



UNCREWED AERIAL SYSTEMS IN THE CAF

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Exercise Solo Flight

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Better Capability-Based Planning with Regard to Uncrewed Aerial Systems in the CAF

The world is changing ever so rapidly, especially when it comes to technology. In warfare, prior to the industrial revolution, change was slow. Cavalry was used at the Battle of Megiddo in 1457 B.C., the earliest recorded battle in history, right up until 1942 A.D. when the U.S. 26th Cavalry Regiment used horses to repel Japanese invaders in the Philippines. Yet today in the 21st Century, the pace of technological change is beyond breathtaking and what was true just five years ago no longer holds true today. The world has been warped by the speed and innovation of the Smart Phone, AI chatbots, social media, The Algorithm, and the rise of the drones everywhere from playgrounds to battlefields. Canada is supposed to take advantage of what *Strong Secure Engaged* (SSE) calls “The Rapid Evolution of Technology”. SSE explains that “Modern militaries rely on networks and data to plan and carry out missions...what gives Western forces their technological and tactical advantage stems from...technology tools to aggregate and manipulate large quantities of data.”¹ Uncrewed Aerial Systems (UAS) are the perfect platform at the tactical level with which to exploit this overarching strategic statement, regardless of how ambiguous that statement is when it comes to actual manifestation. Defense (that is, with a capital ‘D’, meaning the whole of the Military Industrial Complex as it exists in Canada) in the future will be expected to change significantly from its current state, which is shown in the rapid advancement of technology. Information technology, data analysis, deep learning, autonomous systems, the electromagnetic spectrum as well as the cyber domain will continue to challenge the Defense sector, from the senior political decision-makers all the way down to the tactical operators. This rapid speed of technological advancement will require a more agile form of Force Development as well as procurement at all levels of defense governance. As it currently stands, our approach to harnessing even basic technology is lacking when it comes to Uncrewed Aerial Systems (UAS). In order to better align terminology with the current policies *en vogue*, the gender-neutral term of ‘Uncrewed Aerial System’ will be used instead of the typical ‘unmanned aerial vehicle’ (UAS) or the ubiquitous and somewhat ambiguous term ‘drone’. This newer term is used in several legitimate government organizations, such as the United States Geological Survey, one governmental agency which is part of the federal U.S. Department of the Interior.² Succinctly put (after a rather long-winded multi-age introduction), Canada’s Department of National Defense and the Canadian Armed Forces have policies and regulations in place which are leaving our fighting men, women, and others trailing behind our allies and adversaries when it comes to technological adaptation and force development, and specifically when it comes to UAS.

Canada’s more recent published major defense paper, titled *Strong, Secure, Engaged* (SSE), has only this to say with regards to UAS: “The CAF will acquire next generation surveillance aircraft, remotely piloted systems – commonly referred to as

¹ Ibid, p. 55.

² “Uncrewed Aerial Systems,” Uncrewed Aerial Systems | U.S. Geological Survey, accessed May 1, 2023, <https://www.usgs.gov/calval/uncrewed-aerial-systems>.

“drones” – ... to significantly expand its joint ISR capacity.”³ SSE goes on to explain that “These new [UAS] platforms will be integrated with existing assets into a networked, joint system-of-systems that will enable the real-time flow of information that is so essential to success.”⁴

UAS are the future, of this there is no doubt. UAS are distinct from traditional air platforms in that they do not require a human being to be in the platform while it is operational, thereby reducing several operational effects which impose limitations on military planning. Before we delve into the disadvantages of humans in air platforms, let us first examine their advantages so as to present a fair and balanced perspective. Traditionally crewed aircraft have the benefit of human decision-making processes. Crewed aircraft, by virtue of having a human being aboard, can make rapid and complex plans and decisions due to the operators’ individual training, experience, and proximity to any rapidly evolving situation. Humans are also very adaptable in an air platform. Pilots are able to adapt quickly to evolving situations, are able to alter their mission requirements, and can manage unplanned challenges better than automated or pre-instructed artificial systems, such as UAS. Human pilots are also much more flexible than pre-programmed UAS, able to conduct a wider range of missions which require human judgement, human interaction, and special capabilities unique to humans (read: SAR missions).

Despite these positives, human pilots present several major risks. First and foremost is the risk of human error. Humans are susceptible to committing errors unique to their physiology such as fatigue, distraction, cognitive biases, and other human characteristics which can cause accidents or allow tragic mistakes to happen. Another major type of risk associated with human pilots is the safety issues of a pilot. Crewed aircraft put human pilots at risk in dangerous and high-risk situations, such as flying around combat zones or in inclement weather. Human pilots are also very susceptible to physiological limitations on their endurance; this reduces the duration of missions and reaction time. Finally, there is the question of cost. Human pilots must go through expensive training, must be paid, housed (preferably not in a bunkhouse), clothed, fed, and let’s not forget the large liabilities after they have completed their service, namely pensions and future Veterans Affairs claims (Department of Veterans Affairs had a budget of \$6.33 billion in 2022).⁵ Other aspects of human-related costs include the need to have crew support for the pilots (mental health workers, supervisors, pay clerks, etc.) which overall increases the costs of flying the aircraft. All in all, these negatives begin to explain why UAS are becoming more and more attractive. Let us now look at these advantages.

The positive operational effects of UAS are numerous in number, but we shall focus on four for the moment. First, UAS have much greater endurance when compared

³ Strong, Secure, Engaged, p. 15.

⁴ Ibid, p. 15

⁵ Canada, Veterans Affairs. “Department of Veterans Affairs - Departmental Spending.” Facts and Figures - Veterans Affairs Canada, January 10, 2023. <https://www.veterans.gc.ca/eng/about-vac/news-media/facts-figures/2-0>.

to crewed air platforms. Uncrewed aircraft can operate for longer periods without a pilot getting tired, which means an aerial platform can stay in the air longer to conduct surveillance, reconnaissance, or even remote operations (like a SAR mission in the far north). Secondly, UAS are much safer to operate, whether they are remote-piloted or autonomous. They are controlled by humans from a safe location, like the operational and strategic UAS of the USAF based just outside of Las Vegas but their platforms are scattered around the world; this inherently reduces the risks to human beings. Thirdly, UAS have better access to remote areas and dangerous locations where a human-piloted aircraft might not be able to access such as a highly irradiated area (see: HBO's TV mini-series *Chernobyl* for an example). Lastly, UAS are extremely cost-efficient. Uncrewed aircraft will often have lower operating costs since they need fewer people, far less training, and the maintenance schedule on them is far easier as life support systems and comfort of pilots need not be factored into any checklist. This is not to say that UAS are not perfect, as they indeed have risks.

Risks associated with UAS include problems with communications, vulnerability to cyber-attacks, and suffer from a reduction in situational awareness. UAS rely on continuous and reliable communication links from the operator of the aircraft to the aircraft itself, presenting a target for jamming or triangulation of the operator's location. A disrupted signal will usually force a UAS to simply crash into the ground, rendering the platform useless and threatening the lives of friendly forces if a recovery mission has to be dispatched. Secondly, another issue stems from UAS' vulnerability to cyber-attacks. UAS, depending on their level of sophistication, can be hacked rather easily by a professional hacking force. While crashing the UAS immediately might be a simple enemy course of action, the greater danger is an enemy hacking a friendly UAS and monitoring what it reports and where it eventually lands, thereby causing a greater compromise of a friendly intelligence network and putting *actual* lives at risk (side note: how will military ethics evolve once UAS and other autonomous platforms gain general artificial intelligence and become sentient? That is a problem outside the scope of this paper). Third, UAS have a reduced situational awareness when compared to that of a human pilot. Remote UAS operators are limited in seeing and hearing only what the UAS' camera shows them and what the platform's microphone can pick up audibly. This lack of sensory input would necessarily impact the decision-making abilities of the remotely piloted UAS operator and ipso facto that individual's higher chain of command. A human pilot, with his ability to hear, see, smell, touch, taste, and apply his 6th sense, would inevitably make a more wholesome assessment of any situation he was present in by having a greater appreciation of the situation by virtue of being there.

Autonomous UAS are a new breed of UAS which require some special attention, especially in this day and age of increasing artificial intelligence and complex programming. Autonomous UAS are pre-programmed for a mission and then sent on their own to complete their assigned tasks, often with very minimal human input or interference. Autonomous UAS have several advantages and disadvantages over both human piloted aircraft and remote piloted UAS which need to be considered.

Let us begin with the advantages. First, autonomous UAS have better efficiency than piloted or remote piloted aircraft since they are not at the second-by-second mercy

of a human operator who could doubt themselves and lose focus on the tasks at hand. Second, autonomous UAS are much less prone to human error since they contain advanced sensors and algorithms which allow them to minimize errors which would be caused by human errors, leading to an overall increase in safety for both the UAS and any humans nearby. Third, autonomous UAS have increased endurance to complete tasks, even above remote piloted UAS since the autonomous UAS does not need to wait for an operator to take a 'health break' or give it commands. Fourth, autonomous UAS have even better decision-making abilities since the algorithms and autonomous systems aboard can process incredible amounts of data faster than humans and so a more rapid decision can be made in a complex operational situation.

Autonomous aircraft come with risks, very similar to remote piloted aircraft but unique in their own way. Autonomous aircraft have more limited adaptability, in that they may face problems in adapting to unknown and unplanned changes in the situation where a human with their judgement could employ more creative problem-solving to address an issue. Autonomous aircraft (especially those being programmed with early AI software) are beginning to bring about important questions and considerations when it comes to legal and ethical implications of their usage. These implications force us to ask who is liable, who is accountable, and ultimately who is responsible in instances of accidents or other unintended consequences, despite the fact that "there is no principle in IHL [International Humanitarian Law] that says there must be an individual to hold accountable for every death on the battlefield."⁶ Autonomous UAS also come with very significant cybersecurity vulnerabilities. Since they are dependent on complex and sophisticated software systems, they are invariably exposed to attacks on the cyber domain which could adversely impact their control and navigation capabilities. Finally, autonomous UAS are such a new and daring technology that many traditionalists within the civilian and military sphere will naturally oppose trusting and accepting these new tools of war (if a possibly sentient UAS can still be considered a 'tool?'), hindering their widespread application and integration.⁷

More specifically to the CAF, UAS bear great promise at the tactical and operational level since we are mostly irrelevant strategically. As the CAF grapples with a shortfall of 16,000 members⁸, it will have to find solutions to remedy this problem of personnel to conduct operations. Currently, the *Canadian Armed Forces Retention Strategy* (2022)⁹ is attempting to find solutions to this problem from a human resources perspective. However, judging by the success (or lack thereof) of recent past human resource-related initiatives (OP HONOUR, anyone?)¹⁰, a technological solution in the

⁶1. Paul Scharre, *Army of None: Autonomous Weapons and the Future of War* (New York: W.W. Norton & Company, 2019), p. 240.

⁷ Ibid., P. 295.

⁸ 1. Dylan Dyson, "Canadian Armed Forces Facing Member Shortage 'Crisis,'" Ottawa, April 5, 2023, <https://ottawa.ctvnews.ca/canadian-armed-forces-facing-member-shortage-crisis-1.6344761>.

⁹ Defence, National. "Canadian Armed Forces Retention Strategy." CAF Retention Strategy - Canada.ca, October 6, 2022. <https://www.canada.ca/en/department-national-defence/corporate/reports-publications/caf-retention-strategy.html>.

¹⁰ "Campaign to End Sexual Harassment in Canadian Armed Forces Shut down | CBC News." CBCnews, March 25, 2021. <https://www.cbc.ca/news/politics/operation-honour-closed-down-1.5962978>.

form of substituting some missing positions with UAS at least in the combat trades might help reduce the problem of empty billets in the Forces.

But why are UAS pertinent in the here and now? The last few years have truly seen the UAS come of age and become a decisive asset in any military tool-box. As we saw in the 2020 conflict in Nagorno-Karabakh, UAS played a decisive role in ensuring an Azerbaijani victory. Hikmet Hajiyev, the foreign policy advisor to the Azerbaijani President Ilham Aliyev said, “they [Armenia] relied too much on old military doctrine and thinking: tanks, heavy artillery and fortifications. It simply reminded us of the Second World War...instead, mobile forces, drone technology and a modern approach has been applied by us.”¹¹ The result was overwhelming Azerbaijani victory, with the almost complete neutralization of the Armenian military in just under 44 days of conflict. The use of relatively cheap Turkish TB2 drones (priced at roughly \$1 million USD per unit) made it easier for tactical operators to find, fix, and destroy Armenian armored columns, air defense platforms, and entrenched C2 nodes. They were in fact so successful that the UK MoD reviewed its own procurement strategy in 2021 when it saw the economy saved by using UAS such as the TB2 vs. their own Protector drone which were each priced at over \$20 million and procured from the U.S. defense firm General Atomics. While the TB2 is technologically inferior to the Protector, the former still maintains a range of 150km and can loiter in the air for up to 24 hrs. Due to its cheaper cost, the loss of these is not so serious and it also presents a cheaper opportunity for the adversary to destroy, thereby dissuading enemy forces from sacrificing expensive anti-air missiles against one of them. For reference of cost, a US Patriot missile costs on average \$4 million per missile, making its use against a TB2 highly uneconomical and a poor economy of effort.¹² An interesting Canadian twist to this tragic tale is that targeting gear made by Ontario-based Wescam, itself a part of the U.S. L3Harris defense contractor, was found in the TB2 drone, despite the fact that Turkish manufacturer Baykar never obtained the proper licenses from Wescam to use it for such purposes.¹³

Another obvious contemporary reason for doubling down on UAS is the 2022-to-present Russian invasion of Ukraine. Thanks to the fine folks over at the Royal United Services Institute (RUSI), many important lessons about the benefits of UAS at the tactical and operational level from the Ukraine conflict have been analyzed. Probably the single biggest lesson learned from their wonderful report is that there is no longer any sanctuary anywhere on the battlefield, thanks to the saturation of cheap UAS everywhere able to relay rapid and accurate ISR.¹⁴ As these UAS see and hear everything, day or night, in clear or inclement weather, the ability to shorten kill-chains to less than a few minutes makes the modern battlefield extremely deadly.

¹¹ Antal, John F. *Seven Seconds to Die: A Military Analysis of the Second Nagorno-Karabakh War and the Future of Warfighting*. Philadelphia: Casemate, 2022, 68.

¹² Al Jazeera. “What Can the Patriot Missile Do for Ukraine?” Russia-Ukraine war News | Al Jazeera, December 15, 2022.

¹³ 1. Dan Sabbagh, “UK Wants New Drones in Wake of Azerbaijan Military Success,” *The Guardian*, December 29, 2020, <https://www.theguardian.com/world/2020/dec/29/uk-defence-secretary-hails-azerbaijans-use-of-drones-in-conflict>.

¹⁴ Zabrodskyi et al., 2022, p. 53.

A sobering analysis though by RUSI found that over 90% of UAS deployed at the tactical and operational level were destroyed within 3 missions, leading further importance to the need for UAS to be cheap and consumable when operating in a contested near-peer environment. On the brighter side, RUSI found that cheap remote-piloted UAS procured by the Ukrainians (such as the ‘Leleka’, Furia, and the PD-1s and PD-2s) were able to reduce the length of time to generate fire missions by a whopping 80-90%, reducing the kill-chain to 3-5 minutes at the tactical level and less than 48hrs at the operational level.¹⁵

The CAF subscribes to Capability-Based Planning (CBP) in order to plan and project into the future the generic capabilities which will be required to accomplish its missions and to meet the government’s policy objectives, vice conducting Threat-Based Planning (TBP) which was used during the Cold War to prepare for war with the U.S.S.R. and the Warsaw Pact countries.¹⁶ To paraphrase from this author’s personal experiences and what he was told going through the Infantry School at the height of the Afghanistan War: it is better to train for *a war* instead of training for *the war*. In other words, we trained for the entire spectrum of conflict and prepared ourselves for anything instead of focusing all training specifically for the current conflict in Afghanistan. Looking on more than a decade after the last combat mission rotated out of Afghanistan in 2011, that judgement call was the wiser choice. That same logic, then, is applicable at the policy and strategic level.

CBP is an ideal tool for CAF planning purposes, as it is well suited when the threats faced are not entirely certain and complex, and also when defense budgets are restrained. Canada’s SSE policy (published in 2018) only describes North Korea, Daesh, and Al-Qaeda as actual ‘threats’; China, Iran, and Russia are only alluded to as participants in “major power competition”¹⁷ and not as actual threats. This mild ambiguity therefore plays perfectly into CBP’s advantages. Furthermore, as was recently highlighted in the Canadian news, The Canadian Prime Minister, Justin Trudeau, privately admitted to Canada’s NATO allies that Canada would never actually meet the 2% of GDP spending Canada had agreed to meet back in 2006.¹⁸ This lack of political will to increase defense spending further cements the advantageous utility of CBP when it comes to defense planning.

There are several ways that the Canadian Armed Forces' Chief of Force Development could improve Canada's UAS capability and enhance the country's overall security. First,

¹⁵ Ibid., p. 16.

¹⁶ Borzillo, Laurent, Philippe Dumas, Maxandre Fortier, Hannah Hollander, Bibi Imre-Millei, Justin Massie, Marco Munier, Heni Pupco, and Camille Raymond. “Threat-Based Defence Planning: Implications for Canada.” Ottawa: Network for Strategic Analysis, March 1, 2021.

¹⁷ 1. National Defence, “Strong, Secure, Engaged: Canada’s Defence Policy,” Canada.ca, May 1, 2023, <https://www.canada.ca/en/department-national-defence/corporate/policies-standards/canada-defence-policy.html>, p. 50.

¹⁸ Coletta, Amanda. “Trudeau Told NATO That Canada Will Never Meet Spending Goal, Discord Leak Shows.” The Washington Post, April 19, 2023. <https://www.washingtonpost.com/national-security/2023/04/19/canada-military-trudeau-leaked-documents/>.

CFD should further invest in research and development through DRDC to develop cheap and easy to use UAS for tactical operators. CFD should allocate more resources towards research and development to enhance the capabilities of UAS domestically built here in Canada. This could include developing more advanced sensors, improving flight endurance, and increasing their range for tactical operators while also simplifying required user training.

The Chief of Force Development could also help develop training programs to increase the expertise of the Canadian Armed Forces in operating and maintaining UAS with varying degrees of complexity and value; as the Artillery branch has demonstrated, the airspace does not solely belong to the Air Force. This could involve partnering with civilian institutions and industry partners to share knowledge and expertise. Also, the Chief of Force Development could work with other countries and organizations to develop partnerships and share expertise. This could involve working with NATO partners or other countries that have advanced UAS capabilities, or simply see what the current best practices are. For example, we ought to more closely look at the tactical level applications of UAS and micro-UAS which the Israeli Defense Force (IDF) has been using and perfecting for the last twenty years. The IDF operates in very complex and rugged terrain, as their numerous conflicts in urban warfare and the harsh hills of the Holy Lands will attest to.¹⁹ The Chief of Force Development could explore ways to use UAS in support of military operations, but not just in a warfighting context. UAS could be used for surveillance, reconnaissance, target acquisition, and other tasks, which would provide a significant advantage to the Canadian Armed Forces across the spectrum of conflict and should identify different platforms of UAS with which to conduct those operations by consulting more with tactical-level operators what it is they actually need in the contemporary operating environment.

The Chief of Force Development could explore ways to use UAS for support to civil power tasks, such as search and rescue operations, helping CBSA with border patrols (should it ever come to that), and wildfire monitoring such as it could currently happen with the Alberta wildfires of 2023.²⁰ This could enhance the capabilities of first responders and provide additional support to civilian authorities.

Overall, improving Canada's UAS capability could significantly enhance the country's security. UAS could provide the Canadian Armed Forces with a significant advantage in military operations, improve situational awareness, and increase the speed and efficiency of operations. Additionally, UAS could be used for civilian applications, which would enhance public safety and improve emergency response capabilities, especially given the uptick in CAF deployments on domestic emergency response missions, such as OP LENTUS and the COVID-related OP LAZER.

¹⁹ Puttre, Michael. "Israeli MoD to Acquire Mini-UAS for IDF." *Journal of Electronic Defense* 27, no. 3 (03, 2004): 26

²⁰ "Feds Will 'remain at the Ready' to Help Alberta amid Wildfires: Defence Minister: Watch News Videos Online." Global News, May 8, 2023. <https://globalnews.ca/video/9681883/feds-will-remain-at-the-ready-to-help-alberta-amid-wildfires-defence-minister/>.

In conclusion, through the use of CBP as a planning tool and with CFD supporting the drafting of new force development policy, the CAF should begin to re-brand UAS at the tactical level as a consumable item and to allow individual units to purchase Commercial Off the Shelf (COTS) UAS as they please in order to achieve their local tactical tasks and missions. As it stands, line units in the Canadian Army have the ability to purchase small complex machines such as 1 kw portable generators with unit and sub-unit funds in order to meet rapid operational demands. The same should be done with COTS UAS that can be purchased at local stores, like a Best Buy or The Source. Every tactical level of an operational unit should have the ability to purchase drones for the specific missions it will need to undertake, from dangerous but not opposed operations like LENTUS or LAZER to a cataclysmic scenario like a CONPLAN JUPITER whereby we throw the entire Army at a national security threat. Trying to plan and process a requirement from NDHQ takes far too long and produces far too late tools for our operators on the ground. We need to inculcate a culture of risk-tolerance when it comes to tactical level UAS and to stop treating every UAS like it could jeopardize our small and relatively useless tactical helicopter fleet in the form of the civilian helicopter Bell 412 model (otherwise known in CAF circles as the CH-146 Griffon). As the Ukraine War has shown us in the past year, tactical aviation *forward* of the forward edge of the battle area results in unsustainable casualties, with around an eighth of the Russian tactical aviation inventory destroyed in the first month of conflict.²¹ These platforms, such as the Ka-52 and Mi-28, can only operate in *friendly* territory as they are now a giant liability in a contested airspace where there is a proliferation of enemy UAS, SA-7 Stingers, artillery barrages and sabotage, or even 1970s-era anti-air platforms like the Gepard self-propelled anti-aircraft gun.

Sadly, our ability to Conceive, Design and Build the Future Force and remain “relevant’ and effective in the long term” (as stated in the CFD’s Primer on Concepts)²² is not real. Case in point: The Remotely Piloted Aircraft System Project (RPAS). This program was intended to explore acquiring remotely piloted aircraft systems for medium-altitude, long-endurance missions with a beyond-line-of-sight capability to include ground stations and C2 systems to support it. The requirement for this type of platform was identified back in 2012, with a Request for Information (RFI) posted to begin the process of consulting industry on this requirement. The RFI was subsequently updated in 2016, and by 2019 the Government updated the RPAS project with draft invitations to bid. By late 2019, only two bidders had qualified: L3 Technologies MAS Inc., and General Atomics Aeronautical Systems, Inc. by 2020 a draft Request for Proposal (RFP) was issued to these two suppliers, and by 2022 the formal RFP was issued to suppliers. RPAS is hopeful that a contract will be awarded by 2024, with delivery any platforms and training several years after the fact. So, to summarize, it took *twelve years* to identify a need for RPAS until such time as a contract will be awarded. Even after all this time, no

²¹ 1. David Axe, “After Losing an Eighth of Their Helicopters, Russian Attack Regiments Are Switching up Their Tactics,” *Forbes*, February 16, 2023, <https://www.forbes.com/sites/davidaxe/2023/02/14/after-losing-an-eighth-of-their-helicopters-russian-attack-regiments-are-switching-up-their-tactics/?sh=46b77a2b4de9>.

²² 1. Chief of Force Development, Canadian Armed Forces, *A Primer on Concepts* (Ottawa, Ontario: Department of National Defence, 2022), p. 4.

new capability or hardware has been procured, much less trained on.²³ Meanwhile, our allies have begun to equip their tactical-level teams with micro-UAS in order to prepare them for the challenges of the battlefield. Within less than two months of the Nagorno-Karabakh conflict ending, the UK decided to equip its tactical units with micro-UAS rapidly after having seen the lessons of that conflict. BAE systems managed to issue a small ‘nano-drone’ weighing less than 196 grams and with an operational range of 2km, which is an ideal tool for platoons and companies in the contemporary battlespace.²⁴ We need to accept bottom-up solutions, and to stop trying to find platforms which will fit every requirement of every fighting brigade or organization in the CAF. Clearance Divers in the fleet arm need to be able to buy the best and cheapest UAS to fit their respective missions’ needs at any given time. The Air Force with its SAR Techs and Airfield Engineers need their own UAS to help with their own unique tasks which vary wildly from what the other two services require. Perhaps most glaringly obvious, the three fighting mechanized brigades of the Army each have different niches and capabilities (the idea that each brigade should be identical is ludicrous) along with unique missions in relation to the types of tasks they consistently conduct. 1 CMBG in Western Canada will fight more fires in BC and Alberta while 2CMBG will shovel snow in Southern Ontario while 5GBMC fights flooding in Gatineau and around Montréal. Each of these maneuver formations should benefit from the permission to quickly buy the UAS which best fit their immediate missions and tasks unique to their geography and requirements.

²³ 1. Public Services and Procurement Canada Government of Canada, “Remotely Piloted Aircraft System Project,” Remotely piloted aircraft systems - Air procurement initiatives - PSPC Services - PSPC, February 18, 2022, <https://www.tpsgc-pwgsc.gc.ca/app-acq/amd-dp/air/snac-nfps/sdat-rpac-eng.html#s3>.

²⁴ 1. Jasper Jolly, “UK Army Buys 30 ‘bug’ Drones That Can Spy on Targets 2km Away,” The Guardian, December 28, 2020, <https://www.theguardian.com/world/2020/dec/28/uk-army-buys-30-bug-drones-that-can-spy-on-targets-2km-away>.

BIBLIOGRAPHY

- Al Jazeera. "What Can the Patriot Missile Do for Ukraine?" Russia-Ukraine war News | Al Jazeera, December 15, 2022.
- Antal, John F. *Seven Seconds to Die: A Military Analysis of the Second Nagorno-Karabakh War and the Future of Warfighting*. Philadelphia: Casemate, 2022.
- Axe, David. "After Losing an Eighth of Their Helicopters, Russian Attack Regiments Are Switching up Their Tactics." *Forbes*, February 16, 2023.
<https://www.forbes.com/sites/davidaxe/2023/02/14/after-losing-an-eighth-of-their-helicopters-russian-attack-regiments-are-switching-up-their-tactics/?sh=46b77a2b4de9>.
- Barker, R.E. *Organic Indirect Fire Capability for Infantry Battalions*, 2016. Canadian Forces College.
- Borzillo, Laurent, Philippe Dumas, Maxandre Fortier, Hannah Hollander, Bibi Imre-Millei, Justin Massie, Marco Munier, Heni Pupco, and Camille Raymond. "Threat-Based Defence Planning: Implications for Canada." Ottawa: Network for Strategic Analysis, March 1, 2021.
- Canada, Veterans Affairs. "Department of Veterans Affairs - Departmental Spending." Facts and Figures - Veterans Affairs Canada, January 10, 2023.
<https://www.veterans.gc.ca/eng/about-vac/news-media/facts-figures/2-0>.
- "Campaign to End Sexual Harassment in Canadian Armed Forces Shut down | CBC News." CBCnews, March 25, 2021. <https://www.cbc.ca/news/politics/operation-honour-closed-down-1.5962978>.
- Chief of Force Development, Canadian Armed Forces. *A Primer on Concepts*. Ottawa, Ontario: Department of National Defence, 2022.
- Coletta, Amanda. "Trudeau Told NATO That Canada Will Never Meet Spending Goal, Discord Leak Shows." *The Washington Post*, April 19, 2023.
<https://www.washingtonpost.com/national-security/2023/04/19/canada-military-trudeau-leaked-documents/>.
- Defence, National. "Strong, Secure, Engaged: Canada's Defence Policy." Canada.ca, May 1, 2023. <https://www.canada.ca/en/department-national-defence/corporate/policies-standards/canada-defence-policy.html>.
- Dyson, Dylan. "Canadian Armed Forces Facing Member Shortage 'Crisis.'" Ottawa, April 5, 2023. <https://ottawa.ctvnews.ca/canadian-armed-forces-facing-member-shortage-crisis-1.6344761>.

- “Feds Will ‘remain at the Ready’ to Help Alberta amid Wildfires: Defence Minister: Watch News Videos Online.” Global News, May 8, 2023. <https://globalnews.ca/video/9681883/feds-will-remain-at-the-ready-to-help-alberta-amid-wildfires-defence-minister/>.
- Government of Canada, Public Services and Procurement Canada. “Remotely Piloted Aircraft System Project.” Remotely piloted aircraft systems - Air procurement initiatives - PSPC Services - PSPC, February 18, 2022. <https://www.tpsgc-pwgsc.gc.ca/app-acq/amd-dp/air/snac-nfps/sdat-rpac-eng.html#s3>.
- Jolly, Jasper. “UK Army Buys 30 ‘bug’ Drones That Can Spy on Targets 2km Away.” The Guardian, December 28, 2020. <https://www.theguardian.com/world/2020/dec/28/uk-army-buys-30-bug-drones-that-can-spy-on-targets-2km-away>.
- Jason, Dinh Thanh Liem, Ngo Quy Tuan, Dang Luat, and Mohammad Reza Asharif. "Battalion-Organic Electronic Fires: A Tactical Application of Commercial Uncrewed Systems and Software-Defined Radios." IEEE, 2017. doi:10.1109/ACDT.2017.7886150.
- Puttre, Michael. "Israeli MoD to Acquire Mini-UAS for IDF." *Journal of Electronic Defense* 27, no. 3 (03, 2004): 26.
- Sabbagh, Dan. “UK Wants New Drones in Wake of Azerbaijan Military Success.” The Guardian, December 29, 2020. <https://www.theguardian.com/world/2020/dec/29/uk-defence-secretary-hails-azerbaijans-use-of-drones-in-conflict>.
- Sanchez, Wilder Alejandro. “How Will Drones Affect Infantry Tactics?” Defence IQ. International Quality and Productivity Center, October 5, 2022. <https://www.defenceiq.com/defence-technology/articles/how-will-drones-affect-infantry-tactics>.
- Scharre, P. (2019). *Army of none: Autonomous Weapons and the future of war*. W.W. Norton & Company.
- Sherman J. Small UAS seen as ‘a significant and growing’ threat to U.S. infantry forces. *Inside the Pentagon*. 2018;34(10):16.
- “Uncrewed Aerial Systems.” Uncrewed Aerial Systems | U.S. Geological Survey. Accessed May 1, 2023. <https://www.usgs.gov/calval/uncrewed-aerial-systems>.
- Zabrodskyi, Mykhaylo, Jack Watling, Oleksandre V Danylyuk, and Nick Reynolds. “Preliminary Lessons in Conventional Warfighting from Russia’s Invasion of Ukraine: February–July 2022.” *Royal United Services Institute for Defence and Security Studies*, November 30, 2022.