CANADIAN MILITARY JOURNAL

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The Canadian Military Journal is the independent flagship quarterly publication of the Profession of Arms in Canada. The Journal publishes professional and scholarly articles, commentaries, opinion pieces, book review essays, and book reviews, as well as select Letters to the Editor.

It welcomes submission of manuscripts on topics of broad relevance to Canadian defence and the Defence Team, including, but not limited to, the profession of arms, security and defence policy, strategy, doctrine, operations, force generation, force employment and force structure, technology, procurement, military history, leadership, training and military ethics, institutional culture, recruitment, diversity, etc. Forward-looking pieces that present original concepts or ideas, new approaches to old problems and fresh interpretation are especially welcome.

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    - The second copy: An anonymized version with the author's name, contact information, and bio removed. Named and submitted as "Manuscript X Title-Anonymized"
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- Since the Journal is a bilingual publication, manuscripts accompanied by graphics, tables, figures, charts, or maps which support the context of the article must be sent to us separately in a modifiable format to translate them in either official language. Acceptable formats include Word (.docx or .doc), PowerPoint (.pptx or .ppt), Excel (.xls or .xlsx), Vector file (.ai, .eps, .pdf) and any other format that allows the text to be modified. Any supporting photos must be provided in high resolution (minimum 300dpi) in .jpg or .tiff format for print quality and be followed with their appropriate caption and source.
- Manuscripts should conform to standard academic style, using Oxford English or Petit Robert spelling, with endnotes rather than footnotes.
- Endnotes should be embedded and not attached. Full bibliographic references are to be contained in the endnotes. Consult recent editions for examples of appropriate formatting.
- Acronyms and military abbreviations should be used sparingly, but, if unavoidable, they may be used in the body of the text provided that the term is written out in full the first time it is used, followed by the abbreviated form in brackets. Military jargon and slang terms should be avoided: all manuscripts should be readily intelligible to a general informed public readership.

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Members of the Air Detachment, participating in vertical replenishment practice, aboard HMCS St. John's while on route to the Mediterranean for OP REASSURANCE, on July 16, 2025.

Photo: Corporal Annabelle Marcoux, Canadian Armed Forces

Photo details on page 5.

Photo details on page 75.

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NOTE TO READERS
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Members of Land Task Force NUNAKPUT walk to their observation post during Operation NANOOK-NUNAKPUT near Pond Inlet, Nunavut, on September 9, 2025.

Photo: Master Corporal Antoine Brochu, Canadian Armed Forces Combat Camera

Introductory Note from the Editorial Team

Issue 26.1 returns to diverse content received by way of regular submissions, following a series of special issues in volume 25: CMJ's 25th anniversary. Issue 25.1 offered a deep dive into character-based leadership and concepts in *Fighting Spirit* to complement the CAF's new ethos; 25.2 was a collaboration with our colleagues at the Dallaire Centre of Excellence for Peace and Security to showcase work on human security; 25.3 covered the Arctic, human security, historical perspectives, resilience, and a lived experience piece related to the cover, featuring original artwork by Master Warrant Officer (retired) Robert Bradley; 25.4 explored commitments and burden sharing within NATO.

CMJ issue 26.1 features articles on aviation, the Canadian Military Colleges (CMCs), innovation and evaluation, history, and a book review of *The Enduring Crown Commonwealth: The Past, Present, and Future of the UK-Canada-ANZ Alliance and Why It Matters*. Two aviation-related articles explore how technology and strategies of the past might be of use to Canada in the future. Alexander Michael Daniel's "Over-the-Horizon Radar: Overcoming the 'Aurora Challenge" will interest to radar enthusiasts who remember when the "Arctic" and "Polar" over-the-horizon radar (OTHR) were first introduced. The article demystifies the June 2022 announcement regarding the introduction of a "Northern Approaches Surveillance

System" to modernize the North American Aerospace Defense Command (NORAD). That initiative relies on older OTHR technology. Daniels questions the wisdom of modernizing this technology.

As the Government of Canada releases an Indo-Pacific Strategy and engagement priorities, Captain M.K. O'Brien argues that we should consider the history of Canada's engagement in the Indo-Pacific region. "How Canada's Aviation Past in the Indo-Pacific can Shape its Future" highlights some of Canada's previous engagements in the region: maritime patrol, transportation in Burma, and flying to China.

435 Transport and Rescue Squadron transports evacuees from Oxford House, Manitoba, due to forest fires during Operation Lentus, Northern Manitoba on August 14, 2024.

Photo: Aviator Nicholas Zahari, 17 Operations Support Squadron, Imaging Flight

Modernization is also a topic of interest for Davis' "Innovation by Design: A Design-Thinking Strategy for the Canadian Armed Forces." The government plans to foster a "culture of innovation", which is echoed in Canada's 2024 defence policy update, *Our North Strong and Free*. In response, the Government of Canada has developed two innovation programs. Although well-intentioned, Davis argues that the strategy overlooks the CAF's internal capacity to innovate. "Innovation" is not necessarily the first descriptor that comes to mind for government departments. Yet, the military necessarily is in constant transformation to adapt to a changing environment. Referencing several design and organizational models, Davis suggests that the CAF might become a "truly innovative organization, with a culture that embraces innovation"—provided conditions are right. What are those conditions, exactly? The article lays them out.

In a nod to CMJ's 23.2 issue on CMCs, this issue includes two articles that analyze how institutions foster resilient leaders and experts in the Professions of Arms. Both articles reprise a question from the 1998 Wither's report: What type of junior officer should the CMCs produce? For Chérif, Wilkin, and Townson, the answer is resilient members of the CAF. In "Antifragility at the Canadian Military Colleges: The Resilience Plus Program," the authors outline how the Resilience Plus Program educates and prepares psychologically healthy N/OCdts to become antifragile leaders. The Resilience Program was developed with core CMC values in mind, and includes five components: research, education, training, mentoring, and coaching. The article provides an overview of the program's implementation at CMCs and reviews preliminary findings.

In, "Schrödinger's Soldiers: Reviewing How and Why the Military Colleges Create 'Experts' In the Profession of Arms," Major Dr. Fejes argues that CMCs should produce officers who are experts in the Profession of Arms. These institutions should impart knowledge-based education so that future CAF leaders can apply their skills in new situations, rather than just scenarios for which they

have been trained. The expectation that junior officers should be trained to follow orders and leverage their 40 credits of an undergraduate degree to think critically demonstrates a tension similar to Schrödinger's thought experiment, in which a cat was thought to be both dead and alive. Similarly, CMC graduates cannot be both, at once. Yet, current expectations suggest that they should be critical thinkers who follow lawful orders quickly and proficiently. To de-conflict these tensions, Fejes proposes that CMCs be provided with a clearer mandate, more focused on education.

How to measure the performance of junior officers generated by the CMCs? In, "Measuring the Performance of Canada's Military Personnel System," Hlywa, Hachey, and Urban outline the process used to develop the CAF's performance measurement framework. "What gets measured gets managed," and so the ability to identify areas of strength and improvement should improve results. These articles are snapshots of the CAF's evolution. What were the creators of the performance management system thinking when they developed the program? What issues did they encounter? The article also summarizes lessons learned.

On the topic of innovation and development within the Canadian defence community, NATO Defence College fellow Professor Bessma Momani and her colleague Professor Michele Mosca provide insight into how quantum technology changes the potential for intelligence gathering in defence and security. "Quantum Technologies in Defence and Intelligence Security" calls for a greater investment in quantum research and development.

Lessons learned also inform this issue's section on military history, which features an article by Major Bryce Simpson, "The Second War Without Battles: Canadian Army Deterrence in Germany (1951-1993) and Latvia (2017-Present)." Simpson analyzes the Army's experience with deterrence in Germany from 1951 to 1993, and then thematically explores the relevance of lessons learned about strategy, doctrine, equipment, sustainment, and personnel issues to the contemporary Op Reassurance mission in Latvia.

A book review of *The Enduring Crown Commonwealth: The Past, Present, and Future of the UK-Canada-ANZ Alliance and Why It Matters* concludes this issue.

A note to regular readers, many of whom have contacted us over recent months—we always appreciate hearing from you: resource constraints imposed a delay on printing and subsequent distribution of recent issues. The CMJ editorial and production team is striving to resume our regular quarterly printing schedule. Readers should now have received all four issues of volume 24. Readers can always access the latest and previous issues digitally at journal.forces.gc.ca. We hope to be able to share good news soon about newly transformed ways for readers to access CMJ digitally. Meanwhile, please email cmj.rmc@forces.gc.ca to update your subscription details. Thank you for your patience as we adjust to changing resource constraints while transforming the way CMJ is produced and delivered, online and in print.

CMJ Editorial Team

The northern lights over Inuvik, Northwest Territories during Operation NANOOK-NUNALIVUT on February 28, 2025.

Photo: Master Corporal Alana Morin, Joint Task Force – North, Yellowknife

Over-the-Horizon Radar: Overcoming the "Aurora Challenge"

ALEXANDER MICHAEL DANIEL

Alexander Michael Daniel is a Defence Scientist and operational researcher with the Center for Operational Research and Analysis (CORA) at Defence Research and Development Canada (DRDC). He completed a Master's degree in electrical and computer engineering at the University of Toronto in 2017, and joined DRDC's Ottawa Research Centre that same year, where his research focused on radar signal processing and resource management. Since moving to CORA in 2019, his work has included both machine learning applications to open-source intelligence and operational research in support of NORAD modernization. He is currently a member of CORA's NORAD Operational Research Team at Peterson Space Force Base in Colorado Springs.

On 20 June 2022, when Canadian Minister of National Defence (MND) Anita Anand announced the plan to create a "Northern Approaches Surveillance system" as part of the Canadian government's approach to modernizing the North American Aerospace Defence Command (NORAD), three initiatives were identified as the "backbone" of the new system.[1] Given that two of these, the "Arctic" over-the-horizon radar (OTHR) and the "Polar" OTHR, were to be used to monitor the northernmost reaches of the continent, one could forgive students of history for being skeptical of the announcement: NORAD has tried—and failed—to use OTHR in the Arctic before. A 1967 plan to replace the Distant Early Warning (DEW) Line of radars in the north relied heavily on the use of cheaper OTHR

technology.[2] While there was already some scepticism about the viability of north-facing OTHR at the time of the plan's release, by the mid-70s, whatever "original optimism" there had been was "diminished substantially."[3] A decade passed with little to show for it, and the eventual 1985 plan to replace the DEW Line was to make use of OTHR to look in every direction but north; see Figure 1.[4] Indeed, in their recent (and excellent) book, NORAD experts Andrea Charron and James Fergusson dedicate only a single doubtful sentence to the prospect of using OTHR to replace the aging North Warning System (NWS): "...over-the-horizon radars may provide a solution (assuming the problem posed by atmospheric variations at high altitudes can be solved)...".[5]

Was the MND wrong to entrust our northern flank to a technology with this track record? This article will show why the answer to this question is no. An overview of the history of OTHR in North America is given, interspersed with technical "interludes" which, taken together, illustrate how OTHR works in general, why it failed in previous attempts to use it for Arctic surveillance, and how recent innovations have made it a viable choice for a modernized NORAD.

Figure 1: A map of North America showing the radar coverage of the 1985 plan to modernize NORAD's surveillance system. OTHRs are used for surveillance in all directions but north, where the North Warning System's ground-based radars are used.
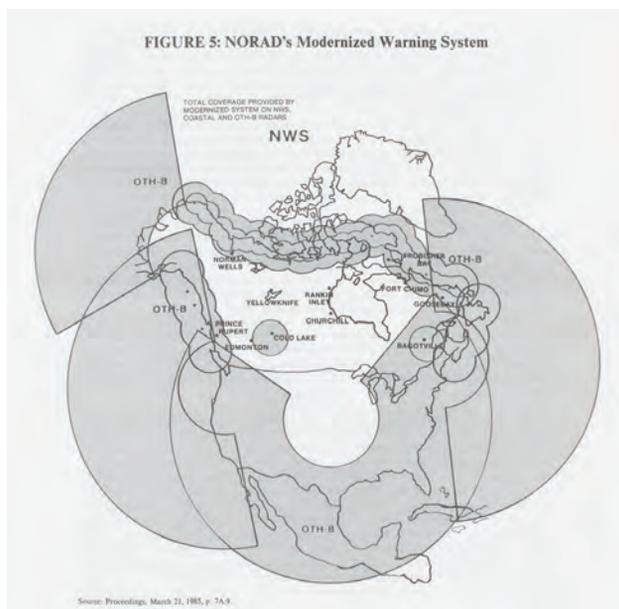
A Brief History of OTHR Development in North America

In the Second World War, radar had, in the words of one author, "altered the basis of warfare more profoundly than any of the inventions that had marked the industrialization of combat."[6] After the war, radar research continued commensurately.[7] Groups in several countries had interest in the development of High Frequency (HF) radar as, in that band (3-30 MHz), waves had unique modes of propagation that could enable detection of targets beyond the radar's usual line-of-sight horizon.[8] By 1956,

the Naval Research Laboratory (NRL) had successfully completed "definitive" experiments showing an HF radar could send a wave through the earth's ionosphere to illuminate an aircraft located beyond the horizon and, subsequently, detect the echoes of that illumination with a receiver.[9] In other words, they demonstrated the possibility of an "over-the-horizon" radar.

Motivated by this success and the contemporaneous advances of signal processing techniques, NRL began the development immediately thereafter of the "Magnetic Drum Radar Equipment" (MADRE) in Chesapeake Bay. Full operation of MADRE began in the fall of 1961, and NRL was soon able to detect and track commercial passenger flights over the Atlantic Ocean; the "program's primary goal of an order of magnitude increase in range for aircraft detection and track was achieved."[10] A separate effort at Stanford in the early 60s developed the "Wide Aperture Research Facility" (WARF), with two sites in California. The WARF improved upon MADRE by providing better spatial resolution in its measurements and ultimately influenced the design of subsequent OTHR systems in both the U.S. and Australia.[11]

By the turn of the century, the U.S. had fielded several operational OTHR systems. These include the AN/FPS-95 (code-named "Cobra Mist"), which was built in the late 60s in collaboration with the U.K. on the east coast of England for the purpose of monitoring "air and missile activities" in the Soviet Union. After scientific tests started in mid-1971 uncovered unresolvable technical errors, the program was ultimately terminated in the summer of 1973, and the radar was dismantled and removed from the test site.[12] The AN/FPS-118 was developed in the late 70s and was included in the 1985 plan to modernize NORAD's warning architecture; see the OTH-B ("B" for "backscatter")[13] radars in Figure 1 and further discussion below. Though two of these radars were built (one each on the east and west coasts of the U.S.), the program was ultimately stopped after the Cold War ended as there was no longer a perceived need for them.[14] Finally, the AN/TPS-71 "Relocatable" OTHR (or "ROTHR")—so named because it could be packaged up in one location and transported/rebuilt at another—was developed in the mid-80s. Originally motivated by the threat of bombers in the air and missile carriers at sea, the ROTHRs, located in Virginia, Texas, and Puerto Rico (and facing south) are now used primarily for drug interdiction.[15] Indeed, the systems are still in use today: in 2021, Raytheon won a five-year contract to operate and maintain the ROTHR systems, which reportedly "contributed to the seizure of 26 metric tons of cocaine from drug smugglers

attempting to cross into U.S. territory" in 2020.[16] Results like these make it easy to understand the claim, in the words of NRL scientist Joseph Thomason, that OTHR is "one of the more significant radar developments since World War II."[17]

Technical Interlude 1 – How does OTHR work?

Though the details become quite involved, there are two basic principles common to all OTHRs that are necessary to understand now to make sense later of the "aurora challenge". The first principle is that of *refraction*, the way electromagnetic waves change direction at the interface between two different media in which the wave propagates. Refraction is caused by changes of the speed of the wave as it enters the new medium and is what causes rainbows and the appearance of a straw bending when submerged in a glass of water (Figure 2).[18] Figure 3 illustrates the concepts relevant to this article. First, when a wave travels from a slower medium to a faster one, the wave bends *towards* the boundary. Second, as the incident wave approaches the boundary, it reaches a point where the refracted wave becomes parallel to the boundary—this angle at which this occurs is known as the *critical angle*. Third, when the incident ray is even closer to the boundary, there is no refraction at all. The ray simply reflects back into the slower medium, a phenomenon known as *total internal reflection*.[19]

Figure 2: A straw in a glass of water. Refraction of light causes the straw to appear bent and disjoint in the water.

Some electromagnetic waves emitted by the sun have such high energy that, when they impinge upon the earth's atmosphere, they ionize the gas they encounter, i.e., they create electrically-charged particles. This atmospheric layer of ionized gas

(technically, a *plasma*), which ranges from roughly 50 to 1,000 km above the ground, is known as the ionosphere. The heavy presence of charged particles in the ionosphere differentiate it sufficiently from the neutral atmosphere we experience at ground level to enable refraction both at and within the ionosphere.[20] Figure 4 provides an exaggerated[21] illustration of how OTHRs can use ionospheric refraction to send waves through the ionosphere and back towards the earth. As the wave enters this toy model ionosphere of discrete layers, it undergoes refraction towards the boundary at each layer. When the angle is so great that a total internal reflection occurs, the wave back is sent down to the earth (where it undergoes refraction several times again). This is the *skywave propagation* that enables the radar to detect targets that go beyond the line-of-sight horizon.

Figure 3: Illustrating refraction (solid blue line), the critical angle (red dotted line), and total internal reflection (magenta dashed line), for an electromagnetic wave traveling from a slower medium to a faster one.
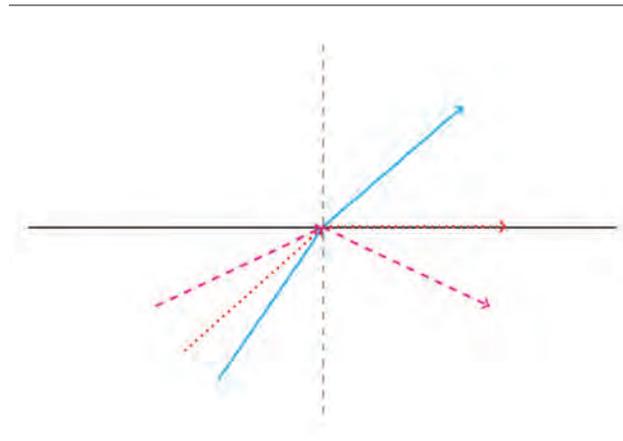
Figure 4: Illustrating skywave propagation via refraction through a toy ionosphere of distinct, homogeneous layers. The skywave is able to see far beyond the line-of-sight horizon of the radar.
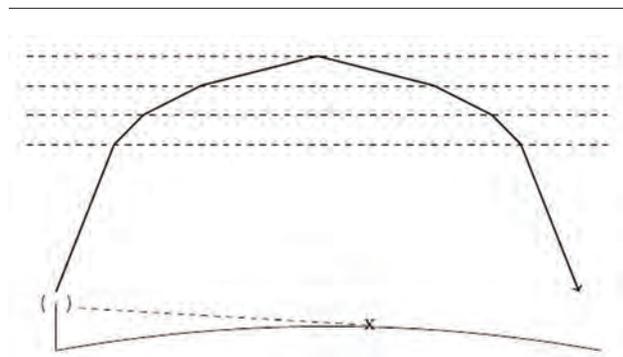
The second important concept is the *beamforming* of antenna arrays. The analogy here is to pebbles in a pond. A single pebble, when dropped in water, produces circular ripples emanating outward from the pebble. When multiple pebbles are dropped, however, the waves they produce undergo *constructive* and

destructive interference, producing patterns far more complicated than any single pebble could produce. Antennas, like pebbles, produce waves with distinctive spatial patterns. When the outputs of many antennas are combined carefully, they too can produce cumulative patterns unlike anything a single antenna could do individually. Figure 5 provides an exaggerated illustration of a *linear* array of antennas (or pebbles) that individually produce waves uniformly in every direction. When all antennas are activated in lockstep, the net interference (at distances far from the array) is well approximated by a single wave propagating normal to the array; however, when the antennas emit waves with a slight offset, the direction of the cumulative wave is no longer normal to the array. Controlling the offset thereby controls the direction of the transmitted wave. Analogous processing can be done with a receiving array, enabling the radar to, for instance, substantially diminish returns (like interference or deliberate jamming) from certain directions.[22]

Figure 5: Illustrating how the combination of outputs from individual antennas can yield plane waves in different directions.
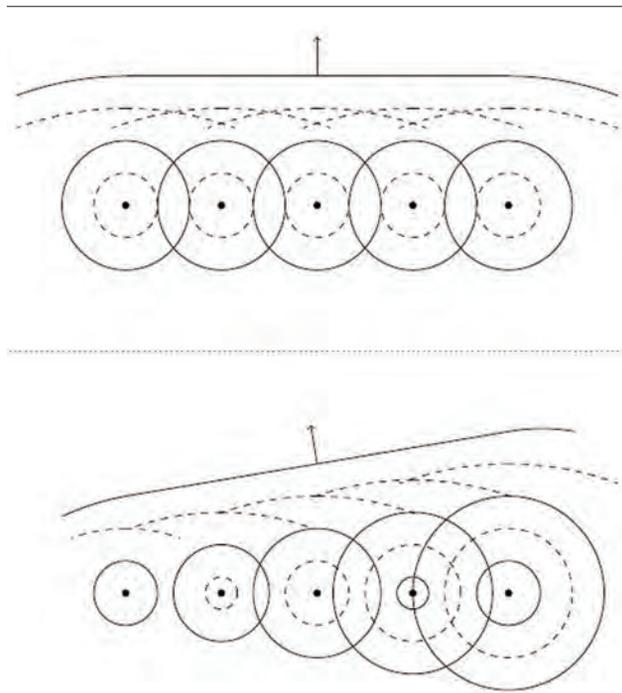
The skywave propagation can enable systems to detect targets as far out as 4,000 km, while operational systems have historically had antenna arrays capable of sending waves at angles as large as 30 to 45 degrees to the left and right of normal.[23] A single OTHR can thus be capable of covering millions of square kilometers, leading NRL scientists James Headrick and Joseph Thomason to describe it as "the most economical sensor on a dollar per square mile basis, where its products and reliability satisfy the mission."[24]

> " Antennas, like pebbles, produce waves with distinctive spatial patterns. When the outputs of many antennas are combined carefully, they too can produce cumulative patterns unlike anything a single antenna could do individually."

The Failure of OTHR in the North

Headrick and Thomason are not the only ones to have appreciated the possible cost savings of OTHR. Although the Distant Early Warning (DEW) Line of radars was completed only in 1957, continental defence planners considered replacing it with OTHR (among other things) as soon thereafter as 1967.[25] The DEW Line was expensive to operate, and, consisting as it did of ground-based radars in the far north, provided a series of easy targets for adversaries, providing only a limited line-of-sight ability to detect them. On all three fronts, OTHR seemed like it would be an improvement.[26] Indeed, the plan estimated that the existing system cost $903 million USD a year to operate, while the proposed replacement system, OTHR included, would only require $342 million a year.[27]

The 1967 plan included a provision approving "a programmed force of two [OTHR] sites beginning in" the 1973 fiscal year.[28] By 1972, this plan was significantly revised—the 1973 target would not be met—to 4 OTHRs, each with 180 degree coverage, with initial operational capability (IOC) by 1977-78.[29] When the difficulties in dealing with the auroral clutter problems for north-facing OTHR are appreciated—see Technical Interlude 2 below—this delay is easy to understand. The experimental "Polar Fox II" OTHR was built in the summer of 1971 in Caribou, Maine, and used in north-facing OTHR experiments in 1971 and 1972.[30] The report for one of the experiments aptly summed up the difficulties: "Under unfavorable conditions, which in Arctic regions north of 60° geomagnetic latitude occur fairly often, a backscatter radar may see the ground only in very limited range sections."[31] The subsequent "Polar Cap III" tests began in December of 1972, with a transmitter and receiver in Hall Beach and a second receiver in Cambridge Bay (now both in Nunavut). The "poor results" over 24 months meant that by 1975, "planners concluded that for the present the

aurora challenge could not be overcome, and directed that studies of alternative approaches be undertaken."[32]

These results required a reversal of a 1973 decision to close the DEW Line (and replace it with OTHR) by 1976. Indeed, such was the outlook on OTHR at the time that in 1976, U.S. Secretary of Defense Harold Brown nearly cancelled the program altogether, despite himself being responsible for the 1967 plan that first brought up the possibility using OTHR for northern surveillance. Though the OTHR program ultimately survived, Brown had no choice but to approve the new Project "Seek Frost" in 1977, which planned to replace the now twenty-year-old DEW Line with modernized ground-based radars.[33] When an agreement to modernize the DEW Line was ultimately finalized in 1985,[34] OTHRs (specifically AN/FPS-118 or "OTH-B" radars) were to be used for surveillance in every direction but north (Figure 1): the aurora challenge could not be overcome.

Technical Interlude 2 – The Aurora Challenge

Consider a person driving in the direction of the sun at sunset (Figure 6). The sun is low enough in the sky that it appears in his field of vision, and due to the intensity of the direct sunlight, it dominates the light that is reflected off the road and any vehicles in front of him.

Figure 6: Direct sunlight interfering with vision of the road. Illustration provided by Sarah Tierney, DRDC Science Visual Documentation Team.

An analogous problem occurs with north-facing OTHR (though as we shall see, rather than it being due to an external source of interference, it something of a self-inflicted wound). Complex interactions between the ionosphere, the Earth's magnetic field, and solar winds produce high-speed irregularities in the ionospheric plasma that "reflect radio waves very efficiently."[35] Figure 7 illustrates how this is becomes a problem for north-facing OTHR. An OTHR based on a linear antenna array (discussed in the previous Technical Interlude) requires a broad beam to ensure "target illumination at all possible elevation angles."[36] Figure 7 shows how, while some portions of this broad beam refract through the ionosphere back towards the earth, other portions illuminate the auroral plasma irregularities. The two thick black lines in Figure 7 have approximately the same length, so any targets illuminated by the upper black ray will appear at approximately the same distance as the irregularities illuminated by the lower black ray: range cannot therefore be used to distinguish targets from clutter.[37] A back-of-the-envelope calculation can be used to show that the auroral clutter returns can be orders of magnitude more powerful than the returns of intended targets;[38] indeed, they can "incapacitate" an OTHR.[39]

Figure 7: The broad beam of an OTHR can illuminate the ionospheric irregularities (red squiggle).
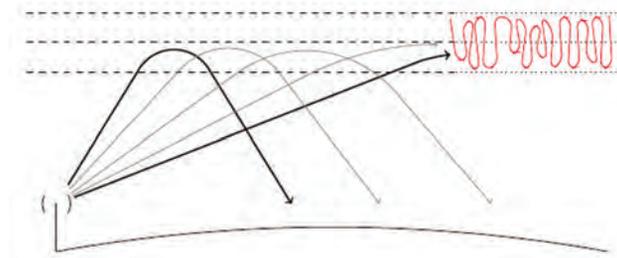
Note that not merely the *presence* of clutter is difficult to deal with. OTHRs at all latitudes must deal with clutter from the Earth's surface, which will also reflect the radar's emissions back towards it. What makes OTHR feasible is the fact that these returns are generally "well-confined in spectral content to the very low Doppler frequencies."[40] In simpler terms, the Earth's surface and things on it move at relatively low speeds, so high-speed targets like aircraft can be distinguished from the low-speed surface

> " In simpler terms, the Earth's surface and things on it move at relatively low speeds, so high-speed targets like aircraft can be distinguished from the low-speed surface clutter by considering the speed of the targets detected, i.e. the Doppler shift of the returned waves."

> **This, therefore, is the aurora challenge: north-facing OTHRs cannot distinguish auroral clutter from legitimate targets of interest either in range or in speed, the two most basic means by which radars in general detect their targets."**

clutter by considering the *speed* of the targets detected, i.e. the Doppler shift of the returned waves.[41] In contrast, the plasma irregularities causing auroral clutter can move fast enough to mask high-speed aircraft, so differentiating auroral clutter from targets using the Doppler shift is not in general possible.[42] This, therefore, is the aurora challenge: north-facing OTHRs cannot distinguish auroral clutter from legitimate targets of interest either in range or in speed, the two most basic means by which radars in general detect their targets.

OTHR in the New Millennium

Again we turn to NRL's Joseph Thomason, who, writing in 2003, describes the state-of-the-art in OTHR at the time: "All operational HF sky wave radars [i.e., OTHR] designs rely heavily on 1970's thinking and technology."[43] Could the new millennium provide new opportunities and approaches to OTHR in the north?

Since 2006, researchers at Defence Research and Development Canada (DRDC), led by Dr. Ryan Riddolls, have been exploring precisely this possibility: "it was the realization that next-generation OTHR techniques being proposed for midlatitude systems, such as planar antenna arrays and multiple-input multiple-output methods, could be applied to attack the unique problems of high-latitude OTHR"[44] [references in original omitted]—see Technical Interlude 3 below. In addition to extensive mathematical modelling, experimental results have been obtained and analyzed using experimental OTHR systems, including a 256-element antenna array in Ottawa and a 1024-element array in Nunavut.[45] This distinguishes the current period of NORAD modernization from the 1967 plan: the latter proceeded in the hopes that north-facing OTHR might eventually be figured out, while the former is occurring only after more than 15 years of study and development on that very problem.

Technical Interlude 3 – Overcoming the Aurora Challenge

Consider again the driver from Figure 6. The sun is overwhelming his eyes, limiting his ability to see the road and vehicles in front of him. Alas, the driver's sensors (i.e., his eyeballs) do not allow him to "turn down" the sun or "turn up" the road. Wearing sunglasses reduces the intensity of the sun's rays but does not improve the *contrast* between the sun and the road. Nevertheless, one feature of this interference can be exploited to mitigate it: elevation. Broadly speaking, the sun is in the uppermost portion of the driver's vision, while the road is only in the lower portions. Lowering the car's sun visor blocks the sun's incident rays, allowing the driver to see the road again (Figure 8).

Figure 8: Spatial processing to null a mainbeam jammer, or in other words, blocking the sun with a sun visor. Illustration provided by Sarah Tierney, DRDC Science Visual Documentation Team.

An analogous idea can be exploited in modern OTHR systems. Recall the illustration of plasma irregularity illumination in Figure 7. Although the part of the beam illuminates the plasma, it is only the lower portion of the beam that does so. Even though auroral clutter occurs at the same ranges and speeds as legitimate targets, the elevation angle provides a means of distinguishing the two, just as the difference in elevation of the sun and road enables Archie to block out one but not the other.[46]

This concept requires the antenna array to be able to distinguish between different elevation angles. Linear antenna arrays, as illustrated in the first Technical Interlude and used in all of the older OTHRs discussed in this article, permit distinction only in azimuth. Adding a second dimension to the antenna array, i.e., using a *planar* array, adds a second dimension in angular control, namely elevation. The two test arrays discussed in the previous section are not just (respectively) 256 and 1024 element arrays—they are 16-by-16 and 32-by-32 square arrays.[47]

The use of a planar array enables, in principle, two possibilities. First, when transmitting using a planar array, the transmit

beam can be steered in elevation (as beam steering in azimuth was depicted in Figure 5) to avoid generating the clutter in the first place. Second, when receiving using a planar array, signal processing techniques can be used to mitigate the input from certain directions as discussed in the first Technical Interlude; this is a closer analogue to the driver and the sun visor. Thus, directions containing auroral clutter can be suppressed, while directions that targets are expected to be in can be (comparatively) amplified.

Conclusion

Despite a history of difficulty in getting OTHR to work for Arctic surveillance, the government has not made a mistake in planning on OTHR forming the "backbone" of the future Northern Approaches Surveillance System. The OTHRs that were built and used beginning in the 60s were linear arrays which could distinguish targets of interest from (nearly) stationary ground clutter, but not from auroral clutter which masked targets in range *and* speed; this is the "aurora challenge" that made all attempts in the last third of the 20th century to use OTHR for Arctic surveillance fail. The modern OTHRs under development by Ryan Riddolls and his colleagues at DRDC overcome the aurora challenge by using planar arrays that enable the OTHR to distinguish between target and auroral clutter in elevation.

Note that details crucial to the successful function of a real OTHR system have been elided in this article in favour of showing how the basic principles on which OTHR operates are familiar concepts from everyday life: rainbows, pebbles in a pond, and the sun in your eyes while driving. Readers interested in greater technical detail will find plenty in the articles written by Riddolls and his colleagues cited in the endnotes.[48]

> " The modern OTHRs under development by Ryan Riddolls and his colleagues at DRDC overcome the aurora challenge by using planar arrays that enable the OTHR to distinguish between target and auroral clutter in elevation."

The previous two sections unfavourably contrasted the "1970s thinking" of past OTHRs with more modern approaches. This is not quite fair. Consider (one more time) the words of NRL scientists James Headrick and Merrill Skolnik, writing in 1974: "The antenna for an HF OTH radar is probably more demanding than for any other radar application. The antenna should be of high gain, cover an extremely wide-frequency range, *be steerable in elevation*, be rapidly steerable over a wide azimuth, and handle high power" [emphasis added].[49] Does this mean that engineers in the 70s could have overcome the aurora challenge after all? Riddolls comes to their defence: "To keep things in perspective, it should be noted that the[se] historical … efforts were carried out at a time when digital signal processing and adaptive array processing was in its infancy, and fully digital multi-channel beamsteering techniques were simply not available to the radar community."[50] So while it may be that case that 1970s *thinking* might have been sufficient to overcome the aurora challenge after all, 1970s *technology* could not.

Notes

1   Government of Canada. 2022. *Minister of National Defence Announces Canada's NORAD Modernization Plan.* June 22. Accessed March 30, 2023. https://www.canada.ca/en/department-national-defence/news/2022/06/minister-of-national-defence-announces-canadas-norad-modernization-plan.html.

2   A brief discussion of this plan is provided in Joseph T. Jockel, *Canada in NORAD, 1957-2007: A History* (Montreal & Kingston: McGill-Queen's University Press, 2007), 66-68, while more detailed accounts can be found in CONAD Command History Division, *CONAD Command History, 1968.* (Joint Staff Headquarters, CONAD, 1969), 1-3 and 59-78, and Richard F. McMullen, The *Aerospace Defense Command and Antibomber Defense, 1946-1972,* (ADC Historical Study No. 39, 1973), 161-163.

3   David N. Spires, *North American Air/Aerospace Defense, 1972-1983* (NORAD Research Report (Contract #F49642-88-C5157), 1992), II-24. The pagination in Spires' book uses Roman numerals for the chapter, and Arabic numerals for the page numbers within a chapter. Expressions of skepticism are described in e.g., Jockel, *Canada in NORAD*, 67-68.

4   The figure is taken from Standing Committee on External Affairs and National Defence. *NORAD 1986* (House of Commons Committee Report, 33rd Parliament, 1st Session, 1986), 29, which also contains further discussion of the plan. The figure is reproduced in Jockel, *Canada in NORAD*, as "Map 7" in the appendix. "Reproduction of the proceedings of the House of Commons and its Committees, in whole or in part and in any medium, is hereby permitted provided that the reproduction is accurate and is not presented as official. This permission does not extend to reproduction, distribution or use for commercial purpose of financial gain," from "Important Notices," *House of Commons*, https://www.ourcommons.ca/en/important-notices, accessed 11 April 2023.

5   Andrea Charron and James Fergusson, *NORAD: In Perpetuity and Beyond* (Montreal & Kingston: McGill-Queen's University Press, 2022), 83-84.

6   Louis Brown, *A Radar History of World War II: Technical and Military Imperatives* (New York: Taylor and Francis Group, 1999), 6.

7   See e.g., Merrill Skolnik, "Fifty Years of Radar," *Proceedings of the IEEE*, Vol. 73:2 (1985), 183-187.

8   J. M. Headrick and J. F. Thomason, "Applications of high-frequency radar," *Radio Science*, Vol. 33:4 (1998), 1045. Note that there are at least two ways the wave can do this: via a *skywave*, propagating through the earth's ionosphere, or via a *ground* or *surface* wave, which adheres closer to the earth's surface. Both can claim to provide visibility beyond the line-of-sight horizon, and so could be reasonably be called "over-the-horizon" radars, but we will use OTHR to refer exclusively to skywave propagation in this article. This article will also not discuss the development of OTHRs outside of North America; see e.g., Ryan J. Riddolls, *A Canadian Perspective on High-Frequency Over-the-Horizon Radar* (Defence Research and Development Canada, TM 2006-285, 2006), 28-29, for discussion and sources about Australian, French, and Chinese OTHR research.

9   James M. Headrick and Merrill Skolnik, "Over-the-Horizon Radar in the HF Band," *Proceedings of the IEEE*, Vol. 62:6 (1974), 665.

10 J. Headrick and J. Thomason, "The development of over-the-horizon radar at the Naval Research Laboratory," *2008 IEEE Radar Conference*, (2008): 1-2; see also Headrick and Skolnik, "Over-the-Horizon Radar in the HF Band," 671.

11 Joseph F. Thomason, "Development of Over-the-Horizon Radar in the United States," *2003 Proceedings of the International Conference on Radar*, (2003):599-601; Headrick and Thomason, "Applications of high-frequency radar," 1047. When researching Australia's OTHR network, the Jindalee Operational Radar Network (JORN), take care to avoid mistaking this for the 2022 album "Over the Horizon Radar" by Norwegian metal band Jorn.

12 E. N. Fowle, E. L. Key, R. I. Millar, and R. H. Sear, *The Enigma of the AN/FPS-95 OTH Radar* (The MITRE Corporation, 1979), 289-291; Thomason, "Development of Over-the-Horizon Radar in the United States," 600.

13 Note that the term "OTH-B" is used sometimes (primarily in the historical literature, like Spires' *North American Air/Aerospace Defense)* as a synonym for OTHR, while other times (primarily in the engineering literature, like Thomason's "Development of Over-the-Horizon Radar in the United States") as another name for the AN/FPS-118 radar specifically.

14 Thomason, "Development of Over-the-Horizon Radar in the United States," 600; Jockel, *Canada in NORAD*, 145-146.

15 Headrick and Thomason, "Applications of high-frequency radar," 1047-1050. Post-Cold War and Pre-9/11, NORAD briefly played a role in "counter-drug operations": see Jockel, *Canada in NORAD*, 147.

16 Naval News Staff, "Raytheon Contracted For US Navy Counter Narco-Terrorism Operations Support," *Naval News*, 24 March 2021, https://www.navalnews.com/naval-news/2021/03/raytheon-contracted-for-us-navy-counter-narco-terrorism-operations-support/, accessed 7 April 2023.

17 Thomason, "Development of Over-the-Horizon Radar in the United States," 599.

18 David Halliday, Robert Resnick, and Jearl Walker, *Fundamentals of Physics* (John Wiley and Sons Inc., 2011), 904-909.

19 *Ibid*., 907-912.

20 See Riddolls, *A Canadian Perspective on High-Frequency Over-the-Horizon Radar,* 3-4, for a longer overview and K. G. Budden, *The Propagation of Radio Waves: The Theory of Radio Waves of Low Power in the Ionosphere and Magnetosphere* (Cambridge: Cambridge University Press, 1985), 1-20, for a more detailed account.

21 Indeed, this account has obscured a number of complicated and subtle details in order to illustrate the basic principles. For instance, an astute reader with a background in physics might notice that the speed of electromagnetic waves in the lower atmosphere is already very close to the speed of electromagnetic waves in a vacuum, the maximum speed permitted by the laws of relativity. Yet in order to bend *towards* the boundary as depicted in Figure 4, the wave in the ionosphere must be travelling *faster* than it was in the lower atmosphere. Resolving this apparent antimony requires careful distinctions between notions like the *phase* and *group* velocities of waves, which is beyond the scope of this article; the interested (and brave) reader is directed to, for instance, Leon Brillouin, *Wave Propagation and Group Velocity* (New York and London: Academic Press, 1960), 1-16, for details. Modelling wave propagation through the ionosphere accurately is important to the success of an OTHR, and models with much greater detail than the illustration in this article have concordantly been developed; see, for example, Thayananthan Thayaparan, Yousef Ibrahim, John Polak, and Ryan Riddolls, "Over-the-Horizon Radar (OTHR) in Canada," *19th International Radar Symposium*, (2018): 1-10.

22 Mathematical details can be found in, e.g., Joe Frank and John D. Richards, "Phased Array Radar Antennas," in *Radar Handbook*, 3rd Edition, ed. Merrill Skolnik (New York: McGraw-Hill, 2008), 13.11-13.13.

23 See, e.g., Tables 20.1 and 20.2 in James M. Headrick and Stuart J. Anderson, "HF Over-the-Horizon Radar," in *Radar Handbook*, 3rd Edition, ed. Merrill Skolnik (New York: McGraw-Hill, 2008), 20.1-20.83.

24 Headrick and Thomason, "Applications of high-frequency radar," 1053.

25 See footnote 2.

26 Spires, *North American Air/Aerospace Defense*, II-23.

27 Richard F. McMullen, The *Aerospace Defense Command and Antibomber Defense*, 161-162. It is not clear form context if McMullen is reporting the figures in the 1966 dollars that would be relevant when the plan was written, or in 1973 dollars relevant when McMullen was writing. Regardless, according to the U.S. Bureau of Labor Statistics, this would be in excess of $6 billion a year in today's U.S. dollars; U.S Bureau of Labor Statistics, "CPI Inflation Calculator," https://www.bls.gov/data/inflation_calculator.htm, accessed 12 April 2023.

28 CONAD Command History Division, *CONAD Command History*, *1968*, 2.

29 CONAD Command History Division, *CONAD Command History*, *1972*, (Joint Staff Headquarters, CONAD, 1973), 38.

30 Lois W. Campbell, Alan H. Katz, and Delbert E. Patton, *Polar Fox II – Experimental Phase Semi-Annual Technical Report*, (Rome Air Development Center, RADC-TR-72-21, 1971).

31 G. J. Grassman and J. Buchnu, *Analysis of Simultaneous Polar Fox II Backscatter and Ionospheric Sounding Data*, (Air Force Cambridge Research Laboratories, AFCRL-72-0432, 1972), 14.

32 Unlike the Polar Fox II tests, unclassified details on Polar Cap III are hard to come by. The above quotes are from Spires, *North American Air/Aerospace Defense*, II-24 - II-25. A further description is contained in Aerospace Defence Command, *History of ADCOM, 1 July – 31 December 1975*, (Office of History, 1976), 20, while Scotty Yool, "Polar Cap III: DRB studies over-the-horizon radar," *Canadian Forces Sentinel*, 9:1, 1973, 24-25 is a brief "photo story."

33 Spires, *North American Air/Aerospace Defense*, II-25 – II-26 and V-6 – V-7.

34 Namely the North American Air Defense Modernization Agreement, signed at the March 1985 "Shamrock Summit;" see e.g., Jockel, *Canada in NORAD*, 121.

35 Headrick and Anderson, "HF Over-the-Horizon Radar," 20.19. See also Riddolls, "A Canadian Perspective on High-Frequency Over-the-Horizon Radar," 18-20.

36 Riddolls, *A Canadian Perspective on High-Frequency Over-the-Horizon Radar*, 8.

37 *Ibid*, 19. Note that Figure 7 here is based heavily on the Figure 6 of Riddolls' article, *Ibid*., 19.

38 Ryan Riddolls, "High-Latitude Application of Three-Dimensional Over-the-Horizon Radar," *IEEE Aerospace and Electronic Systems Magazine*, Vol. 32:12 (2017), 37.

39 Headrick and Anderson, "HF Over-the-Horizon Radar," 20.19.

40 Headrick and Skolnik, "Over-the-Horizon Radar in the HF Band," 665.

41 The Doppler shift of waves is caused by the velocity of the wave added to the relative velocity of the entity transmitting or reflecting the wave and is familiar in the form of the higher-pitched siren of an approaching ambulance transitioning to a lower pitch as it passes by.

42 Headrick and Anderson, "HF Over-the-Horizon Radar," 20.7; Riddolls, "A Canadian Perspective on High-Frequency Over-the-Horizon Radar," 19.

43 Thomason, "Development of Over-the-Horizon Radar in the United States," 600.

44 Riddolls, "High-Latitude Application of Three-Dimensional Over-the-Horizon Radar," 36-37.

45 Ryan Riddolls, "A Canadian Perspective on Arctic and Polar Over-the-Horizon Radar," *2022 IEEE Radar Conference* (2022), 1-2.

46 Riddolls, *A Canadian Perspective on High-Frequency Over-the-Horizon Radar*, 19-20; Riddolls, "A Canadian Perspective on Arctic and Polar Over-the-Horizon Radar," 1-2.

47 *Ibid*., 2. Figures 3 and 5 of that article contain pictures of the arrays.

48 In particular, little distinction has been made between "Arctic" and "Polar" OTHRs; both employ the basic ideas discussed here, but there are important differences nonetheless. See I*bid*., 1-6.

49 Headrick and Merrill Skolnik, "Over-the-Horizon Radar in the HF Band," 667.

50 Riddolls, "A Canadian Perspective on Arctic and Polar Over-the-Horizon Radar," 2.

(From front to back) His Majesty's Canadian Ship (HMCS) Vancouver, Motor Vessel (MV) Asterix and HMCS Ottawa conduct a PHOTOEX in the Pacific Ocean on December 1, 2023.

Photo: Corporal Alisa Strelley, Canadian Armed Forces Photo

How Canada's Aviation Past in the Indo-Pacific can Shape its Future

CAPTAIN M.K. O'BRIEN

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"Canada is a Pacific nation. The Indo-Pacific is our neighbourhood."

– Canada's Indo-Pacific Strategy

On 27 November 2022, Canada released its own Canadian Indo-Pacific Strategy (CIPS), which offers commitments for additional military and intelligence capacity in the Indo-Pacific (I-P).[1] The CIPS signals a clear shift in Canadian foreign policy alignment towards Asia. As a by-product of history and geography, Canada has traditionally been attached to its neighbour to the south and its founding nations across the Atlantic. Given the predominance of Western liberal democracies over the last two centuries, this approach has served Canadian interests well. However, the winds are changing. The I-P is quickly trending towards becoming the economic and political centre of the world, with the rise of China and India contributing significantly to this phenomenon.[2] Concurrent with this ascension, there have been challenges to the rules-based international order (RBIO) by an increasingly hostile People's Republic of China (PRC), Russia, and to a lesser extent, North Korea—all three located in the I-P. We now enter the era of Great Power Competition, with the Indo-Pacific region playing the dominant theatre.[3]

The Indo-Pacific includes much of the Asian continent and Oceania, the vastness of the Pacific and Indian oceans, and 25,000 islands—big and small. The geographic scale and numerous seas that divide it make the Indo-Pacific region a particularly suitable theatre for Air and Navy elements.[4] But in what capacity could Canada meaningfully contribute to the CIPS? Canada has not had significant regional operational experience since the Korean War. Three of Canada's closest NATO allies—the United States, the United Kingdom, and France—have overseas bases and territories in the region that have hosted their forces for decades. Two other Five Eye allies—Australia and New Zealand—call the Indo-Pacific their home. Compared to these countries footprints, Canada's newfound desire to operate in the region might seem misplaced and unsuitable, even if the CIPS makes clear our intent to show our resolve to friends and partners alike.

Despite the distance since Canada's last major operational activities, a significant historical legacy could be built upon. Canada's contributions of Air Power in the Indo-Pacific during the Second World War warrant discussion on two metrics: personality and modern relevance. Regarding personality, it is beneficial to bring the faces and names of heroes to the limelight as part of a public relations strategy. In one study on the formation of stereotypes and attitudes towards countries, "famous personalities" were one of the key cultural dimensions people looked towards.[5] Personality can provide credibility to Canadian presence and add an intimate connection to the region. The sacrifice of named individuals who committed great feats during wartime makes Canada's current operations in the theatre look more like a continuation of such heroics rather than an out-of-place policy conjecture.

Second, Canada's greatest activities and contributions in the region during the Second World War are within capabilities we still maintain and excel at. While technology and tactical practices have changed over the years, there is clear evidence that Canada has maintained and perfected niche capabilities that we used during the Second World War right up into the present day. Through an analysis of Canadian activities and personalities during the Second World War, this paper argues that Canada has a vital regional air power legacy, which it can build upon to become a valued partner. This essay sheds light on Canadian success stories by examining and analyzing case studies in each capability. It offers avenues of approach for future Canadian activities in the Indo-Pacific among allies and partners.

CASE STUDY 1: MARITIME PATROL IN THE INDIAN OCEAN

The Second World War pushed Canada to adopt a total war footing. This change meant a complete mobilization of the nation's resources, manufacturing, and people towards war with the Axis powers of Nazi Germany, Fascist Italy, and the Japanese Empire. Canada would have numerous great achievements during the war—such as the Liberation of Holland, the Juno Beach landings,

the Battle of the Atlantic, and the Italian campaign. Less scholarly and public attention is directed at our more modest contributions in the Indo-Pacific, where thousands of Canadians served in the Pacific War against Japan.

By mid-1942, Japan was at its peak in size and strength, having conquered much of the Far East. There had been a series of devastating Allied losses in the months prior, among them the fall of Hong Kong (where Canadian troops were garrisoned), Singapore, the Dutch East Indies, the Philippines, and the strike on Pearl Harbor. China had been at war with Japan for over five years by this point and lost large swaths of territory, including its capital city. Many Allied commanders had completely underestimated the Japanese and were shocked at the efficiency and speed of their advances and the scale of their losses.[6]

The remnants of defeated British forces in the region consolidated in Ceylon (Sri Lanka), waiting for any possible reinforcements. While news of American participation in the war was the silver lining in an otherwise desperate situation, there were still real fears that the Japanese could completely cut off the British sea lines of communication in the region, leaving India, Australia, and other Commonwealth nations completely isolated.[7] In these circumstances, the British called on Canada to provide further air power in two capabilities: maritime air patrol and transportation.

Royal Canadian Air Force No. 413 Squadron was formed on 1 July 1941 in Stranraer, Scotland.[8] It operated variants of the Consolidated PBY Catalina seaplanes, which were the workhorses of maritime aviation in the North Atlantic.[9] In the months following British losses in the Pacific, No. 413 Squadron was hastily re-located to Ceylon to conduct patrols in the Indian Ocean.[10] It was feared that the British Raj in India would be the next logical target on the back of Japanese offensive successes in the Far East. No. 413 Squadron would spend the rest of the war operating out of a small coastal town called Koggala in southern Ceylon. Their primary role is to provide early warning of the region's Japanese surface and sub-surface activities.

The most prominent Canadian involved in No. 413 Squadron was Air Commodore (then Squadron Leader) Leonard Joseph Birchall. Birchall's role was as pilot and aircrew commander for a Catalina. Within a day of arriving in Ceylon, his crew was expected to begin their patrols immediately. His aircraft was assigned the most southern sector and conducted their searches by flying east-west lines for 150 nautical miles, diverting south by 50 nm, and repeating the process.[11] It was on the last leg of one patrol that the Catalina's navigator persuaded Birchall that he could more accurately confirm their position using the moon if they flew one more sweep south. By this point of the mission, they were approximately 350 nm from the southern tip of Ceylon and were not expected back to base until dawn. This completely banal decision to fly one more leg ultimately impacted history in an extraordinary fashion. Birchall's crew spotted a speck on the horizon, which, through curiosity, led them closer to it. It was

immediately realized that this was a Japanese carrier fleet heading straight towards Ceylon. Birchall's radio operator relayed this information back to base, though they decided to fly closer to the fleet to gauge its size and strength more accurately.[12]

Japanese *Zero* fighters were launched from one of their carriers and shot at the Catalina, forcing Birchall to make an emergency water landing—the crew having to disembark with floatation devices. Two of Birchall's crew were killed when a Zero strafed and sank the floating aircraft. The rest of the crew were picked up by the Japanese destroyer *Isokaze*. During the violent interrogation of the captured crew, Birchall attempted to deflect the question of whether they provided advanced warning to Ceylon by claiming (falsely) that the only one who knew was the radio operator—and the radio operator was one of the dead. The radio operator was safe and among the captured, but the Japanese had no way to confirm their identities or roles. Birchall also claimed that their squadron was based out of Colombo, Ceylon. Japanese signals intelligence eventually proved that Birchall's crew *did* provide advance warning (which led to severe beatings). However, the Japanese bought the lie that the aircraft flew out of Colombo. It was this quick decision that would likely save the bulk of No. 413 Squadron during the Easter Sunday raids on Ceylon, as Koggola was spared from devastating air attacks.[13]

Winston Churchill is reported to have said that "the most dangerous moment of the war [...] was when the Japanese fleet was heading for Ceylon and the naval base there."[14] Despite Birchall's warning, the response from Allied forces was mixed. Colombo's garrison and RAF fighter squadrons were stood up in high readiness while the harbour quickly cleared out. Approximately 60 warships and merchant vessels departed. Despite being on high readiness, the RAF fighter squadrons had not taken to the air first thing in the morning. In fact, some pilots had stood down to make time for breakfast. Allied intelligence, by this point, continued to underestimate Japanese capabilities, even with the numerous offensive successes from the months previously. In this case, the British believed the carrier-based *Zeros* did not have the combat radius for direct strikes on Colombo.[15] Further adding to their woes, Colombo's radar installation had been down for routine maintenance, providing no situational awareness beyond visual line of sight. Japanese *Zeros* made numerous air strikes upon Ceylon over the coming week, destroying nearly 50 aircraft between strafing and air combat. A few ships were also sunk, notably *HMS Cornwall* and *HMS Dorsetshire*, which similarly discounted the combat radius of *Zeros* while sailing within range of the Japanese carrier group.[16]

Despite the appearance of Japanese victory, the Indian Ocean raid holds some similarities to the Battle of Dunkirk some two years prior. In both cases, the Axis forces did not exploit their victory, allowing a sizable body of Allied forces to retreat and live to fight another day safely. But this retreat was only made possible with Birchall's advance warning. Had the Japanese accomplished a similar feat as found in Pearl Harbor—that being a complete surprise—it is possible that the fleet's destruction would allow a follow-on force to occupy Ceylon and dominate the Indian Ocean. This would have threatened Commonwealth allies in the region, the supply lines to China, and Allied access to essential resources, such as rubber and oil.[17] Birchall's warning ensured the survival of the British fleet and spared the relatively defenceless Koggala airfield from Japanese destruction. Birchall would go on to spend the rest of the war as a POW in Japan and serve as an exemplary figure of leadership in the harshest of conditions.[18] He would also retain some connection to Ceylon, having returned there in 1994 as an official election observer. He later led efforts to donate several tons of supplies to local hospitals in need.[19]

The analysis section will examine this capability, its importance, and the significance of Birchall's actions. The following two case studies will examine Canadian capabilities in transportation and resupply on the tactical and strategic levels, respectively.

CASE STUDY 2: TRANSPORTATION IN BURMA

The China-Burma-India (CBI) theatre includes the previous navy-centric activities in Ceylon and the more army-intense Burmese campaign. In this case, Canadians were called upon in 1944 to provide air resupply to ground operations. Here, they would serve in the bordering regions of Burma, with thick, lush jungles, tropical disease, dangerous wildlife, and limited amenities or infrastructure. The terrain and climate were unforgiving; monsoon season would cause seemingly never-ending spells of rainfall, which flooded the lowlands and made what few remaining road networks transform into mud pits. Estimates of the number of Canadian aviators who served vary between 3000 and 7500.[20] The wide discrepancy is due to many aviators being dispersed and assimilated into RAF aircrews already stationed there. Effective logistics stood between life and death in a place with rugged terrain and limited infrastructure. Without constant re-supplies, the fielded troops were at dire risk of starvation, exhaustion, and illness.[21]

Two Canadian squadrons—No. 435 and No. 436—served in the region in 1944-1945. Between the two squadrons, they delivered nearly 60,000 tons of cargo and transported about 30,000 passengers (many of them wounded and sick).[22] Due to the lack of infrastructure, much of this cargo was air-dropped in place. Canadian crews flying Dakotas would circle the drop zone at no more than 600 feet while aircrew would kick the cargo on target. The correct terrain for circling and an experienced crew of "kickers" to know the right moment to jettison the cargo was key to effective delivery.[23] There was very little leeway for error. A missed drop could mean a platoon not eating – or perhaps wasting valuable time scouring for supplies that landed in crocodile-infested swamps.

Every flight held its own inherent risks. In addition to the weather, terrain, disease, and wildlife risks that all soldiers in Burma faced, there was also a significant threat of Japanese

interception in the air. Throughout the campaign, Japanese fighters would constantly patrol and harass Allied aircraft in the skies, which then necessitated the RAF to launch Hurricanes, Spitfires, and Thunderbolts as a protection measure.[24] Even with air supremacy, there was no guarantee of safety, and many Canadians made the ultimate sacrifice during this time. This was the case for the crew of one Dakota that was entirely Canadian in composition and was shot down in January 1945 southwest of Imphal.[25]

Other aircraft disappeared—either due to mechanical troubles or weather—and, due to the thick jungle that covers much of the region, could never be found. One Dakota that had been missing and presumed crashed was that of F/O Joseph Kyle's crew. In June of 1945 (only two months before the end of the war against Japan), his crew took off to conduct operations in the morning but failed to return from their mission. In the disheartening letter that Joe's commanding officer, T.P. Harnett, wrote to his mother, he laments, "[w]e lost one of our best crews when this aircraft failed to return for it had already been mapped out for a great future with my squadron. Joe had many operational trips to his credit and was fast becoming one of my most dependable pilots."[26] The mystery of the fate of the Canadian crew would eventually be solved in 1995, when a hunter in the Burmese jungle found a pocket-watch with Joe's name inscribed on the back, along with wreckage pieces of the aircraft. These were eventually repatriated to Canada and displayed in the Canadian War Museum.[27]

The sacrifices were not in vain, however. The impact of Canadian (and American) resupply is seen when contrasted with the Japanese troops fighting in the same region with limited resources. During the 1944-45 failed Axis offensive into India and subsequent retreat, their losses were estimated at around 100,000—the majority of which were *not* from combat but rather from untreated wounds, illness, and malnutrition.[28] In the same time frame, British losses were approximately 15,000.[29] A newspaper reported, "[a]ir transport is an essential factor in the [Burmese] campaign. We can use this great transport power just where we like [...] Nothing of this detracts from the magnificent work of the army. Still, we must not overlook the essential factor of air supremacy, without which the campaign could not have developed as it did."[30] The introduction of Canadian and American air transportation ultimately turned the tide in one of the most challenging and treacherous campaigns up to that point.

The transportation in the Burmese campaign was inherently *tactical*. The following case study will examine transportation on a more *strategic* level, where aircraft are used to bring large quantities of supplies from one centralized hub to another in support of an entire campaign or theatre.

CASE STUDY 3: FLYING THE HUMP TO CHINA

The civil aviation sector also provided crucial support within the CBI theatre. The Second World War demanded that society transform for total war, just like it did during the First. This meant an expanded military and a transformation of resource distribution and human capital within civilian sectors. Just as the merchant marine fleet was crucial in keeping Britain afloat with commercial and essential goods, civilian airlines performed the same role—but in the air.

As the Japanese Empire expanded, it became dangerous for Allied ships—merchant or military—to sail freely in the Pacific. China had been at war with Japan since 1937 and lost access to all its major ports, from Qingdao to Hong Kong. Japan also had enough control in Southeast Asia to block rail traffic to China. This presented a massive logistical challenge for the Allies. American President Franklin Roosevelt expressed in a letter to General George C. Marshall that "it is of utmost urgency that the pathway to China be kept open."[31] Keeping Japan entangled in a war of attrition with China was essential to the grand strategy of focusing resources in Europe to defeat Germany first before moving on to the Pacific. Had China been defeated, the Japanese could have reallocated troops for service in Burma and India, thus completely undoing the Allied grand strategy.[32]

With ports and land traffic occupied, the only available access to China was through the air. And the only direct route was from Assam (northern India), across the Himalayas, and into Kunming (southern China). This difficult route was called "the hump." Any aviator would fly in the most dangerous conditions, even in the calmest times of the year. Weather was incredibly unpredictable and nearly unflyable during monsoon season, as heavy rain drenched the countryside and would generally be enough to ground all air operations.[33] The debris of hundreds of downed aircraft littered the corridor, creating an "aluminum trail" of destruction.[34] The terrain was mountainous, with thick jungle lining both sides, making any hope of safe emergency landings impossible. By the time the Japanese caught wind of it, they began patrolling the route with fighters based out of Burma. Despite the near-suicidal odds, the India-China airlift delivered over 650,000 tons of supplies, fuel, weapons, and equipment over three years.[35] The brave aviators who undertook such a task were called "flying tigers."[36]

Flying tigers of the China National Aviation Corporation (CNAC) were quite diverse in origin. Despite being a Chinese-state sponsored company, most of its aircrew were American or American-born Chinese. A prominent minority of the crew who served in all roles (navigators, radio operators, engineers, and pilots) were also Canadian, including Archie St. Louis, Russell Weaver, and Harold Chinn.[37] Most prominent of all were two Chinese-Canadian brothers—Albert and Cedric Mah—of Prince Rupert, British Columbia. They initially found wartime employment as flight instructors for the British Commonwealth Air Training Plan. Still, a patriotic desire to be at the front eventually led them both to sign up for the CNAC.[38]

The brothers eagerly took up the profession, flying some of the campaign's most dangerous and tale-worthy flights.

Combined, the two brothers would fly nearly 800 roundtrips across the hump.[39] A particularly memorable flight for Cedric was when his crew was tasked with transporting millions of dollars in Chinese paper currency that had been printed in America. One of the engines in the aircraft went out, and the plane had yet to climb to a safe height above the mountain tops. The aircraft was losing altitude fast, and to prevent a dive, they had to dump nearly all their payload to lose weight. They eventually made it safely to their destination. Still, Cedric, in an interview, expressed amusement over the fact that somewhere in the Himalayan mountains was millions of dollars in unclaimed currency.[40]

Albert Mah displayed one phenomenal act of bravery while on furlough. After landing in Kunming, Albert wanted to visit his remaining family members in China. He disguised himself as a deaf-mute peasant to evade questioning, as his spoken Chinese and comprehension were limited. He also had to find creative ways to get past Japanese-controlled border crossings, and at one point, hid inside of a coffin as cargo in the back of a river-boat.[41] He spent six weeks on leave and arranged to sneak his sister out of China before returning to Kunming.

Recognizing Canada's contribution to the "Flying Tigers" offers additional credibility as a Force Sustainer. The Mah brothers' story shows explicitly the prominent role that Asian Canadians have in supporting Canadian foreign and defence policy in the region. These stories offer a brief snapshot of Canadians' more significant role in the I-P.

ANALYSIS

The three case studies contain similar themes while divulging the diversity of Canadian experience in the I-P. The three case studies show the value of having identifiable personalities who exemplify courage, sacrifice, and heroism. Having one personality embody such magnitude to their singular actions is perfectly encapsulated in Winston Churchill's quote, "[n]ever was so much owed by so many to so few."[42] In case study 1, Leonard Birchall was dubbed the *Savior of Ceylon* for his actions, and the government of Sri Lanka has not forgotten it. The significance of this is only realized with the retrospective hindsight that Ceylon was spared a brutal occupation by Japanese forces. The brutality of such occupations could be seen in China, Korea, Indonesia, Burma, and the Philippines, where Japanese focuses committed mass war crimes.[43] The Sri Lankan High Commissioner to Canada once made a pilgrimage to No. 413 Squadron in Greenwood, Nova Scotia, to pay homage to Birchall's home squadron.[44] The activities of Leonard Birchall, both in Ceylon and the POW camps of Japan, should demonstrate the leadership, dedication, strength, honour, integrity, and peaceful intentions of the Canadian people.

In case study 3, the Mah brothers' familial ties and beliefs in a free China demonstrate Canada's connection to the land and its future. In case study 2, Joseph Kyle shows one of many Canadian aviators making the ultimate sacrifice—a sacrifice that supported

> **"** This experience continued after the war when Canada "earned [...] international admiration and respect as a capable and reliable ally" for the incredible endurance and capability of our CP-107 Argus aircraft patrolling during the Cuban Missile Crisis."

the Allied cause of liberation in Asia. All three are among the many personalities and key figures that Canada could use in a strategic communications campaign to signal our historical commitment to the region and people of the Indo-Pacific.

Despite these case studies all happening during the Second World War, the capabilities detailed are still incredibly relevant today within the Indo-Pacific. In case study 1, it is notable that Canada was specifically chosen for a role in maritime patrol based on our proven record in the Battle of the Atlantic, which Canadian Rear Admiral Leonard Warren Murray commanded. In 1942, it was reported that Canadians were responsible for nearly half of all U-boat kills.[45] Countless other submarines were spotted by maritime patrol aircraft, which then provided the directional warning to naval assets to either evade the enemy or seek and destroy them. Leading the theatre gave Canada significant institutional wartime fighting experience in anti-submarine warfare (ASW) and maritime aviation patrol (MAP).

This experience continued after the war when Canada "earned [...] international admiration and respect as a capable and reliable ally" for the incredible endurance and capability of our CP-107 Argus aircraft patrolling during the Cuban Missile Crisis.[46] Canada also led many ASW exercises within NATO, such as EX *Maple Royal II*, which showed "the growth in stature of the RCN in the NATO forces."[47] Decades later, the skillset has been successfully passed on and indoctrinated between generations of aircrew. This is seen in how Canada has annually hosted the largest NATO ASW exercise, EX *Cutlass Fury,* in recent years.[48] Canada has also won competitive maritime air patrol exercises like the Arctic Maritime Patrol Challenge[49] and EX *Sea Dragon*.[50] All these successes suggest that the MAP and ASW role perfectly suits a country like Canada. Indeed, Canada currently employs MAP in the I-P as part of Operation NEON, which is the Canadian contribution to United Nations Security Council sanctions against North Korea.

This operation has been ongoing since 2018 and has involved the employment of the CP-140 Aurora and Halifax-class frigates to conduct patrols of the East China Sea.[51]

Case studies 2 and 3 both respectively deal with Force Sustainment. The strategic and tactical airlift operations within the CBI theatre were conducted in rugged terrain, terrible weather, and with only basic infrastructure in place. Additionally, many strategic airfields and bases in the I-P are located on small, isolated islands with thousands of miles between them. These conditions are very similar to those found in Canada's very harsh and barren climate in the north (albeit Canada's arctic weather could be considered less ideal). One RCAF officer said, "Due to the long distances, largely desolate landscape, lack of infrastructure and communications, and difficult weather conditions experienced in Canada's Arctic region, [sustainment missions in the north] should be considered a domestic expeditionary operation."[52] To illustrate the distance of sustainment, 8 Wing Trenton to CFS Alert is approximately 4200 km—roughly the same distance as Okinawa, Japan, to Singapore.

Expeditionary operations conducted today also ensure that Canadian airlift capabilities are utilized in a multitude of climates and terrain, including Operation IMPACT in Kuwait, where the CC-130 Hercules provided tactical airlift capability to allies and partners;[53] or Operation HESTIA, where CC-177 Globemasters provided a mass of food aid, mobile hospitals, and military resources to Haiti during the 2010 earthquake.[54]

The next natural question is *where* Canada could contribute these capabilities to the I-P. The United States, New Zealand and Australia are among three of Canada's closest allies. They have begun conducting maritime air patrols in the South China Sea (SCS) with their P-8 Poseidon aircraft, basing them out of the Philippines, Malaysia, or Singapore.[55] These mission sets partly support the interests of ASEAN nations, which have expressed discomfort and concern over the PRC's belligerent SCS policy.[56] Providing a CP-140 to conduct operations here could go a long way in gaining influence with nations who desire situational awareness over PRC intrusions in their economic exclusion zones. All these missions for allies and partners would require sustainment, mainly if a permanent Canadian presence existed in one or two locations in the I-P. ASEAN nations—such as the Philippines—have already expressed interest in expanding this capability to meet their needs.[57]

Base location-wise, Canada could seek to integrate into existing alliance blocs. The Five Power Defence Arrangement involves the United Kingdom, Australia, New Zealand, Singapore, and Malaysia—all Commonwealth nations. Part of the alliance entails accessing the Australian RMAF Butterworth Air Base in Penang, Malaysia, and the British Defence Singapore Support Unit in Sembawang, Singapore. Another option would be the AUKUS, which involves three FVEY nations—the United States, Australia, and the United Kingdom. I-P nations—such as Japan and Singapore—have offered public support for AUKUS, with Singapore specifically requesting Australia to take a more significant part in regional security.[58] The Philippines has also shown itself open to greater integration, with its military now conducting joint patrols with Australia in the South China Sea[59] and opening four bases to the United States.[60] Canada—as part of Operation HORIZON and NEON—has already temporarily used existing military infrastructure to conduct expeditionary operations in the I-P. The next natural step in the CIPS is making this enduring by seeking permanent basing accommodations and conducting operations all year round as our closest allies already do. This is the only way to signal that Canada's desire to conduct operations, defend the RBIO, and seek greater integration with the I-P is *severe* and not transactional.

CONCLUSION

The Indo-Pacific is a vast, diverse, and engaging region quickly becoming the world's most economically important hub. It offers excellent trade opportunities for Canadian investors. However, it also poses significant risks and potential for conflict. A delicate Canadian touch is most necessary in these developing fault lines.

With the CIPS now released, Canada's political and military leaders must look for avenues of approach for diplomatic exchange and operational opportunities. Looking back at the history of Canadian engagement provides us with the basis on where we should start, what kind of activities we should do, and on what credible basis or right we must do it in the first place. Bringing personalities to the forefront of strategic communications makes selling the message easier, as it shows the inherent character of the Canadian people on display. This amplifies the CIPS's message—that Canada is a Pacific nation and the I-P is our neighbourhood.

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Royal Military College of Canada (RMCC) cadets form up on the RMCC Parade Square during the National Day of Honour on May 9, 2014 at Kingston, Ontario.

Antifragility at the Canadian Military Colleges: the Resilience Plus Program

LOBNA CHÉRIF, MEAGHAN M. WILKIN & COURTNEY TOWNSON

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"I am not what happened to me, I am what I choose to become."

– Carl Gustav Jung

Despite widespread interest in the study of resilience since the 1970s, there has never been a universally accepted definition of the concept. It is generally accepted, however, that resilience encapsulates a mental, physical, emotional, and behavioural ability to face, cope, overcome, grow from adversity, and adapt.[1] Adversities, or stressful life moments, can range from situations that disrupt an individual's equilibrium to trauma or serious injury.[2] While some research treats resilience as a trait that is relatively stable within individuals, other research indicates that resilience can be learned.[3,4] The research on resilience shows that individuals with strong resilience skills fare better in a variety of domains than those with weaker ones. Accordingly, two decades of research shows resilience can predict a lower risk for depression[5,6] and greater success in academics.[7,8] Numerous studies highlight the importance of enhancing mental fitness and resilience in healthy populations by improving performance and reducing maladaptive behaviours.[9,10]

Resilience-focused programs are now offered in many civilian universities as part of their transition support or as part of their overall wellness program offerings (for a list of resilience courses/programs currently offered in Canadian universities, see Wood and Chérif 2022[11]). For instance, 7 out of 21 civilian universities in Ontario (Canada) offer resilience-based courses or programs to their student body. These resilience-based programs are primarily course-based (53.3%), and of these course-based programs, 25% are academic in nature. However, it is not mandatory for students to take these courses (i.e., they are considered electives; Wood and Chérif 2022[12]). Resilience is also recognized as a strategic priority for most post-secondary institutions.[13] Similarly, the Canadian Armed Forces (CAF) and military organizations in other countries (i.e., the British Army and the Australian Defence Force) have successfully adopted resilience-based programs in their training curricula (i.e., Canada: Road to Mental Readiness; British Army: Mental Resilience Training; and Australian Defense Force: BattleSMART). The U.S. Army's Comprehensive Soldier and Family Fitness Program (CSF2) serves as a scientifically validated example of a successful military resilience program with positive results.[14] Effective resiliency training can result in improved self-efficacy, cognitive control, self-awareness, academic achievement, goal attainment, overall academic and workplace productivity, as well as decreased stress levels and stress perception.[15,16,17] Furthermore, being resilient also predicts decreased risk for the development of mental illness, such as depression,[18,19] and greater academic success.[20,21] Not surprisingly, Canada's military colleges have also started designing and integrating resilience-based programs into their educational resources.

The Canadian Military Colleges (CMCs) are highly selective institutions that have high standards for applicant acceptance. That is, applicants must be in excellent physical health, have obtained a high school diploma (or equivalent), have acceptable results on standardized tests, and have a clean criminal record. Compared to their civilian counterparts, Naval and Officer Cadets (N/OCdts) face additional challenges once they attend the CMCs. When this article was submitted, during their undergraduate studies, students were required to maintain the "four pillars" of excellence. They must adhere to a strict code of conduct and pass their military training (the military pillar); maintain high physical fitness standards, and complete not only yearly CAF testing, but a specialized physical performance test unique to the CMCs (the fitness pillar); become bilingual and proficient in the two official languages of Canada (the language pillar); while maintaining a high academic standard by passing all their classes every semester (the academic pillar).

Military and academic programs at the CMCs are designed to prepare N/OCdts for future military operations. With that objective in mind, N/OCdts are given opportunities to learn and practise "thinking-outside-the-box" skills within a controlled environment. The goal is for cadets to be able to draw on their training and well-developed skills when they face unpredictable and more significant challenges in the future. Aside from the mandatory classes in a cadet's field(s) of study/degree progression, the CMCs provide mandatory classes for all cadets to attend, including, a variety of military history and military psychology courses. In addition to their combat training, the CMCs also recognize the importance of providing N/OCdts with the necessary training to be successful in life. The aim is not simply to churn out soldiers with tactical and technical skills, but to produce well-balanced

> **" The research on resilience shows that individuals with strong resilience skills fare better in a variety of domains than those with weaker ones."**

individuals capable of handling stress and new challenges with both mental and physical acuity. The CMC programs promote the overall welfare of cadets through a variety of programs. For example, at RMC, N/OCdts can access the Sentinel program, which focuses on a peer-led support system that works in conjunction with the Padres and mental health services. Additionally, there are several student support centres such as the Success Centre, a safe space for students to seek guidance for work, access to financial services, tutors, and a quiet space to study; and the Writing Centre, where students can receive guidance for various academic activities that involve writing skills, presenting, and preparation.

The Resilience Plus Program

The Resilience Plus programme was originally developed based on the core values of the RMCs. It has recently been updated to support the cultural evolution of RMC and, more broadly, the CAF. In particular, the five main components of the program (research, education, training, mentoring and coaching) respond to Justice Arbour's[22] call for the development of the soft skills of N/OCdts. At Justice Arbour's call to strengthen the "soft skills" of the N/OCdts:[23]

"Members need communication skills, interpersonal skills, problem-solving and conflict management skills, creativity, flexibility, work ethic, mutual respect and empathy. This includes learning to speak up and communicate effectively around difficult issues (like sexual assault and misconduct), to resolve conflicts respectfully, and to help team members understand how to treat others fairly." (p. 216)

To help address this, the Resilience Plus program aims to strengthen N/OCdts capacities to thrive while at the CMCs and to prepare them for future responsibilities as CAF leaders who will contribute to ongoing culture change initiatives. The program builds on the science of positive psychology and is based on the PERMA model of well-being. The PERMA model emphasizes five core elements of well-being: Positive emotion, Engagement, Relationships, Meaning, and Accomplishment.[24,25] Additionally, the Resilience Plus program's five core components are designed to help N/OCdts build their leadership and antifragility not only during their time on campus, but also to go forward in their careers within the CAF. Antifragility, originally coined by Taleb,[26] refers to the concept of coming back from adversity stronger and better before being confronted with it. Taleb[27] introduced the concept of "antifragile" systems, which "thrive and grow when exposed to volatility, randomness, disorder, and stressors." In other words, when pressure is applied to a system, it grows stronger. Just like these systems, antifragile people do more than withstand or overcome adversity. They turn closed doors into open ones. They turn existential threats into lessons. They turn personal tragedies into movements. After going broke, Walt Disney sold his

> **"** Additionally, the Resilience Plus program's five core components are designed to help N/OCdts build their leadership and antifragility not only during their time on campus, but also to go forward in their careers within the CAF."

favourite character, only to come back with "everyone's" favourite character, Mickey Mouse. Nelson Mandela endured political imprisonment and then became a revolutionary leader. In recent memory, Malala Youssoufai showed the world the face of antifragility, literally and figuratively, by turning her scarred face into a symbol for bravery, antiviolence, and peace.

Resilience Plus is not a treatment program intended to improve compromised mental health. In addition, it is not targeted at people with moderate or severe mental health symptoms or concerns. It bears repeating that N/OCdts are not being asked to engage in this program because they are lacking resilience or are viewed as deficient in any way. Instead, the program intends to 1) teach resilience fundamentals, concepts, and skills that individuals can use to enhance their current abilities to thrive through disruption and challenges, and 2) conduct research in the field of positive psychology and apply the findings to increase resilience, leadership, and well-being in N/OCdts at the CMCs.

This review will summarize the main characteristics of the content offered by the Resilience Plus program's different components.

Research

Resilience Plus conducts ongoing research to assess its program offerings both quantitatively and qualitatively. For example, the program was internally evaluated by measuring key indicators of resilience and well-being before and after participation in training sessions and initiatives. N/OCdts also provided informal feedback following voluntary and/or mandatory training sessions and program's activities. An internal preliminary program evaluation was conducted in the 2022-2023 academic year to provide insight into what resilience-based information is offered to the N/OCdts at the CMCs. This was achieved by evaluating the program's description, goals, learning outcomes, content, target audience, research, potential benefits, theoretical foundations,

and overall characteristics. Preliminary results demonstrate that Resilience Plus is a conscientious program that is well suited for the target audience at the CMCs. Not only is it tailored to the demographic of young leaders attending the CMCs who have unique priorities, challenges, and stressors, but it is also very well received by the N/OCdts due to its support in maintaining optimal levels of performance and well-being through a variety of student-led initiatives. Outside of this type of program evaluation, Resilience Plus has a variety of ongoing research projects that examine topics such as curriculum development, resilience and mental health, and character-based interventions.[28,29,30] Moreover, N/OCdts at the CMCs are invited to participate in a variety of research activities that provide them with the opportunity to learn about the research process. This includes being involved in the writing process, data collection and analysis, exercising their investigative skills, presenting at international forums and conferences, and diving deeper into academic fields of interest, thereby enriching their learning experience and preparing them for higher levels of education and research that they may undertake in the future.

Education

Resilience Plus offers N/OCdts a comprehensive, theoretical overview of resilience which translates into teaching resilience-based strategies to help them identify personal and professional moments in which they can use/demonstrate their resilience. Overall, the program aims to develop resilience skills in N/OCdts as a way of buffering against and/or overcoming personal challenges (e.g., stress, personal conflict, work/life balance). The program offers a plethora of tailored programs for first-year N/OCdts and students involved in the Indigenous Leadership Opportunity Year, Supplemental Physical Training Program, Sentinels program, and Graduate Studies Program to focus on specific emotional, behavioural, and cognitive skills that these unique populations might need to use at some point in their academic and professional progression. Resilience Plus also presents a variety of engaging and participatory webinars and workshops where evidence-based cognitive, emotional, interpersonal, and behavioural strategies that are shaped by positive psychology, clinical psychology, cognitive psychology, and social psychology are explored. For example, Resilience Plus recently offered a VIA Institute on Character Mindfulness-Based Strengths Practice 8-week program[31] that teaches individuals how to apply research-based mindfulness and character strengths practice.

The Resilience Plus Program also has a variety of student-centred activities on campus to encourage them to participate in the program's activities and positive interventions based on the VIA character strengths. These offerings align with the interests of N/OCdts and CMC cultural values. They are intended to build resilience and empower the cadets. For example, the program offers a monthly newsletter that provides readers with a light

introduction to the science of positive psychology and a variety of useful, science-based tools and strategies. This is also where *"Narratives of Resilience Plus"* from the CMC communities are shared. The narratives celebrate the character strengths of the CMC communities and can inspire others to share their stories of overcoming challenges in their day-to-day lives. The narratives create a positive space to practise journaling, storytelling, and mindfulness. Studies on the benefits of these practices show that narratives create meaning and provide perspective on our reconstructed past, perceived present, and imagined future.[32,33] They are written accounts of lived, past experiences and offer an outlet for courage, reassurance, and hope for others who are currently facing difficult times. The narratives initiative can be beneficial to both the author and the reader. The author can reflect on their own resilience, acknowledge it, and take pride in the fact that they have fostered it. In doing so, many authors report that the process is encouraging and reinforces their resilience. For the readers, it provides them with examples of resilience and character strengths in action with the hope that they are better able to identify and explore their own stories. The *"Wall of Paragons of Strengths of Characters"* is also present at RMC and members of the CMC communities can nominate N/OCdts, faculty members, and staff members as paragons of the various character strengths.[34] The nominations include a brief description of how these individuals demonstrate a specific character strength. This wall encourages individuals to spot and explain character strengths in others and to empower them. Research has shown that strength spotting can effectively improve engagement and positive affect in youth.[35] Strength spotting practices also support the participants in developing and enhancing practices of love, forgiveness, and kindness, which is helpful in cultivating a sense of community and supportive friendships.[36] The *"Team Mosaic with Strengths of Character"* initiative is designed to boost awareness of a particular team's top character strengths and to increase their Character Strengths fluency. Team members are invited to take the Values in Action (VIA) Inventory of Strengths[37] where the results are then compiled into a "mosaic" of strengths for the team. The mosaic shows the top five character strengths of each member according to a colour-coded scheme. This allows everyone to see each member's top character strengths immediately and to see the strengths most represented in their team. The mosaic can then be used as a team-building activity, as a point of personal reflection, and/or for group discussion. A variety of creativity-based events are also hosted regularly by the Resilience Plus *"Creativity Club."* Creativity is a character strength that enhances one's ability to connect abstract ideas and come up with novel solutions. In accordance with Seligman's[38] PERMA model, creativity fosters positive emotions that can broaden our mindset by encouraging us to try new things and to look at situations from a different perspective. The Resilience Plus *"365 Days of Character-Based Challenges"* initiative provides social media subscribers with daily prompts and challenges to practise

> **The program also coordinates a *"Letters Project,"* which passes on CMC alumni letters to graduating students and fourth-year student letters to incoming first-year students. The goal of these letters is to provide N/OCdts with a direct connection to a person who has successfully navigated their time at the CMCs and beyond.**

using their character strengths in a new way every day for a set period (e.g., daily, monthly, and yearly challenges). Research has shown that even "minimalist" interventions (e.g., receipt of emails encouraging character-strength development) can be effective for promoting well-being, even shortly after the intervention.[39] The program also coordinates a *"Letters Project,"* which passes on CMC alumni letters to graduating students and fourth-year student letters to incoming first-year students. The goal of these letters is to provide N/OCdts with a direct connection to a person who has successfully navigated their time at the CMCs and beyond. CMC alumni and graduating fourth-year N/OCdts are invited to write a (short) letter to their graduating self or first-year self respectively. The letter provides the recipient with first-hand knowledge about what the author wishes they had known, thereby offering their younger self some advice and a different perspective on life at the CMCs or in the CAF. The *"Resilience Plus Podcast"* offers monthly, bilingual podcasts that feature an interview with an invited guest, conducted by an N/OCdt of the *"Ambassadors of the Resilience Plus Program."* Each interview is followed by the application of an empirically based tool to facilitate resilience building. The *"Ambassadors of the Resilience Plus Program"* are N/OCdts who are interested in learning more about resilience and passing this information on to their CMC peers. They volunteer to organize, promote, and participate in campus-wide Resilience Plus activities and initiatives.

Training

The Advanced Leadership and Resilience Training (ALRT) is an internationally recognized, evidence-informed program designed to strengthen leadership effectiveness and psychological resilience under operational pressure. Grounded in the science of positive psychology and leadership development, ALRT enhances combat readiness, fosters adaptive leadership, and supports ethical decision-making in volatile, uncertain, complex, and ambiguous (VUCA) military environments.

The curriculum explores specific evidence-based cognitive, emotional, interpersonal, and behavioural strategies from the subfields of psychology (positive, clinical, cognitive, and social) as well as mindfulness-based strengths practices, known to improve well-being and promote flourishing after adversity.[40,41,42,43] It also recognizes alternative ways of knowing (e.g., Indigenous practices) and has parameters in place to be trauma-informed and responsive (e.g., creating safe, accountable learning spaces, recognizing triggering content, and having a support response framework and resources on hand should students express that they are in distress or are triggered by course content). Learners discuss key concepts such as, but not limited to, mindfulness, character strengths[44,45] leader character,[46] mindsets,[47] emotional intelligence,[48] and explanatory styles.[49] (see Table 1) With the completion of this certification, learners have the tools and practised skills to nurture their resilience, to be able to "bounce back," and to overcome adversity that they might face in life. They will be able to apply their knowledge of resilience and its strategies, factors, and tools in their personal and professional lives. They will be able to describe the concept of resilience and its theoretical underpinnings/driving mechanisms, outline and evaluate various resilience-based strategies that will help individuals overcome challenges and be able to identify how their cognitions (mindset) and behaviours (lifestyle) may affect their ability to cope. By raising awareness of the factors and tools of resilience, learners obtain skills that they can foster and use to thrive in challenging environments. They learn how to regulate their emotions and influence superior decision-making, thereby improving team dynamics and increasing their overall awareness of themselves and the people around them.

Building on the foundational insights and early outcomes of ALRT implementation across Canadian Military Colleges, ALRT – Level II was introduced in 2025 as an advanced train-the-trainer certification. Designed for researchers, educators, and leadership professionals in both military and civilian settings, ALRT – Level II expands the program's reach and impact through structured knowledge transfer and capacity building. The inaugural international cohort included participants from South Africa, Portugal, France, and Canada. A second cohort is currently being prepared, with confirmed or pending participation from Tunisia, Denmark, Norway, Qatar, Ukraine, and Italy—contingent on institutional support.

Table 1: ALRT Curriculum

Number of Modules	7
Module Topics & Overview	**Module 1: Antifragility: Resilience 2:0** This module equips participants with the theoretical foundation and applied tools to teach resilience and antifragility within military leadership contexts. While resilience is commonly understood as the capacity to recover from adversity, antifragility describes systems that grow stronger through stress, volatility, and disruption—an essential capability for military leaders operating in uncertain and high-stakes environments. **Module 2: Mindfulness** The purpose of this module is to understand the benefits of mindfulness, describe the relationship between mastery of thoughts, resilience, and leadership, and to practise and experience mindfulness strategies. **Module 3: Character Strengths** This module explores the foundational role of character strengths in fostering effective, values-based, and antifragile leadership. Drawing on the VIA Classification of Character Strengths, participants examine how cultivating and applying one's character strengths can enhance personal resilience, improve team cohesion, and promote ethical leadership in military contexts. **Module 4: Emotional Proficiency** This module examines the critical role of emotional intelligence in strengthening leadership effectiveness and cultivating antifragility. In high-stakes military environments, unmanaged emotions can undermine decision-making, performance, and cohesion. Leaders who develop emotional intelligence are better equipped to regulate their own emotions, understand the emotions of others, and foster psychologically safe, high-performing teams. **Module 5: Behavioral Mastery** This module provides participants with a deep understanding of the psychological foundations of behavior, habit formation, and behavioral change. Drawing on contemporary behavioral science and habit theory, participants examine how automatic and intentional behaviors influence leadership performance and personal growth. **Module 6: Cognitive Clarity** This module equips leaders with a foundational understanding of cognitive processes that shape perception, judgment, and behavior under stress. Participants explore how cognitive distortions and biases undermine decision-making and leadership effectiveness in complex environments. By cultivating awareness of these mental traps and learning evidence-based cognitive strategies, leaders can enhance psychological flexibility, build resilience, and foster antifragility. **Module 7: Empowered Leadership** This module explores empowered leadership as a strengths-based, purpose-driven approach grounded in psychological well-being and optimal functioning. Drawing from the PERMA Model—Positive Emotion, Engagement, Relationships, Meaning, and Accomplishment—participants examine how flourishing leaders cultivate inner clarity, relational authenticity, and sustainable high performance.
Learning Outcomes	• Describe the concept of resilience and antifragility, including their theoretical underpinnings and driving mechanisms • Outline and evaluate key resilience-based strategies that help individuals overcome challenges and bounce back from adversity • Identify how one's emotions (affect), cognitions (mindset), and behaviours (lifestyle) may be affecting one's ability to cope with demands and bounce back stronger from experiences of stress or adversity • Regulate one's emotions thus influencing superior decision-making, improved team dynamics, and increased awareness of self and others • Apply resilience-based strategies and positive-psychology interventions in one's life • Experience an increase in positive affect, perceptions of life mastery, and resilience
Module Format	Webinar/workshop; mini-lectures, videos, military scenarios, role-playing, quizzes, and homework assignments.

Mentoring

"No matter what the situation or context, mentoring is a human endeavour that, like a butterfly, develops over time and maintains and transforms individuals, organizations, and cultures bringing hope and beauty to them all."[50]

The importance of mentoring has increased at the CMCs over the last few years and a growing number of N/OCdts are seeking mentors to help them guide their personal and professional journeys. Research on mentoring demonstrates significant benefits to mentors, mentees, and organizations alike.[51] Creating learning environments which ensure N/OCdts are developed personally and professionally is paramount for both the CMCs and the CAF. Currently, senior team members of the Resilience Plus program offer mentoring for the Ambassadors of the Resilience Plus Program where they share their knowledge, insights, and wisdom with their mentees who wish to benefit from mentoring. The program also offers training activities that can assist CMC staff or faculty members who are interested in mentoring. The goal of these activities is to increase understanding of the fundamental principles associated with effective mentorship and to help CMC staff and faculty acquire these essential skills to guide, support, and motivate their respective mentees.

Coaching

Currently, Resilience Plus offers one-on-one coaching sessions with certified coaches to CMC communities. Coaching sessions are aimed at individuals who are interested in developing strategies to maximize their personal and professional potential while empowering them to build their resilience and thrive.

Several studies have demonstrated the value, efficacy, and impact of coaching in several contexts.[52] Coaching has become a long-term human resource development strategy[53] and has recently attracted a lot of organizational attention. Effective coaching is described as one of the best practices for achieving successful management, leadership, and learning in organizations.[54,55,56] Additionally, effective coaching can significantly impact both employees' experience at work and organization-level performance; for example, increasing their morale, self-confidence, knowledge abilities, work attitudes, and behaviour through coaching contributes to the organization's overall performance.[57] Specifically, coaching facilitates increased psychological capital. This is a positive psychological resource that coaches can help individuals apply to their day-to-day work experiences. It thereby acts as the linking mechanism between coaching interventions and a host of beneficial outcomes, including job satisfaction, organizational commitment, and job performance. More specifically, research shows that 80% of people who receive coaching report increased self-confidence,

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and over 70% benefit from improved work performance, relationships, and more effective communication skills.[58] Similarly, 86% of companies report that they recouped their investment in coaching through increased employee commitment and job performance.[59] These findings are transferrable to N/OCdt engagement at the CMCs. The Resilience Plus coaching initiative is thereby laying the foundation for positive culture change at the CMCs and is helping to improve the CAF ethos in the future careers of N/OCdts.

DISCUSSION

The Resilience Plus program at the CMCs is an important outlet of support offered to the N/OCdts and aligns with many of the efforts of the CMCs to develop and maintain optimal levels of performance and well-being. The program is holistic and has various opportunities for CMC N/OCdts, staff, and faculty to be involved in research, education, training, mentoring, and coaching. But the adaptation of how resilience programs are implemented within the CAF is growing more vital as the world continues to become digitalized.[60] Thus, an area of consideration to extend the reach of the Resilience Program at the CMCs, especially given the generally younger demographic of students, is to use the integration of digital applications (apps) on cellular phones to deliver quick-access information, tools, and services to the users. Additionally, the program itself would benefit from continuous feedback via Intervention Mapping (IM). Intervention Mapping consists of a needs assessment, an identification of the outcomes and objectives of a program, the design elements of a program, production, an implementation plan, as well as the development of an evaluation framework.[61] Resources such as these would

allow Resilience Plus to provide step-by-step, continuous development of the program to better suit the needs of the CMCs in an ever-changing world. Finally, devoting resources to examining the impact of the Resilience Plus program on fostering antifragile leaders will elucidate the changes and improvements needed to create a specifically tailored program that addresses the unique needs of N/OCdts.

CONCLUSION

The Resilience Plus program teaches N/OCdts the necessary skills and tools needed to foster resilience during their time on campus and to thrive in a challenging environment when faced with adversity in the future. The program is thorough and well suited for N/OCdts. N/OCdts report having positive experiences when interacting with the Resilience Plus components presented earlier. This holistic program, which includes student-led initiatives and outreach, gives N/OCdts several opportunities to practise "thinking outside the box," contributes to a positive working and living environment, and ultimately, fosters a network for them to draw upon in their future careers, personal lives, and challenges. Resilience Plus is a well-received program that offers various levels of connection in the general CMC population and establishes an opportunity for the CMCs to "lead by example" when it comes to culture change in the CAF. Ultimately, Resilience Plus supports and serve those who serve us.

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Cadets demonstrate firing skills during the Sunset Ceremony held at Royal Military College of Canada, Kingston ON, on May 14, 2015.

Photo: Mary White, DND

Schrödinger's Soldiers: Reviewing How and Why the Military Colleges Create "Experts" in the Profession of Arms

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"I hope to make a few officers think."

– General Ferdinand Foch on being appointed the Commandant of the French Military College

The Royal Military Colleges of Canada (RMC) are once again at a crossroads regarding their purpose.[1] Over the past several decades, a series of reports and decisions have impacted Professional Military Education (PME) in the Canadian military. Different approaches to PME, defined as the provision of "training, education, and development in the profession of arms including teamwork, leadership, ethics, and military ethos,"[2] have directly influenced the two Canadian Military Colleges (CMC) in Kingston and St. Jean. First, the 1969 Report of the Officer Development Board (or *Rowley Report*), which called for an established set of learning programs, including an undergraduate degree to provide a basis of critical thinking.[3] Then the

1998 Report of the RMC Board of Governors (or *Withers Report*) which called for Cadets to receive both a liberal education and the technical knowledge to effectively apply military force.[4] Two decades later, while recognizing a core curriculum designed to provide a balanced liberal arts, science, and military education, the 2017 Special Staff Assistance Visit (or *Maddison Report*), made an opposite recommendation. Mandated to assess the overall climate, environment, and culture of the Regular Officer Training Plan (ROTP), the report concluded that the Colleges emphasized academic education over military training and were "falling short of providing meaningful and relevant training."[5] The authors argued that a return to training would instill practical meaning

to the Colleges and would "address perceptions … regarding the value of graduates."[6] This was subsequently affirmed by the 2017 Auditor General's Report which recommended that the Colleges "clearly define and strengthen military training [to be] relevant, practical, and provide value to operational units … with a view to concentrating effort into longer, and more meaningful, training and education sessions."[7] As of 2018, recognizing the comprehensive skill set required to become an commissioned officer in the CAF, Cadets must now successfully complete four equal "interlocking" pillars: academics, bilingualism, military leadership, and physical fitness[8] to graduate and receive a commission.

More recently, in May 2022, the Report of the Independent External Comprehensive Review (or *Arbour Report*), provided 48 recommendations to prevent and/or eradicate sexual harassment and misconduct within the Department of National Defence (DND) and the CAF.

Of particular relevance, recommendation 29 advocated for a detailed review of continuing to educate ROTP cadets at the military colleges.[9] In response the Minister of National Defence established the Canadian Military Colleges Review Board (CMCRB), to study culture change through an examination of the quality of education, military training, and socialization.[10]

While perhaps unintentional, these diverging recommendations between training and education have resulted (once again) in an inherent tension for the CMCs—what Barrett has referred to as "the gulf that divides the military and academic worlds" within RMC,[11] generating an important question for the CAF. As an institution, the military needs to (once again) examine the PME experience[12] and re-ask one of Wither's original questions; "what kind of junior officer does the CAF want at the competition of their first Developmental Period (DP1)."[13] Specifically, how much education and how much training does the institution want junior officers to have, and what organisations within the CAF should be responsible (recognizing that the CMCs only addresses a portion of DP1)?

Using a descriptive research methodology to observe and describe a particular phenomenon, I argue that junior officers become "experts" in the profession of arms though the proper balance of obtaining both knowledge and experience, and that the role of the Colleges is to focus on imparting knowledge-based education vice training. This paper will take place in six sections. Following the introduction, the second section will discuss the place of education in the current Professional Development (PD) system. The third section will address the question of how can junior officers best gain knowledge, with a focus on explaining the requirement for knowledge-based expertise and the role of the CMCs. The fourth section will then address the subsequent question of how can junior officers best gain experience with a focus on identifying the existing branch schools and centres within the CAF. The fifth section will address the question what is the best way to combine knowledge and experience in the Profession of Arms, asserting that an institutional balance of the two approaches is required. Last, I conclude that to truly develop

professional officers, through a division of labour the CAF must be encouraged to seek a proper balance between education and training within the total PME system.

Continued reflection on this debate is important to the future of the CAF. While RMC is currently responsible for training between 25-30% of the officers who receive commissions and join the CAF, RMC graduates comprise 55-57 percent of the General and Flag Officers, demonstrating that the CMCs and their approach to PME have a disproportional impact on the senior intellectual capacity of the CAF.[14] As such, this paper aims to identify important characteristics and trends within PME at the Colleges and focus additional light on the debate. Ideally, to help guide deliberations on what kind of *expertise*, defined as "the existence of a military-specific body of knowledge, and the development, dissemination, and application of that knowledge,"[15] is required for junior officers?

While there is nothing in *Canadian Officership in the 21st Century*[16] which suggests this tension, I contend that junior officers at the CMCs are now expected to be something akin to *Schrödinger's Soldiers*—based on Schrödinger's proverbial cat—where there is a paradoxical expectation of achieving two opposing "professional" conceptions at the same time and place. Junior officers are expected first, to be well trained, to quickly follow (lawful) orders and become highly proficient in carrying out specified (often violent) drills and tasks. Second, through completion of a 40 credit undergraduate degree that generally mirrors equivalent disciplinary degrees at civilian universities, cadets are also expected to demonstrate fundamental leadership qualities such as thinking critically, problem-solving, and understanding nuances to make timely decisions under challenging conditions. Two conceptions of professionalism which, while there can be overlap, come with an inherent tension.[17]

Setting the Stage:

> *"To lead men in battle is a profession demanding careful education and thorough training"*
> — *The Science of War, Col. G.F.R. Henderson, CB 1908*

Within the Canadian Defence Academy (CDA), there are two major actors engaged in developing the junior officer; RMC (Kingston) and the Collège Militaire Royal de Saint-Jean (known as CMR). Each CMC is both a military unit that is governed by the *National Defence Act*, and a post-secondary university with its own academic governance. According to its 2003 charter, CDA has a mandate to "uphold distinction in the Profession of Arms" and is tasked "to champion lifelong learning, and to promote the professional development of CAF members."[18] However, its worth noting that within the Colleges, "military education" is the responsibility of Training Wing and the Cadets themselves are part of the Training Wing, which is commanded by the Director of Cadets, who is responsible for training, career progression, administration,

and overall welfare, while under the President "academic education" is the responsibility of the Academic Wing.[19] Externally to the Colleges, the three branches—the Canadian Army, the Royal Canadian Navy (RCN), and the Royal Canadian Air Force (RCAF)—through their Schools and Centres, provide training (ideally in the summer months) for officers and non-commissioned members (NCMs) to learn their assigned trades.[20] I will now briefly discuss academic education.

Theoretically, it is education that sets the professional officer (and soldier) apart from the warrior, recognizing that in addition to bravery and courage, the management of state-sanctioned violence is considered both an art and science. Ideally, education helps militaries to invest in, shape, and build future leaders, and the knowledge gained through education helps to ensure that officers are exposed to models and concepts across the range of Bloom's Taxonomy of Learning,[21] which in turn provides the basis for mastering and applying the complex lessons of the Profession of Arms.[22] Practically, the military, for various reasons such as discipline, immediate applicability, standardization, comfort zones, decreasing military budgets, and above all a desire to retain what Huntington first called *objective professionalism*[23] (where the military professional is relieved of external/civilian supervision or intrusion), will regularly try to either shirk, meet the minimum educational requirement or allow training methods to predominate over education.[24]

While the notion of *professionalism*, synthesized here as a "social institution that brings value to broader society through its expert application,"[25] includes both concepts of knowledge and experience as a method for gaining expertise, I maintain that it is time for a more recognized division of labour in the junior PME system, with the Colleges primarily focusing on education and the branch schools and centres focusing on training so that the end result, described as a pillar of the CAF's PD system, is a more balanced expert junior officer. In principle, this division already exists. Notionally, the branch schools are focused on training and the CMCs are attempting to focus on education—but in practice the CMCs and in turn the Cadets are being oriented towards training by the institutional forces discussed above.

Becoming an expert takes time, usually requiring a level of dedication measured in years. Being an expert generally requires the integration of three different skills: you a). have acquired the technical skills to conduct professional activities (usually through lengthy hands-on practice), b). understand the theory that underpins professional knowledge (you have gained proficiency through study, research, and analysis and know a lot about a subject that you have not experienced personally), and c) have internalized the values and professional ethics that informs independent judgement (socialization within the profession).[26]

The truth of the matter is that the Profession of Arms requires balanced dedication to each one. Gladwell talks about needing 10,000 hours of experience to truly master any skill,[27] and Gallo talks about reading 100 books a year to truly become

knowledgeable in a field of study.[28] This is not to assume that an expert in the Profession of Arms will always make correct decisions, but rather acknowledge that there is a requirement to invest in the balance between education and training that junior officers receive early in their careers to maximize the conceptual tools required to perform their jobs.

Unfortunately, as Last notes, Canada doesn't appreciate big personalities in its General Officers.[29] Subsequently while there is much discussion regarding training and readiness across CAF academic publications and doctrine manuals, there are few Canadian Generals publicly touting the advantages of knowledge-based expertise. As such, quotes from American Generals are used to complete this passage. It was McMaster who wrote that "reading and thinking is a sacred duty … and leaders who choose to learn solely from personal experience are irresponsible."[30] And as Mattis distinctively stated; "if you haven't read hundreds of books … you will be incompetent because your personal experiences alone aren't broad enough to sustain you."[31] The dilemma faced by the CAF today is how to balance technical and theoretical expertise, and where to bring these two demanding and diverse practices—knowledge and experience—together to create junior experts in the Profession of Arms?

How do Junior Officers best gain Knowledge?

"I have read somewhere the remarks of Frederick the Great when speaking about officers who relied solely on their practical experience and who neglected to study; he is supposed to have said that he had in his Army two mules who had been through forty campaigns, but they were still mules"
– *Field-Marshal Montgomery*

The debate over how to develop expertise in the Profession of Arms has long roots. It was Clausewitz who rejected von Bülow's dynamic system approach and the claim that warfare could be reduced to any system that relied solely on experiences.[32] Instead Clausewitz stressed that the purpose of educating the officers was to ensure they had the "total contingency" and creative ability to correctly evaluate unfamiliar "fog of war" environments.[33] Much like the demands placed on the CAF today, "a young officer may be called upon to be a skilled leader, a technical expert, a diplomat, a warrior, an interpreter, and an aid expert—all at once."[34]

More so than ever, to meet these demands there are two essential factors—experience and education—which are required to build the officers of the future. *Education* is defined as "the provision of a body of knowledge and intellectual skill sets, upon which competing facts, information, and ideas can be critically examined, assessed, and interpreted."[35] Within the CMCs, cadets are presented with concepts and information that cannot be learned firsthand—not only for learning about facts, science,

technology, and math—but for effecting lasting perspectives, social attitudes, and values that training cannot achieve. Within the current CAF system, the four-year degree (ideally intermixed with scheduled time at the branch Schools and Centres) was originally indented to provide the opportunity and time for junior officers to invest in and develop their knowledge-based expertise.

What is knowledge? As Grotzer points out, there are three ways to think about knowledge.[36] First, there is procedural knowledge asking; how we do things such as algorithms, recipes, and methods. Then there is conceptual knowledge, such as the framing of ideas and models, or how we construct information in our head. Last there is structural knowledge inquiring how we reason and determine basic assumptions. She argues that there is a need to teach critical thinking skills at an early stage to evaluate each type of knowledge, to ask questions, and to be skeptical—and that this process will produce the next generation of information generators."[37] To provide an empirical example, applying procedural knowledge and possessing the ability to follow the Army's 16-step battle procedure, the operational planning process, or even to jointly campaign plan demonstrates procedural knowledge, but applying conceptual knowledge to find, analyze, and refine the information that goes into the processes demonstrates expertise and helps avoid what Donato has called "misconstrued analogues, erroneous presumptions, and insufficient knowledge."[38]

To successfully gain knowledge, a junior officer requires access to a variety of information sources, an acknowledgement of bias, critical interpretation, and the ability to generalize both positive and negative variables. Evans has observed that being knowledgeable demands the aptitude to develop good data, critically assess demanding scenarios, and implement change based on second-hand knowledge, which is almost the opposite of the current training system which relies on processes including repetition, memorization, and routine.[39] As Erdmann highlights:

> It's particularly important for military officers to read, think, discuss, and write about the problem of war and warfare so they can understand not just the continuities in the character of warfare but also the changes.[40]

While there remains no clear standard for leadership qualities and ethical military behaviour that Cadets are required to demonstrate before receiving their commissions, an affirmation of academic education over military training at the Colleges will help to achieve these objectives. As Rosenstock points out, education is about the providing an opportunity for developing the quality of individual analysis."[41] Nonetheless, when advertising campus life at the College, there is an acknowledgement that the demands of an education go beyond academic achievement, and that the military side of a cadet's life is designed to engage cadets in a wide variety of training activities including drill competitions, range practices, and preparation for periods of summer training.[42]

To clarify, this is not to suggest that the CMC's four pillars be abandoned, but perhaps that they should no longer be considered equal, and there should be a clear acknowledgement in terms of which pillar is a priority when and where during DP1. An example would see Orientation and Integration for 1st Years (OI1) de-conflicted from the academic term where Cadets are required to function under extreme mental and physical stress in August/September each year—an essential training opportunity—but also one where faculty members have pointed out that the CMC's end up losing a large part of the term to training objectives because professors are not expected to assign the cadets any academic work in the first several weeks of the year.

Although it takes time and effort to obtain knowledge, many proficiencies such as intelligence, problem-solving, confidence, and open mindedness have been quantified by the amount of general knowledge students can obtain and apply early in their careers.[43] This education is done at RMC presently, but at best it currently exists in competition with the other three equal pillars, undermining the balance required to produce an "expert" junior officer.

How do Junior Officers best gain experience?

"Experts often possess more data than judgement."
– General Colin Powell

What is experience? *Experience* is defined as "proficiency that is obtained through practical involvement in, or exposure to, an activity or event."[44] Experience can also be described as "familiarity, skill, or practice in a particular activity" and is generally considered to be different from the intangible theoretical knowledge."[45] Training refers to the process of learning specific skills or knowledge through structured instruction (requiring constructive feedback from experts), while experience refers to the knowledge and skills acquired through practical involvement in activities, tasks, or situations (requiring reflection and self insight on the part of the practitioner). By extension, *individual training*, which is the principal focus of DP1, can be defined as "the provision of specific skills and attitudes required to perform assigned tasks and duties,"[46] Training and experience, while different, are related concepts that have significant overlap within the comprehensive Professional Development system which includes senior officers, senior NCMs, doctrine, and other aspects.

Before joining their units where Cadets can receive on-the-job training and mentorship, the CAF recognizes that the best way to provide junior officers with initial experience is through the opportunity to have intense formative practices in specific training locations. Within DP1 (and beyond), there is an understanding that placing junior officers in a range of training scenarios will confirm their aptitude, test their character and actions under pressure, and will help foster a culture of proficiency in

environments characterized by stress, deprivation, and limited resources.[47] This military training often encompasses physical and mental components, with an emphasis on readiness for operational effectiveness, both at the individual and unit level. To perform their duties effectively, junior officers must attain levels of competencies commensurate with their rank,[48] and to confirm the process, there is a planned progression of skill-based learning from individual training to collective exercises. Throughout this progression, the Lessons Learned process provides "constant learning, routine correction of mistakes, and the reinforcement of best practices and correct activities."[49]

Minus the CMCs, and not taking into consideration the thousands of military exercises held across the country and internationally each year, the CAF has almost 50 training establishments instructing junior officers (and NCMs).[50] Within the Canadian Army, the Combat Training Center and its ten lodger units support the CAF's overall readiness and modernization in terms of individual and collective training.[51] Additionally, Naval Warfare Officers attend the Naval Fleet School Pacific for 12 months training to obtain hands-on experience where the RCN has several training and auxiliary ships, submarines and other vessels.[52] The RCN has also just opened a new naval facility at Canadian Forces Base Halifax to provide additional training opportunities to all ranks while ashore.[53] In the RCAF, responsibility for training is assigned to 2 Canadian Air Division, which encompasses training formations such as 15 Wing Moose Jaw, 16 Wing Borden, and 17 Wing Winnipeg (and the Canadian Forces Aircrew Selection Centre), as well as individual Squadrons.[54] Currently, there are seven Squadrons that have the designation *training* added to their title, endorsing a well-established system.[55] At the time of writing, the RCAF is also currently negotiating the construction of a new training center in Winnipeg with an announcement anticipated this year.[56] After the specific branches, and available after completion of military occupation qualifications, the Canadian Special Operations Forces Command also maintains the Canadian Special Operations Training Centre which focuses on critical thinking, innovation, adaptation, and problem-solving within the context of a broad spectrum of conflict.[57]

In terms of joint training (activities in which two or more branches collaborate), since 2014, the Canadian Joint Operations Command has been providing joint individual training through the Canadian Joint Warfare Centre in Ottawa. As an aside, there is also the Canadian Forces Training Development Centre, focused on the delivery of applied training to the Personnel Support Program training cadre, personnel selection officers, training development officers, imagery technicians, and recruitment personnel.[58]

Suffice to say that externally to the CMCs, the CAF has dedicated a multitude of Schools and Centres to provide experience through training, instructing, and exercising junior officers through their DP1 with well-established standards and Training Qualifications—where once completed, junior officers are considered to be occupationally employable. As Jeffery notes, "there is no doubt that Canada has a professional force that is highly capable of providing effective military training."[59]

What Is the Best Way to Combine Knowledge and Experience in the Profession of Arms?

"Be a doer and a self-starter—aggressiveness and initiative are two most admitted qualities in a leader—but you must also put your feet up and THINK."
– Colonel Glover Johns

As Ricks points out, "training tends to prepare one for known problems, while education better prepares one for the unknown."[60] Training tends to be more specific and focused, while education can be broader and covers a wider range of topics. While scholars are often more concerned with understanding and explaining theoretical and empirical events; practitioners are often more concerned with planning and problem solving. As such, a successful PME program requires a level of in-depth knowledge to assess and analyse both current events and future threats—and subsequently the training to plan and act. While critics may point out that intellectual knowledge and practical experience can be acquired at the same time and that the synergies between the two experiences can enhance both, I contend that the CAF's PME system would be better off identifying the tensions that currently exist and seeking to minimize them, identifying synergies through a selective prioritization of academic efforts in specific times within the CMCs rather than concurrently. While the 2017 Maddison Report does call for concentrating efforts and optimize the learning opportunities for Cadets, the report specifically calls for "the training syllabus to be reviewed to determine the best way to schedule it within the *restraints* [italics added] of the RMC programme," proposing to "create hands-on training through a multi-day field exercise environment," as opposed to an additional focus on academics.[61] Another example, much like OI1, sees almost all members of the Cadet Wing dedicate a substantial number of hours to compete in the annual RMC Drill Competition during a duty weekend in November that has no relation to their educational obligations.[62]

To help validate my thesis, and drawing on existing experiential vs traditional learning methods,[63] I have created the table below which considers some of the ideal traits, often contradictory, that Schrödinger's junior officers are exposed to as they start to develop their expertise in the profession of arms:

Table 1: Contradictory Approaches to Balancing Expertise In the Profession of Arms

Expert (skill)	
Training	**Education**
Experience based (empirical)	Knowledge based (theoretical)
Objective (i.e.: drill, marksmanship, tactical manoeuvres, SOPs, thinking in concrete terms)	Subjective (i.e.: critical thinking, problem solving, creativity, thinking in abstract and conceptual terms)
Vertical Instruction (discipline based ensuring mastery of foundational skills over time)	Horizontal Instruction (fostering broad logic-based learning)
Thinking Inside the Box (procedural)	Thinking Outside the Box (improvise)[64]
Specific Problem Solving	Ability To Understand and Explain Correlated Problems
Intuitive (instinctive)	Perceptive (insightful and discerning)
Certainty (confidence)	Skepticism (doubt)

For junior officers, while individual training is about reaching a uniform standard, critical thinking is about considering the all the different inputs into potential action before committing to a plan of action. While entry-level development does have to include teaching new officers how to do their job, as Mitchell stated, the role of the Colleges is not and should not be to teach officers *how* to do their jobs.[65] That is the role of the training institutions covered in the previous section. Nor is it the responsibility of the Colleges to make academics out of the Cadets. However, the mission of the Colleges should remain educating junior officers to reflect on their profession in a knowledge-based manner.

To de-conflict these tensions, the CMCs should be provided with a clearer mandate focused on education. As an institution, the CAF should be asking whether or not all of the required competencies in Table 1 can be obtained through the process of earning a degree, or if they can be acquired through training-based experiences? The Chief of Military Personnel has developed a Competency Dictionary which seeks to convert the Leader Development Framework into practical items and measurable outcomes; including expertise, cognitive capacities, social capacities, change capacities, and professional ideology for each rank.[66] To move forward, the CAF should take the time to fully integrate the Dictionary into the PME system (it currently has limited implementation) and confirm where each attribute can be best learned—in the Branch Schools or in the Colleges.

The CAF Officer Professional Development System, an integrated and sequential development program intended to provide a comprehensive and continuous learning framework for both officers and NCMs, acknowledges that officers are well trained because they have learned to perform an act by doing it well themselves. At the same time, there is a requirement to acknowledge that junior officers become well educated by asking questions, by thinking, by experimenting with questions, and proposing resolutions to problems, noting that;

> The CAF must prepare its members intellectually ... to meet the anticipated challenges in the ambiguous, chaotic and complex security environment. What practical experience has shown over and over is that warfighting skills alone are not enough.[67]

There is a need to acknowledge that in addition to having become the de facto standard for professional employment in Canada,[68] completion of a bachelor's degree signifies attaining the elementary critical thinking skills necessary to function as a junior officer. In other words, helping junior officers to think critically by introducing them to new forms of knowledge that cannot be learned at the Schools/Units remains the responsibility of the Colleges, just as it remains the responsibility of the Schools/Centres to help junior officers learn the tools and best practices of their trade. Instead of both sets of institutions competing and seeking to focus on training, there needs to be a realization that the two approaches are balanced and complimentary, and that it is the end result—an emerging expert junior officer, ready to undertake a career in the profession of arms—which is significant. The branch schools must ensure that officers (and NCMs) are trained to lead through rigorous preparation, and the Colleges must ensure that officers (and NCMs) are also educated and prepared to lead in ambiguity. This approach will ensure that the CAF continues to be able to develop highly skilled, articulate, and critically expressive officers who can assume their role in the profession of arms.[69] In essence, there needs to be an aspiration for junior officers to avoid competing DP1 as "tactically proficient yet strategically inept."[70]

Conclusion:

> "Modern leadership demands officers who can accept challenge with initiative, originality, fidelity, understanding, and, above all, the willingness to fully assume the responsibilities of command."
> – General Bruce C. Clarke

Almost three decades after the release of the *Morton Report*, the *Withers Report*, and *Duty with Honour*, the situation has not changed. The CAF continues to introduce junior officers into "a future which remains characterised by uncertainty, ambiguous threats, and rapid technological change."[71] I will concede that modern militaries do not need junior officers that can discuss the Punic or Peloponnesian Wars in minute detail, but to develop senior officers, the CAF needs junior officers that have been taught to think critically, to research, and to apply intangible data. It

was Santayana who infamously stated that, "those who cannot remember the past are condemned to repeat it."[72]

The Colleges would be well served to remember the goals of today's PME—to provide officers who can "function in an age of strategic competition with a range of actors, including near-peer adversaries, rogue states, and non-state actors,"[73] fostering an "intellectual agility"[74] that may not be attainable solely through modern training systems. As such, there is a necessity for the CMCs to acknowledge the tension that what the military wants junior officers "to do" and what the military wants them "to know" are *different but essential* [italics added] approaches to PD. The contradiction regarding S*chrödinger's Soldiers*, between what should take place at the Colleges and the Schools/Centres emphasizes that while knowledge and experience are very different undertakings, they are nonetheless both inextricably linked. The Training Wing's military pillar, whose purpose is to "identify, develop, and consolidate the moral qualities and ethical values which are essential for a military officer,"[75] should be maintained at all costs, but its experience and training-based activities balanced within the overall framework of DP1, allowing graduates to focus on and complete their knowledge-based education at the Colleges.

While Canada deliberates the future of the CMCs, it's important to acknowledge that in the US, West Point is also transforming to address future challenges. Ensuring that graduates can design and implement solutions to complex problems on the modern battlefield, West Point recently established the Department of English and World Languages and the Department of Law and Philosophy, preparing graduates with an additional focus on the constitution, the law, and their ethical obligations when faced with unanticipated challenges.[76]

On a positive note, and distinct from the CMCRB, CDA recently announced an intent to reinvigorate ROTP's Individual Training & Education System Quality Control Process. Importantly, among several changes to the four pillars, CDA's new model for the CMCs acknowledges the need for a "whole-of-college" approach to ensure that achieving balance between the pillars becomes the new "measure of excellence" for Cadets to succeed as junior officers in the CAF.[77] At the time of writing, implementation has just started.

In the conflicts of the future, the state's military needs to guard against preparing its officers based solely on experience, giving credence to the old adage that a nation's military is "always prepared to fight the last war"—an example of which is the critique that NATO was recently accused of training Ukrainian forces for counterinsurgency operations in Afghanistan.[78] It was Howard who concluded that, one of the foremost attributes of military effectiveness lies in the ability to recognize and adapt to new challenges that conflict inevitably presents,[79] and not as Schadlow notes, "act as a regular soldier whose only duty is obey orders without possessing the resources and grasp of mind suited to the responsibilities of the position."[80] In the CAF, there is a need to ensure that the Profession of Arms contains the necessary breadth and depth of expertise to complete all assigned missions, ranging from peer-on-peer combat to domestic response operations. A role

for the CMC's, the Schools/Centres, and junior officers to take seriously. As Cowen concludes, "complexity of thought and maturity of judgement are the product of strong education, and its application to the interpretation of experience."[81]

While there are several limitations that are associated with using a descriptive research methodology (limited scope, no primary statistics, and a lack of generalizability), nonetheless this paper adds to the intellectual discussion on PME in Canada, helping to identify and understand current trends, emphasizing how important the current education vs. training debate is, and stressing more accurately where education and training for junior officers belong within PME. In terms of policy recommendations, just as CAF branches have rightly assigned individual General/Flag officers to champion specific positions including, visible minorities, indigenous causes, and even volleyball, CDA may wish to consider assigning individual CAF champions for both education and training at the CMCs and elsewhere within the CAF to ensure an equilibrium between the two approaches—they are currently shared within CDA often making efforts to professionalize junior officers difficult to distinguish.

Recognizing that today's officers must "augment their existing qualities and competencies" to meet future operational challenges, *Officership* 2020 establishes first, that comprehensive knowledge and intellectual capability are the hallmark of the military profession, and second, the need for a better balance between education, self-development, training and experience to anticipates future requirements.[82] The task at hand is to ensure that both the Colleges and the Schools/Centres are in synch and working together with the directive, with one focused on a knowledge-based education, and the other focused on experience-based training. While it may appear counter-intuitive, for the CAF to become more professional, the institution may have to train less during certain developmental periods and in certain places like the CMCs.

Last is correct when he concludes that the CAF must be on guard for the status of military education in the CMCs.[83] Like other modern militaries, the next generation of officers must ensure that military capabilities are maintained to a high standard, but unlike the *Maddison Report*, the institution must also ensure that investment in education is also developed to innovate and create opportunities.[84] This approach will allow the CMCs to address important future research questions such as how the military can harness innovation and artificial intelligence, and how can those receiving pre-commissioning learning (of any type) reflect on a profession they don't yet understand?

The Arbour Report acknowledges that the raison-d'être of the military colleges has to rest on the assumption that the CMCs remain the best way to form and educate military leaders, and that in conjunction with the academic program similar to other universities, the institutions value-added must also come from the other three pillars.[85] That said, both types of learning organizations—educational and training—must embrace the opportunity for improvement and acknowledge that achieving distinction in the

Profession of Arms will be that much more difficult if one is repeatedly prioritized over the other. According to Statistics Canada's 2016 Census data, Canadians are among the most educated people in the world,[86] and if the CAF is to continue to reflect the society that it serves, then there is every reason to balance education with training-based expertise at the CMC so that junior officers may continue to serve in the capacity their profession deserves.

"Discipline is the very life and soul of an army; and that army can never rise at the summit of perfection which have not intelligent officers to direct it."
— *Elements of War, or, Rules and Regulations of The Army by Nathaniel Hood, Lieut., H.P. 40th Regt, 1803*

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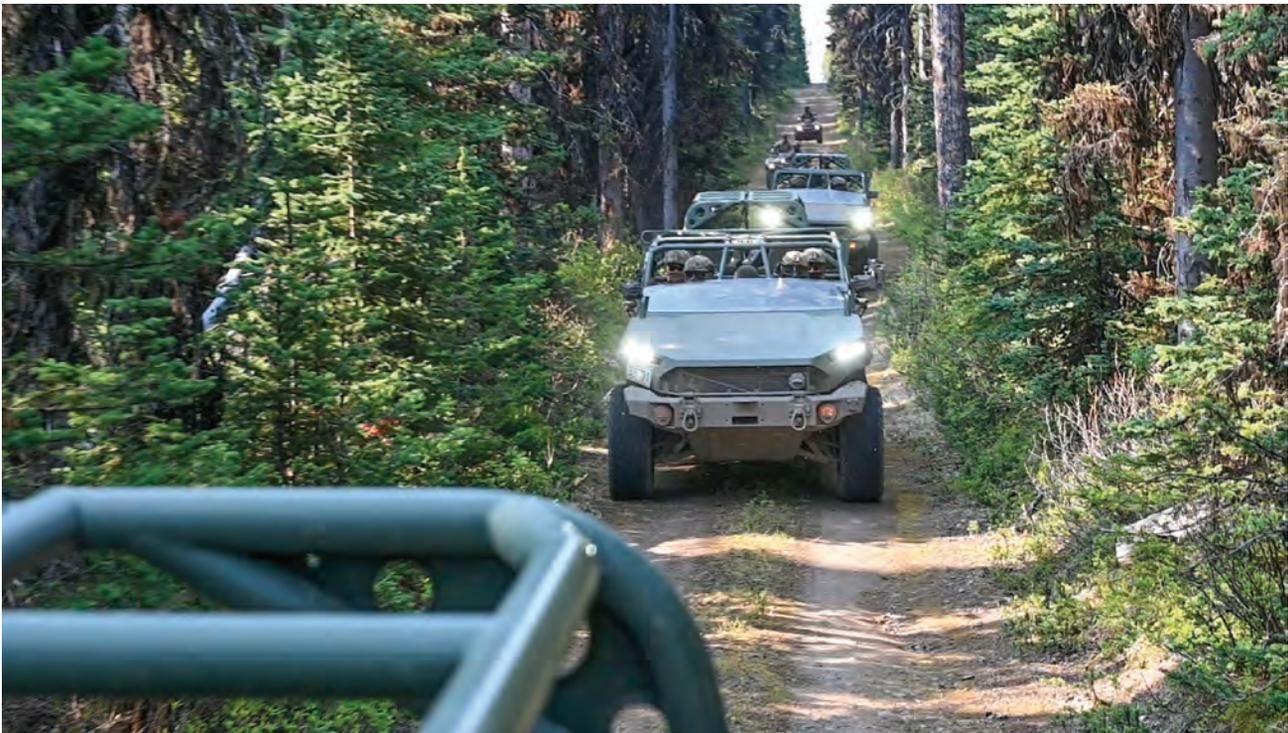
A convoy of Light Tactical Vehicle and ATVs conducting a patrol in Kananaskis, Alberta in support of Op CADENCE on June 8, 2025.

Photo: MCpl Robert Mitchell, 3rd Canadian Division Imagery Technician

Innovation by Design: A Design-Thinking Strategy for the Canadian Armed Forces

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Announced in 2017, the Government of Canada's Innovation and Skills Plan articulated a clear national-strategic goal to "establish Canada as one of the most innovative countries in the world and to foster a culture of innovation."[1] Likewise, Canada's recently renewed defence policy, *Our North Strong and Free*, states that "the speed of technological change requires a shift in organizational mindset—a willingness to embrace innovation and experimentation, and to continuously adopt emerging technologies."[2] Consequently, two key initiatives, namely the Innovation for Defence Excellence and Security (IDEaS) and the Mobilising Insights in Defence and Security (MINDS) programmes have been established in recent years to achieve these goals. The IDEaS program seeks to develop novel solutions by providing funding to researchers and innovators as well as outsourcing defence-related challenges to private industry.[3] Whereas, the MINDS initiative seeks to strengthen collaboration with academia to improve evidence-based policy development.[4] Both of these programs aim to increase collaboration between public and private sectors and to draw innovation into the Canadian Armed Forces (CAF) from external sources, an approach commonly referred to as "open innovation."[5]

What these funded research and development programs largely overlook, however, is the *internal* capacity of the CAF to innovate through the leveraging of skills, experience, and creative potential nascent within its existing workforce. While much needed, these "outside-in" initiatives do not directly contribute to educating and training CAF members to solve problems more creatively nor do they seek to address existing barriers to innovation vis-à-vis a holistic review of the CAF's current structures, policies, and processes. Despite the attention given to digitization and equipment upgrades, bolt-on technologies will not be enough to address the more systemic barriers to innovation that reside at the level of organisational culture. For the CAF to truly embrace innovation, greater strategic focus (and investment) must be given to evolving current structures, policies, and processes to grow innovative capacity and to enable idea-generation and experimentation to thrive at all levels of the organisation.

Design Thinking (DT) practice holds promise for enabling the kind of organisational transformation in view here. As a highly collaborative, human-centred approach, DT provides the mindset, processes and methods required to better harness the creative potential of CAF's greatest resource—its people—in developing solutions to overcome the most pressing obstacles to the accomplishment of their missions. This article aims to visualize the path towards this broad objective, applying DT concepts and drawing support from existing models and research findings. Finally, these concepts are underscored through a case study review of *Plan Qulliq*—a trailblazing innovation initiative of the Royal Canadian Air Force (RCAF).

DESIGNING AN INNOVATIVE ORGANISATION

Militaries ought to be amongst the most adaptive and agile organisations in existence given the life-and-death imperative to achieve competitive advantage and to operate in highly volatile environments. While it may hold true that the CAF demonstrates adaptability and agility at the tactical and operational levels, these attributes are arguably less a reality at the institutional-strategic level. It is at this level that the CAF operates more in keeping with traditional bureaucracies—hemmed in tightly by the slow-changing regulatory and policy constraints of the broader Department.

Important lessons can be learned from private industry in this regard. Jay Galbraith studied the phenomenon of large, successful businesses failing to innovate and, consequently, being overtaken by more agile start-ups. In *Designing the Innovating Organization*, Galbraith states:

> It is my contention that innovation requires an organization specifically designed for that purpose—that is, such an organization's structure, processes, rewards, and people must be combined in a special way to create an innovating organization, one that is designed to do something for the first time... An organization that is designed to do something well for the millionth time is not good at doing something for the first time.[6]

Radical innovation often requires organisations to pivot from the very business models, structures, and processes that were responsible for their initial success. Akin to re-building a plane mid-flight, this is an obvious challenge for more established companies and, as a result, smaller start-ups often win the innovation race.

As illustrated in figure 1, Galbraith's model proposes that organisations are comprised of five distinct components: strategy, structure, processes, rewards, and people. *Strategy* "concerns the long-range goals and objectives ('what we do') as well as the courses of action necessary to achieve them ('how we win')."[7] It provides direction to the system. *Structure* is the internal configuration of the organisation that determines how roles and activities are divided and allocated to teams, departments and divisions. It organises power within the system through the attribution of various authorities. *Reward systems* are the mechanisms that aim to align team efforts and individual performance with the organisation's goals as well as the metrics used to measure these performances. Such systems shape motivations for action within the system. *People Practices* refers to hiring, developing, and promoting the right talent to successfully implement and manage the organisational model. These practices influence the skills and mindsets available within the organisation. *Processes* refers to the broad range of procedures that direct how work is performed and how entities coordinate, encompassing both vertical processes like planning, budgeting, reporting and lateral processes like coordinating, aligning, liaising, integrating. These processes determine how information flows within the system. Altogether, the configuration of these internal components produces specific patterns of behaviour that, in turn, become characteristic of what can be called the "performance" and "culture" of the organisation.

Galbraith particularly advocated for creating structural separation between what he termed the "operating organization"—responsible for ongoing product and service delivery—and the "innovating organization"—responsible for exploring new product and service development. Galbraith proposed that by carefully managing the separation of these structures and roles, companies could reap the benefits of each while ensuring that the operations of one were not inhibiting the operations of the other.

Figure 1: Galbraith's Five-Star Model
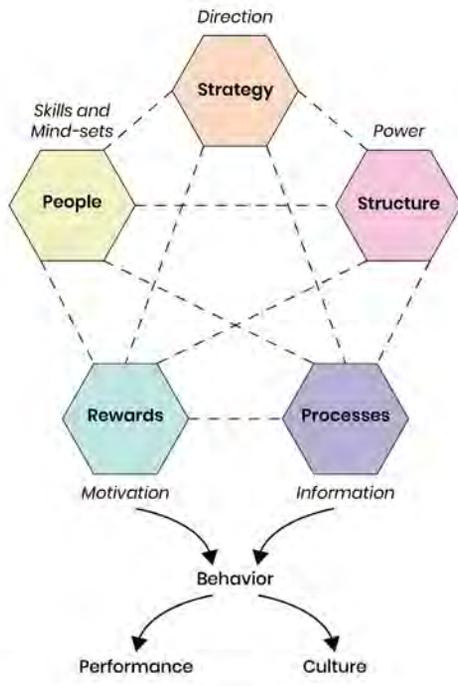
Source: Figure reproduced from illustration in Ronald Jean Degen, "Designing Matrix Organizations that Work: Lessons from the P&G Case," *Revista Eletrônica De Estratégia & Negócios* 2, no 1 (August 2009): 36.[8]

Galbraith further emphasised that innovation required that the constituent components of the organisational design be *aligned* under a common strategy (see figure 1). Echoing this need for strategy and noting a similar void in the United States, Lieutenant-Colonel Cassem states that because air forces are designed with specific purposes in mind, innovation often clashes or conflicts with the routine fulfilment of those purposes. To foster innovation within the US Air Force (USAF), Cassem suggested separating innovation from "day-to-day mission execution (or the 'performance engine')".[9] Arguing that innovation is fundamentally human-centred, Cassem further posited that military organisations needed to "create the conditions necessary for innovators to thrive by reforming three specific areas: organisational empowerment, formal education, and effective evaluation."[10] Cassem's recommendations largely track with Galbraith's model, addressing issues of structures, people, and reward systems.

In summary, from Galbraith we gather a useful model for understanding the role of strategy in directing innovative activity within an organisation, wherein performance and culture are expressed as the byproducts of an organisation's strategic alignment of structures, processes, people, and reward systems. In other words, organisations are not innovative by accident– their ability to adapt themselves in response to the changing demands of their environment is largely a function of how they are organized. This raises several questions concerning how the CAF is currently organized to enable innovation. How central is

innovation in its directing strategies and is this reflected in how resources are allocated? Is the organisation structured in such a way as to enable both stable operations and disruptive innovation to occur in parallel? Are its reward systems conceived in such a way as to motivate innovation or to stifle it? Are the people who comprise the CAF trained and skilled in the right ways to support innovation? Are the processes that govern the flow of information within the organisation conducive to the free exchange of ideas and playful collaboration? These are complex, interrelated questions that are not easily interrogated. Nevertheless, they serve as a starting point for describing how the CAF could frame "innovation" as a design problem to be explored and interrogated. We turn then to discussing how a Design Thinking (DT) approach could be applied in this exploration.

DESIGN-THINKING FOR THE CAF

Created in 1944 under Winston Churchill's wartime government, the Council of Industrial Design was stood up to tackle Britain's looming challenge of post-war economic recovery.[11] Now branded as the Design Council, the group has evolved to become the United Kingdom's national strategic advisor for design writ large, with an expanded vision to helping their "government, businesses and communities better understand what design is and the economic, social and environmental benefits it brings."[12]

The "Framework for Innovation" advanced by the Design Council centres on the application of a "Double Diamond" design process which is now widely referenced (see figure 2). Each diamond represents a process of exploring issues in depth (aiming for divergence of thought) and then narrowing collective understanding (aiming for convergence of thought) to take focused actions. The process is applied first in *discovering* and *defining* the "problem" (the first diamond) and then subsequently in *developing* and *delivering* "solutions" (the second diamond). Though sequential, the process involves numerous feedback loops, underscoring the need to iterate frequently at each stage of the process to achieve clarity and consensus.

The framework is further characterized by four design principles (see figure 2): "put people first" (striving to understand the needs and aspirations of stakeholders); "communicate visually and inclusively" (working to develop a shared understanding of core problems); "collaborate and co-create" (working together to expose a broad range of potential solutions); and "iterate, iterate, iterate" (detecting errors early and to build confidence in the viability of potential solutions). A "methods bank" is depicted alongside the process, acknowledging the vast array of design methods and tools available to guide these efforts. Finally, the framework emphasizes the role of *leadership* and *engagement* in creating a culture of success.[13] The Council states that "as important as the process and principles... we adopt, is the culture of an organisation and how it connects with citizens and partners."[14]

Underlying the Design Council's framework are three varied conceptualizations of DT as reflected in the literature: DT as *mindset*, DT as *process* and DT as *method*. Mirroring this, the following definition of DT has been proposed: "Design Thinking is an iterative problem-solving and innovation process in organisations, which is based on specific principles (such as a focus on user needs, multi-disciplinarity, etc.) and uses specific methods (such as creative thinking, visualization, experimentation, etc.)."[15] Given this plurality of elements, many describe DT more generally as an "approach"[16]—suffice it to say, it is all of the above. Describing DT as the de facto "language of innovation," Hernandez et al. observe that "design practices, design visualizations, and design methods—not to mention the push toward integrating design thinking—often form the common ground upon which conversations can be built in the complex context of innovation process."[17]

Figure 2: The Design Council's Innovation Framework, 2019
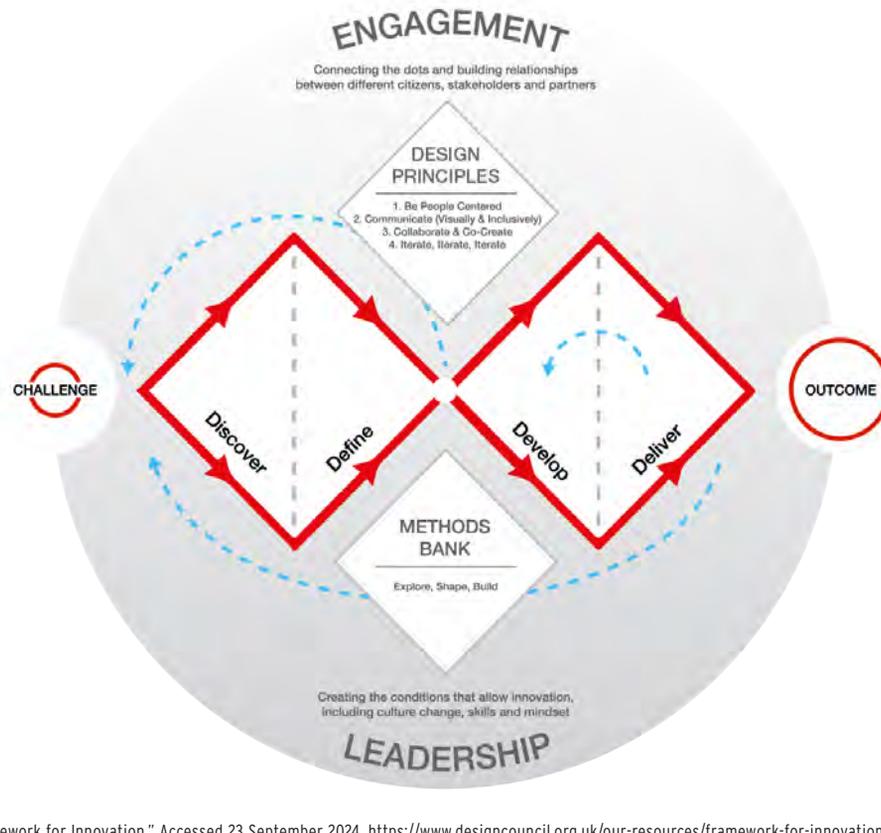
Source: Design Council, "Framework for Innovation," Accessed 23 September 2024. https://www.designcouncil.org.uk/our-resources/framework-for-innovation/

Moving from the theoretical to the more practical, the question arises: what is the value proposition for applying DT within the CAF specifically? Acknowledging that other authors have given this question a longer treatment,[18] let us simply consider how DT aligns with the aspirations of CAF leadership. In the updated *Canadian Armed Forces Ethos: Trusted to Serve*, we read:

> *Inclusion is a force multiplier because it increases our operational effectiveness by integrating various perspectives and insights to improve decision-making… It encourages creativity, fosters group motivation, speeds up problem-solving, improves risk management, and increases productivity and performance… It also engenders trust and creates a sense of belonging which enhances group cohesion. Embracing diversity produces stronger teams, with leaders capable of making better-informed decisions and with team members contributing their unique knowledge, skills, experience and perspectives to the team.[19]*

With its emphasis on user-focus, stakeholder engagement and collaborative problem-solving, the DT approach aligns exceptionally well with the expressed aim of promoting inclusivity. Similar language is reflected in the outcomes of DT application. For example, studies have shown DT to increase individuals' creativity,[20] motivation and empowerment,[21] self-confidence[22] and skill-development leading to improved performance.[23] At the group level, DT practice has been shown to increase creativity,[24] to reduce hierarchies,[25] and to reduce cognitive

biases leading to improved decision-making and innovation outcomes.[26] As such, the DT approach has potential for improving the level of engagement of CAF members of all ranks, trades, and backgrounds in innovation processes (and, by extension, the culture-change effort).[27]

Applying DT also comes with certain challenges. Rosch et al. state that for DT practice to be successful "non-designers need to learn the design skills and principles of dealing with ambiguity and uncertainty, developing a holistic view, and collaborating in teams among divergent thinking and convergent thinking."[28] Given the low likelihood that DT approaches will be perfectly compatible with the established culture, it is further stressed that "the organisation should have a strategic vision and clear goals known among employees"[29] and that facilitators should be employed to teach design processes and mediate, where necessary, between the design process and barriers within the organisation."[30] In short, successful implementation of DT within organisations requires leadership vision, long-term commitment and deliberate investments in design education.

RE-DESIGNING THE CAF FOR INNOVATION

Transforming the CAF into a truly innovative organisation, with a culture that embraces innovation, is a worthy aspiration that demands a holistic review of the organisations strategies, structures, processes, people policies, and reward systems. It is an endeavour that would require both top-down leadership and bottom-up engagement. It would require risk-taking, trial and error, collaboration, and a willingness to experiment. It would require a clearer understanding of the current impediments to innovation (i.e. the problem space) and potential means to eliminate them (i.e. solution space). Moreover, it would require pioneering investment in exploration activities that are not all guaranteed to produce immediate results. Considering these realities, the goal of fostering a culture of innovation in the CAF is best approached as a continuous design-challenge to be tackled through continuous, structured design interventions and guided by a DT methodology.

The design challenge. *How might the CAF evolve its organisational design to optimise its capacity for innovation?*

The design framework. By integrating concepts from both Galbriath's Five-Star Model (figure 1) and the Design Council's Innovation Framework (Figure 2), an initial design challenge framework is proposed that seeks to provoke inquiry across multiple domains in a quasi-sequential manner. The framework presumes that multiple, interrelated design problems need to be explored to address the full scope of the organisation's design, including its strategies, structures, reward systems, people, and processes. An example of a potential design problem could be: "How might the CAF adjust its organisational structures to enhance innovation?" Another design problem might focus on rewards: "How might the CAF better incentivise its members to contribute innovative solutions to well-known and lesser-known problems?" Yet another may focus on the people dimension: "How might the CAF improve the skills and abilities of its members to think and solve problems creatively?" Following the design-thinking process and conducting multiple iterations of framing and re-framing problems would refine thinking towards a more holistic and unified view of larger design challenge.

A 1 Canadian Mechanized Brigade Group Headquarters and Signal Squadron telecommunications dish set up during Op CADENCE at Mount Kidd RV Park, Kananaskis, Alberta, on May 24, 2025.

Photo: Master Corporal Robert Mitchell, 3rd Canadian Division Imagery Technician

Figure 3: Innovation as an Organisational Design Challenge
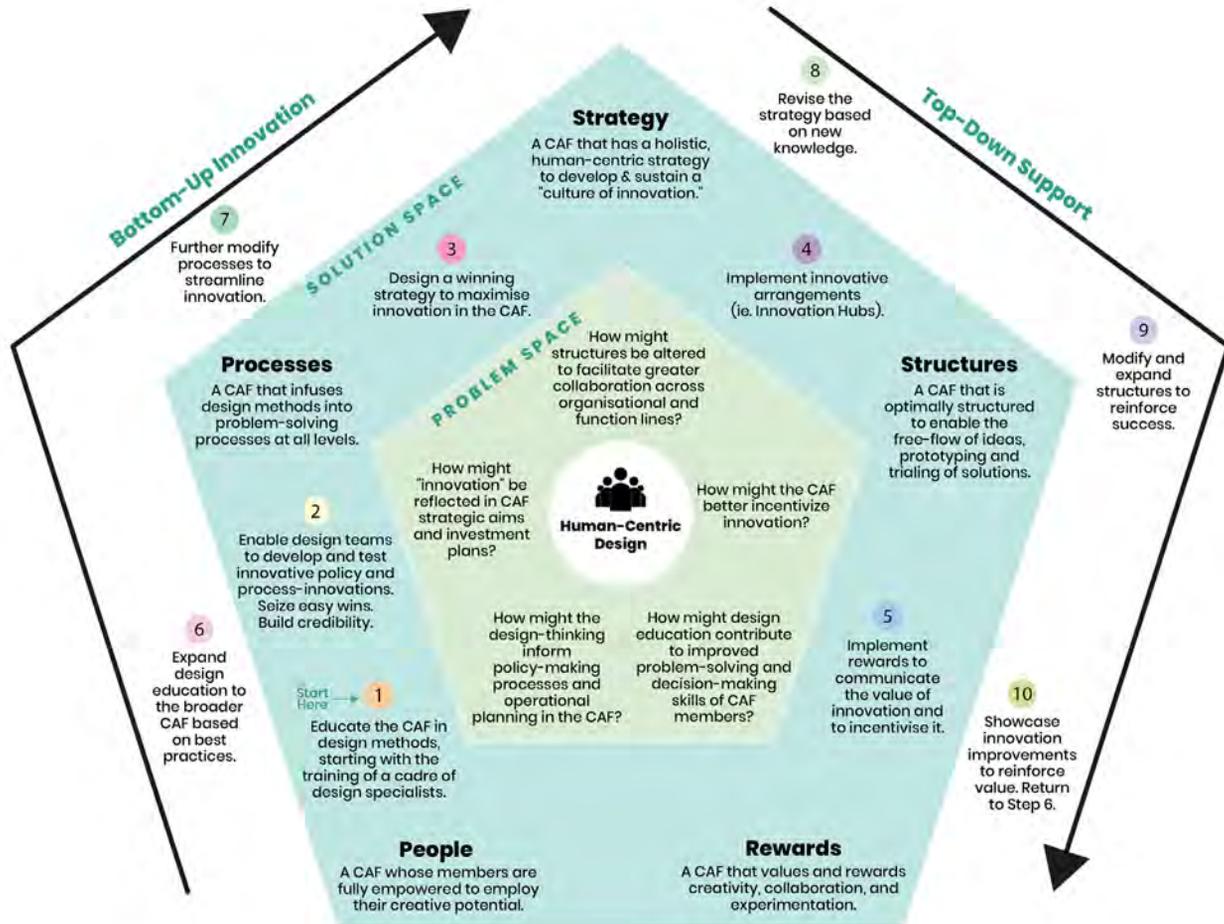
Source: Original (created with Miro, https://miro.com/app/)

Ultimately, the design team would need to validate the five-part framing of the problem through extensive stakeholder engagement. Moreover, design inquiry would need to expand beyond the current framing to consider external stakeholders and environmental factors. Of note, using the model would be intended to guide inquiry rather than constraining it. The solution space is left intentionally blank and undefined, though desired outcomes are proposed in the absence of a defined strategy.

The design roadmap. As described previously, the design exercise is intended to foreground real-world conditions and to serve, simultaneously, as a roadmap for advancing design-thinking education in the CAF. Acknowledging design-thinking's current, peripheral status in the CAF, a conservative approach that builds on existing capacity and knowledge is the most realistic path forward. Thus, the proposed experiment leverages extant design education programs as its start-point and builds outwards. The experiment envisions a progression of activities starting with continued efforts to reinforce the "people" component of the CAF's internal capacity. This people-centred approach intends to expand design education beyond the introductory-level familiarisation that is afforded to members on JCSP and NSP. For instance, specific design courses and workshops could be developed or curated for members of all ranks to facilitate broader participation in CFC-led design activities.[31]

Next, the design experiment proposes to focus initial efforts on improving processes related to innovation to include those mechanisms which facilitate or impede the flow of information and collaboration within the CAF. This is purely a pragmatic suggestion, as the longevity of the experiment itself would depend upon its ability to generate results and processes (to include policies). It is unlikely that the structures and reward-systems of the CAF would see any adjustment unless driven by the implementation of top-down strategic direction. Yet, no such strategic direction and "championing" of design efforts will emerge in the absence of more concrete evidence of its utility to the CAF. To that end, the experiment is proposed as an iterative series of discrete design sprints that are bounded in such a way as to ensure that proposed solutions are viable to be prototyped, tested, and implemented.

> **"** In time, it is posited that this approach will generate the momentum necessary to justify the more formal adoption of design thinking methodology into professional military education streams."

Next, design efforts can work towards framing an appropriate strategy for the CAF to improve innovation in the long run. This effort would be informed by an increasingly broad design community and would be legitimised by a lengthening résumé of successful design interventions. A design-informed strategy would also provide the required direction to implement proposed changes to various structures and reward-systems.

In summary, the proposed design experiment envisions a sustained bottom-up effort to demonstrate the utility of design thinking for applications in the context of the CAF while simultaneously addressing the broader and more complex (perhaps 'wicked') problem of improving the CAF's capacity for innovation. In time, it is posited that this approach will generate the momentum necessary to justify the more formal adoption of design thinking methodology into professional military education streams. Moreover, guiding design inquiries along a consistent theme, instead of applying them in an ad hoc manner, is more likely to generate cumulative effects and broader-level solutions. Until such design work is done, the CAF will likely remain ignorant of its own potential.

PLAN QULLIQ: LEADING THE WAY

Plan Qulliq is an innovation initiative of the Royal Canadian Air Force (RCAF) that targets bottom-up idea generation and facilitates the development, testing, and resourcing of solutions to problems identified by individual members. It serves as an ongoing case study against which to evaluate the proposed design experiment and its value-proposition for the CAF. Most notably, it serves to highlight the role that an innovation strategy has played in establishing the requisite structures, processes, people policies, and reward systems within the context of the RCAF to foster innovation.[32]

Strategy. Plan Qulliq was issued a formal mandate letter from the Commander of the RCAF in July of 2020, which lays out the vision, mission, and key tasks of the initiative.[33] The initial vision for the team was "to provide the RCAF with relevant and holistic focus points to evolve our capabilities of today, so as to ensure the RCAF is postured as an integrated and interoperable leader amongst its allies tomorrow."[34] Recently updated, the vision now reads: "to inspire people through *agile, integrated & inclusive* innovation."[35] Its mission remain unchanged: "to analyze and identify gaps, deficiencies and opportunities in connectivity, interoperability and processes and then champion solutions that allow the RCAF to optimize its weapon systems, exploit emerging and disruptive technologies, and empower RCAF personnel to continue to thrive in the modern battle space."[36] Additionally, an Innovation Charter was issued that provides a governance framework and "innovation management strategy" for the RCAF.[37] Together, these strategic documents clearly communicate a firm commitment from leadership and lay down a common framework and orientation for all members of the RCAF.

Structure. Plan Qulliq saw the establishment of a distinct "Innovation Team" which has the role of guiding the innovation process and helping idea-owners further develop their solutions through the application of DT methods. The team was established as a direct report to the RCAF Deputy Commander which is, in and of itself, an innovative structure. The separation of the team from other force development elements within the RCAF is reminiscent of what Galbraith proposed when advocating for the establishment of an *innovating organisation* to operate alongside the *operating organisation*. Also, the strategic positioning of the Innovation Team within the hierarchy translates into unusual access to senior leadership, enhanced credibility when collaborating with parallel organisations, and flattened approval processes.

Processes. Largely reflecting DT approaches, the RCAF Innovation Charter lays out an innovation process, commencing with *ideation*, through *evaluation, development*, and *approval,* and ending in *implementation*. With the aim of fast-tracking ideas through to approval (and resource investment), Plan Qulliq employs a uniquely agile process-flow that runs in parallel with traditional governance processes within the RCAF. Central to the innovation process is the convening of bi-annual "Vector Check" events, whereby innovators are given a platform to pitch their ideas directly to the RCAF Commander. Beyond facilitating a few good ideas through to execution, this unique and highly-visible exercise serves also to raise awareness of innovation efforts across the RCAF and is another means for leadership to reinforce and celebrate innovation efforts.[38]

People. The earliest initiatives of Plan Qulliq saw the development of digital tools to enable and improve communication within the RCAF. A notable example has been the development of "Hangar," a cloud-based digital ecosystem that currently houses eight distinct applications that facilitate collaboration in executing a range of tasks including flight administration, flight safety, cargo operations, financial claims processing, internal communications, and ideas management. Designed *by* the RCAF *for* the RCAF, these digital tools directly enable its members to do their work more effectively, thus contributing to job satisfaction.

In addition, an "Innovation Network" was established to link innovation reps from across all Wings and Bases and to increase connectivity and information-sharing about innovation activities between units, formations and command. Furthermore, Plan Qulliq delivers educational opportunities to RCAF members as a means of fostering a "culture of innovation." Online courses are currently being offered on Design Thinking, Data Analytics, Power BI, and Generative Artificial Intelligence. Finally, the RCAF Innovation Team benefits from uniquely flexible remote-work arrangements, removing geographic barriers and enabling the selection of diversely-talented and motivated candidates from across the organization to lead the initiative.

Reward Systems. With the formal designation of innovation roles, Plan Qulliq has established a means for recognizing and rewarding members for formally contributing to innovation efforts in either a full or part-time capacity. Through the Vector Check process, idea-owners remain involved to see their innovative solutions carried through to formal endorsement by the RCAF Commander, which is a form of public recognition. In addition, resources have been, in some cases, awarded to the Base or Wing that presents the best innovation idea, which adds playful and competitive energy to the process.

Only a short number of years into its existence, Plan Qulliq has come a long way in formalizing a bespoke innovation strategy for the RCAF. While it does not seek to supplant the research and development work occurring elsewhere across the Department, it does provide a unique conduit for RCAF members to directly engage in the innovation effort and to tackle issues that may otherwise go unaddressed in the larger system. As an evolving initiative, it is ever adapting. Plan Qulliq has already revised its innovation planning cycle to a "version 2.0" and is working to revise and reissue the Innovation Charter as an Innovation Handbook. It has achieved notable success in standing up a centre of excellence for innovation within the RCAF and in facilitating a unique, bottom-up innovation process that drastically enhances member engagement in innovation activities. Altogether, Plan Qulliq represents a model example of an innovation strategy that accounts for structure, processes, people, and reward systems. While these bold strides are being taken to foster innovation within the RCAF, there is opportunity to expand these lessons and initiatives to the broader CAF.

CONCLUSIONS

Canada's defence policy makes it exceptionally clear that the rate of technological and geo-political change is accelerating and that this context demands that the CAF fully embrace a more innovative mindset.[39] Yet such pronouncements are slow to translate into true organisational change. Efforts to partner with industry, to upgrade technologies and to procure more modern equipment are necessary but near-sighted. They fall short of addressing the institutional barriers that currently prevent units and individual members from pursuing innovation at all levels of the organisation. As discussed herein, the strategic goal of promoting a more inclusive and innovative culture in the CAF is a design challenge in its own right: a complex set of problems that demand innovative solutions.

This article represents an initial effort to frame the problem space around innovation in the CAF. It raises, rather than answers, questions regarding how components of the CAF as an organisation—its strategies, structures, reward systems, people, and processes—might be adjusted to improve its innovative capacity. It proposes that these questions be treated as design problems to be explored through a human-centred design lens, leveraging DT methodologies to engage CAF members more directly in co-creating the CAF of the future. The CAF would benefit from an innovation strategy to guide this continuous effort. In the meantime, bold ventures like Plan Qulliq are leading the way.

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Sailor watching BLACKHORSE a CH-148 Cyclone Helicopter flight away from HMCS St. John's during OP REASSURANCE, on October 9, 2025.

Photo: Corporal Annabelle Marcoux, Canadian Armed Forces

Measuring the Performance of Canada's Military Personnel System

MAX HLYWA, KRYSTAL K. HACHEY, AND SAMANTHA URBAN

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One of the goals of organizational research is to develop decision-support tools for managing the performance of organizations.[1] One such tool can be developed through a process called performance measurement, and this article describes the application of that process to the Canadian Armed Forces' (CAF) Military Personnel System (MPS). Also covering some of the lessons learned in the process, the article should be of interest to readers curious about how such systems and the organizations that manage them measure and report on their performance.

The Department of National Defence (DND) and the CAF have one of the largest departmental budgets in the Canadian government, much of which is allocated to CAF personnel. It is therefore important that the MPS is efficient, effective, and aligned with Canadian strategic priorities for defence. The main challenge in developing a Performance Measurement Framework (PMF) for such a system is identifying the best evidence that the system is working as intended. Unlike for-profit private firms, which have traditionally measured their performance in terms of profit,[2] the performance of a military personnel system must address a variety of outcomes, some of them less tangible or straightforward, such as personnel readiness and well-being. In the past, uncertainty about what exactly to measure contributed to a reliance on the loosely related data that was at hand.[3] Such practices are particularly inadequate since the Government of Canada's 2016 Policy on Results[4] has called for increased transparency around the delivery of results by each department. Espousing the tenets of 'deliverology'—a results-oriented approach to managing governments,[5] the policy aimed to define and improve departmental outcomes through the creation and ongoing use of Departmental Results Frameworks.[6] As institutional capacity to meet the demands of the policy did not immediately exist, a new (at the time) project to develop a PMF for the MPS would better position the department to report on the generation, support, and management of military personnel. By establishing detailed articulations of the relevant organizational strategies where they did not previously exist, the project provided the clarity and opportunity needed to develop metrics grounded in specific activities, the outputs they produce, and the logical outcomes.

The project began with the establishment of a stepped process to develop the PMF. The first step in that process was to create a visual overview of the *mission* for the military personnel system and its various objectives. The next steps included the identification of key performance questions pertaining to each objective, the use of logic models to describe how different organizations within the system are intended to work, and the development of relevant metrics (i.e., output measures and outcome indicators). Some consideration was also given to a communication platform suitable for reporting on organizational performance to the intended audiences. In this article, the authors describe the lead-up to the project, the process that was followed, and some examples from each step in the process. Also included are some lessons that could assist with related future efforts.

The Military Personnel System Performance Measurement Framework Project

Prior to 2014, there were several measurement and reporting systems related to CAF personnel. However, these systems were often inconsistent, incoherent, or lacked explicit alignment with organizational mandates and strategies. Altogether, they were incapable of sufficiently monitoring or reporting on the results of the variety of organizations included in the MPS for the CAF. Consequently, in 2014 CAF senior leadership initiated an unprecedented project to create an authoritative framework spanning the entire military personnel system that would enable performance reporting, support evidence-based decision making, and inform strategic planning.[7]

To put it differently, while researchers have described a variety of reasons for measuring organizational performance,[8] there were two main purposes for the project. The first purpose was to enable upward reporting of performance to the relevant authorities and out to external partners, stakeholders, and other interested parties. The second purpose was to enable performance management—as the saying goes, "what gets measured gets managed."[9] By identifying areas of strength and areas needing improvement, the framework was intended to highlight specific opportunities to focus management efforts on improving results. In addition to these two main purposes, five other specifications were that the PMF should:

(a) reflect the DND and the CAF's mandate and align with strategic direction;

(b) assess performance at both the strategic (e.g., meeting legislated requirements) and operational (e.g., meeting recruiting targets) levels;

(c) include measures related to outputs (e.g., counts of tangibles produced), outcomes (e.g., indicators suggesting desired effects), and efficiencies (e.g., cost per product unit);

(d) encompass the right measures (not merely those that are convenient); and

(e) leverage a combination of organizational data and member feedback.[10]

Two phases were planned for the project. Phase 1 consisted of the research and development of the PMF, led by researchers at Director General Military Personnel Research and Analysis (DGMPRA). Phase 2 involved the implementation, operation, and maintenance of the framework going forward, led by staff at Chief Military Personnel (CMP). As will be seen, Phase 2 was to include

the establishment of a software-based communication platform that could provide on-demand situational awareness on the performance of the military personnel system.[11]

The Performance Measurement Framework Development Process

The PMF development process established by the project team was based on best practices from the relevant literature,[12] expert advice from CAF members experienced in such processes, and guidelines[13] put forth by the Treasury Board of Canada Secretariat. The simplest description of the process can be summarized in two parts. The first part of the process (steps 1 to 4 below) is articulating the strategy through which the organization strives to achieve its mission. In other words, it is about explaining how the organization intends to work. The second part (step 5) identifies data that can be used to demonstrate that the organization is working as intended. Overall, this approach aims to "rationalize the programmatic structure as a prelude to measurement."[14] It would be difficult to assess the performance of an organization without a clear understanding of its intended results and a rational explanation of how it intends to deliver those results. The process also gives some consideration to the communication organizational performance (step 6). More specifically, the steps in the process are as follows...

Steps 1 and 2: Develop a Strategy Map and Establish Strategic Objectives

The "strategy map" is a one page visual that expands upon the organization's mission, featuring strategic objectives for its different functional areas.[15] Typically informed by strategic-level documents (e.g., mandate, doctrine, legislation, policy), the strategy map connects the organization's mission to foundational elements that drive and support it, as well as to the ultimate goal that it pursues through the fulfilment of the mission.[16]

Step 3: Develop Key Performance Questions

Key performance questions (KPQs) help an organization identify the aspects of performance that are critical to the achievement of its different objectives (identified in the previous steps). KPQs focus the discussion on the most relevant aspects of performance and help management identify the best data for evidence-based decision-making. The development or revision of KPQs can also help ensure that an organization is not using an outdated perspective on the essential aspects of its business.[17]

Step 4: Build Logic Models

Logic models are used both inside and outside of government organizations to depict the ways in which a program contributes toward its intended outcomes. In the MPS PMF project, logic models were created to show *how* different organizations within the MPS achieve the objectives articulated in their own strategy

maps. Table 1 summarizes the six main components of a logic model: inputs, activities, outputs, direct outcomes, intermediate outcomes, and ultimate outcomes.[18]

Table 1: The Components of a Logic Model

Inputs	The resources used by an organization to conduct its business (e.g., human and financial resources); may also include relevant direction, requirements, and/or constraints facing an organization, as well as outputs or outcomes from other logic models
Activities	How an organization produces their outputs (e.g., processes)
Outputs	Tangible products resulting from activities (e.g., documents)
Direct Outcomes	Effects resulting directly from one or more outputs (e.g., the target audience is informed)
Intermediate Outcomes	Effects that direct outcomes contribute to (e.g., some desired behaviour in that audience)
Ultimate Outcomes	Effects that intermediate outcomes contribute to (e.g., some desired state in an organization or in some population)

Step 5: Determine Key Performance Indicators

Key performance indicators are used in the process to demonstrate organizational performance in two ways. First, they answer specific KPQs by pointing to relevant data (see Table 2 for an example). Secondly, they form evidence of results described in logic models—either as measures of output, or as indicators of intended outcomes. In either case, they were explicitly tied to what was produced in the earlier steps of the process (i.e., KPQs and/or logic models). As highlighted in the specifications for the MPS PMF listed above, there was a need for the framework to concentrate on the right aspects of performance, but also to include a complimentary balance between indicator types. For example, the project team aimed to balance indicators based on subjective data (e.g., survey research) with related indicators based on objective data (e.g., administrative data), and balance measures of output produced against indicators suggestive of the related outcomes.[19]

Step 6: Develop a Communication Platform

The final step in the project was to develop a software solution for displaying all of the relevant performance information. There was a need for the solution to be easily modified in accordance with changes to the MPS, and to present performance

information that is up-to-date. Such a platform would enable performance management and assist with the timely fulfilment of reporting requirements.[20]

Notably, steps 1-6 in this process were meant to be cyclical. It was intended that each step of the process would periodically be revisited (e.g., every few years) to ensure that it accurately reflects the natural evolution of the MPS in response to internal changes in policies or programs and external factors including trends in society, technology, environment, economy, or politics.

The Military Personnel System
Performance Measurement Framework Strategy Map

The first step in the PMF development process was to create a strategy map that encompassed the entire MPS. This was accomplished using feedback from key representatives and stakeholders throughout the system, as well as strategic documents describing the higher level aims of the system.[21] The goal was to identify the objectives of each functional area and to make it obvious which organization within Military Personnel Command was responsible for each objective. An outdated model of CMP's functions[22] from 2008 was used as the base structure in the development of the MPS PMF Strategy Map.

Figure 1 is a simplified version of the MPS PMF Strategy Map, with some details removed. The map is meant to be read from the bottom to the top, with the elements at the bottom supporting those above.[23] The foundational elements at the bottom were the relevant policies, functions, and knowledge base relevant to the MPS. The categories *Societal, legislative*, and *regulatory* refer to the governmental priorities and other external conditions affecting the system. *Defence plans and priorities* referred to relevant DND/CAF plans and priorities. *Military personnel management doctrine* and *CMP mission and vision* refer to the specific guiding principles for the MPS. Above these foundational layers sat *personnel governance and integration*, which referred to important MPS functions affecting the whole system such as research, policy, and financial planning.[24] The two sections above that were *personnel generation*, which covered recruitment, individual training, and education, and *personnel support*, which covered health services, personnel management, and member and family support.[25] At the top of the map was the ultimate goal for the MPS—to produce the "right person," with the "right qualifications," in the "right place," at the "right time," who was "ready to deploy."[26]

Figure 1: The MPS PMF Strategy Map (Simplified)[27]
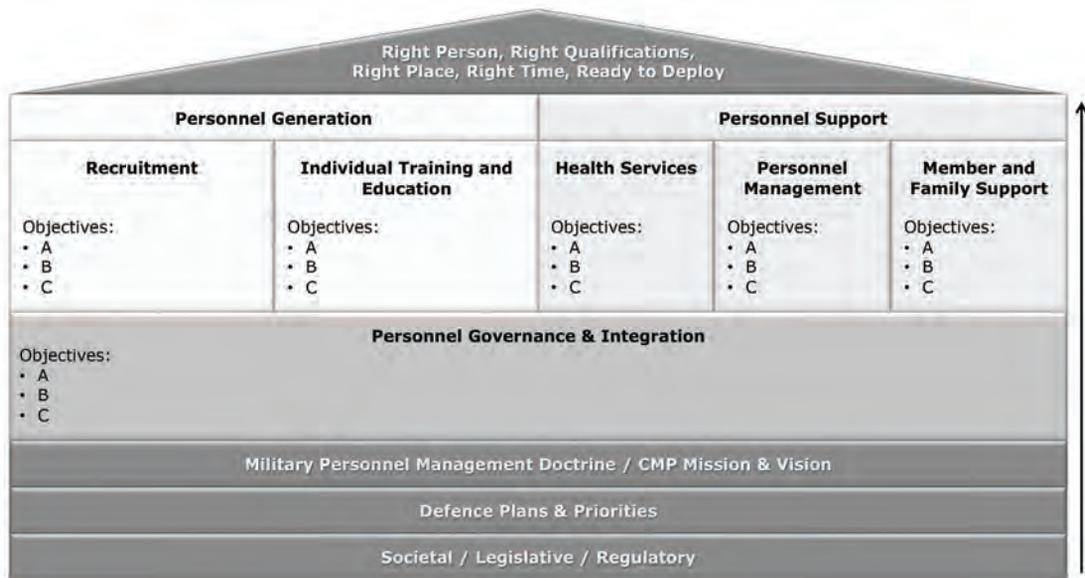
Once the MPS PMF Strategy Map was developed, CMP then directed over a dozen subordinate organizations (responsible for different sections of the strategy map) to create their own performance measurement frameworks, following DGMPRA's process for PMF development.[28] This was to enable a more detailed articulation of relevant efforts and results, and increase the precision with which different elements of the MPS could be measured. However, this direction also diverted the process away from summarizing the strategy and results of the MPS as a whole. It is important to consider the end user(s), their different purposes, and what level of detail is sufficient for those purposes when deciding at what organizational level to proceed with PMF development. The following section provides

insight into the products that emerged from just one of the organizations in the MPS, namely Military Personnel Generation Command (MILPERSGEN).

Example: Military Personnel Generation Command

MILPERSGEN remains responsible for recruitment, training, and education.[29] In accordance with the PMF development process, the first step was to develop the MILPERSGEN PMF Strategy Map.[30] This was accomplished using key strategic documents[31] and the expertise of knowledgeable senior staff members.

Figure 2 is a simplified version of MILSPERSGEN PMF Strategy Map. Similar to the map developed for the broader MPS, its foundational elements included *societal, legislative,* and *regulatory* influences, *Defence plans and priorities*, and the *MPC mission and vision*.[32] The MILPERSGEN strategy map also included specific foundations, namely *force structure* and *career management policy*.[33] Four main sections were also identified for the strategy map: *recruitment, professional development* (which had four sub-sections), *personnel generation requirements*, and *MILPERSGEN doctrine, policy, and governance and integration*. The following paragraphs provide an example of the strategic objectives, key performance questions, logic models, and key performance indicators that were developed for just one section of the MILPERSEGEN strategy map.

Figure 2: The MILPERSGEN PMF Strategy Map (Simplified)[34]
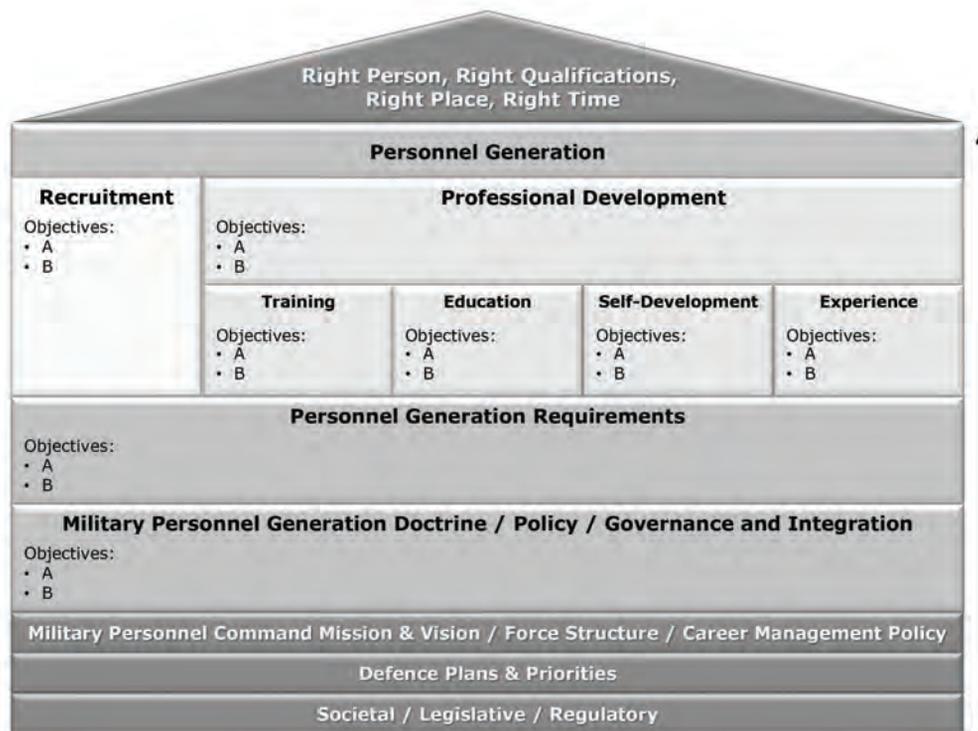
The *recruitment* section encompassed attracting, processing, selecting, and enrolling/transferring personnel (i.e., both external recruitment and internal transfer of existing CAF members). As an example, Table 2 lists one of the strategic objectives proposed for recruitment, one of the key performance questions focused on the attraction aspect of the objective, and a relevant key performance indicator. In most cases, one to three questions were created for each objective, and one to three indicators were developed to answer each question.

Table 2: Example Strategic Objective, Key Performance Question and Key Performance Indicator for the Attraction aspect of Recruitment[35]

Objective	Meet the dynamic personnel generation needs of the CAF by attracting, processing, selecting, and enrolling quality external applicants.
Question	How effectively does the external attraction process meet the needs of the CAF?
Indicator	The number of external applicants received for processing.

A logic model was also developed for each objective, and Table 3 provides an example from the logic model developed for the attraction objective. It shows just one of the inputs for a single activity, one of the outputs produced, and some of the outcomes to which that output theoretically contributes. Establishing measures of such outputs and identifying data that could be used as evidence of such outcomes was another way that key performance indicators were developed for each of the organizations in the MPS.

Table 3: Example Input, Activity, Output and Outcomes for the Attraction aspect of Recruitment[36]

Input	Potential applicants
Activity	Recruiting activities (e.g., career fairs)
Output	Applicants
Direct Outcome	Public interest in employment opportunities in the CAF
Intermediate Outcome	Increased pool of quality applicants
Ultimate Outcome	CAF occupational requirements are met

Over a dozen organizations in the MPS applied this method to their PMF development process, which helped each of them explain their mission in terms of the objectives for different functional areas and to identify the best data to use to answer key performance questions related to those objectives. It also helped each organization articulate their organizational strategy, and the evidence ideally demonstrating that their strategy is working.[37] By identifying and monitoring the relevant key performance indicators, those organizations were better positioned to manage and report on their results.

Communicating Organizational Performance

The MPS PMF was meant to be an authoritative resource for senior leadership, providing both at-a-glance information about the overall performance of the MPS, and more detailed information on specific aspects when needed. Relating to the final step in the PMF development process, the following section describes certain requirements and best practices for communications solutions that could provide such breadth and depth for reporting organizational performance.

Communication Platform Requirements[38]

The ideal means to maximize accessibility and to preclude the need for specialized software on the user's end was a web-based platform. There was a requirement for this web-based platform to embody user-centred design,[39] usability heuristics,[40] persuasive technology,[41] and best practices in the presentation of visual information.[42] There was also a requirement for the platform to be expandable and collapsible, affording both broad and deep views of MPS performance. Other requirements were related to the thoughtful stewardship of the underlying data—performance-related data coming from a variety of organizations that document and store information independently from one another. There was a requirement that the platform could be easily modified, as it was expected that the MPS would evolve over time in response to the constant shift of internal and external factors. A final requirement was for permission controls for different user profiles (e.g., those who maintain the platform versus those who simply want to view it).

Best Practices in Communicating Organizational Performance

Researchers have found that the best practices for communicating organizational performance include cascading scorecards and interactive modular dashboards, described as follows.[43] Performance scorecards offer a quick overview of all the performance critical to an organization's strategic objectives in a single location.[44] By using a table or spreadsheet, scorecards list many performance indicators sorted by the objective, goal, purpose, or function to which they relate. Each column represents a different property belonging to the indicators. These properties typically include past, present, and target performance levels, with some colour coded shapes to signal current performance against expected level of performance. For example, a red circle may be used to indicate poor performance.[45] Scorecards were popularized by The Balanced Scorecard, a specific type of scorecard that categorizes indicators across four different perspectives on the organization.[46] In a similar fashion, a scorecard for reporting MPS performance could categorize indicators (e.g., by functional area).[47] The cascading structure offered by such an

expandable—collapsible scorecard would provide a great communication platform for a PMF.[48]

Performance dashboards differ from performance scorecards in that a dashboard depicts a variety of information in several graphs and charts.[49] Presenting the results in different ways can consolidate disparate but complementary performance-related information from sources throughout a system or an organization, giving them great potential as management tools.[50] Researchers have noted that the best dashboards are modular, allowing different displays that are easily swapped in or out, and interactive, preferably through direct manipulation at the surface level instead of through layered menus.[51]

The project team envisioned a large cascading scorecard allowing users to navigate through the different elements of the MPS and discover performance information relevant to each strategic objective. Specifically, it was proposed that each row of the scorecard would display the status of a particular indicator, and that clicking on an indicator would take the user to a dashboard displaying a variety of information or metadata related to that indicator.[52]

Lessons

A few of the lessons emerging from the MPS PMF development process have informed other applications of the process and could be useful to anyone employing similar processes.

Attitudes toward Performance Measurement

The project team learned that discussing the performance of their organization made some representatives apprehensive about the purpose of the task, anxious about its complexity, and uncertain about how to proceed. It was therefore important to frame this activity as a valuable opportunity for each organization to clarify its strategy and results for those less familiar with the organization. Moreover, it was important to explain that identifying unsatisfactory performance is the first step in bringing about improvements. When individuals saw the process as an opportunity to communicate the organization's success, and a mechanism through which results could be improved, they were more engaged in the process and the tasks involved.[53]

Sustaining Agendas and Change Agendas

An important distinction that emerged repeatedly during the development of the MPS PMF was that between an organization's *sustaining* agenda and its change agenda, as well as the understanding of how they are connected. The sustaining agenda reflects the day-to-day efforts of the organization against its enduring mandate. It references on-going roles or responsibilities that have existed for some time and are intended to continue indefinitely.[54] The change agenda, on the other hand, typically introduces a new strategy or initiative related to the organization's purpose. Since the change agenda is often meant to

> " The project team learned that discussing the performance of their organization made some representatives apprehensive about the purpose of the task, anxious about its complexity, and uncertain about how to proceed."

improve, transform, or expand upon the sustaining agenda, the lifespan of that agenda (and thus, the measurement of its performance) typically ends once the improvement, transformation, or expansion is complete. Organizational representatives were at times eager to focus on the change agenda for their organization and had to be reminded that the exercise was mainly intended to capture the performance of the sustaining agenda for the MPS, a good example of which is the personnel generation function.[55]

The Importance of Logic Models

In most applications of the process, the development of logic models was the most essential step. By identifying the inputs that go into specific activities, by precisely describing the outputs produced, and by clearly expressing the intended outcomes of those efforts, logic models provided an important tool for each organization to clarify how exactly it is meant to work. The agreed-upon understanding that resulted simplified the identification of the most relevant performance measures. Logic models were also useful communication tools for those less familiar with the operations of each organization.[56]

One lesson specific to the development of logic models is the importance of assumptions inherent to the strategies expressed in the models. Put simply, logic models suggest that producing certain outputs will result in certain outcomes, and that those outcomes will contribute to other outcomes. A logic model contains many such expectations, and any one of those expectations can carry assumptions that are not exactly true. In such instances, the integrity of the logic can break down and certain organizational outcomes may no longer be reasonable. By acknowledging and validating the assumptions most critical to the expectations expressed in its logic model, an organization can discover and correct certain dysfunctions that are impeding its success.

Another lesson related to logic model development has to do with the appropriate expression of the outcome hierarchy. An organization requires a sense of humility to accurately portray the diminishing influence it has on the expected chain of

outcomes from its efforts, as well as to acknowledge the increasing influence that external factors play. However, doing so can be an important apparatus for clarifying accountability and managing expectations around results. While the scope of the project to develop the first PMF for the MPS prevented the inclusion of such details, it was learned that the inclusion of assumptions and external factors in the relevant logic models would make for a more robust framework.[57]

Internal Capability for Performance Measurement

As described earlier, the requirement for government departments including the DND/CAF to measure and report on their contribution to the country exceeds anything that existed previously. Additionally, leaders of organizations are increasingly relying on data driven decision-making and results-based management tools. Since organizational performance measurement can meet both needs, the demand for such work has increased throughout DND and the CAF. However, increases to the resources, such as staff, with the tools, training, and experience to meet the demand has not kept pace. For example, not all MPS organizations had the resources needed to implement the PMF that was developed, and only some of those organizations were able to commit the additional resources necessary. Shortages in capability and resources to meet expectations for performance measurement and reporting were raised at the 2023 Performance and Planning Exchange in Ottawa. There, leaders from Treasury Board Secretariat acknowledged suggestions presented by public service professionals from different departments, including the addition of relevant training at the Canada School of Public

Service and the provision of direction and resources to integrate performance measurement with planning efforts (e.g., strategies and business plans) at all levels of the department. Challenges and limitations also exist within and between levels of the department regarding the availability, integrity, and meaningful expression of all the relevant data. After all, critical to any performance measurement process is the quality of the underlying data. As such, by allocating and prioritizing resources (e.g., staff) towards performance data stewardship, there is an opportunity for departments to better monitor their effectiveness and demonstrate their value.

Summary and Conclusion

This article described the process that was used to develop a performance measurement framework (PMF) for the military personnel system (MPS) of the CAF. A description of each step in the process, examples of results from each step, and several important lessons from over a dozen applications of the process were presented. As anticipated, the MPS has continued to evolve since the completion of this work. As suggested, revisiting and updating the PMF will support the management and reporting of the various results produced by the system—results that are particularly important at a time when the DND/CAF has prioritized the reconstitution of the forces.[58] Increasing the resources available for the development, implementation, and use of such frameworks throughout the department will support the Defence Team's ability to deliver results that Canada and its allies depend on.
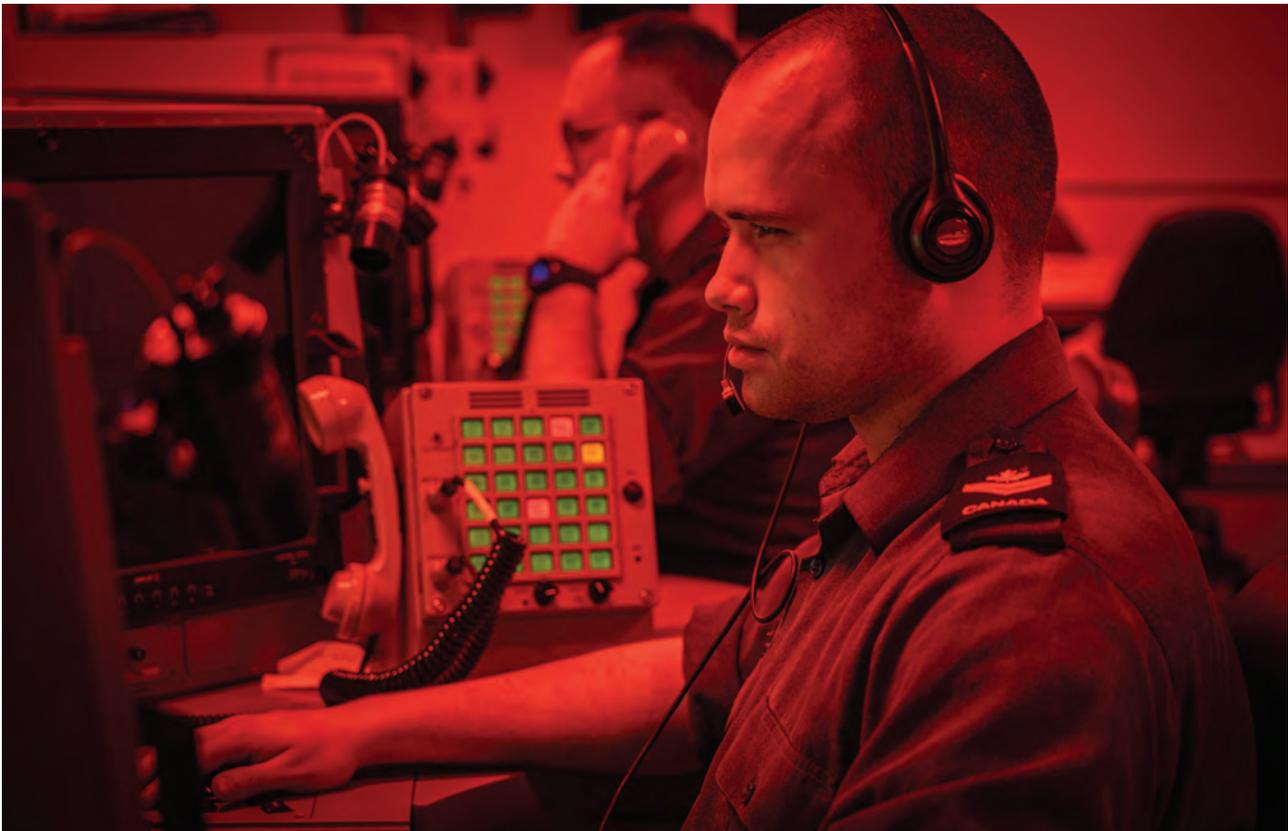

Members of HMCS Ville de Québec wave goodbye to HMS Prince of Wales as the ships conduct a PassEx, before HMCS Ville de Québec departs the UK-led Carrier Strike Group, during Op HORIZON, in the Sea of Japan, on September 12, 2025.

Photo: Corporal Brendan Gamache, Formation Imaging Services

Notes

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This photo has been digitally altered due to operational security. A sailor monitors their computer as HMCS HARRY DEWOLF sails the Atlantic Ocean during Operation CARIBBE on April 14, 2022.

Quantum Technologies in Defence and Intelligence Security

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The impact of quantum technology on intelligence gathering for defence and security operations may become significant, but it is imperative to be prepared and not reactionary. As a dual-use technology, quantum technologies can be used for both good and harm and for civilian and military uses. We take an agnostic view of this technology while arguing that we may be at the cusp of a technological breakthrough that will expose tour vulnerabilities in protecting sensitive information and grant adversary's new military capabilities. Moreover, this could apply to

adversaries that are both states and, eventually, when the technology is more diffused and commercialized by non-state actors, including criminal and political terrorist groups. The latter threat will come in the long term since the quantum capability is still relatively expensive to acquire and concentrate in state institutions and select multinational commercial entities. One partial exception is quantum computation, where access to the device (versus possession) suffices for threat actors so that the time lag may be much less. That said, policymakers must invest in this critical area to proactively address disruptive shifts resulting from quantum's transformative capabilities. This article explains quantum technology's potential defence and security implications while emphasizing the policy imperative of investing in and supporting this Canadian industry. Canada's National Quantum Strategy is a positive step, and its full implementation is necessary to see this strategy come to fruition and benefit a burgeoning industry that can have a positive spillover to Canadians' overall wealth and prosperity.

The quantum threat to our digital systems is impending and requires urgent policy attention. While the timeline of the threat is unknown, key milestones continue to be achieved, and policymakers must invest in research, development, and deployment to ensure we keep our comparative advantage in this space and thwart and/or mitigate quantum-related attacks. Although many quantum technology applications have lower Technology Readiness Levels or Solutions Readiness Levels, the scientific knowledge and direction of these applications are becoming more transparent and more diffuse, and there is a national security and national prosperity imperative to have Canada remain a strong player in the global quantum race, which is intensifying.

Throughout this article, we review open-source documents and studies on the potential application of quantum technologies to national defence and security, focusing on intelligence gathering. Each author has expertise in quantum science, cryptography, international affairs, cybersecurity, geopolitics, and defence and security studies. Where possible, we have embedded links to related academic and news items.

This article discusses the application of quantum computing, quantum communication/networks, and quantum sensing to intelligence gathering, analysis and dissemination. These three areas of quantum science are the most salient to our discussion of applying quantum technologies to the defence and security space. In layperson's terms, the latest evolution in quantum technologie—often called the second quantum revolution or Quantum 2.0—will enhance many aspects of the digital world, making processes faster, measurements more precise, and data processing more potent than current technologies and previous generations of quantum technologies. Importantly, this second wave of the quantum revolution will not necessarily bring new types of instruments or weapons, but it will significantly enhance existing ones, enhancing overall capabilities.[1]

Within Canada, Vancouver, Calgary, Sherbrooke, Toronto and the region of Waterloo are home to a critical mass of Canada's intellectual power and start-ups behind quantum technology.[2] Yet, we are losing ground to competitors in countries like China and the United States, who outspend, out-invest, and outsmart Canada in quantum technology's research, application, and commercialization.[3] This article reviews the technological landscape and its application to defence and security, focusing on intelligence gathering and analysis. However, the rapid pace of technological change cannot be overstated. The National Quantum Strategy to help Canada compete offers a promising initiative to advance the country's quantum capabilities, but its full implementation requires considerably more investments in research, talent development, and industry commercialization to help Canada be globally competitive in this critical sector.[4]

In the final section of this article, we aim to provide some policy rather than technical recommendations on how Canada can better navigate and address the challenges and opportunities arising from emerging quantum technologies. There is still time to maintain our important place in this field, particularly in the areas where Canada has had a global lead for some time, such as quantum computer algorithms and applications, quantum-safe cybersecurity, and certain types of quantum sensing.[5]

1. What is Quantum?

This section begins with a fundamental review of what quantum is before delving into its application to intelligence gathering, analysis and dissemination, and its risks and benefits. We first give an overview of how quantum impacts three main areas of technology, and in the next section, we elaborate on the defence and security implications. To begin with, quantum mechanics is a fundamental theory that has enabled physicists to resolve challenging problems and paradoxes in understanding various physical phenomena. Quantum technologies are the realization of applications that depend on quantum effects. Built upon quantum mechanics, quantum information theory provides the basis for quantum computing and other quantum information processing technologies. A key feature of this framework is the ability to describe a physical system's state as occupying two or more distinguishable configurations "simultaneously," also known as superposition. For example, a single electron may occupy multiple energy levels of an atom at once, and a single photon may simultaneously traverse multiple paths.

Quantum rules are a fundamental theory of physics that impacts what is possible. For example, quantum rules determine

whether codes are breakable and how precisely we can measure an object.

One implication of quantum is for computation. Computers store information in physical bits with two distinguishable states labelled 0 and 1. Quantum physics implies that a complete description of a single bit of information requires two complex numbers to represent the amplitudes of 0 and 1 states, whereas describing n qubits requires representing 2^n complex numbers representing the amplitudes of all 2^n possible configurations. The only known method for a classical computer to simulate n quantum bits is to track these 2^n amplitudes. For even a few hundred qubits, the storage demands would exceed all the matter in the known universe. This observation highlights the potential of quantum computers to solve problems that would take exponentially more classical resources.

Another implication of quantum is for sensing. The quantum framework implies that an outcome detectable with probability p exists with quantum probability amplitude proportional to $\sqrt{p}$, which is greater than p if p is less than one (with 0 = 0% and 1 = 100%). Quantum sensors manipulate objects at the quantum level, allowing for detection with a sample of size N instead of size N^2, or with N probe signals instead of N^2 probe signals. Furthermore, some advanced instruments developed for quantum technologies can also enhance classical sensing and measurement applications.

The third family of applications impacted by quantum is communication. Quantum technology is transforming communication networks and the digital security landscape. For example, the additional complexity intrinsic to quantum bits implies that any eavesdropping, that is, any extraction of information about the quantum bits, leads to a measurable disturbance proportionate to the amount of information extracted. This foundational quantum property opens the door to new tools for protecting information, including quantum key distribution (which we elaborate on later).

Quantum communication networks can enable distributed quantum computations, sometimes with much less communication between the different computers in the network. Quantum linking of quantum computers enables enhanced quantum computing power. They also enable quantumly correlated quantum sensing, combining information from different sensors in different locations to reconstruct potentially better images. Quantumly correlated quantum sensors, using a quantum network, can similarly enable a sensing or measurement capability beyond what would be possible with only classical communication networks connecting the sensors.

The timing and impact of the potential of quantum technologies depend on several factors. These factors include, for example, achieving technological advances that enable less noisy and faster fundamental operations, such as the conversion of quantum information between photons, which are effective for moving information, and other qubits, which are more effective for multi-qubit operations or storage, and on the development of

improved methods for leveraging imperfect quantum operations. Lastly, the timing and impact will also depend on the amount of effort and focus dedicated to the different challenges and opportunities.

2. Quantum Applications

We have noted three areas of application of quantum technology that are likely to interest the defence and security community: quantum communication/networks, quantum computing, and quantum sensing. In this section, we also discuss the implications of quantum technology for the work of defence and security policymakers, practitioners, and military personnel.

a. Quantum Communication/Networks
Modern communication networks are essential to global society. Quantum technology will enhance and revolutionize communication channels and networks that underpin our interconnected devices. As devices become more digitally enabled and interconnected, they become highly reliant on safe and secure forms of communication.

Emerging quantum technologies will impact the intercommunication of planes, ships, vehicles, personnel, and command centres in defence and security. While there is enthusiasm about improving these networks, the risk of adversaries intercepting communications and deciphering them with new quantum capabilities increases. Secure and reliable communications are vital for military operations and intelligence sharing and could be compromised if not quantum-proofed with new cryptography designed to thwart quantum-enabled attacks.

Quantum computation can expose intelligence and data currently encrypted on classical computers and digital infrastructure. Conventional secure communication networks will become more vulnerable to quantum technology, but advancements in cryptography and quantum networks offer opportunities to bolster communication networks' security and privacy. Secure communication systems are essential for a robust economy. Quantum-safe cryptography, designed to counter quantum-enabled attacks, includes classical algorithms (called post-quantum cryptography).[6] In addition, quantum key exchange/distribution (QKD) is a type of cryptography that can protect digital communications and is not susceptible to quantum or classical code-breaking. QKD technology has been commercially available for years and used by some governments and private entities. Ongoing standardization, certification, performance improvements, and more extensive network deployments will facilitate broader deployment.

It is still premature to suggest that this communication technology is the precursor to a quantum internet. Still, with advancements in satellite communication and the communication of quantum nodes, which are evolving rapidly, there is optimism that these scientific discoveries could move us closer

to achieving the various capabilities that reliable long-distance networks would enable.

b. Quantum computing

Quantum computers will be able to solve specific problems with astronomically fewer steps and thus be much faster than classical computers. For example, breaking today's public-key cryptography using classical computers requires exponentially more time compared to quantum computers. In 2020, Chinese researchers used the Jiuzhang quantum computer to solve a mathematical problem in under 5 minutes, a task that would take a classical computer 2.5 billion years.[7] Notably, this followed Google's 2019 claim of quantum supremacy with its Sycamore processor. While Noisy Intermediate Scale Quantum (NISQ) devices don't fully leverage quantum mechanics' computational power, these experiments validated that sufficiently large and well-controlled quantum computing systems cannot be practically simulated by classical computing platforms using the best-known algorithms. Researchers are exploring practical applications of NISQ computers by examining real-world computational challenges through NISQ computing capabilities. The only known way to capture all the computational capabilities of quantum computers is by using fault-tolerant quantum error correction, which minimizes errors and noise, similar to classical error correcting codes used in classical computing and communication systems to enable reliable communication and computation in the presence of errors.

Quantum computers' computational power threatens current public-key cryptography, potentially exposing encrypted intelligence data if access to the encryption keys is protected by public-key cryptography. This risk is heightened for data communicated today or in the past using public-key cryptography for session keys. It is worth emphasizing that malicious actors may have already intercepted and stored encrypted data, where the keys were shared with public-key cryptography, awaiting computing abilities to decrypt it.

Today's threat models may underestimate the risk of data encrypted with public-key cryptography, as it is viewed as inaccessible without quantum computing or irrelevant until advanced AI reveals new patterns. However, adversaries may have already conducted such offensive hacking operations, and security breaches may not be exposed in the future. Therefore, it's crucial to quantum-proof sensitive and classified information today, as data protected by Suite B or similar algorithms may have already been siphoned off to be unlocked by future quantum cryptanalysis.

Protecting intelligence gathered and state secrets will take years to prepare, and quantum-proofing intelligence data is imperative to national security and defence. The Department of National Defence should inventory sensitive data, assess risk tolerance, and develop a strategy for moving to quantum-safe cryptography through its technology lifecycle management processes. In support of this migration, quantum communication

> **"** In 2020, Chinese researchers used the Jiuzhang quantum computer to solve a mathematical problem in under 5 minutes, a task that would take a classical computer 2.5 billion years."

enables a key exchange that is not susceptible to algorithmic cryptanalysis (quantum key distribution, QKD). QKD can be integrated into the suite of solutions, including pre-shared keys, to provide resilience against unexpected cryptanalytic advances.

Beyond breaking codes faster than any known classical method, quantum computing could more efficiently address other computational challenges, making possible improved predictive analytics with machine learning and artificial intelligence. This capability may enable pre-emptive actions by anticipating adversaries' moves based on previous battlefield plans, improving target accuracy, and limiting collateral damage.

Among the more futuristic predictions is the issue of cognitive warfare powered by quantum computing as society expands its digital footprint and puts more information about its thought processes and decision-making on digital devices. Quantum computing advancements may facilitate the manipulation of leaders and societies by identifying behaviour patterns through advanced machine learning and artificial intelligence. Indeed, social media is an integral part of this mass societal digital footprint collection; hence, we already see significant commercial interest in understanding human behaviour. This will only accelerate with advances in quantum computing. Moreover, as open and Western societies with increased public expectations for government transparency, we contribute to our adversaries' increased understanding of our societies. The same cannot be said for them, as their digital authoritarian tendencies have meant less contribution to the virtual public space. Moreover, polarization within Western democracies exposes internal weaknesses, providing opportunities for adversaries to find fault lines to disturb cognitive warfare.[8] Calls to improve our awareness of the risks of Cognitive Warfare need to be heeded.[9]

c. Quantum Sensing

Quantum sensing and metrology will also transform the collection and analysis of intelligence. Quantum sensing may enhance our ability to measure temperature, acceleration, time, and gravity. It could improve instruments used to detect and measure objects and movement, potentially enabling precise mapping and situational awareness in positioning and navigation. Quantum

sensors may be used to improve intelligence gathering and surveillance on the movement of individuals, camouflaged vehicles, and objects behind walls and around corners. It may also detect movement in bunkers, tunnels, or caves below the Earth's surface. However, some potential applications are speculative and still face challenges like high sensitivity and data processing issues in unclear environments.

Quantum sensors will also significantly advance the application of quantum metrology to low-brightness or night-time situations, enhancing military intelligence, surveillance, target acquisition, and reconnaissance (ISTAR) capabilities on a multi-domain battlefield. Advancements in quantum sensing are already in use and commercially available in atomic clocks and gravimeters. However, some challenges remain, requiring extensive global research to overcome these limitations.[10]

Quantum sensors used for Position, Navigation, and Timing (PNT) may supplement or replace GPS, particularly where signals and reception fail. For example, significant excitement surrounds the potential of quantum sensing used in ocean depths as an odometer. Advances in quantum sensing could expose submarines and torpedoes previously undetectable at specific depths, potentially disrupting the balance of power and complicating detection.[11] Moreover, new territorial claims could accelerate with the application of quantum sensors and impact a race for claims to newfound territory. The South and North poles are areas to watch for new territorial claims partly attributable to multiple scientific advancements such as quantum sensing.

Increased underwater warfare may be observed with increased use of quantum sensors. Quantum magnetometers, such as those based on a superconducting quantum interference device (SQUID), could revolutionize the detection of materials and magnetic fields. Current dependence on sonar to detect submarines may give way to increased use of SQUID-based technology. Scientists have used an airborne device of multiple SQUIDs to identify buried metal balls.[12] Scientists have also referenced the possibility of using this to detect submarines several kilometres away, but this remains a speculative and potentially distant realization of this technology. The data analysis of the study is ongoing, and there are likely many difficulties in applying this in the field, let alone in a militarized setting. These instruments require significant cooling and miniaturization to be helpful in most moving platforms, for example, on an unmanned vehicle's reconnaissance mission. The short battery life of these drones continues to be a significant challenge in making them operable. These challenges have dampened expectations that SQUID-based magnetometers will be used in anti-submarine warfare.[13] Similar challenges exist with gravity gradiometers.

Quantum sensors can detect electromagnetic emissions, enhance military capabilities in locating adversarial forces, and improve electronic warfare. At the same time, military detection of electromagnetic emissions using quantum sensors could help thwart electronic warfare. Quantum antennas will also enhance electronic warfare systems to intercept low-frequency signals. In areas like signals and communications intelligence and counter-radar jamming, quantum technology may enhance intelligence collection, interception, and object identification. Additionally, quantum networks can better detect potential eavesdropping, especially in low-frequency ranges and dynamically switching bandwidths. As Krelina notes, "In the future, quantum antennas could look like an array (matrix) of Rydberg atom cells. Different cells can measure different signals, and in the joint measurement of two or more cells, the angle-of-arrival of the signal could be determined."[14] However, the same author notes that the cooling of these atoms poses challenges. Hence, the U.S. Defence Science Board has expressed skepticism about quantum radars significantly enhancing the Pentagon's radar capabilities in the near future.[15] In particular, ovenized crystal oscillators (OCXO), which maintain temperature and synchronize with GPS, are already incredibly accurate, small, and inexpensive, improving precision in location applications.

Turning to a quantum radar technique called quantum illumination, we may see more advanced detection of light that could lead to deciphering more delicate details of an identified object and could improve targeting on the battlefield. Quantum radars could improve detection and accuracy in harsh conditions such as space, fog, smoke, clouds, low light, night, and high temperatures, like wildfires.[16] Conventional radars are also more sensitive to geomagnetic storms and solar flares, which is particularly relevant for Canadian operations in the Arctic. Quantum radars could improve search and rescue missions and operations in difficult environments by emitting much less energy and offering 'stealth detection' where a target is much less likely to know it is being detected. That said, this use of quantum radar technique is still underdeveloped. There are many challenges with "...obstruction, cancellation calculations, and factual examination of unused space."[17] bistatic quantum radar cross-sections often exhibit sidelobe quantum effect, posing a persistent challenge in the scattering field.[18] This is a nascent development. Some argue a 'futuristic' view of potential applications of quantum radars that still needs significant research to find practical purposes.[19]

Hence, quantum radars are in the very early stages of application, mainly in laboratories with the lowest TRL. There have been some debated[20] and exaggerated claims of quantum radar usage and its application to the battlefield.[21] Austrian researchers in 2019 briefly claimed "quantum supremacy" in a laboratory demonstration of quantum radar, but the claim was quickly removed from the arXiv pre-print server after significant criticism. Engineers have debunked[22] claims that quantum radars can detect stealth aircraft.[23] Moreover, other researchers have posited that quantum radars only outperform conventional radars where signals are weak or background noise conditions are strong, limiting their application on the battlefield for the time being.[24]

Nonetheless, there is considerable interest in developing quantum radars for stealth aircraft detection and

low-probability-of-intercept applications, which could revolution-ize battlefield dynamics. Great powers and the military industry are in a global race to produce this capability. Certainly, NORAD modernization and updating Canada's radar system are pressing procurement issues. For now, the readiness of this quantum radar technology in any update of the NORAD system is likely limited by engineering considerations.

3. Emerging Global Trends

This section examines recent developments in quantum capabilities globally, focusing on the competition among the global players in the quantum race, such as the US, China, the UK, Canada, and Europe.[25] Many of these global players have identified a national strategy on quantum to focus on research and development, building commercial ecosystems, advancing workforce talent, and technological independence.[26] As noted earlier, state-led invest-ment in research and development and the military-industrial sector has led the way, except in Canada, where private-sector in quantum technology exceeds government investment.[27]

China has made significant investments and, therefore, has a likely lead in quantum communication. According to a CNAS paper, the Micius satellite's launch marked a significant milestone, lead-ing to numerous 'megaprojects' in quantum communications.[28] Using their national civil-military integration strategy with great determination to be a science and technological superpower, China has invested heavily in its scientists and researchers, reducing dependence on foreign technology transfers—a shift partly driven by the Snowden revelations of the US spying on Chinese systems. The Chinese state has invested in quantum communication and computing, hoping that these advancements would protect them against foreign espionage and data mining on their systems.[29] Moreover, China's 2008 'Thousand Talents Plan' seeks to repatriate ethnic Chinese scientists working abroad, with nearly 60,000 professionals recruited so far, often through support to scientists' commercialization efforts, as noted by a US Senate report.[30]

Recognizing the international race for quantum suprem-acy and hence the potential foreign interference in Canadian researchers' capacity to advance quantum research and develop-ment, one can appreciate the existing Canadian government's concerns about advancing research and development in the quan-tum domain. Indeed, government research funding in this area now undergoes significant national security oversight, including added screening of funding applications. However, excessive national security controls could disincentivize international collaboration, particularly with leading Chinese researchers, potentially hindering Canada's progress in quantum technology. China is more assertive in acquiring foreign talent and intel-lectual property, including from Canada, with partial taxpayer subsidies, which invariably raises national security concerns.

An Australian think tank has been tracking Chinese uni-versities engaged in military research to assist international universities in identifying partner institutions that could facilitate potential technology and research leakage to the Chinese state.[31] This has generated considerable unease in many universities and the Canadian government, fearing a leaky pipeline of talent and scientific knowledge to the advantage of China. That said, academic communities are considerably uneasy about excessive national security attention to universities and research when many scientists publish their research findings for the broader benefit of the quantum scientific community. Canada's tri-council funding agency and some provinces have grown more aware of this potential leakage, mandating a security review of grant applications. Ironically, researchers are concerned that these tri-council security reviews are pushing them to seek out more industry funding instead, which might lead to further leakage to countries like the US and parts of Europe. Moreover, researchers at RAND noted that as TRL of quantum computing and communi-cations remains low, export controls might further slow scientific research and technological advancements.[32]

Both the US and the UK were viewed as leaders in quantum sensing. Significant DARPA investment in quantum technology is driving scientific progress in the US. US academic research has expanded with significant government investment, mainly through the National Quantum Initiative, which spent $710M in research and development in 2021 alone, increasing by 20% annually in recent years. According to RAND researchers, the US focuses on quantum computing and sensing, while China priori-tizes quantum communication with quantum computing closely following.[33] The US' AUKUS agreement with Australia and the UK to advance military technologies has raised speculation that the US was outfitting Australian submarines with quantum sensing technology and advancing innovation in this technological area that might exclude Canada.[34]

4. Policy Recommendations

We outline recommended measures to prepare for and address challenges and opportunities arising from emerging quantum technologies while noting that DRDC has developed a quantum strategy for DND/CAF.[35] ISED has undertaken a consultative process to formulate an integrated National Quantum Strategy (NQS).[36] Quantum research is evolving rapidly, and Canada's DND/CAF must continue to involve the academic sector to overcome the many scientific challenges, many of which are engineering considerations that will turn the research into a deployable real-ity.[37] Budget allocation in 2021 to $360M over 7 years to a National Quantum Strategy is insufficient to keep existing quantum domin-ance and to catch up to peer competitors.

International collaboration with NATO allies on commercializ-ation, research, and development is crucial for collective success and interoperability. That said, China is successfully attracting

A CAF member monitors the progress of firefighters during a fire exercise aboard HMCS HALIFAX during Operation REASSURANCE on January 14, 2021.

Photo: Sailor First Class Bryan Underwood, Canadian Armed Forces photo

and funding global researchers. The dual-use nature of quantum technology will naturally lead to commercial advances in quantum technology that DND/CAF can utilize. Continued investment by DND/CAF in researching quantum sensing and radars, particularly for submarine and stealth aircraft detection, is imperative for our national defence and Arctic surveillance.

Leveraging Canada's academic and SME strengths is vital to address scientific challenges. Given the competitive talent pool, this integrated approach across sectors is needed to maximize Canada's quantum technological developments. Therefore, we must develop a coherent program exploring quantum sensing, computing, and communications/networking for national defence and intelligence. This could imply we take inspiration from a DARPA/IARPA type model where the ultimate mission is to prevent strategy surprise, where IP ownership remains with researchers to foster commercial activity and support the Canadian quantum ecosystem, including projects of varying TRL. Part of the program can include education/training for DND/CAF personnel via secondments at universities and in industry while noting that this would also support SMEs that dominate this ecosystem.

We need to remember that the impact of quantum technology is more likely to be exponential and not linear; hence, we need an urgent investment. Canada cannot afford a "wait-and-see" approach, particularly in securing national intelligence. The impact of this technology can leap from "no known impact" to "transformative impact," as seen with public key cryptography between 1993 and 1994. Quantum computers did not even exist at the time. Once quantum computers appear, there will be no "time-out" to prepare for the security implications. Once the IP, in the form of knowledge and products, is in the hands of adversaries, we will not have an easy path to accessing the transformative quantum capabilities. We have to proactively bring the owners of the challenging problems together with the world-class experts in Canadian academia and industry to discover and develop the potential application areas of quantum technology.

In many cases, the conclusion will be that there is no known quantum advantage. This is not a failure but rather part of the scientific discovery process. It steers us away from less promising applications and toward more promising applications while advancing the expertise needed. Successes can be further developed in higher TRL projects.

We must also enhance the national defence and intelligence community's capacity to advance their understanding of potential quantum threats and opportunities through continuous training and education from academia and industry. The knowledge base on this technology is rather thin and relatively young. To ensure a continuous talent pool, Canada needs to nurture the young professionals working in this space, and provide a vibrant ecosystem in Canada that enables them to create value for Canada. Graduate student and post-doctoral funding are lacking in Canada, and many opt to leave to study elsewhere. Apart from competitive salaries, researchers require opportunities to work on impactful cutting-edge projects. Moreover, outside their labs and academic environments, graduate students, post-doctoral fellows, and early career researchers would also benefit from opportunities to network, share information, and collaborate with the defence and security policy community to solve some of the pressing national defence challenges discussed in this article.

Conclusion

Quantum information science and technology is a vast field with different elements at various stages of maturity and many pockets of expertise worldwide. The global players in the quantum race, primarily the United States, China, the United Kingdom, Canada, and Germany, have identified a national quantum strategy focussing on research and development, building commercial ecosystems, advancing workforce talent, and technological independence. Overall, the broadly held view is that North America is the overall leader in quantum computing technology (followed by China and then Europe), China is the overall leader in quantum communications (including its Micius satellite), and there is a strong concentration of leadership in quantum sensing (which is a much broader field) in the UK and North America.

Geopolitical tensions and concerns about potential scientific leakage to China are increasing pressure for export and other controls around quantum technologies. This is more relevant considering that state-led investment in research and development and the military-industrial sector have led the way. In protecting our scientific knowledge and technological capabilities, quantum poses some unique challenges. It is difficult to control a technology still in development whose implications are still being discovered, developed, and assessed. Premature or misdirected attempts at controlling will slow down and potentially undermine the developments. Yet, the implications of not having adequate controls may be unexpected and potentially exponential. Navigating these uncertain waters requires significant policy attention, funding, and commitment.

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The North Atlantic Treaty Organization's (NATO) enhanced Forward Presence Battle Group-Latvia conducts Exercise GANGSTER PRIME in the Camp Ādaži training area, Latvia as part of Operation REASSURANCE, September 6, 2019.

Photo: Corporal Djalma Vuong-De Ramos

The Second War Without Battles: Canadian Army Deterrence in Germany (1951-1993) and Latvia (2017-Present)

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As war rages between one of the great powers and its great power rival-supported enemies in what is considered one of its vital peripheries, the North Atlantic Treaty Organization (NATO) experiences growing concern for the physical security of its member states, all while tensions continue to mount in the Far East. Even casual observers of current events will recognize the international conditions of the Russo-Ukrainian War (2014-present), which led NATO to reinforce member states bordering Russia with rotationally-assigned brigades. One of these is the multinational brigade based in Latvia led by Canada, contributing 2,200 troops to the allied formation.[1] These events, coupled with increasing Sino-American tensions, contribute to a world increasingly characterized by the reemergence of what Canada's new defence policy—*Our North, Strong and Free*—refers to as "strategic competition" between Great Powers.[2] However, a keen observer of history will recognize that the introductory set of world

circumstances is similar to the early 1950s, where the raging Korean War (1950-1953) created concerns that North Korea's Soviet allies would use the conflict there to divert alliance nations from an assault by Soviet-led forces on Western Europe. Just as today, NATO has responded with the reinforcement of its conventional deterrence forces along the shared border with its most probable adversary; in 1951, the Canadian government joined its Allies in augmenting Europe through the commitment of a brigade to West Germany.

This article analyzes the Canadian commitment to Latvia by exploring the experience of the Canadian army with establishing a European-based deterrence force in Germany.[3] Ultimately, it will demonstrate significant historical parallels between the two missions, including strategic intent, doctrinal and equipment problems, sustainment challenges, and questions of personnel welfare. Examined in parallel, this article will make the case that today's army can learn from its experience in Germany.[4] This analysis will be broken into two parts. Part I will provide a chronological summary of the Canadian NATO brigade in Germany from 1951-1993. This summary is heavily indebted to the previous work of other historians, most prominently Sean Maloney's *War Without Battles: Canada's NATO Brigade in Germany* (whose singular work on the subject inspired this article's title) but also draws on now-declassified historical reports from the early days of the Army's commitment to Germany. The second part will use a thematic approach to examine specific aspects of the German deployment to shed light on the potential lessons that may apply to Canada's Latvian commitment. As with the title of Maloney's book, the present situation the CAF finds itself in Latvia may be characterized as another 'war without battles.'

PART I: THE CANADIAN BRIGADE IN GERMANY, 1951-1993

The Genesis of the Brigade

In May 1951, the Canadian government agreed to commit ground and air forces to Europe. The context for this agreement was the Korean War (1950-1953), then raging in the Far East, and increased tensions between the West and the now-nuclear-armed Soviets in Europe. NATO strategists were concerned about the dissipation of Western military strength in the Korean theatre, and indeed, "many believed that the Far Eastern operations were just a feint orchestrated by the Soviets so that scarce Western military resources would be expended in an inconclusive conflict."[5] In essence, the Korean War militarized NATO, which, to this point, was effectively a loose alliance of several Western countries. The commitment of a brigade group entailed dispatching 5,807 soldiers and their replacement base to Europe, which was a significant undertaking for the then small, post-Second World War Canadian Army.[6] The Regular Force consisted of a single brigade for the defence of Canada, and the army had had to raise a 'Special Force,' made up mainly of new recruits and the large pool of Second World War veterans to fill what would prove to be the first of several rotations of a brigade for Korea.[7] Further, the NATO

brigade group, dubbed '27th Canadian Infantry Brigade Group' (27 CIBG), was intended as the vanguard of a much larger Canadian commitment to Europe if the Cold War 'went hot,' that on mobilization would provide two infantry divisions in the 30-180 days after the outbreak of war.[8]
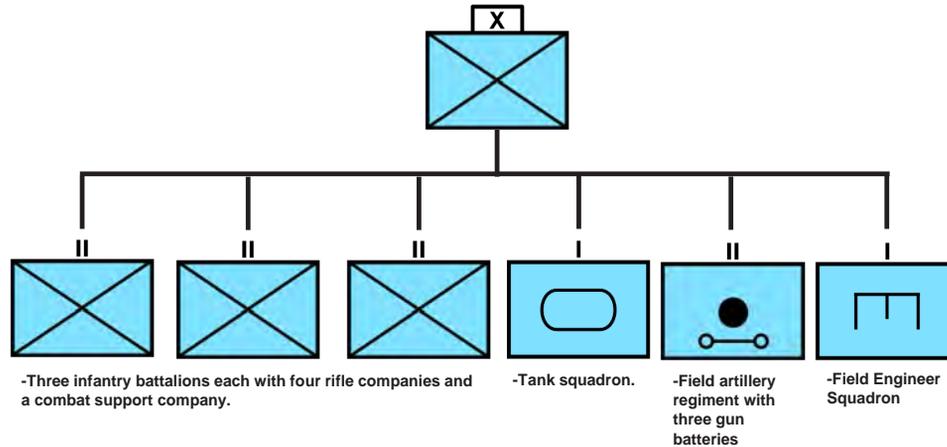
Despite the significant challenges, the Canadian Army managed the herculean task of virtually tripling its active soldiers and dispatching the first elements by 4 October 1951.[9] It consisted of three infantry battalions, a tank squadron, a field artillery regiment, an engineer squadron, and various combat service support and base units.[10]

> **" Despite the significant challenges, the Canadian Army managed the herculean task of virtually tripling its active soldiers and dispatching the first elements by 4 October 1951."**

Canadian Armed Forces members with enhanced Forward Presence Battle Group Latvia conduct a quick shoot exercise during Exercise URBAN REAPER, in the training area of camp Ādaži, Latvia, as part of Operation REASSURANCE, October 21, 2019.

Photo: Corporal Djalma Vuong-De Ramos

-Three infantry battalions each with four rifle companies and a combat support company.

-Tank squadron.

-Field artillery regiment with three gun batteries

-Field Engineer Squadron

***Only Combat and Combat Support units are shown. Formation included significant Combat Service Support elements in addition to external base units.
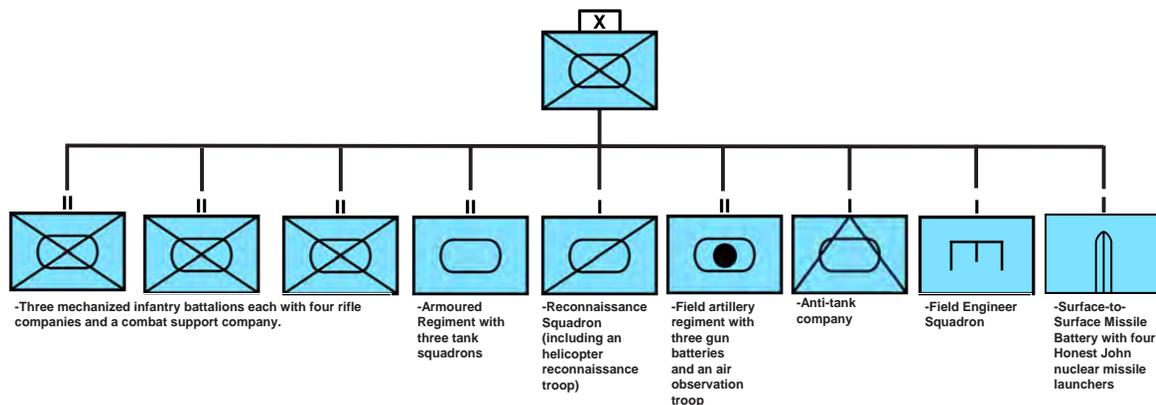
Significant debate had occurred over what portion of West Germany the brigade should be stationed in and, therefore, under whose command: British or American. In brief, the Canadian Army favoured its placement under the British Army of the Rhine (BAOR). At the same time, the Royal Canadian Air Force lobbied to have its air division placed in the central region of France and Germany and integrated with American forces. In the pre-unification Canadian military establishment, both services got their way, and 27 CIBG would initially deploy to bases in the Hanover area under BAOR.[11] However, as we shall see, the more significant strategic questions of basing and command arrangements were never entirely closed, and as Maloney warns, "problems which would plague the brigade over the next forty years had their genesis in 1951."[12]

Canada's Commitment at its Height, 1951-1969

Initially, 27 CIBG was meant to be a rotational force with personnel rotated out after one or two years.[13] However, with the stabilization of strategic commitments in 1953, due to the end of the Korean War and the decision to maintain the land commitment to Europe, the army, as part of a considerable expansion of all three services, opted for a rotation program using one of the three brigades recently stood up in Canada. Thus, 1 CIBG replaced 27 CIBG, while the three other brigades remained in Canada.[14] Temporary basing arrangements in Hannover were replaced by ten permanent sites further west in the Soest area.[15] Initially, the rotations were conducted by complete brigades as 2 CIBG replaced 1 CIBG in 1955, followed by 4 CIBG in 1957. However, in 1959, the Army replaced this system by rotating individual units on a three-year basis.[16] Thus, after seven short years, the Canadian land commitment to NATO solidified around a permanently assigned 4 CIBG complete with established garrisons and infrastructure to support dependants.

Between 1951 and 1969, the years were characterized by near-constant growth in the brigade's personnel establishment and fighting capability.

Figure 2: NATO Brigade at its Height – 4 Canadian Mechanized Brigade Group (4 CMBG), 1969

-Three mechanized infantry battalions each with four rifle companies and a combat support company.

-Armoured Regiment with three tank squadrons

-Reconnaissance Squadron (including an helicopter reconnaissance troop)

-Field artillery regiment with three gun batteries and an air observation troop

-Anti-tank company

-Field Engineer Squadron

-Surface-to-Surface Missile Battery with four Honest John nuclear missile launchers
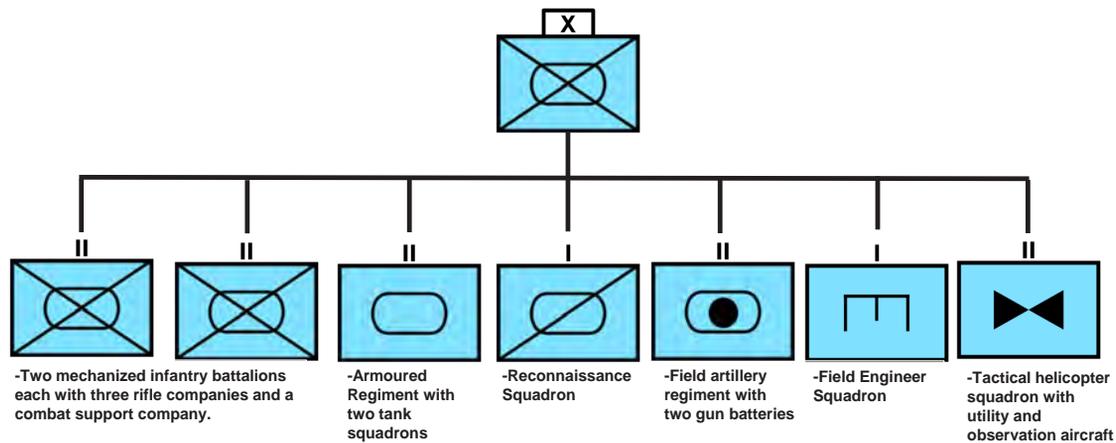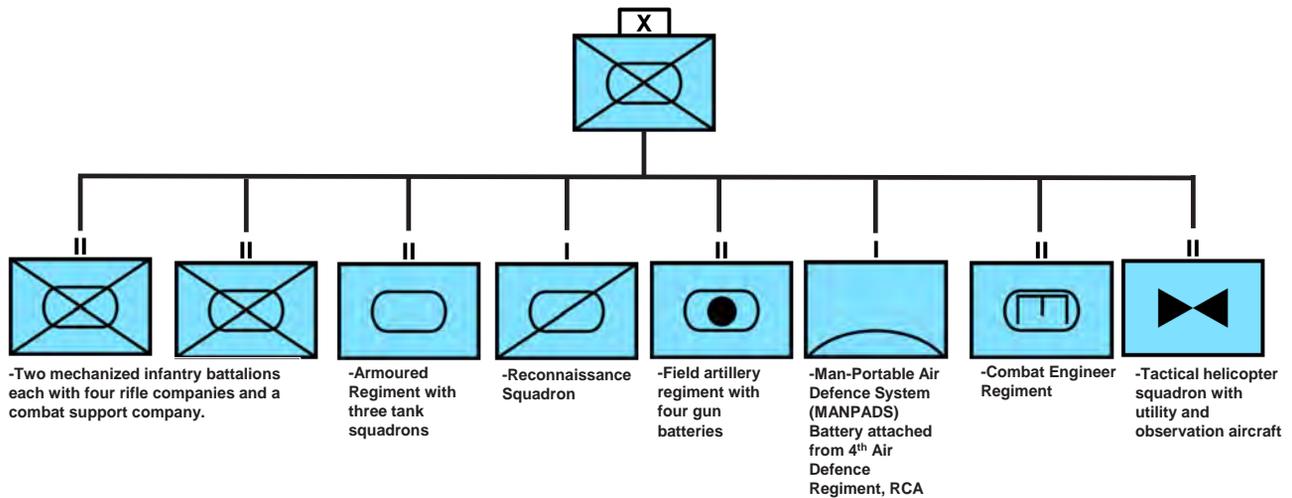
***Only Combat and Combat Support units are shown. Formation included significant Combat Service Support elements in addition to external base units.

Maloney provides a detailed analysis of each of these changes. Still, a summary is warranted: 1957 saw the addition of a complete armoured regiment and an independent reconnaissance squadron, an air observation troop in 1960, a helicopter reconnaissance troop in 1962, and an anti-tank company stood up in 1965.[17] Two important additions significantly changed the brigade's capabilities and structure. First, to keep pace with the growing mechanization of armies, between 1965 and 1969, the brigade received armoured personnel carriers and self-propelled howitzers, leading to it being redesignated as "4 Canadian Mechanized Brigade Group" (4 CMBG).[18] More significantly, by 1961, the brigade gained a tactical nuclear delivery capability through four 'Honest John' missiles under the 1 Surface-to-Surface Missile Battery, Royal Canadian Artillery.[19] Due to these continual augmentations, by 1969, the Canadian ground commitment to NATO was considered the equivalent of a small or 'light' division. It constituted 15% of BAOR's ground strength and 20% of its nuclear firepower.[20] The outsized significance of this force would create political troubles once it had been decided to reduce and relocate this force.

Reduction, Revitalization and Retirement, 1970-1993

In 1969, the Canadian government made major changes to its military establishment, which included reducing the size of the NATO brigade from close to 6,000 personnel to 2,800.[21]

Figure 3: Post-Cuts – 4 Canadian Mechanized Battle Group, 1970

-Two mechanized infantry battalions each with three rifle companies and a combat support company. -Armoured Regiment with two tank squadrons -Reconnaissance Squadron -Field artillery regiment with two gun batteries -Field Engineer Squadron -Tactical helicopter squadron with utility and observation aircraft

***Only Combat and Combat Support units are shown. Formation included significant Combat Service Support elements in addition to external base units.

This controversial decision had international repercussions. Further changes were made to the brigade's role, from a front-line task in NORTHAG, both army and air elements were relocated to the Central Army Group (CENTAG), where the brigade would be assigned as a reserve, as part of an American or German corps in the Lahr area.[22] This change in role and position cut costs and was meant to be followed by a transformation into a light, airmobile-mechanized force at a later date. However, the new role in CENTAG was undeniably lower profile, and this, combined with the fact that the ambitious air-mechanized light force never materialized, leads Maloney to describe the post-reduction brigade as "the nadir of its existence."[23] To reduce the political fallout from these changes, the government announced its commitment of a brigade to the northern flank of Europe, known as the Canadian Air-Sea Transportable (CAST) Brigade, although, from the very beginning, it was clear the Canadian Forces lacked the strategic resources to move the brigade and its dedicated aircraft to the Northern Flank.

Despite its relocation to Lahr under CENTAG, 4 CMBG continued regular training and soon regained some of its cut strength. By 1979, the personnel permanently based in Europe had increased to 3,268.[24] The 1987 Defence White Paper announced the addition of 935 additional soldiers, which brought brigade units close to their war establishments.[25]

-Two mechanized infantry battalions each with four rifle companies and a combat support company.

-Armoured Regiment with three tank squadrons

-Reconnaissance Squadron

-Field artillery regiment with four gun batteries

-Man-Portable Air Defence System (MANPADS) Battery attached from 4th Air Defence Regiment, RCA

-Combat Engineer Regiment

-Tactical helicopter squadron with utility and observation aircraft

***Only Combat and Combat Support units are shown. Formation included significant Combat Service Support elements in addition to external base units.

Historian Peter Kasurak asserts that the cancellation of the CAST task, the consolidation of the land commitment to the central front and reactivation of 1st Canadian Division—with one brigade forward-based that in war would be joined by another from Canada and either a German or American brigade—was the result of long-term lobbying by army leadership to create a 'Big Army' on NATO's Central Front rather than a significantly altered strategic situation.[26] Regardless of how realistic the deployment or sustainment of such a division might have been for the army, timing is everything and international events ended any debate on the subject.

With the fall of the Berlin Wall in 1989 and the subsequent collapse of the Soviet Union and the Warsaw Pact, the justification for permanently stationing land and air forces in Europe evaporated. Kasurak calls this period "the end of one era and the beginning of another" for the army, where the expensive European commitment quickly came under government review.[27] In late 1991, the government announced its decision to withdraw 4 CMBG and all brigade units were slated for disbandment or return to Canada by 1993.[28] With the completion of this withdrawal, the Canadian army's permanently stationed presence in Europe went on a quarter century hiatus until 2017 with the establishment of enhanced Forward Presence Battlegroup (eFP BG) Latvia.

PART II: HISTORICAL PARALLELS WITH LATVIAN COMMITMENT

Deterrence and Credibility

The purpose of both the historical commitment to Germany and present-day Latvia was the deterrence of aggression against European territory, which current defence policy considers to be "inextricably linked to Canada's continued security and economic well-being."[29] The literature on deterrence theory is vast, much of it devoted to the Cold War. However, it is sufficient here to highlight that deterrence is an effort to dissuade or stop adversary action: either through *denial*, by demonstrating the capability to defend an area which an adversary might otherwise wish to seize, or *threat of punishment*, by making clear to an adversary that a local incursion may have broader kinetic consequences or lead to wartime escalation.[30]

Of course, in both the German and Latvian commitments, hostile action against the Canadian-defended NATO territories would be met by escalation to general war (a *threat of punishment*), effectively making both forces a 'tripwire': a characterization which official statements on both commitments to Europe have resisted.[31] Conversely, rather than threatening strategic escalation, including the possibility of a nuclear exchange, a denial strategy seeks to frustrate an adversary's immediate aims by imposing losses or preventing the conquest of a specific region, thus creating the impression that such an action would be too challenging. Therefore, in both these cases, the Canadian commitment is best characterized as a *deterrence through a denial* strategy. Any success with such a strategy rests on the credibility of the deterring force, as the adversary must believe that the risks and costs of taking the undesired action, that is, warlike actions against a NATO member, are outweighed by the capability of the deterrence force to prevent the action or inflict costs on the aggressor, thus making any warlike moves undesirable.[32]

For Canada, the existential problem as a deterring force in Latvia is how much force is a sufficiently credible deterrent. When the German commitment began in 1951, Lieutenant-General Guy Simonds, the Chief of the General Staff, held that the "contribution of the brigade group was militarily insignificant" in the context of a NATO alliance defended primarily by American nuclear firepower.[33] The strategic calculus of this assessment soon changed as the NATO strategy saw conventional forces as a means to avoid automatic

recourse to strategic nuclear weapons. During the Cold War, the improvement of the Canadian brigade reflected this strategy. However, the tension between military leadership and successive civilian governments who were "convinced that the brigade group in Europe was no more than a 'tripwire' for nuclear retaliation" and resourced it accordingly is a significant theme of Kasurak's history of the postwar Canadian army. Conversely, uniformed leaders sought the resources for a potentially lengthy conventional war, including reinforcing the brigade to division or corps as part of a denial strategy.[34]

These differences in perspectives between military and political leaders were problematic. Maloney's study of the brigade is replete with examples of how budget cuts hamstrung the fighting capabilities of the formation. While resource constraints reduced the capabilities of the formation, deterrence theory does not require local forces to fight and win in *all* circumstances. Instead, as RAND analyst Michael J. Mazaar contends, denial strategy "can succeed by deploying sufficient local forces to raise the cost of a potential attack, to make escalation inevitable, and to deny the possibility of a low-risk *fait accompli*."[35] Canada's 1987 defence policy articulated its strategy by noting that "it may not be necessary to match the other side weapon for weapon, but the more effective the conventional forces, the less is the reliance which has to be placed on nuclear weapons."[36] Just as the Canadian NATO brigade contributed to deterrence by ensuring that any attempt by the Soviets to seize any part of alliance territory would come with severe costs, the commitment to Latvia does not necessarily need to achieve outright tactical victory to succeed in all scenarios. Instead, maintaining a credible level of capability sufficient to inflict significant costs on the adversary and thus deny the possibility of the invasion and rapid collapse of a NATO member can deter a challenge to Baltic sovereignty.[37]

Ultimately, it is possible to state that there is no 'correct' response to the civilian-military conundrum in the case of the Cold War commitment. However, military professionals and political leaders must ensure the brigade is a credible deterrent in Latvia. Its capability cannot decline to where NATO allies and potential adversaries see it as a "Hong Kong Central" force, alluding to the 1941 disaster where the Japanese wiped out Canadian and Commonwealth forces attempting a hopeless defence of an isolated allied periphery. Some planners sardonically utilized this title for the Cold War era army commitments to NATO, a reflection of the institutional unease around the policy of the day.[38]

The remaining themes of this part of the article will explore improving deterrence credibility while balancing resource availability.

Doctrine and Force Structure

During the Cold War, Canada effectively had two armies: one highly mechanized and trained for high-intensity mobile operations in Europe, and another, Canada-based with understrength brigades equipped with a mix of wheeled and tracked combat vehicles. This bifurcation of the field force was a problem that dogged the army throughout this period and is particularly relevant to the present situation in Latvia. The problems encountered during the Cold War were due to two broad means: doctrinal development and equipment.

In his history of the development of doctrine in the Cold War army, Lieutenant-Colonel Andrew Godefroy contends this process became wholly dominated by challenges in reconciling the problems of fighting a conventional war against the Soviets in Europe against the full spectrum of conflict that might occur in other theatres.[39] Maloney presents a similar assessment, concluding that as the "operational centrepiece" of the army, the NATO brigade "drove and influenced all matters of army developments in doctrine, training, organization and equipment."[40] By 1987, the army was so engrossed by the NATO commitment that its keystone doctrinal publication, *Land Formations in Battle*, would open with a multi-page description of the Warsaw Pact threat in a conventional war with no discussion of other potential adversaries or types of operations.[41] Contemporaneous subordinate publications included descriptions of Warsaw Pact doctrine and structures in parallel with each functional operation of war related to the unit described, for instance, in *Reconnaissance Squadron in Battle*.[42] Similarly, Canada's commitment to Latvia will likely be the locus of most army collective training. Lessons from that theatre will inevitably inform doctrinal development in Canada with the same risk of myopic focus on a single adversary and geography.

> " Historical evidence suggests that heavy mechanized elements are the optimal deterrence forces, but equipping units in this manner was, and is, expensive."

Sufficient equipment to support conventional warfare doctrinal structures posed another problem during the commitment to Germany. Historical evidence suggests that heavy mechanized elements are the optimal deterrence forces, but equipping units in this manner was, and is, expensive.[43] Consequently, the temptation to buy lower quantities of equipment solely for the formations most likely to use them was sometimes overwhelming. For example, the first-generation anti-tank guided missiles were initially provided to 4 CIBG in the mid-1960s. The tank was retired in Canada-based units, and new main battle tanks in the 1970s went only to Germany.[44] The decisions to prioritize these systems to Europe were entirely sensible in the light of budgetary limitations but contributed to the divergence between what was increasingly becoming two armies. A similar process has already

begun for Latvia, with procurement of anti-tank and anti-aircraft systems as urgent operational requirements for the new Canadian 'centrepiece' force.[45]

If this experience is any indication, history may bend in a circle, and a situation similar to that of the Cold War may soon be repeated. In the realm of doctrine development, Godefroy believes it is dangerous to allow a single problem-set, like a conventional war in Europe, to dominate doctrinal processes since "training for the moment often trumps investments in long-term knowledge development, even though such activities are akin to letting the brain freeze to keep the hand moving."[46] Unlike the doctrinal development process during the Cold War, the Canadian Army of today should continue the exploration of the full range of conflict which could occur 'tomorrow' rather than focus solely on the problems of 'today.'

Operational realities and resource limitations forced the Cold War-era Canadian army to generate formations capable of tackling a variety of peace-support and aid-to-civil power tasks. By 1965, the army had divided in two, with 4 CIBG stationed in Europe preparing for conventional war, 3 CIBG stationed in Eastern Canada ready to augment Europe, and 1 and 2 CIBGs assigned as light air-portable brigades for use in lower-intensity environments.[47] Today, the army should investigate the viability of a similar division of its force structure into heavy-medium forces stationed in Latvia or destined to replace it on a rotational basis, and light forces assigned for other contingencies. It must also accept that it is unlikely to procure adequate equipment to identically equip all three Canada-based brigades, plus the forces stationed in Latvia. Thus, this bifurcation of the army will likely occur whether or not force structures are explicitly altered to reflect it. Regardless of the decisions taken, the army must ensure those units slated to replace or augment the Latvia force are equipped to, at a minimum, train in Canada and have sufficient lethality and survivability in the event of deployment.

Host Nation Support

The credibility of Canada's Germany-based brigade was primarily based on its capability to fight in the high-intensity European theatre; however, as a relatively small formation in a multinational environment, this capability rested partly on the host nation's (HN) support. Situated on the front lines of any potential conflict, the Federal Republic of Germany created a highly-developed military and civilian support system for the NATO forces stationed on their territory. By the 1980s, the German Territorial Command was explicitly responsible for a wide variety of essential services: rail transport, road and bridge repair requisitioned public utilities and transport, rear area security, refugee movement control, chemical biological radiological nuclear (CBRN) reconnaissance, prisoner of war control, and the provision of hospitals to allied forces.[48] These capabilities, staffed primarily through the ex-conscript German servicemen on a reserve basis following their obligatory service, were vital to the ability of 4 CMBG to be effective in the

event of war. While the brigade demanded many Canadian-specific sustainment supports, had it been forced to provide these services in addition to the wide variety of HN remits, its limited personnel strength would have been dissipated into non-combat functions, thus reducing its deterrence value.

The Canadian-led brigade in Latvia will generate a similar demand for most or all of the above-listed functions, which the HN Territorial Command filled through the Cold War. While the roadmap publicly promulgated by the Canadian and Latvian governments highlights the HN's commitment to developing medium-range air defence, rocket artillery, and coastal defence capabilities, which will provide combat support to allied forces in the country, work is required to develop many service support capacities.[49] With conscription implemented in Latvia,[50] Canada should strongly encourage and assist Latvia in developing territorial forces focused primarily on the essential support tasks the German Territorial Command provided to 4 CMBG during the Cold War. As conscripts complete their terms of service, territorial units with specific HN support responsibilities should be formed, thus allowing the multinational brigade in Latvia to be comprised primarily of combat troops from contributing nations. Such a utilization of reserve personnel would dovetail nicely with the concept of "Comprehensive Defence" being explored by many of the smaller nations in the region, as outlined by Latvian researcher Ieva Berzina.[51] Other Latvian commentators, including Tom Rostocks, have noted that the costs of increased HN supports will inevitably compete with the improvement of Latvian combat capability, but concludes that the presence of NATO troops constitutes such a high priority that further investments are justified "despite the opportunity costs."[52]

Sustainment Challenges

The discussion of HN support raises the issue of sustainment, which ranks among the most serious challenges for both the German- and Latvian-based forces. In the realm of supply, the Cold War brigade initially required the creation of a Canada-specific communications zone generating a chain from Canadian ports, through Antwerp to Canadian third-line sustainment organizations, to its bases in northern Germany.[53] However, much of the realism of the sustainment apparatus was allowed to decay and by 1978 the situation was such that rather than the NATO-mandated 30 days of supply stockpiled in theatre, Canada had less than seven days of key anti-tank and tank ammunition on hand.[54] Perhaps worse from a professional perspective, Maloney argues that the brigade of that period engaged in much "illusory" war sustainment planning until a 1983 logistics exercise exposed the flaws in these assumptions.[55] Consequently, considerable efforts were made through the rest of the decade to re-create a more viable Canadian sustainment chain including third-line logistical, medical and personnel sustainment chains.[56]

Given this historical precedent, Canada's Latvia-based formation must guard against magical thinking concerning

> **" Given this historical precedent, Canada's Latvia-based formation must guard against magical thinking concerning sustainment. Unlike an exercise in Canada, where some logistical realities can be sidelined for the sake of meeting specific training objectives, operational plans in Latvia must remain grounded in the realities of the situation."**

sustainment. Unlike an exercise in Canada, where some logistical realities can be sidelined for the sake of meeting specific training objectives, operational plans in Latvia must remain grounded in the realities of the situation. For instance, it would be unwise to train and plan for the doctrinally called-for expenditures of artillery ammunition if stockpiles in theatre would not support them, supply lines do not exist to move more ammunition forward if necessary, and new ammunition is not even being produced.[57]

Unlike 4 CMBG, the supply situation of the Canadian-led brigade in Latvia is further complicated by its extremely diverse composition: at least 10 NATO countries currently contribute to the mission. This level of multinationalism at the unit level was unheard of during the Cold War, with many contemporary commentators arguing that intermingling national formations at even the division or corps levels would create an ineffective "tactical stew," and that consequently "the level at which interoperability should be practiced cannot be high enough."[58] As a former member of the eFP BG Latvia's combat service support company, the author can personally attest to the complexities of sustaining a multinational unit of this type on a relatively small scale: each nation brings bespoke equipment, ammunition, and rations which must be sustained along individual supply lines utilizing occasionally conflicting national sustainment doctrines.[59] However, the "most multinational battlegroup ever put together in the NATO context" has made significant strides towards alleviating the challenges posed by multinationalism, which the Canadian-led brigade will undoubtedly carry forward.[60] Still, as the framework nation, Canada should take the lead in encouraging interchangeability within the brigade by taking steps to limit ammunition and

equipment diversity, including pushing for more homogenous units where possible. Such efforts are vital to the sustainment credibility of the brigade to avoid becoming the "Frankenstein" formation warned against by some eFP commentators.[61]

The brigade staff in Germany devoted significant effort to planning for personnel sustainment in wartime. Two primary planning forms were involved: planning for augmentation and planning for casualty replacements. The former came to be addressed by Operation Plan (OPLAN) PENDANT, which by 1979 involved the use of civilian airlift to bring 2,347 augmentees to Germany to add two rifle companies, a third tank squadron, and a fourth artillery battery.[62] The accompanying casualty replacement OPLAN BARBET was designed to bring 938 replacement soldiers over the first 30 days of any conflict.[63] These plans were exercised occasionally throughout the Cold War. In 1964, the brigade utilized BARBET to locate 77 replacements for critical specialists in Canada, who were then flown into theatre. In 1987, PENDANT was implemented to bring 653 augmentees to Germany for a significant exercise.[64] More importantly, augmentation plans were a way for the Canadian government to signal strategic resolve during increased tensions. During the 1961 Berlin Crisis, 1,100 troops were flown to Germany to augment 4 CIBG's fighting strength.[65]

Current army planners should take note of the above augmentation and casualty replacement plans as a key aspect of the overall deterrence through denial strategy. Specifically, an individual replacement pool should be created in the Canadian Forces Tasking, Plans and Operations system with sufficient personnel to replace moderate casualties within a reasonable planning window. This system should be exercised periodically, and all contributing nations should require a similar one. Regarding augmentation, the brigade roadmap issued by the HN and Canadian governments commits Canada to providing "Canada-based reinforcements."[66] Similarly to PENDANT, these forces should include formed elements to add key capabilities or augment existing ones. However, to ensure the credibility of these augmentation plans, identified elements should be an enduring task rather than an ad hoc arrangement so that appropriate equipment and stores can be stockpiled in the theatre.

Maintaining 2,200 soldiers stationed in Latvia, plus the bona fide requirement for replacements and augmentation elements, may divert a significant portion of CAF personnel to operational tasks. An honest appraisal within the Canadian Army and Canadian Joint Operations Command (CJOC) may reveal an uncomfortable truth: the CAF is facing operational strain that the Latvia brigade task has compounded, perhaps beyond the point where it can be maintained indefinitely in the absence of significant reform or resource injection. Some commentators, including among Canada's Latvian hosts, have already questioned the feasibility of the existing personnel commitment, noting that this "may compromise the quality of Canada's contribution."[67] The failure to establish such plans may inadvertently signal to allies

> **" Assuring an adequate flow of personnel through theatre and their Canadian bases will be vital to the deterrence's credibility; therefore, recruitment and retention must remain high priorities."**

and adversaries alike that the Canadian-led brigade in Latvia is simply a token tripwire force rather than a part of a comprehensive Allied denial strategy.

Recruitment and Retention

Even without taking the militarily responsible steps of constituting augmentation and replacement pools, the 2,200 soldiers committed permanently to Latvia are likely to impose a significant strain on the CAF's personnel, whose strength the Minister of National Defence has already referred to as being in a "death spiral."[68] Assuring an adequate flow of personnel through theatre and their Canadian bases will be vital to the deterrence's credibility; therefore, recruitment and retention must remain high priorities. Though the commitment to Germany took place in a very different societal context for Canada, experience from that period in both efforts can be instructive.

As we have seen, the initial commitment to Germany in 1951 strained the existing personnel resources in the army in a way that is far more serious than the problem faced today: staffing the brigade for Germany required a near-tripling overall army strength. Though the brigade was supposed to be based on the Reserves, only a disappointing 1,681 enlistees came from the reserve units themselves. New enrolment methods were employed to attract civilian recruits to fill the balance of the initial 6,525 positions.[69] Most of these recruits were attracted by what General Charles Foulkes, the Chairman of the Chiefs of Staff Committee, called a "Soldier of Fortune" enlistment path, in which individuals were enrolled for a short (two-year) term of service with the explicit understanding that a year of their enlistment would be spent overseas with the German-based brigade.[70] This unique enrolment option was accompanied by an aggressive nationwide print and radio advertising campaign explicitly targeting civilians interested in overseas service.[71]

This short-term campaign was largely successful, and in just a few months, the army achieved a net increase of 14,292 personnel by the fiscal year 1951-1952.[72]

Despite the separation of 70 years, the concerns and motivations of today's soldiers (and potential soldiers) share some commonalities with those who initially filled 27 CIBG. With a similarly attractive overseas experience available in Latvia, the army should consider prominently placing service in that theatre in future recruitment efforts. Further, just as Germany-specific enrollment methods were used to fill the ranks of 27 CIBG, the army should consider creating a Latvia-specific short term of service in which recruits could join, be trained, and be guaranteed a position in the NATO brigade for a set period. However, a short-service program should be approached with caution, as was done in the 1950s: short-service personnel impose additional training costs on the institution if a sufficient number of them are not convinced to stay in the force following their initial enlistment period. That said, Latvia's increase in personnel demand may be worth the necessary resource expenditures. The scale of the Latvia commitment should, at a minimum, cause the Canadian

Army and Military Personnel Command to examine whether existing intake plans are sufficient to meet operational demand.

Maintaining the enthusiasm for the overseas mission in Germany was a challenging prospect for the army, and it quickly had to adapt to accommodate the wishes of its peacetime recruits who, though dedicated, required improved living conditions if any personnel were to be retained. As indicated in Part I, the NATO brigade was intended to be deployed on a rotational basis, and dependents were not initially authorized. This prospect of repeated deployments without their families made long-term service in the Army unattractive to many. In less than a year, morale problems in 27 CIBG were noted both within the army and in the national press, with one scathing *Maclean's* article describing morale issues as part of the "Failure of the 27th."[73] Frustrated soldiers took matters into their own hands, and Maloney notes that some simply ignored the Army's regulations and moved their families to Europe at their own expense.[74] By 1953, the Army gave in to the now-public demands of its soldiers and authorized the movement of dependents to Germany with the accompanying commitment to quarters and base facilities. Dependents would come to build a Canadian community in Germany as the mission became more and more a permanent fixture in the strategic landscape.[75]

Since 2017, the commitment to Lativa has been based on a six-month rotational model, and except for permanently posted Task Force Latvia headquarters personnel, dependents are not authorized. Given its experience in Germany, the army can anticipate that the current policy of what amounts to repeated unaccompanied foreign postings will become a source of dissatisfaction for its personnel. Consequently, the army should seriously examine options to progressively turn the bulk of the 2,200 soldier positions into permanent postings with dependents authorized. The increased costs involved would not be insignificant: funded moves, quarters, schooling and other base services would all be required, to say nothing of what one 4 CIBG commander called the "moral obligation" to maintain a realistic dependent-evacuation plan in the event of war.[76] Despite these challenges, the historical disadvantages of retaining a rotational model will likely be resurrected without action.

Additionally, from an operational-output perspective, maintaining two six-month 2,200 soldier rotations under the current model will require an annual commitment of 4,400 personnel, which a permanently stationed force would cut by half. These savings in personnel outlay contributed to the recent Centre for Strategic and International Studies report recommendation to transition rotational U.S. Army brigades in Europe into permanently posted formations.[77] The hidden costs of locking the army into a high personnel tempo rotational model may have consequences beyond retention: a recent *Army Times* investigation revealed that American soldiers assigned to repeated rotational tours to Europe were three times more likely to commit suicide than the general U.S. Army population with one battalion that was repeatedly deployed losing six soldiers in just 14 months.[78] This

study identified particular risks associated with the armour personnel community. Their lower density in the Army force structure did not reflect the high demand for their units in international rotational deployments. The mission in Latvia is similarly likely to draw disproportionately on specific units and specialist trades with potentially similar consequences. The risk to the mental health of our soldiers alone should be enough to justify an investigation into the benefits of postings over a rotational model.

CONCLUSION

One aspect of the Canadian experience in Germany that was not considered here was Canada's difficulty in extracting itself from the European commitment. Even after the end of the crisis of the early 1950s, which had sparked the brigade's establishment, the many efforts to reduce, reformulate or remove its land forces were strongly resisted by other members of the Alliance. Even the government's relatively modest 1969 decision to move its forces from northern to central Germany and the accompanying force reduction led one NATO ambassador to "burst into tears" and reduced NATO military leadership to "near-apoplexy." One official referred to the decision as a "national disaster."[79] Only the earth-shattering events leading to the welcome collapse of European communism allowed Canada to remove its forces from Europe. The Latvian commitment faces a similar situation, and it may continue far longer than imagined when the eFP BG was established in 2017. The Canadian Armed Forces must remain aware that a seemingly short-term commitment could quickly become a generational one, and plan accordingly.

The prior Canadian experience with a similar deterrence task in Germany was the foundation of this examination of some of the challenges posed by Latvia. However, the recommendations offered here are not fully developed courses of action. One must remember that the historical contexts of both commitments differ and that the direct extrapolation of a 'Germany-solution' may not apply to Latvia. That said, any or all of the sections covered in the second part of this article are worthy of detailed examination by individuals or military decision-makers. The lengthy deployment of a brigade in Europe during the Cold War involved more than 100,000 service members and their dependents, and can, in the wake of hindsight, be considered a positive contribution to Alliance efforts to deter an aggressive adversary and prevent the ultimate escalation to war.[80] A similar level of perseverance by the present-day CAF, perhaps benefitted by historical experience, can increase our optimism that the basing of a Canadian-led brigade in Latvia will positively contribute to the successful conclusion of a second war without battles.

Notes

1   NATO, "NATO's military presence in the east of the Alliance," *NATO* (8 December 2023), https://www.nato.int/cps/su/natohq/topics_136388.htm (accessed 20 March 2024).

2   Department of National Defence, *Our North, Strong and Free* (2024), 5, https://www.canada.ca/en/department-national-defence/corporate/reports-publications/north-strong-free-2024.html

3   While Canada also committed air elements to the European deterrence mission, this article takes as its focus the land forces and directly attached aviation elements and makes reference to the separate Royal Canadian Air Force mission only where necessary to the discussion of changes to the land brigade.

4   Canada's land forces would undergo several changes in title throughout the period covered by this article: from the "Canadian Army" in 1950, to the "Force Mobile Command" or just "Mobile Command" following unification, "Land Force Command" after the conclusion of the Cold War and the "Canadian Army" once again in 2011. In the interests of simplicity, this article will utilize the term 'Canadian army' to refer to the land forces of Canada regardless of their official title at the time, a process also adopted by other historians of the institution throughout this period. See Peter Kasurak, *A National Force: The Evolution of Canada's Army, 1950-2000* (Vancouver: University of British Columbia Press, 2013), 3.

5   Sean Maloney, *War Without Battles: Canada's NATO Brigade in Germany*, 1951-1993 (Whitby, ON: McGraw-Ryerson Ltd., 1997), 18.

6   R.B. Oglesby, Report No. 51: The 27th Canadian Infantry Brigade Group, February 1951 – May 1952 (Historical Section, Canadian Army Headquarters, 1952), 7.

7   Maloney, 17.

8   D.J. Goodspeed, Report No. 93: The Canadian Army, 1950-1955, Part I: Canadian Defence Policy (Historical Section, Canadian Army Headquarters, 1961), 22.

9   Oglesby, 15.

10   Maloney, 22-23.

11   Goodspeed, 23-28.

12   Maloney, 62.

13   Oglesby, 4.

14   Maloney, 74.

15   *Ibid.*, 75.

16   *Ibid.*, 131 and 148.

17   *Ibid.*, 130, 148, 165, and 191.

18   *Ibid.*, 191 and 224.

19   *Ibid.*, 141.

20   *Ibid.*, 234.

21   The brigade was also retitled as '4 Canadian Mechanized *Battle* Group.' *Ibid.*, 235-237 and 240.

22   Kasurak, 125-132.

23   Maloney, 243.

24   *Ibid.*, 292.

25   *Ibid.*, 400.

26   Kasruak, 210.

27   *Ibid.*, 252-254.

28   Maloney, 484-485.

29   *Our North, Strong and Free*, 6.

30   Michael J. Mazaar, *Understanding Deterrence* (Santa Monica, CA: RAND Corporation, 2018), 2.

31   For a discussion of "tripwire" versus more robust deterrence forces, see Wesley Clark et al, *Closing NATO's Baltic Gap* (Tallinn: International Centre for Defence and Security, 2016), 21-22.

32   *Ibid.*, 9-10.

33   Goodspeed, 27.

34   Kasurak, 12.

35   Mazaar, 6.

36   Canada, Department of National Defence, *Challenge and Commitment: A Defence Policy for Canada* (Canadian Government Publishing Centre, 1987), 20.

37   For a discussion of the historically high success-rate of *fait accompli*-type invasions in the 20th century, see Dan Altman, "By Fait Accompli, Not Coercion: How States Wrest Territory from Their Adversaries," *International Studies Quarterly* 61.4 (December 2017).

38   Maloney, 293.

39   Andrew B Godefroy, *In Peace Prepared: Innovation and Adaptation in Canada's Cold War Army* (Vancouver: University of British Columbia Press, 2014), 184.

40   Maloney, 494.

41   Canada, Department of Defence, B-GL-301-001/FP-001, *Land Formations in Battle*, (27 November 1987), Chapter 1, Section 2.

42   Canada, Department of Defence, B-GL-305-002/FT-001 (CFP 305 (2), *Armour, Volume II: The Reconnaissance Squadron in Battle*, (9 February 1979).

43   For the heavy forces as the ideal deterrence forces, see Bryan Frederick et al., *Understanding the Deterrent Impact of U.S. Overseas Forces* (Santa Monica, CA: RAND Corporation, 2020), https://www.rand.org/pubs/research_reports/RR2533.html (accessed 1 May 2024), xvii.

44   Maloney, 191, and 320-321.

45   David Pugilise, "Canadian NATO Troops in Latvia Get Air-Defense, Anti-Tank Upgrades" *Defense News* (15 February 2024) https://www.defensenews.com/global/europe/2024/02/15/canadian-nato-troops-in-latvia-get-air-defense-anti-tank-upgrades/ (accessed 28 March 2024).

46   Godefroy, 216.

47   Maloney, 189.

48   *Ibid.*, 298.

49   National Defence, Roadmap - Scaling the EFP Latvia Battle Group to Brigade (10 July 2023). https://www.canada.ca/en/department-national-defence/news/2023/07/roadmap---scaling-the-efp-latvia-battle-group-to-brigade.html (accessed 28 March 2024).

50   *Ibid*.

51   Ieva Berzina, "From 'Total' to 'Comprehensive' National Defence: The Development of the Concept in Europe," *Journal on Baltic Security* 6.2 (2020): 1-9.

52   Tom Rostocks, "Latvia as Host Nation," in *Lessons from Enhanced Forward Presence, 2017-2020*, edited by Alexander Lanoszka et al, (NATO Defence College, 2020), 58.

53   Maloney, 56-57.

54   Kasurak, 188.

55   Maloney 412-413.

56   For the government's decision to rectify these serious sustainment gaps, see *Challenge and Commitment*, 62.

57   Murray Brewster, "As allies scramble to supply Ukraine, Canada still has no deal to ramp up munitions production," *CBC News* (20 February 2024) https://www.cbc.ca/news/politics/ukraine-munitions-canada-artillery-1.7118004 (accessed 28 March 2024).

58   John A. English, *Marching Through Chaos: The Descent of Armies in Theory and Practice* (Westport, Connecticut: Praeger, 1996), 160.

59   The author was Second-in-Command, CSS Company from January to July 2020.

60   Christian Leuprecht et al, "Canada as a Framework Nation," in *Lessons from Enhanced Forward Presence, 2017-2020*, edited by Alexander Lanoszka et al, (NATO Defence College, 2020), 48.

61   Clark et al, 22.

62   Maloney, 292.

63   *Ibid.*, 293 and 410.

64   Maloney, 210 and 421.

65   Godefroy, 172.

66   National Defence, Roadmap.

67   Toms Rostocks and Alexander Lanoszka, "Success Assured: Appraising the Canadian-led Enhanced Forward Presence Battlegroup in Latvia," *Macdonald-Laurier Institute* (2024): 21, https://macdonaldlaurier.ca/success-assured-canada-latvia-enhanced-forward-presence-battlegroup-toms-rostoks-alexander-lanoszka/ accessed August 2024).

68   Murray Brewster, "As Bill Blair ramps up his warnings about the state of the military, Trudeau sticks to his script," *CBC News* (8 March 2024) https://www.cbc.ca/news/politics/bill-blair-trudeau-canadian-armed-forces-readiness-1.7137369 (accessed 28 March 2024).

69   Oglesby, 7.

70   Goodspeed, 22.

71   Oglesby, 5.

72   Goodspeed, 22.

73   Goodspeed, 28.

74   Maloney, 52.

75   Goodspeed, 29.

76   Maloney, 162.

77   Seth G. Jones et al, *Forward Defence : Strengthening U.S. Posture in Europe* (Washington: Centre for Strategic and Intentional Studies, 2024), 71.

78   Davis Winkie, "Broken Track: Suicides and Suffering in Army's Exhausted Armor Community," *Army Times* (11 March 2024), https://www.armytimes.com/news/your-army/2024/03/11/broken-track-suicides-suffering-in-armys-exhausted-armor-community/ (accessed 27 March 2024).

79   Kasurak, 120-121 and Maloney 242-243.

80   Maloney, xxxiii.

Canadian Armed Forces members rehearse a parade in the streets of London with other Commonwealth country contingents for Her Majesty the Queen's Platinum Jubilee celebrations in London, England on May 31, 2022.

Photo: MCpl Nicolas Alonso, Canadian Forces Combat Camera

The Enduring Crown Commonwealth: The Past, Present, and Future of the UK-Canada-ANZ Alliance and Why It Matters

An Inspiring Manifesto for Canada, Australia, New Zealand and the U.K.
By J. William Galbraith

Smith, Michael J., and Stephen Klimczuk-Massion, The Enduring Crown Commonwealth: The Past, Present and Future of the UK-Canada-ANZ Alliance and Why It Matters, Rowman & Littlefield Publishers, Lanham, Maryland, U.S.A., 2023, pp. 502.

J. William Galbraith was a federal public servant for 30 years in investment review, intelligence and national security policy. He retired as Executive Director of the CSE Commissioner's Office in 2018. Before his public service career, he spent seven years with the Conference Board of Canada. Mr. Galbraith holds a BA Hon. from Carleton University and a two-year graduate degree, "grande distinction," from the Université Libre de Bruxelles. He is the author of "John Buchan: Model Governor General."

"This last year has been a year of great anxiety and unrest throughout the world." Indeed, it has! This quote, however, was part of the New Year's Day message of the Governor-General of Canada, Lord Tweedsmuir (1935-40), in 1937. He was better known as the renowned author John Buchan. That pre-Second World War period saw Japan invading and occupying parts of China, civil war in Spain, Fascist Italy conquering Abyssinia (Ethiopia), and Hitler's troops re-occupying the Rhineland. In this darkening context, Tweedsmuir's speeches and activities encouraged Canadian unity, emphasizing "loyalty to Canada and to Canada's King" in free association with the other countries of the Commonwealth. Canada was finding its role in the world post 1931-Statute of Westminster, which formally gave it (and the other Dominions) responsibility for its own foreign policy.

In a world where dictatorial regimes are again challenging democracy, *The Enduring Crown Commonwealth: The Past, Present, and Future of the UK-Canada-ANZ Alliance and Why It Matters* is an important book and should be read by foreign policy practitioners, academics and parliamentarians. The co-authors, Michael J. Smith and Stephen Klimczuk-Massion provided what historian Andrew Roberts describes as a timely and "inspiring manifesto for the future." Professor Roberts highlights some urgency in this work's timing and prescriptive nature, launching his comment from the authors' statement that the "United States is not predictable anymore." Roberts never thought he would agree with such a sentiment but adds that "a world where the United States is stumbling and uncertain of her role, her allies need to be as united as possible."

The basic premise of this treatise is that for countries with "[shared] language, history and governing culture" as well as sharing a Head of State—Canada, Australia, New Zealand, United Kingdom, abbreviated CANZUK—it makes sense they should work closer together in a multi-polar world where democracies are challenged by the axis of China, Russia, Iran and North Korea. The geographically dispersed CANZUK nations have been steadily increasing their relations over the past decades, and, after a period of each finding their way in the post-WWII period, reconverging "in terms of trade, defence, foreign policy coordination, freedom of movement, mutual recognition of professional qualifications and other new and deeper links."

In the words of Australian academic Peter Boyce in 2008: "The non-revolutionary constitution development in Canada, Australia and New Zealand may be seen as testimony to the genius of British and Westminster-derived political institutions and practice." In Canada, we find a similar comment by then-professor Michael Ignatieff in a 2004 presentation at the Department of Foreign Affairs: "We have reason to be proud of our loyalty to British institutions, proud of our peaceful achievement of national independence." The current, hyper-critical "woke" wave of self-loathing in the West does nothing to diminish the accomplishments of countries deeply committed to democracy and that remain magnets to immigrants and refugees from around the world seeking a freer and safer life.

This stimulating book is divided into three major chronological parts, with many sub-titles that are effectively standalone essays. The reader is led through a detailed and analytical progression from the "rise and fall of the Crown Commonwealth" through a re-convergence of the four principal realms—CANZUK—to a hoped-for but not guaranteed "potent international alliance." The authors are neither nostalgic for the old Empire nor dreamers about the future, but they are perceptive, practical, and thorough in their exploration of this theme.

Queen Elizabeth's accession to the throne in February 1952 and her Coronation in June 1953 created a euphoric mood in post-war Britain and the Commonwealth. It was the "high-water mark of a common spirit embracing Britons, Canadians, Australians, New Zealanders and many others." Re-enforcing this were two significant events: the formation of a Commonwealth Division, under the auspices of the United Nations, at the start of the Korean War in 1953 and the very successful six-month tour of the Commonwealth by Queen Elizabeth in the Royal Yacht Britannia in 1953-54. The authors focus on the effects of Her Majesty's presence in New Zealand and Australia, supporting the idea of the monarch spending time "residing" in the different realms, a theme raised in more detail later in the book.

The Queen's 1959 Royal Visit to Canada, also in Britannia, to open the St. Lawrence Seaway, twenty years after the first-ever visit of a reigning monarch to Canada in 1939, was successful, but the euphoric mood had been tempered. The authors astutely segregate the then-still "sense of Britishness" in Canadians, Australians and New Zealanders from the point that this "did not automatically equate to unquestioned loyalty to Great Britain." It was a "twilight" period for CANZUK.

The Suez Canal crisis catalyzed the "twilight" period when Egypt seized control of the Canal in 1956. Britain and France attempted to take back control but failed. The episode split the Commonwealth. Australia and New Zealand supported Britain's intervention, Canada and South Africa abstained, and the Asian Commonwealth members opposed. It became a defining time for Canada as Lester Pearson, Secretary of State for External Affairs, was instrumental in organizing the first large-scale United Nations Peacekeeping force, for which he was awarded the Nobel Peace Prize in 1957.

The fallout from Suez enveloped the monarchy, leading to public criticism by the media and even a peer from the House of Lords, including "unprecedented personal attacks" on the Queen. It signalled "the end of deference." Britain's declining stature prompted it to examine the integration occurring on the continent during the 1950s.

Through the following decades, the Crown was being diminished in the realms. In Canada, the government of Pierre Trudeau introduced the unification of the armed forces in 1968, "a disaster for morale." As a Sea Cadet on board HMCS Preserver for over two months in early 1971, I heard and saw the impact. "Royal" disappeared from the navy and air force in the unified Canadian Forces. In Australia in 1975, a constitutional crisis erupted with the dismissal of Prime Minister Gough Whitlam by Governor-General Sir John Kerr. This enraged many Australians despite constitutional experts stating the Governor-General could do it with the prerogative reserve powers of the Crown. The incensed Labour Party included an express article in its constitution to rid the country of the monarchy.

The authors examine the geographic and cultural contexts of Australia, New Zealand, and Canada, which acted as catalysts for the republican forces and the sense of distancing from the monarchy. In Australia and New Zealand, there was a growing orientation toward Asia. In Britain, the Commonwealth was overtaken by the growing pull of integration on the Continent; Britain joined the European Common Market in 1973. In Canada, the United States loomed ever more prominent in economic and cultural terms and became a defining element of Canadian identity – not being American.

There is an astute analysis of the rising strength of the republican movement in Australia. After 13 years of Labour Party rule (1983-1996), the authors deftly describe how "the resolute monarchist" John Howard "perceptively turned the tables," defeating the Labour Party in a general election and beating the republican question in a national referendum in 1999. As the authors incisively comment, "Australia, the world was told, wanted an elected head of state, and now it had one"—the point "where the paradox loses its contradiction"…"that the ultimate guardian of democracy is an unelected figurehead." The authors acknowledge the referendum result "was not so much that Australians were enamoured with the monarchy in the 1990s but that they were enamoured with the republican option far less." They also rightly remark later, in the conclusion, that twenty years and more after the referendum, the current political dysfunction in the American republic does nothing to encourage the republican option.

Beyond Australia, there was a restoration of sorts occurring. In 1996, the New Zealand Labour government ended the use of British honours "to better reflect New Zealand identity" and, in 2000, abolished knighthoods, instituting instead a New Zealand Order of Merit. However, a new government (National Party) in 2009 restored knighthoods within a New Zealand-based order. Across the CANZ realms, efforts to retain the most-revered award for bravery, the Victoria Cross, were victorious against the zeal to strengthen national identity and replace the award. In Canada, "Royal" was restored to the Canadian Navy and Air Force in 2011.

Within the same timeframe, in Canada, the appointment of Adrienne Clarkson as governor-general (1999-2005) revived the post after it had been degraded over 25 years by prime ministers submitting names of mostly dull former politicians. Clarkson, a renowned television broadcaster, journalist and agent-general for Ontario in Paris, "elevated both the Crown and her office back to prominence with intelligence, style and panache." She travelled widely, highlighting Canada's North and the special relationship between the Crown and Indigenous peoples. Her appointment and approach were reminiscent of one of her predecessors whom she greatly admired, Lord Tweedsmuir. But her time wasn't without criticism, as her approach is reflected in the authors' sub-title of "Queen Adrienne," alluding to her reference as Head-of-State.

The changed, more positive and bipartisan mood toward the monarchy in Canada was reflected in the text of a statement by the Hon. Stéphane Dion, former Liberal Party leader, responding to a motion by the Conservative government, celebrating the 2013 birth of Prince George (now second in line to the throne). Dion explained, "why the institution of the monarchy is more than just a relic of the past and why it remains relevant to Canada in the early 21st century."

What was at the root of this changed mood toward the Crown? The authors explain, with sarcastic humour in the context of Australia, but which applies more broadly, that "if the unexpected return of the monarchy's popularity has caused psychological harm to the many nationalists ... they at least partly have the millennials to thank for it." A new generation of royals attracted attention from the younger generation. The authors note that in the case of Australia, the older generation pushing for a republic in the referendum was seen as elitist and out of touch.

However, if the monarchy depends on personality and celebrity for popularity, it is a fickle base. The further I read into the book, the more I expected to find references to, if not a separate, sub-titled essay about, the role that education plays and, in Canada at least, the high level of civic illiteracy. Without a basic understanding of the constitutional role and gaining an appreciation of the institution itself, it is easy in ignorance to criticize an "archaic" and "settler-colonial" symbol (the latter theme is examined in the book's last chapter under the sub-title "Decolonising the Colonial Past").

There is a useful history and discussion of British politics in the second decade of the 2000s, culminating in the successful, if close, Brexit referendum, which put "global Britain" in focus. There are essays on: the Anglosphere; on putting the "C" back into the FCO (discussion about whether the Commonwealth will ever be more than a "useful talking shop" is stimulating); on Ireland; on Scotland; and under the amusing sub-title "The empire strikes back" they treat the serious subject of the expanded pool of expertise and experience that the CANZUK realms can represent but which is mainly one-way now with "Aussies, Kiwis and Canucks" being appointed to senior positions in key British institutions.

The third major Part of the book sees the authors weaving between high optimism and "enormous challenges." "CANZUK Rising: Strategic Cousins in a Multipolar World: From Postimperial Club to Potent International Alliance." It is an expression hopeful of

increasing trade, defence and foreign policy coordination, freedom of movement, and other linkages of longer standing. More recently (2021), a joint letter from CANZUK parliamentary leaders recognized the benefits of their shared traditions, "commitment to the rule of law and a history of working together in defence of democracy."

The authors present the arguments of CANZUK critics and those questioning its viability or desirability even, given, in part, the existence of other groupings (e.g. AUKUS, the Quad, the Commonwealth Pacific-focussed Five Power Defence Arrangement, G-7) to which one or more of the CANZUK countries belong. But even here, some critics recognize why "middle powers" may band together in an environment of increasingly aggressive dictators. In the defence and intelligence fields, there is a privileged alliance of the Anglosphere and the U.S.-dominated "Five Eyes" intelligence alliance. The discussion continues and leads the authors to reference historian Andrew Roberts' suggestion that CANZUK could constitute a third pillar of Western Civilization, the USA and the united states of Europe being the other two. The theme is enhanced with geopolitical discussions such as collaboration by Canada, Australia and the UK on a common warship design, the AUKUS arrangement for building Australian nuclear submarines based on UK and US technology, and prospects of UK-Canada cooperation for surveillance and defence in the Far North. The authors suggest, however, that "CANZUK will come about not through a formal grand alliance/summit ... but rather through a steady, cumulative buildup of individual agreements and initiatives."

The death of Queen Elizabeth, the authors astutely observe, created a paradox for critics of monarchy: "Billions mourn the Queen, yet the Monarch is Considered Anachronistic?" It is a provocative question to challenge the doubters. It leads to a discussion of the late Queen's exemplary life of service, duty and moral orientation, making it impossible for even the most brutal Republicans to cast aspersions on her. However, they may still doubt the future of such an "undemocratic" system of government. The anticipation of Queen Elizabeth's death had raised questions for monarchists and anti-monarchists alike. Would her death trigger calls in Canada and the other realms to end the monarchical connection? The time since her death has given a preliminary answer with the seamless transition to the reign of King Charles III, who transformed from an advocating Prince of Wales expected to misstep into the constitutional monarch he knew he must become.

The authors argue that "the greatest risk to the monarchy nowadays is not so much that King Charles III will remain a global king but whether he can survive as a British one." It may seem baffling for the reader to stumble on a point that jars after all that has so far been presented as the **enduring** Crown Commonwealth. It is, however, a useful provocation to reflection. The point made is that the King is also King in each of the distinct realms, but how, the authors rightly point out in referring to the book "Canada's Deep Crown," do so many elements exist in what they term a "realm of opposites": "hereditary yet democratic, an individual and an institution, it's both national and British, it enables and prevents constitutional change, and it's a symbol of both colonialism as well as independence." I would argue that these contradictions make it difficult for more literal-minded individuals to see the subtle brilliance of constitutional monarchy, recalling the quotes by Peter Boyce and Michael Ignatieff.

The authors ask if CANZUK relations will "strengthen further over time post-Brexit, or eventually surrender to the modern dictates of anti-colonialism and decolonization? Canadian Prime Minister Trudeau has apologized more often for past sins of his country, rarely speaking about its accomplishments. Canadian journalist Jeffrey Simpson writes that for most English Canadian elites and their institutions, "Canada's past is a sad litany of sins unleavened by triumphs of the human spirit or generosity." Simpson adds: "Under Justin Trudeau and the identity politics he has embraced, [patriotism] has almost entirely disappeared." The consequence is a decline in pride in the country's population under age thirty. This is likely a contributing factor to recruiting crises in the armed forces of Canada, the U.S. and the U.K.

The authors' conclusion leads with a provocative question: "The Stone of Destiny: Will the Hereditary Principle Durably Last for Nonresidential Monarchies?" The authors discuss the prospects for republicans and nationalists in the CANZ countries, noting that, apart from the anomaly of Barbados becoming a republic (done without a referendum), the possibility of removing the Crown is more difficult for varying reasons in each country. They note, however, that "the departure of a key realm would almost certainly pose a grave existential threat to the rest," as Canadian PM Jean Chretien's relief demonstrated after the defeat of the Australian 1999 referendum.

At the end of the opening discussion, the authors link what they believe is a second, more important question than the first about a non-resident monarch: "Can the King's senior realms continue to build on their reconverging ties? To both questions, the authors reply with "a very qualified yes." The "very" is curious. The activities of the CANZUK realms are seeing the practical benefits of closer relations over the past decade, and now, the geopolitical motivation. The authors suggest the future for CANZUK is "not only promising but increasingly unavoidable." "[T]he reality is that all four of the CANZUK nations need each other."

As amply demonstrated throughout this book, there are "ups and downs," but the "extraordinary staying power of the Crown" is evident. "[I]n an age laden with danger," the authors remark, "the resilience of an ancient institution that has stood the test of time immemorial is likely to live on as against the unprecedented crises and upheavals in our own time." We hear this as an echo and confirmation from the closing of Lord Tweedsmuir's 1937 New Year's message, that "our free and democratic monarchy is a cornerstone ... and that whoever occupies the throne, that throne remains the most stable thing in an unstable world."