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Modernizing NORAD: A Chance to Regain Competitive Advantage

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Exercise Solo Flight

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Modernizing NORAD: Chance to Regain Competitive Advantage

Introduction

The requirement to modernize North American Aerospace Defence Command (NORAD) presents an opportunity to regain the competitive advantage against a resurgent and increasingly belligerent Russia and globally involved China. A more capable NORAD is needed based on the Russian annexation of Crimea in 2014 and the current aggressive warfare policies taking place in the invasion of Ukraine on February 24, 2022.[1] Russia has demonstrated on the global stage that they do not conform to the current rules-based international order and signalled the desired return to great power competition.[2] The counterargument is that Russia is already acting like a great power by protecting core strategic interests with the Ukraine and Crimea military actions.[3] Fortunately, the need to modernize ageing NORAD infrastructure and capabilities provides Canada and the United States of America (USA) with an opportunity to regain the competitive military advantage against potential adversaries to North America such as Russia and China.

The concept of competitive military advantage is ethereal in that many definitions exist, but few can agree on how they apply to the profession of arms. The central theme to having and maintaining a competitive military advantage is deterrence.[4] For example,

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[1] Global Affairs Canada, "Canada and the Russian Invasion of Ukraine," *GAC*, February 4, 2022, Political Situation, https://www.international.gc.ca/world-monde/issues_development-enjeux_developpement/response_conflict-reponse_conflits/crisis-crises/ukraine-situation.aspx?lang=eng.
[2] Roy Allison, "Russian Revisionism, Legal Discourse and the 'Rules-Based' International Order," *Europe-Asia Studies* 72, no. 6 (July 2, 2020): 979, doi:10.1080/09668136.2020.1773406.
[3] Ibid.
[4] Jim Garamone, "Dunford: U.S. Military Advantage Over Russia, China Eroding," *Joint Chiefs of Staff*, November 14, 2017, https://www.jcs.mil/Media/News/News-Display/Article/1374604/dunford-us-military-advantage-over-russia-china-eroding/.

if potential adversaries think NORAD has a significant military competitive advantage, they will be less likely to start a conflict or encroach on sovereignty claims. The business world defines an organization's competitive advantage as "what sets the organization apart from others and provides it with a distinctive edge for meeting customer or client needs in the marketplace".[5] While in a military context, competitive advantage refers to the ability "to shape the rules that govern violent competition in favour of one's own inherent asymmetries, such as domain-specific advantages due to geography, internal domestic conditions and the particular components of material power".[6] Canada's latest Defence Policy Strong, Secure, Engaged (SSE) released in 2018 links technology with a competitive advantage for the Canadian Armed Forces (CAF) because of the improved capability against adversaries operating without the newest technology.[7] The Royal Canadian Air Force (RCAF) even identifies sensitivity to technological advances as one of the eleven main characteristics of air power.[8]

Signed initially on May 12, 1958, the bilateral treaty level NORAD Agreement predicates the continental defence policy of North America.[9] In 2006, the NORAD Agreement was reaffirmed in perpetuity with formal reviewing to occur a minimum of

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[5] Richard Daft, *Organization Theory and Design*, 11th ed. (Mason, OH: South-Western, 2013), 636.
[6] Peter Roberts and Sidharth Kaushal, "Competitive Advantage and Rules in Persistent Competitions," *Royal United Services Institute* RUSI Occasional Paper (April 2020): vi, https://www.rusi.org/explore-our-research/publications/occasional-papers/competitive-advantage-and-rules-persistent-competitions.
[7] National Defence Government of Canada, *Strong, Secure, Engaged - Canada's Defence Policy.* (Ottawa, 2017), 14.
[8] National Defence Government of Canada, *B-GA-402-001/FP-001, Royal Canadian Air Force Doctrine: Command and Control*, 2nd ed. (Ottawa, 2018), 2, http://www.rcaf-arc.forces.gc.ca/en/cf-aerospace-warfare-centre/aerospace-doctrine.page.
[9] National Defence Government of Canada, "Agreement Between the Government of Canada and the Government of the United States of America on the North American Aerospace Defense Command," Pub. L. No. E105060 (2006), https://www.treaty-accord.gc.ca/text-texte.aspx?id=105060.

every four years.[10] The NORAD Agreement outlines the roles and responsibilities of the USA and Canada. The primary missions of NORAD were originally limited to aerospace warning and aerospace control. The NORAD Agreement was amended in 2006 to include the maritime warning role that reflects the need to monitor all approaches to North America.[11] The role of NORAD has changed from the traditional defence of North America from the Union of Soviet Socialist Republics (USSR) threat and evolved to the monitoring and interception of all suspect air traffic following the terrorist attacks on September 11, 2001, against the World Trade Centre in New York and the Pentagon in Arlington, USA.[12] However, with the resurgence of Russian great power competition and resumption in 2007 of long-range patrols for nuclear submarines and strategic bomber aircraft near NORAD airspace.[13] The focus is back on the defence of North America from the peer or near-peer potential adversaries.

This paper will focus on Canada's contributions to NORAD and the need to maintain a competitive advantage against foreign aggression and potential adversaries in the north. The primary focus will be on the aerospace domain as the leading driver of the historical NORAD competitive advantage. However, it will include other elements to reinforce the maritime monitoring role added in 2006.[14] The paper will explore select

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[10] National Defence, "March 24: Letter from the Acting Chief of the Defence Staff (A/CDS)," March 24, 2021, Background, https://www.canada.ca/en/department-national-defence/maple-leaf/defence/2021/03/march-24-acting-cds-letter.html.
[11] Government of Canada, Agreement Between the Government of Canada and the Government of the United States of America on the North American Aerospace Defense Command, para. 1.
[12] Wilson Brissett, "NORAD's Next Evolution," *Air Force Magazine*, February 27, 2017, https://www.airforcemag.com/article/norads-next-evolution/.
[13] Pavel Devyatkin, "Russia's Arctic Strategy: Military and Security (Part II)," *The Arctic Institute*, February 13, 2018, Military Activity in the Arctic, https://www.thearcticinstitute.org/russias-arctic-military-and-security-part-two/.
[14] North American Aerospace Defense Command, "About NORAD," 2022, https://www.norad.mil/About-NORAD/.

examples of NORAD modernization initiatives that could help regain the competitive military advantage. However, it is not an exhaustive list because there are many ways to innovate and solve a problem. The USA is a great power heavily invested in maintaining a competitive military advantage against existing and emergent global threats. Conversely, Canada is a small middle power that needs to balance defence spending with political needs constantly.[15]

Historical Competitive Advantage

During the Cold War era, Canada and the USA worked feverishly together through NORAD to attain and maintain a competitive advantage against the USSR to guarantee the defence of North America. The apparent threat to North America was realized in 1953 when the USSR joined the nuclear-capable countries with a successful detonation of a thermonuclear weapon.[16] The USSR had acquired the ability to build a nuclear arsenal and various delivery systems through espionage.[17] The USSR stole and copied the plans of USA munitions and strategic bomber aircraft.[18] The nuclear capability combined with the extreme long-range Tu-34 Bull and new Tu-95 Bear strategic bomber aircraft put mainland North American cities and critical infrastructure targets at risk from USSR aggression.[19] At the time, American and Canadian leaders determined that closer

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[15] Ann Denholm Crosby, "A Middle-Power Military in Alliance: Canada and NORAD," *Journal of Peace Research* 34, no. 1 (1997): 38.
[16] David S. McDonough, "Canada, NORAD, and the Evolution of Strategic Defence," *International Journal* 67, no. 3 (Summer 2012): 800, doi:http://dx.doi.org/10.1177/002070201206700314.
[17] Michael Dawson, "NORAD: Remaining Relevant," *The School of Public Policy Publications (SPPP)* 12 (2019): 2, doi:http://dx.doi.org.cfc.idm.oclc.org/10.11575/sppp.v12i0.68098.
[18] Ibid.
[19] Joseph T. Jockel, *No Boundaries Upstairs: Canada, the United States, and the Origins of North American Air Defence, 1945-1958* (Vancouver: University of British Columbia Press, 1987), 32, https://cfcc.ent.sirsidynix.net/client/en_GB/cfc/search/detailnonmodal/ent:$002f$002fSD_ILS$002f0$002fSD_ILS:18149/ada.

joint cooperation was needed to defend North America and the NORAD Agreement was the result.

The new strategic North American bilateral defence policy consisted of a state-of-the-art layered aerospace monitoring system, specialized aircraft, and a series of staffed and unstaffed listening stations throughout the Canadian arctic and Alaska. The joint strategic defence requirement for early detection and monitoring of threats to North America from the USSR resulted in a series of three increasingly capable radar monitoring lines across Canada and into the USA. The first attempt in 1954 was the jointly funded but Canadian controlled Pinetree Line, which consisted of 33 listening stations and followed the Canada and USA border along the 50th parallel.[20] Quickly assessed as insufficient to provide adequate early warning capability for fighter aircraft interception of enemy threats due to the Pinetree Line's southern location along the shared border.[21]

A drive for a competitive military advantage in radar and communication technology to compete with the USSR's long-range bomber aircraft threat resulted in a new monitoring line across the middle of Canada called the Mid-Canada Line. A joint agreement was made between Ottawa and Washington that Canada would fund the Mid-Canada Line and the USA would fund the new northern arctic monitoring stations line.[22] Created in 1957, the Mid-Canada Line consisted of 98 stations along the 55th parallel, but would only operate for seven years due to an inability to track the new USSR cruise

[20] McDonough, "Canada, NORAD, and the Evolution of Strategic Defence," 799.
[21] Ibid.
[22] Ibid., 800.

missile threat.[23] In 1957, the USA created the Distant Early Warning (DEW) Line in the extreme northern arctic to provide the earliest warning possible of approaching threats to North America.[24] The DEW line consisted of 63 monitoring stations across over 8,000 kilometres from Greenland in the east to Alaska in the west.[25] After completing all three radar monitoring lines, the Canadian and American air forces advocated for complete joint cooperation on the strategic defence of North America and the NORAD Agreement was created in 1958.[26] The present nuclear threat of the USSR drove technological innovation to gain and preserve NORADs competitive military advantage.

The three radar lines worked together with air and sea patrols to track and monitor threats within NORAD air and maritime defence sectors.[27] For example, a USSR bomber or squadron of attack aircraft entering NORAD airspace would first be picked up by the northern DEW Line and relayed to the NORAD command centre at Peterson Air Force Base, Colorado.[28] The following radar contact would be the Mid-Canada Line providing further coordination for airborne interceptors and fighter aircraft for engagement.[29] Finally, the Pinetree Line picked up any enemy aircraft that made it through the first

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[23] A.G. Lester, *A Story of Defence Communications in Canada*, Arctic Operational Histories 6 (Antigonish, NS: St. Francis Xavier University, 2019), vii.
[24] Richard Morenus, *Dew Line; Distant Early Warning: The Miracle of America's First Line of Defense* (Chicago, USA: Barakaldo Books, 2020), 107, http://ebookcentral.proquest.com/lib/cfvlibrary-ebooks/detail.action?docID=6235244.
[25] Myra J. Hird, "The DEW Line and Canada's Arctic Waste: Legacy and Futurity," *Northern Review*, no. 42 (2016): 24.
[26] Joseph T. Jockel, "Five Lessons from the History of North American Aerospace Defence," *International Journal* 65, no. 4 (December 2010): 1014, doi:http://dx.doi.org/10.1177/002070201006500401.
[27] Morenus, *Dew Line; Distant Early Warning*, 109.
[28] National Defence Government of Canada, "North American Aerospace Defense Command (NORAD)," March 12, 2018, https://www.canada.ca/en/department-national-defence/services/operations/allies-partners/norad.html.
[29] Morenus, *Dew Line; Distant Early Warning*, 109.

interception engagement. The Pinetree Line stations would guide additional fighter aircraft onto the remaining targets, or ground air defence systems would engage them.[30]

The competitive advantage of the three radar and communication lines was evident in the exclusive cutting-edge radar technology. Specifically, the Pinetree and DEW lines had the latest scatter broadcast radar. While the Mid-Canada Line had the doppler effect radar fence developed exclusively for the installations. McGill University scientists developed the Mid-Canada Line.[31] It was even referred to informally as the McGill Line using a new purpose-built doppler effect radar fence technology to track all aircraft that went through the line. [32] Massachusetts Institute of Technology (MIT) scientists developed the DEW Line technology as part of a secret Summer Study Group.[33] It used cutting-edge tropospheric high-wave scatter broadcast signals to determine the position of an aircraft from range, course, altitude, and speed information.[34] The NORAD representatives handed the problem to the scientists collected at MIT with free rein and encouraged them to develop innovative solutions.[35] An ambitious series of northern arctic monitoring stations powered by cutting-edge technology was the result.[36] Early engagement with the communication industry ensured the MIT scientists included Bell Laboratories in the early planning and installation discussions, which helped smooth out complex system interoperability in the north.[37] The engagement by NORAD with

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[30] Ibid.
[31] Lester, *A Story of Defence Communications in Canada*, viii.
[32] Ibid.
[33] Morenus, *Dew Line; Distant Early Warning*, 15–19.
[34] Ibid.
[35] Ibid., 15.
[36] Ibid., 15–20.
[37] Ibid., 17.

specialists at universities and within the communications industry ensured that the competitive military advantage would remain secret and viable against potential threats.

Specialized interceptor fighter aircraft were developed and fielded by Canada and the USA exclusively to fill the NORAD primary role of intercepting enemy aircraft and were unsuitable for many other functions. Canadian RCAF examples include the CF-100 Canuck, CF-104 Starfighter and CF-101 Voodoo all-weather interceptor fighter aircraft. Built-in Canada, the CF-100 and CF-104 provided a significant competitive advantage for the domestic aviation industry.[38] During the Cold War, NORAD would field hundreds of purpose-built aircraft on alert status. At the height of the Cold War, Canada accounted for 26.6 percent of the total NORAD interceptor fighter force.[39] However, Canada lost the technical expertise in the domestic defence industry to build advanced fighter aircraft after the cancellation of the CF-105 Avro Arrow interceptor fighter project.[40] The USA was focused on designing and fielding the next strategic bomber to compete against the USSR, and did not want to split defence funding or focus on a new interceptor fighter aircraft. As a result, NORAD cancelled plans for new interceptors and accepted an updated version of the existing F-101 Voodoo.[41] The new F-101 Voodoo did not fulfil the long-range interceptor fighter aircraft requirements, but could be fielded quickly and carry nuclear weapons.[42] The loss of the CF-105 Avro Arrow project was a turning point

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[38] Donald C. Story and Russell Isinger, "The Origins of the Cancellation of Canada's Avro CF-105 Arrow Fighter Program: A Failure of Strategy," *Journal of Strategic Studies* 30, no. 6 (December 1, 2007): 1031–33, doi:10.1080/01402390701676535.
[39] John Clearwater, *Canadian Nuclear Weapons: The Untold Story of Canada's Cold War Arsenal* (Toronto: Dundurn Press, 1998), 47, https://cfc.overdrive.com/media/1184336.
[40] Story and Isinger, "The Origins of the Cancellation of Canada's Avro CF-105 Arrow Fighter Program," 1047.
[41] Ibid.
[42] Ibid., 1045.

in the Canadian aerospace defence industry. As a result, Canada lost the competitive advantage capability to design and build advanced fighters domestically.

The pillar of NORAD strategic defence is the concept of deterrence through the demonstration of nuclear capability and the will to deploy nuclear weapons. NORAD assured deterrence by mutual nuclear-capable weapon systems the USA and Canada fielded. Between 1958 and 1984, Canada had nuclear weapons in the form of the CIM-10B Bomarc ground-based interceptor missile, Honest John and Genie rockets, and air-dropped gravity bombs from the CF-104 Starfighter and CF-101 Voodoo interceptor RCAF aircraft.[43] Controversially the nuclear deterrence competitive advantage resulted in nuclear weapons on Canadian territory as part of the USA atomic deterrence strategy against the USSR.[44] Further, it saw many radar and monitoring stations staffed by American and Canadian military members along the three lines. NORAD withdrew all USA troops following the creation of the newest radar and communication monitoring line, the Northern Warning System (NWS).[45]

Need for Modernization

The last major modernization of NORAD occurred in the 1980s with the creation of the NWS almost 40 years ago. Created in 1985, the current NWS was a state-of-the-art series of monitoring stations that provided NORAD with a clear deterrence and competitive advantage against Russian long-range bomber and patrol aircraft.[46] At the

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[43] Clearwater, *Https*, 31.
[44] Story and Isinger, "The Origins of the Cancellation of Canada's Avro CF-105 Arrow Fighter Program," 29–30.
[45] Jockel, "Five Lessons from the History of North American Aerospace Defence," 1015.
[46] Canada and United States, *Exchange of Notes and Memorandum of Understanding Constituting an Agreement between the Government of Canada and the Government of the United States of America on the*

time, the need for modernization was the new advances in cruise missile technology and bomber aircraft fielded by potential adversaries.[47] The NWS was created by updating existing DEW Line stations and consists of 52 stations with 13 long and 39 short-range radar capabilities.[48] The NWS also resulted in the complete decommissioning of the old Pinetree and Mid-Canada Lines as they were no longer required.[49] The NWS over-the-horizon backscatter radar is now 37 years old and is no longer at the leading edge of military radar and communication technology.[50] As a result, the NWS is nearing the end of its service life and no longer presents a competitive military advantage over adversary threats such as emergent hypersonic threats, cruise missile technology, and ballistic missiles.[51] A similar problem exists today with the NWS compared to when the DEW Line needed replacement. Advances in technology constantly require NORAD to modernize to regain the competitive advantage against potential adversaries.

Further, the NWS radar range does not entirely cover the Canadian Air Defence Identification Zone (CADIZ). The NORAD aerospace monitoring capability does not fully protect Canadian sovereign interests as expressed by the NORAD Agreement. [52] NORAD modernization efforts need to account for this oversight and cover all Canadian sovereign areas.[53] Due to the change in the CADIZ in 2018 to include extreme Canadian

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Modernization of the North American Air Defence System (1985) (Ottawa: Department of National Defence, 2001), 3.
[47] Ibid., 1.
[48] Ibid., 3.
[49] James G. Fergusson, *Canada and Ballistic Missile Defence, 1954-2009: Déjà Vu All Over Again* (Vancouver, CANADA: UBC Press, 1996), 80, http://ebookcentral.proquest.com/lib/cfvlibrary-ebooks/detail.action?docID=3412912.
[50] Canada and United States, *Exchange of Notes and Memorandum of Understanding Constituting an Agreement between the Government of Canada and the Government of the United States of America on the Modernization of the North American Air Defence System (1985)*, 3.
[51] Government of Canada, *Strong, Secure, Engaged - Canada's Defence Policy.*, 79.
[52] Ibid., 80.
[53] Ibid.

northern arctic territory, the existing NWS is no longer sufficient to meet the early warning detection, deterrence, and defence mission of NORAD.[54] Modernizing the NWS by simply installing new locations to replace the NWS farther north is complex and potentially cost-prohibitive. The new NORAD Commander, General Glen D. VanHerck, has reinforced the need for "focused investments in improved sensor networks, domain awareness, and information dominance capabilities".[55] Simply updating the NWS will not help NORAD regain a competitive advantage to address the new threats posed by climate change, advanced cruise missiles, ballistic missiles, and hypersonic weapons.

Climate change is another significant driver not just to modernize NORAD but also to regain the arctic region's competitive advantage. Traditionally, the northern arctic environment has been extremely inhospitable, which has lessened the attention and importance of the region during great power competition. However, the extreme north of Canada is becoming more and more accessible due to warming climate change.[56] The melting ice and warmer weather have led to increased foreign military and civilian traffic encroaching on Canadian interests in the Arctic.[57] Researchers into sea ice erosion have estimated that the Northwest Passage will be open for commercial traffic in the summer as early as 2040 and potential year-round by 2100.[58] Increased commercial traffic in the arctic will present challenges to NORAD for monitoring and controlling the region.

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[54] Ibid.
[55] Brian W. Everstine, "NORAD: Advanced Cruise Missile Threat Requires Better Awareness," *Air Force Magazine*, March 16, 2021, https://www.airforcemag.com/norad-advanced-cruise-missile-threat-requires-better-awareness/.
[56] Government of Canada, *Strong, Secure, Engaged - Canada's Defence Policy.*, 51.
[57] Ibid., 79.
[58] Thomas Herrmann, "Shipping Through the Northwest Passage: A Policy Brief," *The Henry M. Jackson School of International Studies*, June 27, 2019, https://jsis.washington.edu/news/shipping-through-the-northwest-passage-a-policy-brief/.

In January of 2018, China self-identified as a near-arctic nation and presented a strategic policy named the Polar Silk Road to increase its influence in the region.[59] Russia has been steadily rebuilding forces in the arctic and now has the most extensive military presence in the region.[60] The Russian militarization of the arctic is not at USSR levels yet. However, Russia's presence in the arctic continues to rise as it invests heavily in air, land, and sea forces while building and reactivating over 100 arctic bases.[61] Rogue threats such as terrorist attacks, North Korea, and other extremist state aggression also present challenges to NORADs competitive military advantage. Following 9/11, USA and Canada started Operation NOBLE EAGLE to redistribute NORAD alert forces to respond to suspect aircraft travelling within North America.[62] NORAD must take advantage of the opportunity presented by modernization to recapture the competitive military advantage against potential adversaries in the arctic region like Russia, China, and rogue threats.

After the end of the Cold War, NORAD drastically reduced the number and location of interceptor squadrons and aircraft as the threat from the USSR was removed. The reduction was justified because Russia had not yet restarted long-range bomber and patrol aircraft flights near North American airspace. As a result, modern NORAD aircraft are no longer dedicated interceptor fighters, but primarily multi-role aircraft such as the CF-18 Hornet, F-15 Eagle, and F-16 Fighting Falcon.[63] The USA only maintains actual

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[59] State Council Information Office, *China's Arctic Policy(English Version) 中国的北极政策（英文版）* (Beijing: China Intercontinental Press, 2018), 6, http://ebookcentral.proquest.com/lib/cfvlibrary-ebooks/detail.action?docID=5620428.
[60] Devyatkin, "Russia's Arctic Strategy," Military Activity in the Arctic.
[61] Ibid.
[62] North American Aerospace Defense Command, "Operation Noble Eagle (ONE)," n.d., https://www.norad.mil/Newsroom/Fact-Sheets/Article-View/Article/2817211/operation-noble-eagle-one/.
[63] North American Aerospace Defense Command, "About NORAD."

air superiority aircraft such as the F-22 Raptor.[64] The CF-18 Hornet multi-role fighter performs the interceptor role in Canada but not to the same level as a dedicated, purpose-built, high-speed interceptor fighter aircraft. A series of procurement delays with the CF-18 replacement project has reduced the operational capability of the NORAD multi-role fighter aircraft against potential adversaries. Since the Cold War, the USA has done most of the heavy lifting for NORAD by fielding consistently new capabilities and dedicated aircraft. Canada needs to do more to help NORAD modernize and regain its competitive military advantage.

The USA military forces dedicated to NORAD have consistently maintained a competitive military advantage over Russian forces and innovation. However, the USA is in a new position as it engages in strategic global power competition with two nuclear-capable countries of Russia and China.[65] In contrast, Canada has deferred or demurred critical decisions on continental ballistic missile defence and nuclear armament. The result is a slow decay of Canadian competitive military advantage and overreliance on USA involvement to settle disputes. Defence policy apathy exists within Canada, and it is difficult to make significant changes quickly to meet the changing threats developed by potential adversaries. It is vital that the latest NORAD modernization not just update the existing model of monitoring but recapture the competitive advantage through agile and innovative thinking. Canada's Defence Strategy SSE outlines the strategic intent to maintain a competitive advantage over potential adversaries through Canadian defence

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[64] Ibid.
[65] David Vergun, "Commander Offers Strategies for Deterring Aggression From China and Russia," *U.S. Department of Defense*, n.d., https://www.defense.gov/News/News-Stories/Article/Article/2726258/commander-offers-strategies-for-deterring-aggression-from-china-and-russia/.

industry engagement.[66] A high level of competitive military advantages must set NORAD apart from potential adversaries and provide a distinctive edge against potential adversaries.

Canadian NORAD Policy

A series of controversial policy decisions in Canada have contributed to the degradation of the CAF's ability to contribute to the NORAD competitive advantage. First was the 1969 defence policy decision by former Prime Minister Pierre Trudeau to remove and restrict nuclear weapons on Canadian sovereign territory as part of the nuclear non-proliferation policy.[67] Before this decision, Canada had nuclear weapons and delivery systems for rockets, missiles, and gravity bombs.[68] Canada never fielded maritime nuclear weapons, but the option existed to acquire these weapon systems before the atomic disarmament decision.[69] The decision to remove nuclear weapons from Canadian NORAD installations, territory, and aircraft led to a reduced capability for CAF alert forces. In 1985, Canada returned the last nuclear weapons to the USA.[70] Much anger from the USA resulted from this decision because it shifted the entire nuclear deterrence burden onto the USA.[71] Once again, Canada relied on the USA to do the NORAD heavy lifting for nuclear deterrence against the USSR and other modern potential adversaries. Removing nuclear weapons from the CAF reduced NORAD's

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[66] Government of Canada, *Strong, Secure, Engaged - Canada's Defence Policy.*, 74.
[67] Paul Meyer, "Pierre Trudeau and the 'Suffocation' of the Nuclear Arms Race," *International Journal* 71, no. 3 (September 2016): 393, doi:http://dx.doi.org/10.1177/0020702016662798.
[68] Clearwater, *Https*, 30.
[69] Ibid., 494–95.
[70] Ibid., 476.
[71] Joseph T. Jockel, *Canada in NORAD, 1957-2007: A History* (Kingston, ON: McGill-Queen's University Press, 2007), 61.

competitive military advantage. Within the NORAD command structure, nuclear deterrence policy was no longer assured.

Another controversial NORAD policy decision by Canada was the decision to not take part in the integrated continental North American missile defence proposal. Starting in 1967 with the Sentinel anti-ballistic missile program, the Government of Canada would continue to delay making a formal policy decision on joining.[72] Missile defence was a sensitive political topic with the public as early systems had nuclear warheads. Finally, in 2005 former Prime Minister Paul Martin formally declined participation in the newest ground-based mid-course missile defence system.[73] The continued lack of response and the final formal decision resulted in a visible rift between forces within NORAD as the CAF could no longer fully participate in the defence of North America. As a result, CAF members serving with NORAD can perform the detection and monitoring of ballistic-mission threats.[74] However, USA members must complete the actual defence or offensive action.[75] The missile defence decision also affected NORADs ability and desire to protect Canadian cities and territory.[76] NORAD would now not be able to defend and protect all Canadian cities and major infrastructure from attack.[77] Canada's decision not to participate in the missile defence system resulted in angst and mixed command structures within NORAD. The confusion about what parts of the

[72] Fergusson, *Canada and Ballistic Missile Defence, 1954-2009*, 2.
[73] Ibid.
[74] Ibid., 237.
[75] Ibid., 244.
[76] Ibid., 46.
[77] Ibid.

defence of Canada the CAF members can participate in could have disastrous results when a quick decision is required, and a Canadian is the acting NORAD Commander.

The final controversial policy decision made by Canada was to not participate in an expansion of the NORAD role to include full integration of continental North American defence. After the failure of NORAD to stop the events of 9/11, the USA wanted to tighten command relationships to deconflict homeland defence. The momentum generated by the anger over being caught unprepared by 9/11 had the potential to turn NORAD into a full-blown North American bilateral defence command.[78] However, Canada decided it did not want to tie the domestic defence of Canada with USA forces. As a result of this decision not to expand NORADs role, the USA decided on October 1, 2002, to stand up a new US Northern Command (USNORTHCOM) entirely dedicated to continental defence.[79] The US NORTHCOM Commander is double hatted as the NORAD Commander and co-located in the NORAD headquarters at Colorado Springs.[80] Missile defence is official under US NORTHCOM, and CAF members have no part in the decision-making process after NORAD identifies a viable missile threat. Even if the attack is against a Canadian target, the CAF NORAD officer has no authority to activate or launch the missile defence system. In comparison, the double hatted USA NORAD and NORTHCOM officer does not have a requirement to protect Canadian targets using the missile defence systems. This command-and-control

[78] Jockel, "Five Lessons from the History of North American Aerospace Defence," 1021.
[79] U.S. Northern Command, "About USNORTHCOM," 2022, https://www.northcom.mil/About-USNORTHCOM/.
[80] Jockel, "Five Lessons from the History of North American Aerospace Defence," 1022.

confusion generated by conflicting defence policy decisions results in an apparent degradation of the NORAD competitive advantage.

The current 2018 Canadian Defence Policy SSE outlines ambitious plans for continued NORAD participation and modernization.[81] As part of SSE, a new vision for the CAF is presented as "strong at home, secure in North America, engaged in the world".[82] The secure in North America portion refers to the NORAD Agreement as "active in a renewed defence partnership in NORAD and with the United States".[83] The SSE defence policy mentions modernizing NORAD as a system-of-systems approach focusing on evolving Canada's contribution to NORAD.[84] Highlights of the CAF NORAD policy include updating the NWS, procuring new fighter aircraft, new Arctic Offshore Patrol Ships (AOPS), new arctic land vehicles, new polar satellite communications, new Nanisivik Naval Facility, ensuring USA interoperability, improving domain awareness, and Remotely Piloted Aerial Systems (RPAS).[85] The breadth and scope of the SSE policy for the arctic are commendable and aimed to increase NORAD aerospace and maritime monitoring and control within the arctic. However, Canada has a terrible record of delivering major procurement programs on time without a series of delays costing time, funds, capability, and competitive military advantage. Delivering on the NORAD defence procurement initiatives outlined in SSE would go a long way to reaffirming Canada's commitment to NORAD. It would also

[81] Government of Canada, *Strong, Secure, Engaged - Canada's Defence Policy.*, 14.
[82] Ibid.
[83] Ibid.
[84] Ibid., 80.
[85] Ibid., 61, 80.

demonstrate to the USA that the CAF is a contributing partner in maintaining the competitive military advantage in defence of North America.

Recapture Competitive Advantage

The American and Canadian defence communities understand the need to modernize NORAD, and the requirement is not in question with the NWS nearing the end of service life. The real question is how to modernize NORAD to regain a competitive advantage against likely adversaries such as Russia, China, and Rogue threats. In August of 2021, the Canadian Minister of National Defence and American Secretary of Defence issued a joint statement on NORAD modernization that focused on situational awareness, command and control systems, detection and defeat of aerospace threats and collaborative research.[86] As part of NORAD modernization, the USA is testing a new long-range over-the-horizon discrimination radar in Alaska.[87] Advanced aerospace monitoring and control areas will improve and modernize existing northern warning and alert capabilities to recapture a dwindling radar detection competitive advantage against hypersonic, cruise, and ballistic missiles.

The USA Interim National Security Strategic Guidance released by President Joseph Biden in March 2021 highlights the competitive advantage requirement as "investments in the cutting-edge technologies and capabilities that will determine our military and national security advantage in the future".[88] Comparably, the current

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[86] National Defence Government of Canada, "Joint Statement on Norad Modernization," statements, (August 14, 2021), https://www.canada.ca/en/department-national-defence/news/2021/08/joint-statement-on-norad-modernization.html.
[87] Everstine, "NORAD."
[88] Joseph R. Biden, *Interim National Security Strategic Guidance* (Washington, DC: The White House, 2021), 14.

Canadian Minister of National Defence Anita Anand has stated in April 2022 that soon the office "will present a robust package to modernize NORAD and ensure our Arctic sovereignty in the years to come".[89] The exact details of the NORAD modernization plan are unknown due to the sensitive nature of the draft plans before approval and the need to regain the competitive military advantage. Based on future force design concepts, the CAF provided to industry and Defence Research and Development Canada (DRDC). The modernization plans should include system-of-systems solutions, advanced next-generation long-range over-the-horizon radar, and space-based monitoring.[90]

Replacing the NWS with new over-the-horizon radar systems will increase NORAD situational domain awareness through the range and accuracy of aerospace monitoring. The new radar will protect NORAD from untracked cruise missiles and other threats launched outside the radar range not trackable by the current NWS. The plan for the new radar systems coverage will need to include the extended CADIZ that the existing NWS does not cover. However, replacing the NWS radar systems allows for the opportunity to break down barriers and think creatively to regain competitive military advantages. It is important that DRDC and the defence industry are engaged early to develop the best cutting-edge solution to the problem. The military cannot develop truly competitive advantage technology in a stovepipe, but need early and often engagement with academia, DRDC, and industry. Like how the MIT Summer Study Group came up with the DEW Line concept and Bell Laboratories planned the technology installation.

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[89] Steven Chase and Patrick Brethour, "Canada Eyes New Era of Defence Spending with Boost to NORAD and North," *The Globe and Mail*, April 5, 2022, https://www.theglobeandmail.com/politics/article-canada-defence-spending-federal-budget-nato-arctic/.

[90] National Defence Government of Canada, "Future Force Design," navigation page, (February 25, 2021), https://www.canada.ca/en/department-national-defence/corporate/reports-publications/departmental-plans/departmental-plan-2022-23/planned-results/future-force-design.html.

The military must provide a clear statement of the problem and the desired effect and then allow the defence industry, DRDC, and academia to develop innovative solutions.

Interestingly, there may no longer be a requirement for a purely ground-based radar systems solution such as the DEW Line and NWS. Space-based systems like the RADARSAT replacement from the SSE defence policy can conceivably monitor, control, and track all aerospace and maritime objects entering the CADIZ.[91] In effect, the space-based system could take over the role of ground-based radar stations, and even replace the NORAD airborne early warning and control system (AWACS) aircraft. The system-of-systems approach would ensure that space-based monitoring systems communicate quickly and securely between ground-based, sea-based, or airborne NORAD assets. Satellite orbit path and viewing time over the target constrained early space-based monitoring programs. The new Starlink satellite system demonstrates an innovative way to avoid this problem by establishing a huge network of smaller replacement satellites in a near-earth orbit at approximately 550 kilometres.[92] Starlink is an excellent example of what the space industry can accomplish, given the desired effect and free reign to innovate. A similar network of downward-looking small satellites would provide continuous coverage of the extreme northern NORAD region. Space is a relatively new domain for NORAD, and the sky is no longer the limit for how far innovation can drive NORAD's competitive military advantage.

The options to conduct the maritime warning, aerospace warning and control could include the design and fielding of a northern-based RPAS. Alternatively,

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[91] Government of Canada, *Strong, Secure, Engaged - Canada's Defence Policy.*, 39.
[92] Starlink, "Satellites," *World's Most Advanced Broadband Internet System*, n.d., https://www.starlink.com.

development could focus on fielding a smaller drone swarm technology to conduct monitoring and warning activities in the north. A series of ground-based stations or even legacy NWS locations could be updated to support forward operating bases for the RPAS or smaller drones. RPAS systems have extended range and loiter time in days with some new solar models in weeks and could operate out of existing CAF bases or forward operating locations.[93] RPAS and drone technology would be relatively low cost compared to interceptor missiles and fighter aircraft. Further, it could be updated or replaced at the end of service without a need for lengthy procurement processes associated with new fighter aircraft or ship purchases. However, either RPAS or smaller high-altitude drones need the capability to operate in an austere and harsh northern environment. As seen with the war in Ukraine, drone warfare has proven highly successful against advanced Russian military equipment and tactics.[94] Ukraine is showing the value of cheap off-the-shelf drones for intelligence gathering, surveillance, warfighting, and monitoring.[95] A system-of-systems approach would provide NORAD with a competitive advantage by employing advanced unstaffed remotely piloted vehicles.

The CAF has recently received a few positive procurement successes to support domain awareness and NORADs competitive advantage. The new Canadian Navy AOPS ships will serve to increase the CAF presence in the north and contribute to the NORAD maritime warning mission. Further, the recent Canadian decision to procure the F-35

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[93] Analysis, "The 10 Longest Range Unmanned Aerial Vehicles (UAVs)," *Airforce Technology*, June 19, 2019, https://www.airforce-technology.com/analysis/featurethe-top-10-longest-range-unmanned-aerial-vehicles-uavs/.
[94] David Axe, "Ukraine's Drones Are Wreaking Havoc On The Russian Army," *Forbes*, n.d., https://www.forbes.com/sites/davidaxe/2022/03/21/ukraines-drones-are-wreaking-havoc-on-the-russian-army/.
[95] Jack Detsch, "Drones Have Come of Age in Russia-Ukraine War," *Foreign Policy*, n.d., https://foreignpolicy.com/2022/04/27/drones-russia-ukraine-war-donbas/.

Lightning II stealth multi-role fighter aircraft has provided the CAF with the ability to contribute to NORADs competitive advantage in the air defence and deterrence of potential adversaries.[96] Stealth technology-capable fighter aircraft like the F-22 and F-35 are a true NORAD competitive advantage for an airborne interception that Russia and China are working quickly to replicate. RCAF doctrine identifies stealth technology as another one of the eleven main characteristics of air power that the RCAF will have access to for the first time.[97] Further, establishing a year-round military facility in the north at the Nanisivik Naval Facility would drastically reduce the time needed to identify and intercept foreign aircraft and weapons systems entering the CADIZ.

Integrated system-of-systems technology to coordinate all the raw data quickly and accurately from the various NORAD sensors is required to inform decisions. Speed of decisions is critical when seconds matter after a confirmed launch attack against North America. The requirement for NORAD to regain a competitive advantage in systems technology like that experienced at the onset of the NWS is clear in SSE.[98] Commanders are trained and ready to make decisions at all levels, but need the most up-to-date comprehensive systems information possible to make the right decision.[99] When nuclear weapons are part of the NORAD deterrence response posture, all decisions are critical and need the best systems integration possible. Artificial intelligence-assisted systems integration would alleviate many of these systems of senor integration problems. NORAD has already fielded the Pathfinder artificial intelligence program that

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[96] Chase and Brethour, "Canada Eyes New Era of Defence Spending with Boost to NORAD and North."
[97] Government of Canada, *B-GA-402-001/FP-001, Royal Canadian Air Force Doctrine: Command and Control*, 2.
[98] Government of Canada, *Strong, Secure, Engaged - Canada's Defence Policy.*, 61.
[99] Everstine, "NORAD."

consolidates all the data to provide Commanders with a consolidated operating picture.[100] Regardless of the approach selected, the new NORAD systems will still need the capability to talk to each other quickly and accurately without user transcription between systems.

The counterarguments are that Canada is already inherently protected from most external threats due to the geography of North America. The presence of a strong nuclear-capable USA as a friendly great power neighbour reinforces the argument that the USA will protect Canada. The thinking is that there is no need to invest in defence, NORAD, or to regain a competitive military advantage because the USA will protect Canada. This argument puts the defence of Canada under the control of another sovereign state and alleviates defence policy responsibility. However, it is ultimately short-sighted because it relies on the good intentions of the USA for the defence of Canada. There is a reason why strong at home is the first priority of Canada's Defence Policy SSE.[101] Canada must remain engaged and responsible to ensure the defence of its sovereignty or risk losing it.

Conclusion

Political and military leaders in Canada and the USA understand the need to update and modernize NORAD. The focus of NORAD modernization should be a targeted approach that will regain a competitive military advantage against potential adversaries. The NORAD military competitive advantage serves as a means of deterrence

[100] Nathan Strout, "NORAD Is Using Artificial Intelligence to See the Threats It Used to Miss," *C4ISRNet*, March 1, 2021, https://www.c4isrnet.com/artificial-intelligence/2021/03/01/norad-is-using-artificial-intelligence-to-see-the-threats-it-used-to-miss/.
[101] Government of Canada, *Strong, Secure, Engaged - Canada's Defence Policy.*, 59.

against Russian aggression and Chinese encroachment in the arctic. Russian aggression against Ukraine with political support from China has reiterated the need for a vigorous defence of North America. The public and political support gained from Russia's actions in Ukraine provides Canada with an opportunity to secure new fighter aircraft, improved space-based monitoring systems, and unique maritime arctic control capabilities.

After the fall of the Cold War, Canada has become complacent about defence spending and the threats to Canada. The invasion of Ukraine by Russia has served as a wake-up call to the Canadian government and public on the need for spending and procurement decisions to be made about SSE defence policy. Canada's contribution to NORAD has traditionally been misguided with mixed messaging provided through opting out of domestic nuclear weapons, the continental ballistic missile defence shield, the opportunity to create a shared continental defence command, and significant investments in northern arctic infrastructure. Potential adversaries such as Russia, China, and Rogue threats will continue to look for ways to exploit or defeat existing and future NORAD competitive advantages through advanced cruise missiles, ballistic missiles, hypersonic weapons, and new weapons. The CAF and NORAD must evolve to stay relevant with a resurgent Russia and global China. Ultimately, to maintain the safety and security of the Canadian and American public, NORAD must regain a competitive military advantage against all likely adversaries in the north.

Further Research

Direct engagement with the Canadian and American defence and communication industries was not possible for this paper. However, it would add value to solicit innovative ideas about performing the NORAD roles from industry specialists using new

technology methods. After the NORAD modernization plan is published, it would add value to revisit the proposals to determine which ones are genuinely attempting to regain a competitive military advantage and which ones are just repeating the NWS modernization of the past.

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