Department of Defense (DoD) use of the "Q" designation (previously for target drones) to label these aircraft since 1997. Though other names will be used in this article, the word drone will be most common, as the media has overwhelmingly adopted this term.
2. P. Alston, "Report of the Special Rapporteur on extrajudicial, summary or arbitrary executions" (United Nations Human Rights Council, 2010).
3. J. Mayer, "The Predator War," *The New Yorker* 85, no. 34, October 26, 2009, 36–45.
4. Ibid.
5. H. Ofek, "The Tortured Logic of Obama's Drone War," *New Atlantis: A Journal of Technology & Society* 27, spring, 2010, 35–44.
6. Mayer.
7. Ofek.
8. Comprehensive study of the legal issues surrounding UAV-fired missiles in Pakistan would be overly in-depth and potentially too esoteric for this piece. Suffice to say, there is a definitive legal issue to this topic which is currently evolving in the international arena.
9. Ofek.
10. Alston.
11. BBC, *Mapping US drone and Islamic militant attacks in Pakistan*, News South Asia, July 22, 2010, http://www.bbc.co.uk/news/world-south-asia-10648909 (accessed February 17, 2011).
12. Ibid.
13. Mayer.
14. Ibid.

USAF Photo

ATTACK OF THE DRONES

2010 was already The Year of the Drone with the highest number of attacks by unmanned aerial vehicles in the tribal areas linking Pakistan and Afghanistan. But now September has become the Month of the Drone with 22 strikes, the highest since the War on Terror began.

After extensively researching media reports, the New America Foundation, a Washington-based think tank, has produced an analysis of the drone strikes. It says 10 terrorist leaders have been killed in the 76 strikes this year. It also says reports put the number of terrorist deaths since the War on Terror began at between 842 and 1,238 and total deaths including civilians at between 1,153 and 1,772.

KEY

AIRSTRIKE DEATH TOLLS

Minimum Maximum

80 20 2 2 20 80

Epicentre of strike

KEY TO MAP

Town or village

International border

Provincial border

District border

Tribal area boundary

Roads

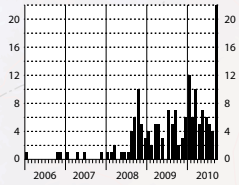
Rivers

ELEVATION (metres)

5,000 and above
4,000 - 5,000
3,000 - 4,000
2,500 - 3,000
2,000 - 2,500
1,500 - 2,000
1,000 - 1,500
800 - 1,000
600 - 800
400 - 600
200 - 400

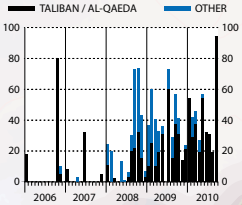
DRONE STRIKES 2006-2010

NUMBER BY MONTH

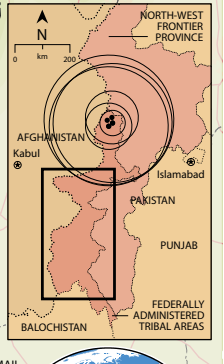


STRIKE KILL RATIO 2006-2010

ESTIMATED CASUALTIES



Bokar
KHYBER AGENCY
Jabba
JAMURD
Kachkot
Khair-ud-din
Dandar
Sursurang
Parachinar
FEDERALLY ADMINISTERED TRIBAL AREAS (FATA)
Bizoti
Tabai
UPPER KURRAM
Burgi
Kurram
Zakhtan
LOWER CENTRAL
Darga
ORAKZAI AGENCY
Bisatu
FR KURRAM
Khanki Bazar
UPPER
Ghuliango
Arkhi
Naray
Sadda
Karmai
ISMAIL
Chinarak
KURRUM AGENCY
April 1, 2009, Khadezai: Between 10 and 12 people killed in strike against Pakistani Taliban commander Baitullah Mehsud's deputy, Hakimullah Mehsud.
LOWER KURRAM
Alizai
PAKISTAN
Darsamand
Ahmadi Shama
HANGU
Thal
NORTH-WEST FRONTIER PROVINCE
AFGHANISTAN
KHOST
BANDA DAUD SHAH
SHEWA
Shewa
Dargai
May 23 2010, Muhammad Khel area: Al-Qaeda No. 3, Mustafa Abu al-Yazid, killed
TRIBAL AREA ADJACENT BANNU
Datta Khel
WAZIR AHMEDZAI TRIBE
SPINWAM
Gumatti
Aziz Khel
Domail
TRIBAL AREA ADJACENT LAKKI MARWA
Pai Muhammad
Bannu
BANNU
GHULAM KHAN
Baka Khel
Sept 22, 2010, Azam Warsak: Attack on funeral for seven people killed in a previous drone attack earlier that day kills between five and 12 more.
Zabo China
Bharat
DHANA BHITTANI TRIBE
Nov 19, 2008 Jani Khel: Between two and five people killed in strike against local militant commander Taj Ali Khan
Boya
MIRAN SHAH
Bibi
MIR ALI
NORTH WAZIRISTAN AGENCY
Jani Khel
LAKKI MARWAT
January 17, 2010, Nizba village: Five Taliban leaders reported killed.
Sheranni
Tut Narai
DOSSALI
Asad Khel
DATA KHEL
Karkanwam
PAKTIKA
Razani
Mazai Raghza
Feb 18, 2010 Dandey Darpa Khel: Mohammad Haqqani, a son of Jalaluddin Haqqani, head of the Haqqani network killed. Haqqani network is linked to several high-profile al-Qaeda attacks in Afghanistan.
GHARYUM
Chapraí
RAZMAK
SARAROGHA
Madamir Kalai
Babar Ziarat
LAKKI MARWAT
Oct. 24, 2009, Damadola area: Taliban Shura is targeted, killing around 25 people.
Mana
Razmak
MAKIN
Razin
Kanazai Kalai
Khaira Khel
Aug. 5, 2009, Zangra: Baitullah Mehsud, leader of the Taliban affiliated group, Tehrik-i-Taliban, dies after being hit in drone strike.
Dabar Miami
LADHA
Kot Tagga
Kachkai
Ahnai Tangi
Juma Gul Manrai
TRIBAL AREA ADJACENT TANK
Chalwekht
Ahmadwam
TIARZA
JANDOLA
Shinn
SOUTH WAZIRISTAN AGENCY
Jandola
Ispana Raghza
Kharqai
BIRMAL
PAKISTAN
Tank
Piquet
SERWEKAI
NORTH-WEST FRONTIER PROVINCE
Kot Murtaza
Oba Sar
Tatai
Nili Kach
Kot Azam
WANA
Kara Khel
DERA ISMAIL KHAN
Oct 30 2006, Chenagai: House of Taliban commander who harboured al-Qaeda fighters targeted killing four.
Khajuri Kach
FEDERALLY ADMINISTERED TRIBAL AREAS
Kot Zafar Baladasti
Spalipon
TOI KHULLA
Khan Kot
Zarmelana
Wazhe Gat Mela
BALOCHISTAN
DRAZINDA
KULACHI



SOURCE: NEW AMERICA FOUNDATION - TERROR FREE TOMORROW, NEWS REPORTS, GRAPHIC NEWS

ANDREW BARR AND RICHARD JOHNSON / NATIONAL POST

LESSONS LEARNED[1]

THE AIR FORCE ON ITS WAY TO CONTINUOUS IMPROVEMENT

BY LIEUTENANT-COLONEL MARIO FORTIN, OMM, CD

CF Photo: MCpl Angela Abbey

"You must learn from the mistakes of others. You can't possibly live long enough to make them all yourself."

Sam Levenson[2]

INTRODUCTION

The Canadian Forces Aerospace Warfare Centre (CFAWC) has been designated as the Air Force centre of excellence for analysis[3] and lessons learned and the manager of the Air Force Lessons Learned Programme (AFLLP). CFAWC includes a branch known as the Analysis and Lessons Learned Branch (A&LL BR). While the first few years were spent researching, discussing, and developing the AFLLP, the lack of doctrine, policy, and procedures significantly impeded any real progress. The A&LL BR did a lot of research and exploration, but could not produce a coherent LL programme until very recently. Early in 2009, the A&LL BR finally developed two pivotal keystone documents, namely the AFLLP Manual and the Air Force Lessons Learned Campaign Plan (AFLLCP). So, it is only recently that the AFLLP has started to take shape and has been articulated into a coherent programme.

Since mid-2009, the A&LL BR has been actively involved in implementing the AFLLP as mandated by the Chief of the Air Staff (CAS). Its stated mission is to rapidly implement an effective AFLLP, driven by commanders (comds) at all levels, that continuously captures operational experience and knowledge and transforms these into capability-improving change. Its current mandate is to develop the AFLLP in order to facilitate analysis of aerospace power issues and the subsequent application of lessons[4] stemming principally from operations, exercises, and near-term war games in both national and coalition contexts. The organization consists of nine officers, one non-commissioned officer (NCO) and two civilians, divided into three small teams, one focused on analysis, another on operations, and the third on exercises.

The programme is currently guided by a small number of capstone and keystone documents, some of which are in the process of being officially ratified by the Air Force senior leadership. The Department of National Defence (DND) Joint Doctrine Note (JDN) 04/08 and B-GA-005-780-AG-001 *Air Force Lessons Learned Programme Manual*, issued in March 2010, serve as the model and guidance for the AFLLP. The Manual provides Air Force policy, doctrine, and procedures to implement the programme. This manual has been designed for use by comds, commanding officers (COs), and delegated officers and lessons learned officers (LLOs) at all levels of command. The AFLLCP is currently under revision and has still to be ratified by the CAS; it will outline the currently accepted Air Force lessons learned procedures and various tasks associated with it.

AIR FORCE LESSONS LEARNED PROGRAMME

In order to accomplish the mission, the AFLLCP has been sequenced into four phases. Phase 1 establishes all the core elements of the AFLLP, concentrating on the specific activities and effects designed to provide the Air LL doctrinal foundation and to enable the capture, prioritization, and management of air observations, issues, and best practices[5] from the full spectrum of Air Force activities. Main activities during phase 1 are the provision of clear and concise AFLL guidance, doctrine, and tactics, techniques and procedures (TTPs) through the development and promulgation of the AFLLP Manual, Air Command Order (ACO), communication strategy, and Air Force critical topics list[6] (AF CTL); as well, effective manning and training of key Air LL positions, particularly at the wing and higher headquarters (HQ) levels, to enable the capturing and passing on of observations, issues, and best practices related to air operations, training, or activities.

Phase 2 concentrates on implementing the Air LL battle rhythm. It will concentrate on full commander engagement to provide regular and cyclical direction and guidance to enable cyclical strategic/operational steering of the AFLLP to occur. Also, the Air Force leadership will provide direction to focus and guide LL collection efforts using the AF CTL and taskings and related information. Commanders at all levels will implement cyclical mechanisms to continuously participate in the full LL process at their level. Doctrinal guidance on how this can be achieved has been developed during phase 1, but the implementation of specific processes tailored to the needs of the individual units and formations will be the responsibility of the appropriate air commander.

Validation of the AFLLP will occur during phase 3. Once the AFLLP has been implemented and allowed to operate in its envisioned form for a full cycle (one year), the effectiveness of the program will be validated. The results of this validation will determine if the goals of the AFLLP have been met, and what program changes are required to improve overall effectiveness. The main effort of phase 3 will be the performance measurement of the program.

Phase 4 is Steady State. This phase will involve the incorporation of AFLLP changes recommended during phase 3, and the continuous identification and implementation of incremental capability improving change to the Air Force. The main effort of phase 4 will be the inculcation of the LL culture that enables capability-improvement changes to be identified and implemented in order to continuously improve the Air Force.

FIVE-STEP PROCESS DESCRIPTION

The aim of the Air Force Lessons Learned (AFLL) process is to effectively capture, document, disseminate, and action observations, best practices, and issues pulled from all Air Force activities in order to improve organizational learning and operational capability. It is designed as a deliberate method of capturing and analysing current best practices for the purpose of developing and implementing broad-scope institutional improvements across the Air Force. This process recognizes both short- and long-term recommendations will result from its analysis of lessons. As well, although the goal of its process is to improve operational capability (i.e., force employment), the primary clients and implementers of the process are its force generators and force developers. The entire AFLL process is command-driven and incorporates centralized knowledge management in order to ensure maximum transparency of capability improvement efforts, and the avoidance of duplication of effort in Air Force development.

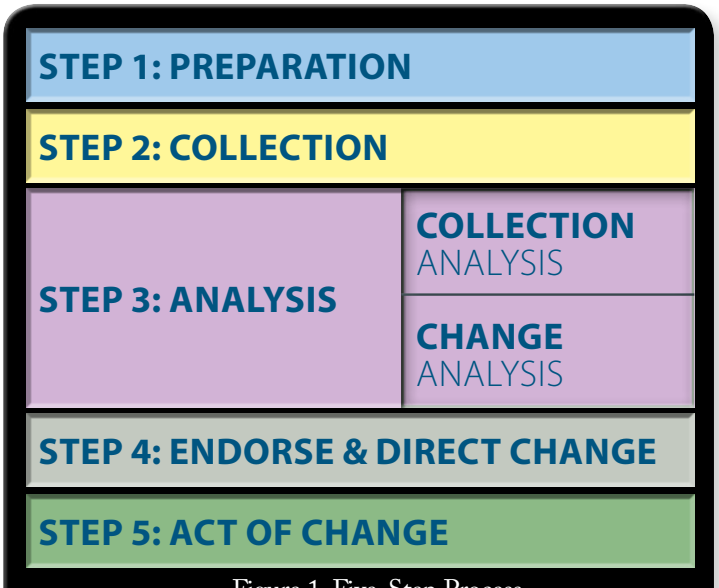


Figure 1. Five-Step Process

The AFLL process employs the five-step DND / Canadian Forces (CF) lessons learned process shown in Figure 1. These steps provide a generic roadmap to implement the AFLLP at all levels of command consistent with the stated principles and fundamentals.

STEP 1 – PREPARATION. The initial step of the AFLL process centres on developing collection and analysis plans for routine monitoring of the events or activities from which LL and best practices will evolve. The keystone document that guides LL planning and priorities at all levels is the annual AF CTL. Lessons learned planning should, to the extent possible, be done collaboratively with other Air Force lessons learned officers (AFLLOs) and stakeholders to maximize the synergy of a wider knowledge and experience base. The purpose of LL planning at each level is to:

- adapt the Air Force / superior level CTL for application at the level of command by preparing an organizationally focused collection plan to best satisfy the information requirements of both the local and superior commanders;
- develop and obtain the responsible comd's/CO's approval on collection priorities, plans, methods, and resources to support the Air Force / Air CTL; and
- allocate resources to support the approved LL/analysis plans.

STEP 2 – COLLECTION. During this step, observations are collected in accordance with the CTL and an LL collection plan developed during Step 1. Observations may be collected from routine event monitoring and reporting in accordance with approved LL collection plans, as unsolicited observations from event observers, and from focused LL projects and reports. The collection should be coordinated and mutually supported by LLOs at all levels of command, and performed by either specially trained LL personnel or appropriately guided event observers. Commanders and commanding officers should facilitate LLO/event observer access to staff meetings, conferences, events, and documents to ensure they are able to provide informed, comprehensive, and accurate inputs and recommendations. Collected observations, both positive and negative in nature, are scrutinized for relevance, then grouped by subject areas as a means of identifying where further collection effort may be needed, and to support subsequent analysis to develop lesson findings.

STEP 3 – ANALYSIS. As depicted in Figure 1, the Step 3: Analysis includes two distinct forms of analysis: collection analysis, which is performed by the LLO, and change analysis, which is performed by the change manager.[7] The collection analysis portion of this step is critical to the success of the LL process as this is when findings and change recommendations are developed, the change scope is assessed, and the change authority[8] is identified. Once the change authority is identified, a change manager will be appointed by the authority to review the results of the collection analysis, and conduct the required change analysis. The change manager may engage a wide range of expertise and stakeholders, such as technical/functional subject matter experts (SMEs), and joint, combined, interagency, or corporate stakeholders who may have an interest in the matter or in a proposed change.

Analysis Scope. Analysis is performed at all organizational levels employing the five-step LL process, but the scope tends to differ by organizational level and authority. Essentially, at each level, the person performing LL analysis seeks to identify problems and best practices, what can or should be done, and who is best positioned to effect the required change(s). Except when a broader mandate has been assigned, the analysis scope conforms to the level of command/activity at which it is performed. Analysis activities commensurate with the scope may, in general terms, be related as follows:

- **Event Observer**. Even persons at the lowest levels of command intrinsically perform an element of analysis when they identify and report lesson items to their LLO. These observations will have required the observer through an

analysis of their observation to note what change may be required and to determine to whom the matter should be communicated for resolution.

- **Lessons Learned Officer.** The LLO is concerned with synthesizing and analysing all collected observations, and where appropriate, seeking specialist advice to identify where change may be appropriate and at what level(s), and what should be done. The change requirements are communicated to superiors as findings and recommendations.

- If the required change is within the scope of the current level of command, this would normally be the extent of analysis performed, and the recommendations are referred to the commander / commanding officer for Step 4: Endorse and Direct Change.

- If the required change is beyond the scope of the current level of command, the matter is referred to the LLO at the next level of command, who will confirm the requirements, scope, and change authority from the perspective of that level. If it is determined that the scope is beyond the current level of command, the matter will be referred to the LLO at the next level for further analysis and resolution.

- **Change Manager.** Change analysis and further refinement of findings and recommendations are normally performed and/or supervised by the change manager. The extent of analysis performed at this level is dependent on the thoroughness of the information available and analysis performed at lower levels of command. It may be necessary to engage SME and other stakeholders to perform further analysis in order to present a comprehensive solution to the change authority.

STEP 4 – ENDORSE AND DIRECT CHANGE. The change authority approves, modifies, or rejects recommendations presented by the LLO / change manager and/or other levels of command. When recommendations are approved, the change authority, with planning and coordinating assistance of the change manager, directs change and assigns resources to effect the desired change for approved recommendations.

- Change action should involve all affected formation/unit commanders and staff to facilitate timely change consistent with the change authority's intent.

- Change direction should be promulgated in written form to all stakeholders of the intent, requirements, and the validation plan.

STEP 5 – ACT OF CHANGE. The change authority implements directed change and then validates that the remedial action is achieving the desired effect. The change authority normally appoints a change manager to coordinate the implementation and validation on their behalf. Once the change has been validated and is achieving the desired effect, it has become an LL. The change manager prepares a communication plan for endorsement by the change authority to inform all stakeholders of the successful validation and pronouncement of an LL. Finally, the change manager will cause the LL to be permanently documented in the LL database and any related policies, directives, doctrine, or procedures.

AFLLP – ROLES AND RESPONSIBILITIES

AIR FORCE LESSONS LEARNED AUTHORITY (AFLLA). The Commander, 2 Canadian Air Division (Comd 2 Cdn Air Div), as the AFLLA, is the custodian of the AFLLP.

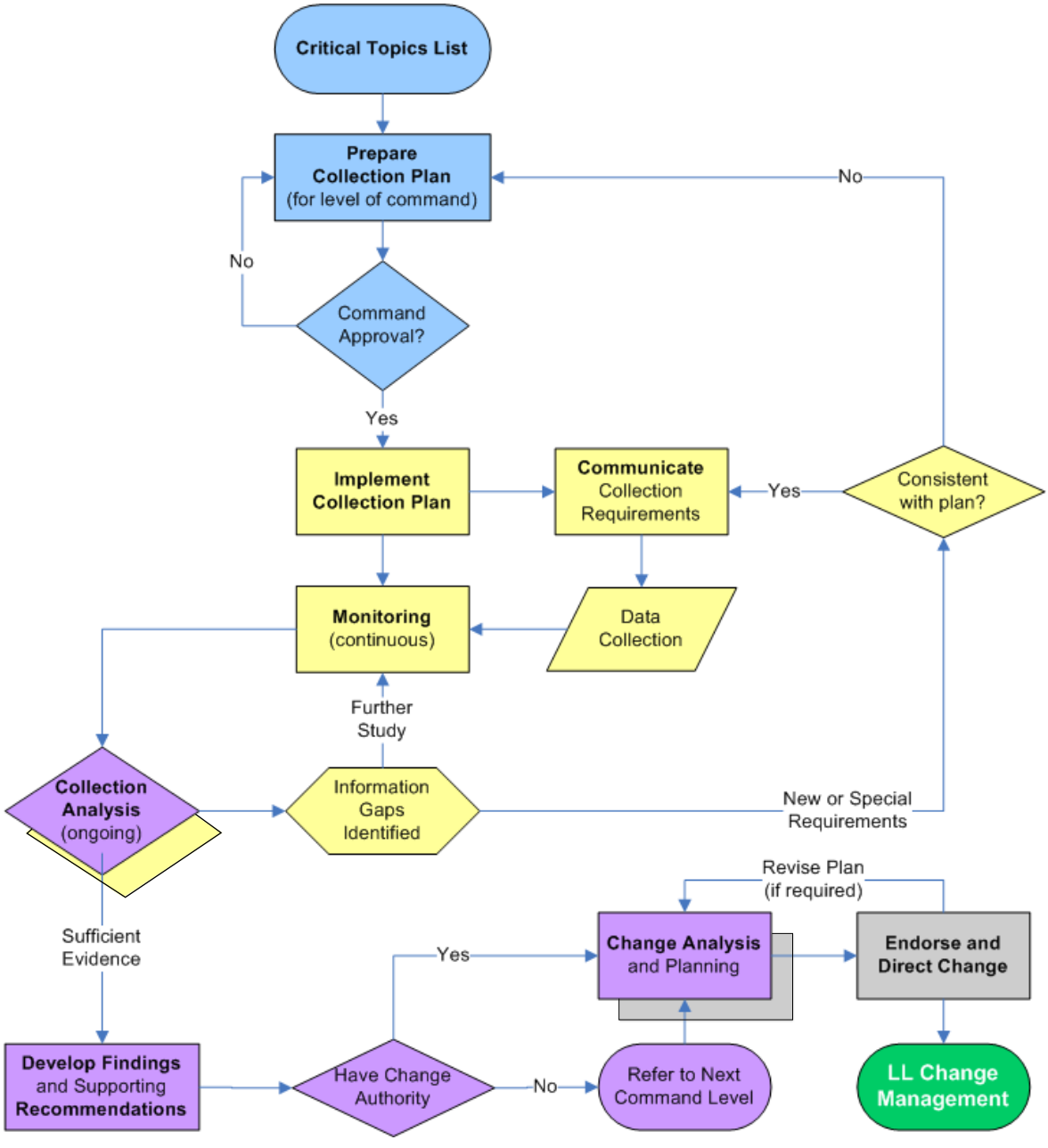


Figure 2. Lessons Learned Process

The AFLLA is assisted in the performance of the programme level activities by the CO CFAWC and analysis and lessons learned branch. As the AFLLA, the Comd 2 Cdn Air Div is responsible to:

- provide a uniform and common AFLL policy and programme consistent with the DND/CF programme for harmonizing LL efforts across and external to the Air Force;

- ensure the AFLLP complements all agreed upon conventions related to information sharing with other organizations in the DND/CF, other government departments, and our foreign military partners and alliances;
- coordinate continuing LL process development with the Chief of Force Development (CFD) at National Defence Headquarters (NDHQ) as required;
- promulgate the AFLL collection of a CTL and any required force employment (FE)-focused Air CTLs, following CAS endorsement;
- promulgate process and procedural guidance as may be required to facilitate the effective Air Force-wide implementation of the approved CTL;
- monitor implementation of the AFLLP to keep the CAS appropriately informed on quality, efficiency, and effectiveness of the effort across the Air Force; and
- address joint operational level LL issues which extend across an organizational boundary into another chain of command and which demand the engagement of more than one commander and/or delegated authority.

CFAWC – AIR FORCE LESSONS LEARNED CENTRE OF EXCELLENCE. CFAWC, by virtue of its structure and mandate, provides the Air Force with a centre of excellence for LL. Consistent with this role, the CO CFAWC is the AFLL office of primary responsibility, and is responsible to the LL authority to:

- maintain oversight of the LL programme components with emphasis on the process and procedural application;
- support within capacity, strategic, operational, and tactical level LL efforts;
- represent the Air Force across the DND/CF and North Atlantic Treaty Organization (NATO) / international LL community in all matters related to the AFLLP;
- act as the conduit for LL matters external to the Air Force, including Air Force elements attached to other CF commands for international and/or domestic operations, and other organizations external to National Defence;
- provide immediate oversight to AFLL community efforts, including quality assurance and programme-level performance measurement;
- act as the Air Force knowledge management database application authority, and articulate the AFLL community's performance requirements to the CO of the Canadian Forces Experimentation Centre (CFEC), the DND/CF functional authority for the knowledge management system (KMS);
- manage AFLL in- and out-service training; and
- manage an LL outreach programme, including national and international LL liaison to support AFLLP development and to facilitate information sharing.

COMMANDERS AND COMMANDING OFFICERS. Commanders and commanding officers at all levels shall implement the AFLLP within their area of responsibility. Command endorsement and promotion of the AFLLP is critical to all four programme components: governance, culture, environment, and process.

This commitment can be demonstrated at formation and squadron/unit level through:

- appointing an LLO and non-commissioned member (NCM) representative deputy;
- providing direction in the form of an LL collection plan based on the Air Force / Air CTL. This is normally developed by the LLO for the commander's / commanding officer's approval;
- approving LL plans and initiatives and allocating sufficient implementation resources;
- encouraging open communication and collaboration across the AFLL community in support of the direction provided;
- ensuring key programme support documents are generated and stored electronically in the LL knowledge management database to support current and future knowledge requirements and analysis; and
- encouraging subordinates at all levels to participate in the LL effort without fear of reprisal.

When acting as a change authority, commanders and commanding officers shall:

- review and approve lesson findings as appropriate, and provide implementation direction for the approved items (lessons identified [LI][9]);
- validate that implemented change for the LI is having the desired effect;
- disseminate to the submitting organization and other stakeholders that the LI progressed to LL, once the change has been validated;
- communicate lesson findings beyond responsibility level/scope to the next level of command for resolution; and
- support LL change direction and validation measures.

CHANGE MANAGERS. Change managers are appointed by the change authority to plan and coordinate and oversee the transition of lesson findings to LI and ultimately to LL on behalf of the change authority. The change manager is normally a senior officer other than the LLO, who is either responsible for or knowledgeable about the findings needing resolution. The change manager plays a critical role in the LL process and is the primary change enabler for the change authority.

LESSONS LEARNED OFFICERS. Lessons learned officers and deputies will be appointed at the Air Staff, air division (div), wing and squadron/unit levels to coordinate their application of the AFLLP. Officers appointed to undertake LL responsibilities will normally report directly to their commander or commanding officer on all matters related to the AFLLP. There should be a mix of both commissioned officers and NCMs contributing to the LL process for a balanced examination and interpretation of events and observations.

AIR FORCE LESSONS LEARNED STAFF OFFICERS' COURSE (AFLLSOC)

The centre of gravity for the success of the AFLLSOC is the program's credibility. The most assured way to achieve this credibility is to establish momentum by generating a core cadre of knowledgeable LLOs with a solid foundation of program knowledge and operational applicability of the LL processes. The AFLLSOC will provide that core cadre of personnel infused with the knowledge to ensure program success.

The initial phase of training of the AFLLSOC is achieved through self-directed study using resources found on

the CFAWC web site (http://trenton.mil.ca/lodger/CFAWC/AF_LL/Index_e.asp?Menu=Training). The EO 401.01, "Describe the Air Force Lessons Learned Program" (http://trenton.mil.ca/lodger/CFAWC/AF_LL/Training/AFLLSOC/AFLLSOC-Training_e.asp), is a prerequisite to attend phase two of the AFLLSOC course, which is a five-day residential program at CFAWC. The distance learning (DL) block of training consists of PowerPoint presentations covering the following topics: programme description, AFLLP, LI and reporting, planning and administrating change, collection and analysis techniques, and knowledge management tools.

COMMAND AND CONTROL (C2)

The CAS has appointed the Comd 2 Cdn Air Div as the AFLLA who, in that capacity, shall promulgate policy, doctrine, and procedures to effectively manage the programme on behalf of the CAS. As illustrated in Figure 2, air division commanders retain full authority over LL activities within their formations, consistent with the AFLLP manual and any supplementary LL collection guidance that may be published by or on behalf of the CAS. The AFLLA is further responsible for the maintenance and periodic review of the AFLLP. The AFLLA has delegated the responsibility for the routine management and coordination of the AFLLP to CO CFAWC. As the delegated AFLL officer of primary responsibility (OPR) and AFLL centre of excellence, CO CFAWC and CFAWC manage the AFLL Program through the A&LL BR.

Generally speaking, LLOs and staffs coordinate with and/or through the LLO at the next level of command as depicted in Figure 2. The heavy dashed lines represent LL activity/

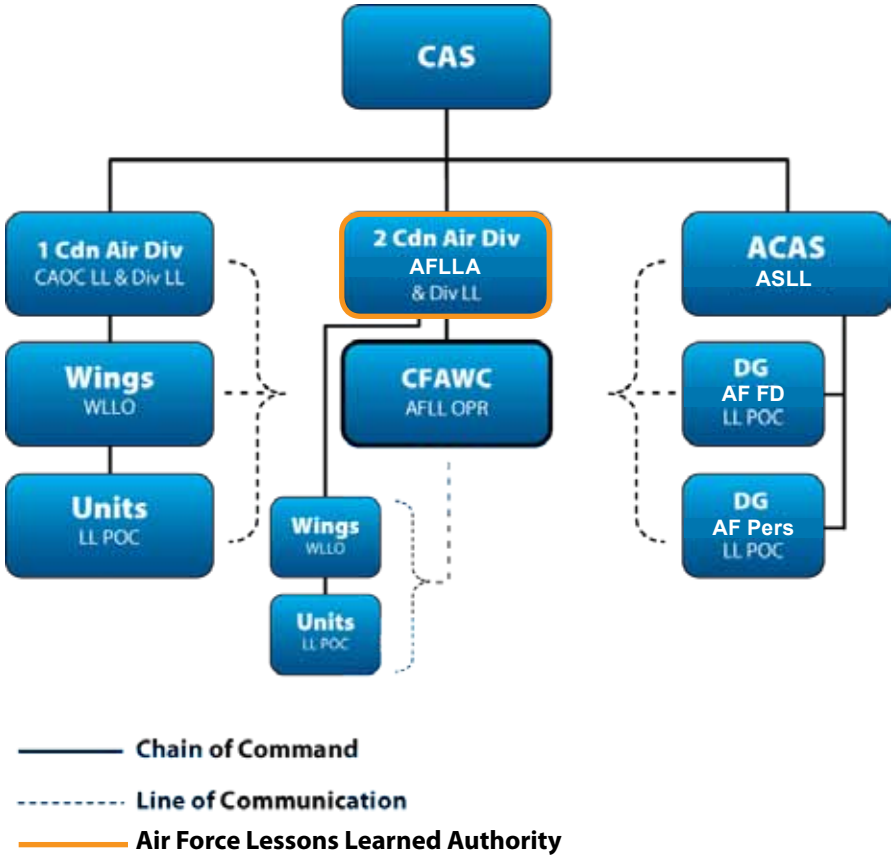


Figure 3. Lessons Learned Communication and Coordination

report coordination and staffing processes, while the dotted/thinner lines represent general programme and process coordination. The AFLLP is applied by the chain of command at all levels, and CFAWC as the AFLL centre of excellence is a coordinating centre for LL matters both internal and external to the Air Force. As the conduit for LL matters outside the Air Force, CFAWC:

- coordinates with FE commands and provides a div/wing LL management role for deployed air resources reporting through their task force commander;
- examines and shares information received from external sources with external stakeholders through their command LL organization, and with Air Force stakeholders normally through the Air Staff lessons learned officer / division lessons learned officer (ASLLO/DLLO) as appropriate; and
- coordinates LL matters for Air Force elements with external LL entities.

The AFLLP respects the chain of command and is supported by a parallel LL coordinating network that reaches within and across the chain of command to facilitate more effective and timely information sharing to support LL at all levels. Key points to note:

- **Air Staff Lessons Learned Officer (ASLLO)**: The ASLLO is unique because of the placement at the strategic level HQ. The ASLLO may routinely need to communicate with other NDHQ LL staff and other government departments/entities. Communication with these organizations will be related only to Air Staff issues, and matters related to the construct or application of the AFLL Programme/Process will be referred to CFAWC.
- **Division Lessons Learned Officer (DLLO)**: The DLLO routinely communicates with the ASLLO for matters of a shared operational and strategic interest, with subordinate wing lessons learned officers (WLLO) related to application of the programme within the air div and with CFAWC for programme coordination and assistance.
- **Wing Lessons Learned Officer (WLLO)**: The WLLO routinely communicates with the DLLO for matters of a shared tactical and operational (or higher) interest, with subordinate unit lessons learned officers (ULLO) related to the application of the programme within the air wing, and with CFAWC for programme coordination and technical assistance. Advice related to the implementation of the div LL programme will be referred to the DLLO.
- **Unit Lessons Learned Officer (ULLO)**: The ULLO routinely communicates with the WLLO for assistance and guidance in the application of the wing LL programme within the unit. Units may seek technical help and advice from CFAWC with the concurrence of the WLLO.

CFAWC has authorized direct liaison with:

- LL staff of FG/employment commands, CFEC and other DND/CFLL entities concerning assigned AFLLP and process-related responsibilities;
- air division LLO and wing LLOs in support of assigned AFLLP advisory and coordination duties; and
- allied LL organizations to support the AFLLP.

OPERATION (OP) HESTIA PROJECT

One of the important projects that CFAWC has participated in at this early stage of the programme is the Op HESTIA Project. This analysis project was undertaken at the request of the Comd 1 Cdn Air Div to objectively examine the C2 of the airlift as a contribution to the existing knowledge base and change processes. The analysis requirement was to examine the appropriateness of C2 processes employed to engage and direct 1 Cdn Air Div air mobility resources providing air lift of humanitarian assistance (HA) prior to arrival in the theatre of operations for Op HESTIA. Ultimately, the intent was to establish the most efficient means to plan and generate air lift to ensure the optimal use of scarce air mobility resources.

Op HESTIA's analysis objectives were to determine the most effective and efficient aircraft task coordination process to support HA operations and to determine the suitability of Air Force doctrine and operating processes related to C2 of air assets. The project focus was at the operational to tactical levels from the perspective of 1 Cdn Air Div concerning the generation of air forces for Op HESTIA during the period from 12 January to 15 February 2010. The main effort involved the participation of 1 Cdn Air Div's combined air operations centre (CAOC), 1 Wing and 8 Wing, and to a lesser extent, some consultation with staff at Canadian Expeditionary Force Command (CEFCOM) and Canadian Operational Support Command (CANOSCOM) involved in the coordination of air requirements to better understand the communication processes employed.

The project focused on C2, task processes, and outcomes from the viewpoint of 1 Cdn Air Div. This study looked at the C2 of two areas related to airlift in support of Op HESTIA. The specific areas of examination were:

- the authority and decisions that underpinned aircraft scheduling and load priorities for Op HESTIA;
- C2 of airlift assets (CC177 and CC130);
- C2 and prioritization of airlifted assets (cargo); and
- existing doctrine, operating procedures, and communication protocols.

THE WAY AHEAD

The AFLLP is just about to complete phase 1 of the programme and to embark on phase 2. As noted above, the AFLLP is a simple process which facilitates the reporting of observations and lessons into the Air Force's decision/action cycle. The process can be applied at any level along the Air Force chain of command. The process depends on a culture of learning and a staff-supported lessons review that analyses current operational experiences to encourage evolution in how the institution is improved. A self-regulating organizational learning culture underpins any professional institution. A professional organization must be able to learn from mistakes and successes, and always remain open to critique and improvement.

Within the Air Force, the LL process and after-action reviews allow units to learn from experience (their own and others') in order to avoid repeating errors and to build on successes, and to enhance organizational learning. We all know that these tools have proven their value in operations—lives have been saved—but they can be applied in other settings as well. An organization that learns is characterized by systematic problem solving, by learning from past experience and the best practices of others, and by the efficient dissemination of knowledge internally. Organizational learning relies on this sharing of information and experiences, and by collaborating on learning and problem solving.

The potential loss of knowledge as experienced people retire is of great concern within the Air Force. Tools of organizational learning can capture and transfer knowledge before people leave. Fortunately, individuals and organizations within the Air Force are aware of the potential for loss of knowledge and are taking steps to address it. It is possible for all Air Force personnel to get involved in the AFLLP to ensure that their legacy helps achieve the success of plans for continuous improvement.

Organizational learning does not need to be complicated or involve a lot of extra work. There are many tools and programs available within the Air Force to help make more effective and efficient use of the knowledge and experience within units, within other elements of DND/CF, and, in some cases, from other organizations. It is all about sharing and learning, and occasionally taking a bit of time to reflect on what we and others are doing and what we could be doing better.

CONCLUSION

Organizational learning is defined as an organization's ability to create, acquire, capture, and share knowledge and skills. It involves using learning processes to find new and better ways of achieving the organizational mission. The AFLLP is that learning process that describes people, things, and activities related to the act of learning from experience to achieve improvements. The idea of LL in an organization is that through a formal approach to learning, individuals and the organization can reduce the risk of repeating mistakes and can improve the chance that successes are repeated. In the Air Force context, this means reduced operational risk, lower cost, and improved operational effectiveness; in other words, we all benefit.

The implementation of the AFLLP will require a solid understanding of the process and engagement by all ranks. The AFLLP is a mechanism to assist in processing observations and recommendations, and where deemed necessary, developing and transforming those recommendations into institutionalized changes, and, thus, into lessons learned. If the institutionalization and inculcation of a true learning culture is to be achieved, it cannot be merely legislated through orders. The success of the AFLLP depends on leadership engagement and total Air Force personnel involvement and ongoing commitment. All must understand and embrace the tenets of the programme. A truly mature, open learning culture is key to ensuring the continued success of not only the Air Force, but also our relevance to the CF and to Canada.

Commanders at all levels will be instrumental in enabling Air Force personnel assigned LL duties to fulfill their responsibilities. This foundational effort is critical to the overall success and longevity of the programme. The ultimate goal of the LL process is to support continuous improvement, from the correction of mistakes to the adoption of successful practices in order to improve effectiveness and efficiency. The AFLLP is one of the ways the Air Force will institutionalize agility, enabling the Air Force to react deliberately and effectively to a continuously changing tactical, operational, strategic, and technological environment. The ultimate goal of the LL process is to support continuous improvement—from the correction of mistakes to the adoption of best practices—all with the objective of improving effectiveness and efficiency. The end result is to help create a continuous learning environment for the Air Force. Our desired end state is an Air Force committed to and capable of effectively and continuously fulfilling two key LL functions:

- capturing experience and knowledge gained during the conduct of operations, training, and routine Air Force activities; and
- developing and implementing capability improving change to address issues and institutionally incorporate best practices identified and captured during the conduct of operations, training, and routine Air Force activities.

Some truisms that will help in implementing AFLLP:

- An AFLLP is not an assessment; there is no pass or fail. It is truly a great opportunity to improve the organization.
- No one has all the answers and everyone has an equal say.
- Keep it professional, not personal.
- Disagreement does not equal disloyalty.
- A leader's job is to bring out the best in people to improve the organization and to accomplish the mission.
- An LL is knowledge or understanding gained by experience. The experience may be positive or negative. One can learn from both successes and failures.
- The greatest legacy that a leader can leave behind is a better organization. ■

Lieutenant-Colonel Mario Fortin is an Air Combat Systems Officer with 7,440 hours flown during multiple tours in search & rescue, strategic, and tactical roles at 435 Squadron (Sqn), 429 Sqn, Canadian Forces Air Navigation School (CFANS), currently Canadian Forces Flying Training School (1 CFFTS), and 426 Sqn. He has assumed a variety of command positions, including commanding officer (CO) 426 Sqn, 8 Wing Trenton, wing operations officer (WOpsO), and CO Rotation (ROTO) 4, Camp Mirage. He has had many deployments, mainly in Africa and Cyprus, and his most recent one, in 2009, was working in the Combined Planning Group with United States Central Command (USCENTCOM) Headquarters. He is currently employed at the Canadian Forces Aerospace Warfare Centre (CFAWC) as the Branch Head of Analysis & Lessons Learned.

List of Abbreviations

A&LL BR	Analysis and Lessons Learned Branch
ACAS	Acting Assistant Chief of the Air Staff
AFLL OPR	Air Force Lessons Learned officer of primary responsibility
AFLL	Air Force Lessons Learned
AFLLA	Air Force Lessons Learned Authority
AFLLCP	Air Force Lessons Learned Campaign Plan
AFLLP	Air Force Lessons Learned Programme
AFLLSOC	Air Force Lessons Learned Staff Officers' Course
AF FD	Air Force force development
AF Pers	Air Force personnel
Air Staff LL	Air Staff Lessons Learned
ASLLO	Air Staff lessons learned officer
CAOC LL	Combined Aerospace Operations Centre Lessons Learned
CAS	Chief of the Air Staff
CFAWC	Canadian Forces Aerospace Warfare Centre
CFEC	Canadian Forces Experimentation Centre
CO	commanding officer
Comd 2 Cdn Air Div	Commander 2 Canadian Air Division
CTL	critical topics list
DG	director general

Div LL	Division Lessons Learned
div	division
DLLO	division lessons learned officer
DND	Department Of National Defence
FE	force employment
HQ	headquarters
LI	lessons identified
LL POC	Lessons Learned point of contact
LL	lessons learned
LLO	lessons learned officer
NDHQ	National Defence Headquarters
Op	operation
SME	subject matter expert
WLLO	wing lessons learned officer

Notes:

1. A lesson learned is a lesson identified for which validated remedial action has been implemented, resulting in a tangible improvement in performance or capability. DND, *Defence Terminology Bank*, Record 41420, http://terminology.mil.ca/term-eng.asp (hereafter cited as DTB).

2. BrainyQuote, http://www.brainyquote.com/quotes/authors/s/sam_levenson_2.html (accessed February 23, 2011).

3. The study of a whole by examining its parts and interactions. Note: In the context of military forces, the hierarchical relationship in logical sequence is: assessment, analysis, evaluation, validation, and certification. DTB Record 33047.

4. In lessons learned, knowledge generated from the analysis of an issue to determine underlying causes. DTB Record 41418.

5. An effective method that is promoted to effect change and to ensure its continued use. DTB Record 41392.

6. In lessons learned, a list of subjects deemed crucial by a commander to focus the data collection effort. DTB Record 41404.

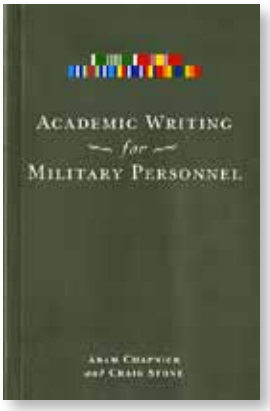
7. An individual responsible to the change authority for analysing, advising, planning and managing change initiatives. DTB Record 41397.

8. An individual empowered to approve change at the appropriate level of command where it is required. DTB Record 41396.

9. A lesson identified for which validated remedial action has been implemented, resulting in a tangible improvement in performance or capability. DTB Record 41419.

BOOK REVIEWS

ACADEMIC WRITING FOR MILITARY PERSONNEL



BY ADAM CHAPNICK AND CRAIG STONE

OTTAWA:
UNIVERSITY OF OTTAWA PRESS, 2009
133 PAGES ISBN: 978-0-7766-0734-4

Reviewed by **Major William March, CD**

What could be more exciting than reading a book for military personnel on how to write an essay? There are times when I think I really need to get a life. However, in all seriousness, this is a useful little book. In a concise, easily-readable format, it strives to demystify academic writing and provide some guidance on this most basic of scholastic requirement. *Academic Writing* should be a welcome addition to the reference library of anyone in uniform who needs to develop, and anyone in or out of uniform tasked with assisting in the development of, this type of writing ability.

Both authors are currently engaged at the Canadian Forces College (CFC), Toronto, in assisting in the professional development of senior officers. While both Chapnick and Stone have impressive academic credentials, Stone also brought to the book the unique perspective of almost 30 years of service in the Canadian Forces (CF). So both individuals have the rare insight associated with being not only familiar with the subject of their book, but also an understanding of the point of view of the audience to whom the book is directed.

The rationale behind this book comes across loud and clear in the opening paragraph, which states, amongst other truisms, that academic writing is "long-winded, incomprehensible, and elitist...[so] why not spend the time and effort on improving staff writing?"[1] At one time or another, we've all been there and had these exact same thoughts (or at least I have); however, the authors make some excellent points in the Introduction as they strive to answer the question: "Why Read this Book?" Perhaps the two most important reasons are that good academic writing "can serve as an effective form of communication with the policy elite both nationally and around the world,"[2] and that it is "more than just writing. It is a process of critical thinking, research, and analysis that can only enhance an officer's ability to do his or her job effectively."[3]

The majority of the rest of the book seeks to explain—and provide guidance on / examples of—just what good academic writing is. They take the reader through a logical progression by describing what makes it good, the research process and the writing process, before focusing on some of the "nuts and bolts" of academic writing, such as the use and abuse of notes and quotes, run-on sentences, passive and active voice, et cetera. Of special note to young officers undertaking this type of writing are the suggestions on how to use the Internet as a research tool, and a whole section dedicated to the "Overusing Abbreviations, Acronyms, and Initialisms."[4] I dare say that with respect to the latter, most of us could learn a thing or two.

There is also an entire chapter focusing on "Evaluating an Academic Essay for Credit."[5] Although I dare say that most of us will never be in a position where we would have to grade an essay, the time may come when we will be required to produce a paper that will be graded. So it is worth the read if only to understand how our work will be assessed. In other words, "know your enemy," so to speak.

Academic Writing for Military Personnel is a short, focused, useful book. For the most part, it

achieves its aim to explain why academic writing is both useful and important, and to provide some basic guidance on how to get started. It does not seek to turn military officers and non-commissioned members into academics; instead, it attempts to provide the basic building blocks to assist in developing a style of research, analysis, and writing that will serve them well in the long run. With this in mind, Chapnick and Stone have produced a good, little book. ■

Major William March, an Air Combat Systems Officer (ACSO), is the Academic Liaison Officer at the Canadian Forces Aerospace Warfare Centre. He has taught Canadian defence and air power history at the undergraduate level and is currently pursuing his doctorate in War Studies at the Royal Military College.

Notes

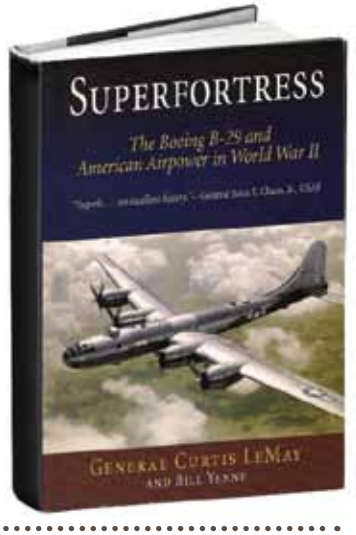
1. Adam Chapnick and Craig Stone, *Academic Writing for Military Personnel* (Ottawa: University of Ottawa Press, 2009), 1
2. Ibid., 2.
3. Ibid.
4. Ibid., 98–99.
5. Ibid., 101–110.

SUPERFORTRESS:
THE BOEING B-29 AND AMERICAN AIRPOWER IN WORLD WAR II

BY GENERAL CURTIS LEMAY AND BILL YENNE

**YARDLEY, PENNSYLVANIA:
WESTHOLME PUBLISHING, 2007
209 PAGES ISBN 978-1-59416-039-4**

Reviewed by **Colonel Peter J. Williams, CD**



General Curtis Emerson LeMay (his mother liked the sound of the name "Emerson"[1]), United States Air Force (USAF), is remembered by most people for two things: first for the inevitable cigar clenched between his teeth, and second for apparently suggesting that America's enemies in Vietnam should be "bombed back into the Stone Age." Though this quote appeared in his autobiography *Mission With LeMay*, written with the help of novelist McKinley Kantor, LeMay later said that he never uttered those words, telling friends and family that, "I was just so damned bored going through the transcripts that I just let it go by."[2]

Legend or not, what is true is that LeMay would command the B-29 bombers which launched devastating raids on Japan in the final stages of the Second World War. Bill Yenne, who collaborated with LeMay in writing this book, is a San Francisco-based author with a specialization in aviation, having written elsewhere on the Boeing Aircraft Company and Strategic Air Command (SAC), which LeMay commanded after the war.

The book covers the story of the B-29 from conception, capability definition development, through what we would call today force generation and force employment. So, the book represents an end-to-end story of this devastating weapon. LeMay was the ultimate (well, sort of; I'll explain later) force employer of the B-29s, and the book is based on a series of interviews Yenne had with General LeMay in 1986, some four years before the general passed away. This material is necessarily supplemented with a

number of secondary sources. While the B-29 was in the final development phases in the US, LeMay was in England commanding B-17s in the Combined Bomber Offensive (along with Britain's Royal Air Force, the RAF) over Nazi-occupied Europe.

In chapters entitled "Getting the Idea" and "Getting the Tools," the authors describe the birth and growth of the concept of strategic bombing in the pre-war US Army Air Forces (USAAF), a period which would result in the development of the B-17 Flying Fortress, and the B-24 Liberator, a prototype of the B-17 actually flying by July 1935. With the attack by Japan on Pearl Harbor in 1941, US leaders realized that the requirement existed for an aircraft of much longer range to be able to reach and bomb the Japanese islands, and so the idea of the B-29 was born.

Development of the B-29 was not without difficulties: engines continually posed problems, and on one test fight, Boeing's leading test pilot, Eddie Allen, was killed when a B-29 (the first experimental version) that he was piloting crashed in February 1943. The aircraft contained many novel features for its day, including a pressurized cabin and remote-controlled gun turrets.

By spring 1943, the B-29s were ready to go to war, and it was initially decided to base them in India and China to fly against Japanese targets in the Asian and Pacific theatres. It was to China that LeMay was sent to command B-29s. Here's where I return to the "well, sort of" remark I made at the outset. The B-29s, being seen as a truly strategic weapon, were grouped under the XXth Air Force, which was in fact commanded by General H. H. ("Hap") Arnold, Commander of the USAAF in Washington, as part of the US Joint Chiefs of Staff. Initial results were not promising, due to the long ranges to be covered and the difficulty in providing logistics to the force. When other B-29s were deployed under General Haywood S. ("Possum") Hansell, they delivered similarly disappointing results, in part due to the horrendous weather which pilots found over Japanese targets. Arnold eventually relieved Hansell, replaced him with Lemay, and concentrated all the B-29s in the Marianas Islands in the Pacific Ocean, thus being Arnold's "agent" on the ground. LeMay, realizing he too would get the axe if he didn't deliver, instituted a number of changes to the concept of employing the B-29s, deciding to remove most of the armament to allow for more fuel and a larger payload, which he determined needed to be of an increasingly incendiary nature, following the ruthless logic that since most Japanese cities were built mainly of paper and wood they would burn prodigiously.

It was the lessons in command and control of airpower that I found particularly fascinating, and which have relevance for modern Canadian Forces (CF) audiences, faced as we are with the next phase of CF Transformation and the ongoing Defence Force Structure Review (DFSR). While LeMay's bombers were based in the Marianas he was in fact a "lodger unit" on one of Admiral Nimitz's bases, the admiral being responsible for the Central Pacific Area of operations. When discussing command arrangements with LeMay, Nimitz expressed concern that he would have no control of B-29 operations. LeMay then showed him the directive he received from the Joint Chiefs in Washington, and in an expression of jointness, Admiral Nimitz said, "If I had known this, I would have opposed it vigorously. I didn't understand it this way, but since the Joint Chiefs of Staff have set up this method, I will abide by it and I can assure you I will give you all the help I can."[3] Nimitz was as good as his word, though LeMay noted that when he had difficulties later with air-sea rescue operations, for which Nimitz was responsible, LeMay dealt with them, and in his own inimitable way, stated that "after raising a little hell and inviting the air-sea rescue crews over to play poker, we got it squared away."[4] That got me to thinking of other uses to which we might put the big conference tables at National Defence Headquarters (NDHQ)!

At a time when the CF is about to take delivery of new maritime helicopters and when the planned purchase of the Joint Strike fighter by Canada makes front-page news, lessons learned from past experiences of developing, integrating, and employing new capabilities provide useful lessons as we move forward, not forgetting that it may be necessary to "raise a little hell" from time to time along the way. Highly recommended. ■

Colonel Peter J. Williams, an artillery officer, is Director Current Operations on the Strategic Joint Staff.

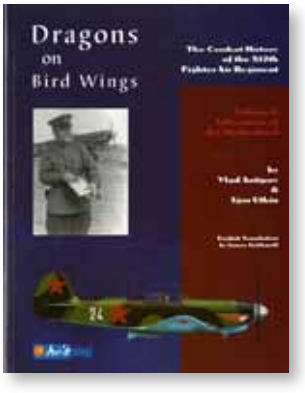
List of Abbreviations

US	United States
CF	Canadian Forces
USAAF	United States Army Air Force

Notes

1. Barrett Tillman, *LeMay: A Biography* (New York: Palgrave Macmillan, 2009), 4.
2. Warren Kozak, *LeMay: The Life and Wars of Curtis Lemay* (Washington, DC: Regnery Publishing Inc., 2009), 341.
3. General Curtis LeMay and Bill Yenne, *Superfortress: The Boeing B-29 and American Airpower in World War II* (Yardley, Pennsylvania: Westholme Publishing, 2007), 100.
4. Ibid., 142.

DRAGONS ON BIRD WINGS:
THE COMBAT HISTORY OF THE 812TH FIGHTER AIR REGIMENT, VOLUME 1: LIBERATION OF THE MOTHERLAND



BY VLAD ANTIPOV & IGOR UTKIN (TRANSLATED BY JAMES GEBHARDT)

KITCHENER, ON: AVIAEOLOGY, 2006
150 PAGES ISBN 0-978-0696-0-9

Reviewed by **Major William March, CD**

When Nazi Germany launched *Unternehmen Barbarossa* (Operation Barbarossa) on 22 June 1941, this invasion of the Soviet Union was the largest military offensive in history. Roughly 166 Axis divisions clashed with 190 Soviet divisions in the start of a bloody four-year conflict that would eventually see the destruction of the German forces on the Eastern Front and the fall of Berlin. That day in June also witnessed the commencement of one of the largest aerial conflicts in history as over 4,000 aircraft of the German *Luftwaffe* squared off against almost 12,000 machines of the *Voenno-Vozdushnye Sily* (VVS, or Soviet Air Force). Flying obsolete aircraft, and hampered by inadequate support and training, the VVS initially were outmatched by the *Luftwaffe* and in the opening days of the campaign almost one–quarter of the Soviet Air Force was destroyed on the ground or in the air. However, by the end of war, the VVS had become a first-class service, with aircraft and pilots that were more than a match for their German adversaries. *Dragons on Bird Wings: The*

Combat History of the 812th Fighter Air Regiment is the story of one of the VVS units that took part in this epic struggle.

Authors Vlad Antipov and Igor Utkin have written a fascinating first volume of the history of the 812th Fighter Air Regiment. Aptly sub-titled *Liberation of the Motherland*, the authors take the reader on a journey that starts in the early days of 1942 with the formation of the Regiment until the closing days of 1944 when the German forces had been pushed back beyond the 1939 borders of the Soviet Union. It is a story of perseverance, growth, and tragedy as the Regiment, born in the chaos of war, slowly evolves from a collection of green air and ground crew into a professional fighter unit. Using exceptional access to Soviet records, and relying on a wealth of personal interviews with veterans, the authors have crafted an excellent study of an oft-neglected area of aerospace power—the Soviet Air Force during the Second World War. Western air forces, Canada's included, tend to focus primarily on the aerial battles over European skies (such as the Battle of Britain, the Bomber Offensive, Normandy Campaign), and spare little, if any, time to examine what was taking place over the Eastern Front. As these two authors frequently point out, the achievements of Soviet air and ground crews were on par with those of their Western counterparts, and in some cases, exceeded them. This may sound like idle hyperbole, but it should always be remembered that the Soviet Union basically had to rebuild its air power after June 1941, both front-line combat forces and support, all while fighting for its continued existence. That they succeeded so well is worthy of careful examination.

I would also like to comment on the exceptional illustrations that are included in this book. The aircraft profiles are executed in exquisite detail, and they will serve to engage the interest of aviation enthusiasts. Also, the maps and diagrams that explore the battles and tactics employed by the Regiment's pilots provide a visual reference point to anchor the accompanying narrative. The combination of the two, diagram and written word, adds a new dimension to understanding the failures and successes of this wartime unit.

Dragon on Bird Wings would not be considered an academic work, nor would it be considered a purely anecdotal history. Instead, I would classify it as a hybrid work that should appeal to a broad range of interests. Antipov and Utkin have written an excellent book, and the executive editor, Terry Higgins, included outstanding diagrams and illustrations to make a product that has exceeded the sum of its parts. There is much to be gained by a careful reading of this book, both by aviation enthusiasts and students of aerospace power. ■

Major William March, an Air Combat Systems Officer (ACSO), is the Academic Liaison Officer at the Canadian Forces Aerospace Warfare Centre. He has taught Canadian defence and air power history at the undergraduate level, and is currently pursuing his doctorate in War Studies at the Royal Military College.

Abbreviation

VVS	*Voenno-Vozdushnye Sily* / **Soviet Air Force**

70th Anniversary Anniversaire

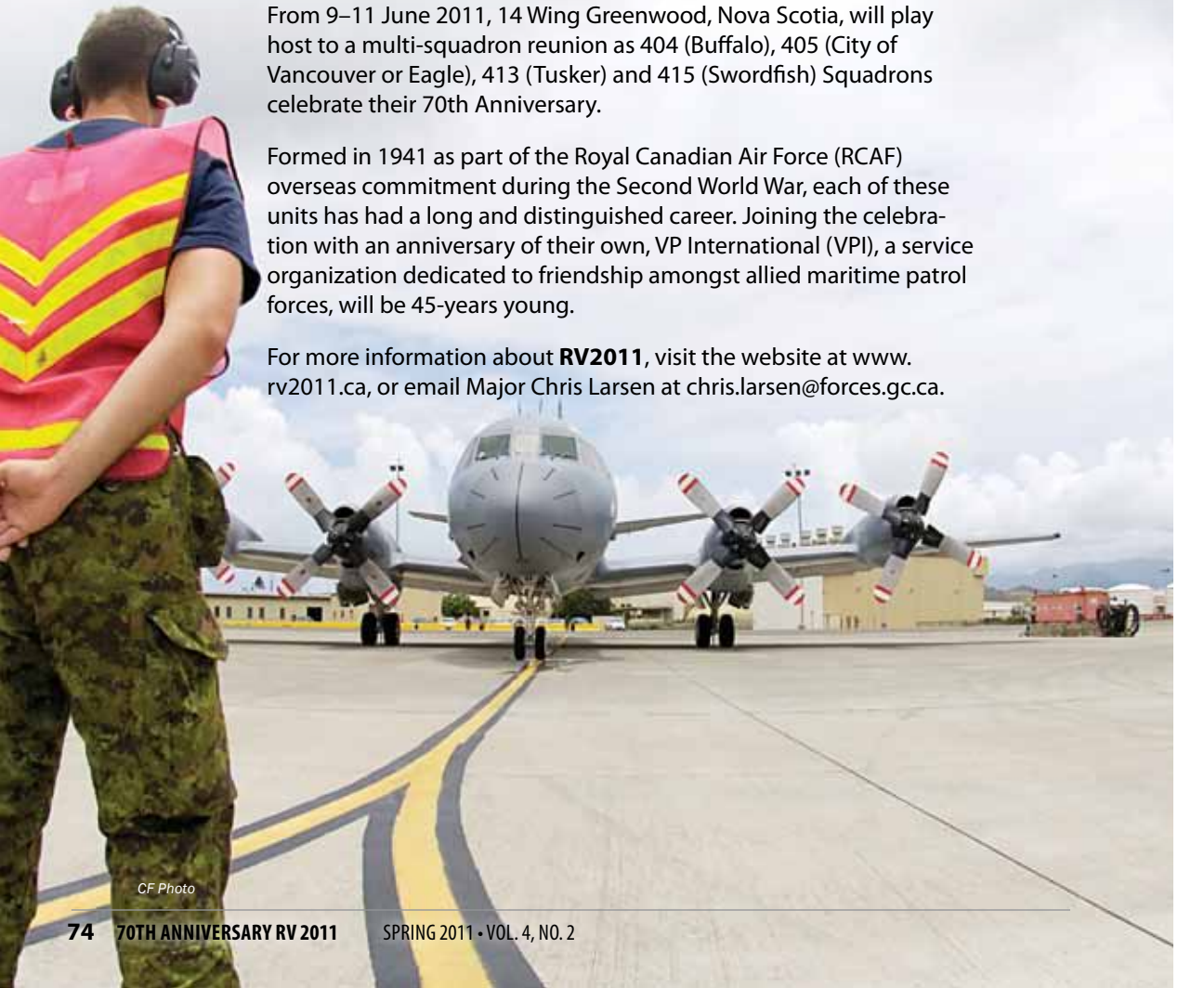
RV 2011

Multi-Squadron Reunion

From 9–11 June 2011, 14 Wing Greenwood, Nova Scotia, will play host to a multi-squadron reunion as 404 (Buffalo), 405 (City of Vancouver or Eagle), 413 (Tusker) and 415 (Swordfish) Squadrons celebrate their 70th Anniversary.

Formed in 1941 as part of the Royal Canadian Air Force (RCAF) overseas commitment during the Second World War, each of these units has had a long and distinguished career. Joining the celebration with an anniversary of their own, VP International (VPI), a service organization dedicated to friendship amongst allied maritime patrol forces, will be 45-years young.

For more information about **RV2011**, visit the website at www.rv2011.ca, or email Major Chris Larsen at chris.larsen@forces.gc.ca.



CF Photo

Air Force Electronic Warfare: Preparing for the Future

By Lieutenant-Colonel John Anderson, CD

Traditionally, electronic warfare (EW) in the Canadian Air Force has, out of necessity, been largely focused on electronic protection (EP) measures—those capabilities that would increase aircraft survivability in a hostile environment. Our thinking on this has evolved over the past 25 years as the Air Force has deployed a variety of aircraft fleets in support of United Nations (UN) and North Atlantic Treaty Organization (NATO) missions. Today, most of our aircraft fleets have had EP equipment installed, and many of our more recent aircraft acquisitions were procured with an EW self-protection capability as part of the basic aircraft suite of equipment. But EW is not limited to EP. The other two elements are electronic support (ES) and electronic attack (EA). The former (ES) is a means of detecting, locating, and identifying electromagnetic emissions while EA offers a variety of means to engage the sources of those emissions. Planned or ongoing acquisition of a variety of new Air Force platforms, or modifications to existing platforms, will see a rapid expansion in both these areas of EW. The CP140 Aurora Incremental Modernization Program (AIMP), Cyclone, Joint Unmanned Aerial Vehicle Surveillance Target Acquisition System (JUSTAS), and joint strike fighter (JSF) will all have significant ES capabilities that will contribute to the emerging Air Force intelligence, surveillance and reconnaissance (ISR) mission. The JSF will also have an EA capability, providing the commander with a more complete operating picture and the capability to deliver a wider variety of effects.

In order to posture the Air Force for this significant expansion of Air Force EW capability, the Canadian Forces Aerospace Warfare Centre (CFAWC), in collaboration with a wide

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range of Air Force, Department of National Defence / Canadian Forces (DND/CF), and allied stakeholders, has undertaken four major initiatives: doctrine, education, knowledge management, and capability development and validation.

Air forces have traditionally spent more energy on doing what air forces do and less energy on writing about it. CFAWC has been focused on changing that trend and is publishing a series of doctrine manuals. The B-GA-403-002/FP-001 – *Aerospace Electronic Warfare Doctrine* was published on the CFAWC website in December 2010. This manual describes how the EW process works at the operational level. The first chapter uses examples of how EW fits into Air Force roles and missions in support of Canadian defence policy. The second chapter establishes a framework for further doctrinal development as the Air Force moves from EW as an enabler of effective Air Force operations to EW as a specific Air Force mission.

In order to ensure Air Force personnel have the requisite knowledge and understanding of how EW affects Air Force roles and missions, it was decided to revisit the way we educate and train ourselves. The aim is to move from what had been referred to as the "EW community," perceived by many as a group of technical wizards practicing a black art, to an EW-savvy Air Force; that is, a wider community of officers and non-commissioned members (NCMs) having the requisite tools in the toolbox to make the best use of EW in the modern battlespace. This initiative has been undertaken with the Canadian Forces School of Aerospace Studies.

Also contributing to reaching a wider audience and raising the general awareness of EW issues, CFAWC added an EW link to the CF Knowledge Management System. It provides a one-stop-shopping approach to the sharing of EW information.

Finally, in order to ensure Air Force EW systems are capable of operating effectively today and have the capacity to continue to operate effectively as technology advances, the fourth initiative—the EW Capability Development and Validation Process—is being implemented. This process coordinates acquisition, intelligence, training, technical engineering, and developmental/operational test and evaluation to capture operational requirements, articulate operational vulnerabilities or capability gaps, develop technical solutions, and capture lessons learned to minimize those capability gaps. It is accomplished through a collaborative effort to identify and assess systems of interest against current aircraft fleet EW capabilities.

By advancing these four EW initiatives, CFAWC is contributing to the successful integration of new EW capabilities within the Air Force, ensuring we have both the capability to operate effectively today and the capacity to continue to do so into the future. ■

Lieutenant-Colonel John Anderson is an Air Combat Systems Officer (ACSO) with two tours flying fighters and EW aircraft and three tours flying tactical airlift on CC130s. He has experience as a project director for a variety of EW projects and is currently the Branch Head for EW and Education and Specialty Training at the Canadian Forces Aerospace Warfare Centre.

List of Abbreviations

CF	Canadian Forces
CFAWC	Canadian Forces Aerospace Warfare Centre
EA	electronic attack
EP	electronic protection
EW	electronic warfare
JSF	joint strike fighter