

Canadian
Forces
College

Collège
des
Forces
Canadiennes



Commander Ben Thomson

Innovation Cannot be Outsourced: The Importance of CAF Technical Experts with Direct Involvement in Research and Development and Owning Intellectual Property

JCSP 47

Exercise Solo Flight

Disclaimer

Opinions expressed remain those of the author and do not represent Department of National Defence or Canadian Forces policy. This paper may not be used without written permission.

© Her Majesty the Queen in Right of Canada, as represented by the Minister of National Defence, 2022

PCEMI 47

Exercice Solo Flight

Avertissement

Les opinions exprimées n'engagent que leurs auteurs et ne reflètent aucunement des politiques du Ministère de la Défense nationale ou des Forces canadiennes. Ce papier ne peut être reproduit sans autorisation écrite.

© Sa Majesté la Reine du Chef du Canada, représentée par le ministre de la Défense nationale, 2022

CANADIAN FORCES COLLEGE – COLLÈGE DES FORCES CANADIENNES

JCSP 47 – PCEMI 47

2020 – 2022

Exercise Solo Flight – Exercice Solo Flight

Commander Ben Thomson

Innovation Cannot be Outsourced: The Importance of CAF Technical Experts with Direct Involvement in Research and Development and Owning Intellectual Property

“This paper was written by a student attending the Canadian Forces College in fulfilment of one of the requirements of the Course of Studies. The paper is a scholastic document, and thus contains facts and opinions, which the author alone considered appropriate and correct for the subject. It does not necessarily reflect the policy or the opinion of any agency, including the Government of Canada and the Canadian Department of National Defence. This paper may not be released, quoted or copied, except with the express permission of the Canadian Department of National Defence.”

“La présente étude a été rédigée par un stagiaire du Collège des Forces canadiennes pour satisfaire à l'une des exigences du cours. L'étude est un document qui se rapporte au cours et contient donc des faits et des opinions que seul l'auteur considère appropriés et convenables au sujet. Elle ne reflète pas nécessairement la politique ou l'opinion d'un organisme quelconque, y compris le gouvernement du Canada et le ministère de la Défense nationale du Canada. Il est défendu de diffuser, de citer ou de reproduire cette étude sans la permission expresse du ministère de la Défense nationale.”

INNOVATION CANNOT BE OUTSOURCED: THE IMPORTANCE OF CAF TECHNICAL EXPERTS WITH DIRECT INVOLVEMENT IN RESEARCH AND DEVELOPMENT AND OWNING INTELLECTUAL PROPERTY

Most 20th century war-changing technologies, from airplanes to the atomic bomb, did not originate in response to a specific military capability requirement.¹ Instead, they originated from talented defence scientists and engineers who were able to envision possible military applications of these emerging technologies and capitalize upon them. By investing in these emerging technologies, often under a shroud of secrecy, they developed these capabilities first, giving them a technological advantage over their adversaries.

In the 21st century, technology is changing even more rapidly.² The Canadian Armed Forces (CAF) and NATO allies rely on their technological advantages over potential adversaries.³ Within a few years, the U.S. predicts that they will lose their qualitative and quantitative advantage over “great power” competitors.⁴ A recent RAND corporation report assessed that despite U.S. outspending both China and Russia, U.S. forces could lose their next war.⁵ To reassert a technological advantage, NATO countries need to return to a focus on military research and development (R&D) and transform their partnerships with industry to better manage intellectual property (IP) and foster

¹ John Whiteclay Chambers, and Fred Anderson, *The Oxford Companion to American Military History* (New York: Oxford University Press, 1999), 791.

² Daniel C. Billing, Graham R. Fordy, Karl E. Friedl, and Henriette Hasselstrom. "The Implications of Emerging Technology on Military Human Performance Research Priorities." *Journal of Science and Medicine in Sport* 24, no. 10 (10, 2021): 948.

³ National Science and Technology Council, *Maintaining Military Advantage Through Science and Technology Investment* (Washington, DC: Office of Science and Technology Policy, 1995), 2.

⁴ General Joseph Dunford, Speech, Testimony Before the Senate Armed Services Committee, Washington, DC., June 13 2017.

⁵ David Ochmanek et al, *U.S. Military Capabilities and Forces for a Dangerous World* (Santa Monica, CA: RAND Corporation, 2017), xii.

collaboration. This paper argues that the CAF should invest significantly in developing internal experts in technological innovation and purchase the associated IP.

First, this paper will present the immediate threats to Western national security from a technological perspective and the need for urgent institutional transformation toward innovation. Second, arguments will be made in favour of DND owning and controlling defence IP. Third, a case will be made that the CAF needs to immediately grow a significant internal cadre of technological experts who will work together with industry and defence scientists. This cadre is needed to both maximize the capabilities of our current platforms and also create opportunities to leverage emerging technologies and sciences. Once established, this cadre will lead Canada and their NATO allies to discover new potential capabilities, reassert a technological advantage, and prepare a response to emerging threats.

Military power is traditionally measured by the strength and number of their platforms.⁶ Since the Second World War, defence spending has prioritized new and better versions of existing combat-proven platforms: tanks, fighter jets, submarines, and aircraft carriers.⁷ In contrast, “great nations” competitors, especially China, have invested specifically into defeating those improved NATO platforms and countering the very ways and means by which the West fights wars.⁸ Between 1990 and 2017, China increased defence spending by 900 percent for that purpose.⁹ The February 2022 Russian invasion

⁶ Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York, NY: Hachette Books, 2020), 16.

⁷ *Ibid.*, xxvii

⁸ *Ibid.*, xxviii

⁹ Andrew J. Nathan, "The Chinese World Order." *The New York Review of Books* 64, no. 15 (Oct 12, 2017): 31.

of Ukraine was a wake-up call not only regarding the willingness of “great power” competitors to use hard power but also in terms of the effectiveness of weapons purpose-built to defeat specific platforms. Ukraine’s use of shoulder-fired missiles has resulted in the destruction of hundreds of Russian armoured vehicles¹⁰ and aircraft.¹¹ Relatively inexpensive shore-based anti-ship missiles destroyed a Russian cruiser.¹² These examples show how deadly and cost-effective purpose-built weapons to counter platforms are against more capable adversaries.

China, however, is as technologically capable as NATO. China is quickly closing the GDP gap¹³ and is much more technologically capable than any adversary that the U.S. has faced in decades.¹⁴ Recent victories against less technologically capable nations such as Iraq and Afghanistan have led to a false sense that their current platform-centric approach will continue to dominate.¹⁵ In some areas of emerging technology, such as hypersonic missiles, NATO is admittedly behind the Chinese, with no known counter to such technology.¹⁶ It is possible that NATO could be pulled into a conflict with China through an unintentional escalation or in direct response to supporting a threatened ally.¹⁷

¹⁰ Editorial, “How Tanks Can Survive Against Cheap, Shoulder-Fired Missiles” *The Economist*, 2 April 2022.

¹¹ Editorial, “What are MANPADS, The Portable Missiles Bringing Down Russian Aircraft?” *The Economist*, 6 April 2022.

¹² Sardarizadeh, Shayan and Sands, Leo, “Ukraine War: Dramatic Images Appear to Show Sinking Russian Warship Moskva” *BBC News*, 18 April 2022.

¹³ Paton, Callum, “World's Largest Economy in 2030 Will be China, Followed by India, With U.S. Dropping to Third, Forecasts Say” *Newsweek*, 1 Oct 2019.

¹⁴ Andrew J. Nathan, “The Chinese World Order.” *The New York Review of Books* 64, no. 15 (Oct 12, 2017): 32.

¹⁵ Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York, NY: Hachette Books, 2020), 7.

¹⁶ Richard M. Harrison, “Welcome to the Hypersonic Arms Race” last accessed 26 May 2022, <https://nationalinterest.org/blog/buzz/welcome-hypersonic-arms-race-42002>

¹⁷ Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York, NY: Hachette Books, 2020), xii.

With a real risk of the West losing the next war that they might be called upon to fight,¹⁸ especially if that war is with China in their backyard, an immediate focus on reasserting technological supremacy and moving away from a platform-centric approach to warfare is paramount. A return to the broader concept of deterrence is needed, with a focus on outcomes and not specific tools.¹⁹ In a world of quickly advancing technology with new potential defence applications being introduced almost daily, researchers are needed who understand the defence potential of these emerging technologies and can transform them into a tangible deterrence. A cadre of CAF research specialists working with civilian defence scientists and industry partners, with unfettered access to IP, would meet this imperative.

A specific area where NATO is lagging behind the People's Republic of China (PRC) is with regard to interoperability and information-sharing²⁰. NATO struggles to pass target information effectively between similar platforms, let alone between joint elements and allied forces. Getting the right information to decision-makers quickly gives any military a significant advantage in combat by prosecuting the right targets faster.²¹ The inability of U.S. defence systems to quickly gather and pass information to decision-makers was identified by Andrew Marshall as a major weakness decades ago²² and has not yet been resolved.

¹⁸ David Ochmanek et al, *U.S. Military Capabilities and Forces for a Dangerous World* (Santa Monica, CA: RAND Corporation, 2017), 5.

¹⁹ Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York, NY: Hachette Books, 2020), xviii.

²⁰ *Ibid.*, 14

²¹ *Ibid.*, 106

²² *Ibid.*, 39

IP, specifically patents, inhibit information-sharing. The fundamental intent of a patent is to block competitors and grant the inventor market exclusivity over the technology.²³ It should be no surprise that the West suffers from the inability to share information effectively between platforms during combat when IP rights prevent design information from being shared with other designers when systems are being built and integrated. As IP rights are not enforced in China,²⁴ there are no proprietary obstacles to creating highly effective information-sharing networks between all their systems and platforms.

There is much debate about IP rights and the Canadian defence industry.²⁵ With few exceptions, companies in contract with the Canadian Government maintain ownership of the IP used and created.²⁶ This is important for Canadian industry as it allows them to maintain exclusivity and generate revenue by selling their products to other customers, both domestically and internationally. This, in turn, drives regional economic benefits that are a boon to the Canadian economy.²⁷ This arrangement, however, is ill-suited for defence, as exclusivity and competition between companies does not create the collaborative and cooperative environment needed to stay ahead of “great

²³ Canadian Intellectual Property Office, “What is a Patent?” last accessed 25 May 2022, <https://www.ic.gc.ca/eic/siTe/cipointernet-internetopic.nsf/eng/wr03716.html>

²⁴ Rechtschaffen, Daniel, “How China’s Legal System Enables Intellectual Property Theft” *The Diplomat*, 11 November 2020.

²⁵ Pugliese, David, “Canada to Require New Tech, IP as Offsets” *defence News*, 16 June 2015.

²⁶ Public Services and Procurement Canada, “Supply Manual Chapter 3.95 Intellectual Property” last Modified 12 May 2022, <https://buyandsell.gc.ca/policy-and-guidelines/supply-manual/section/3#section-3.95>

²⁷ Innovation, Science and Economic Development Canada, “Policy on Title to Intellectual Property Arising Under Crown Procurement Contracts” last Modified 1 April 2015, <https://ised-isde.canada.ca/site/policy-title-intellectual-property-crown-procurement/en/policy-title-intellectual-property-arising-under-crown-procurement-contracts>

nation” competitors. The current construct for IP management also slows down innovation while lawyers and bureaucrats resolve IP disputes.²⁸

IP rights are also affecting Canada’s ability to maintain our current and future fleets from the perspective of sustainability, reliability, availability, and maintainability (SRAM). In order to avoid disclosure of patented designs and trade secrets, the amount of technical detail that goes into CAF training and repair manuals is limited.²⁹ In some cases where industry retains full IP, repairs and intrusive maintenance are performed through exclusive in-service support contracts (ISSCs). This service model contradicts the need for deployed CAF members to be self-sufficient, with the detailed system knowledge needed to troubleshoot problems and keep their equipment operational.

Canadian ownership of IP also facilitates the sustainability of current and future equipment. The CAF supply system is struggling to provide the replacement parts needed in a timely manner to keep current platforms operational.³⁰ Unlike other industries, Canada will operate much of their equipment for 30 years or more, and often beyond their design lives. It is not reasonable to expect the original equipment manufacturer (OEM) to stay in business producing replacement parts and maintaining system-design expertise for equipment that was provided for a limited purchase decades ago. As a worked example, consider the 140KW Motor Generators (MGs) used onboard the Canadian Victoria-Class

²⁸ Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York, NY: Hachette Books, 2020), 50.

²⁹ IP Osgoode, “Canada Should Not Be Left Behind as the US Moves Towards a Right to Repair” last modified 22 December 2022, <https://www.iposgoode.ca/2021/12/canada-should-not-be-left-behind-as-the-us-moves-towards-a-right-to-repair/>

³⁰ Office of the Auditor General of Canada, *Supplying the Canadian Armed Forces – National Defence* (Ottawa: Reports of the Auditor General of Canada, 2020), 8.

submarines. Regular failures of these MGs are a leading cause of lost sea-days³¹, and several projects have been considered to improve reliability. The UK-based OEM divested from these MGs and sold all their IP, including the engineering and manufacturing drawings, to a company in the U.S. that has no experience with this specific equipment yet is now the sole-source provider. Complicated technical agreements had to be created between the company and the ISSC that maintains the submarine.³² As an additional complication, because the IP is now U.S.-based, the rules of International Traffic in Arms Regulations (ITAR) now apply, further restricting the ability to share information.³³

Despite persistent efforts since the reliability issues were first identified two decades ago, the design remains unchanged due to IP challenges and operational sea-days are still lost.³⁴ If Canada owned the IP, they could provide the drawings and choose the most competitive and best-suited company to modify the system. Alternatively, Canada could use a government-owned repair facility to conduct the needed modifications. Fortunately, in this case, the OEM sold their IP to an ally. However, what if the IP had been sold to a “great power” competitor instead?

Another consideration for Canadian defence is the cyber threats to their systems and platforms. To use another example, the Integrated Platform Management System

³¹ Babcock Canada, “SRAM Dashboard Report:140KW Motor Gen & Assoc. Equip” Report ID: GG-BI-CAN00018, 26 April 2022, 1.

³² Ward Leonard CT LLC and Babcock Canada Inc. *Technical Assistance Agreement*, (Babcock File No: WLCANADA/BABCOCK/JUNE2017(Rev 1), 12 June 2018), 1.

³³ United States Department of State, *Commodity Jurisdiction Determination for: 140 KW 60Hz Motor-Generator Set, Model A/CS/1106 Rev 5* (Case: CJ 0285-17, 20 July 2017), 1.

³⁴ Babcock Canada, “SRAM Dashboard Report:140KW Motor Gen & Assoc. Equip” Report ID: GG-BI-CAN00018, 26 April 2022, 1.

(IPMS) used onboard Canadian warships provides monitoring and control of vital propulsion, electrical, and damage-control machinery.³⁵ It would be a substantial threat to the platform should the IPMS be compromised by a cyberattack. The company that designed and built IPMS for the CAF also does so for 20 other navies worldwide, including non-NATO countries³⁶, and is building similar control systems for Chinese companies^{37 38}, which are obligated to share it with their government.³⁹ This is not to imply that the company that built IPMS has done anything nefarious by generating revenue by selling their technology to foreign markets, as this is precisely what Canadian policies for economic development have incentivised and encouraged them to do.⁴⁰

The PRC also obtains IP through other means. A Chinese citizen employee of this same defence contractor was convicted in 2013 for providing China with thousands of files containing sensitive information on weapon-guidance systems and other technologies.⁴¹ China could potentially use the compromised information to improve their own weapon systems or to build systems designed specifically to defeat Western weapons

³⁵ Naval Technology, "L-3 MAPPs Selected to Design the Integrated Platform Management System for the Royal Canadian Navy's Arctic/Offshore Patrol Ship Project " last accessed 26 May 2022, <https://www.naval-technology.com/contractors/simulators/l-3-mapps/pressreleases/pressl-3-mapps-design-system-navys>

³⁶ Naval Technology, "L-3 MAPPs Integrated Platform Management Systems" last accessed 26 May 2022, <https://www.naval-technology.com/contractors/consoles/l-3-mapps2>

³⁷ World Nuclear News, "L-3 MAPPs to Update Hongyanhe Simulator" last accessed 26 May 2022, <https://world-nuclear-news.org/Articles/L-3-MAPPs-to-update-Hongyanhe-simulator>

³⁸ L3 Harris, "Air China Selects L3Harris Technologies for Three Full Flight Pilot Training Simulators" last accessed 26 May 2022, <https://www.l3harris.com/newsroom/trade-release/2021/01/air-china-selects-l3harris-technologies-three-full-flight-pilot>

³⁹ Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York, NY: Hachette Books, 2020), 92.

⁴⁰ Innovation, Science and Economic Development Canada, "Policy on Title to Intellectual Property Arising Under Crown Procurement Contracts" last Modified 1 April 2015, <https://ised-isde.canada.ca/site/policy-title-intellectual-property-crown-procurement/en/policy-title-intellectual-property-arising-under-crown-procurement-contracts>

⁴¹ Finn, Peter, "Chinese Citizen Sentenced in Military Data-Theft Case" *Washington Post*, 25 March 2013.

using this technology. China has stolen sensitive technical data directly from other defence contractors.⁴² The U.S. estimates that over \$250 billion of IP is stolen through industrial espionage each year, with most going to China.⁴³ Conversely, Canada respects the privacy and IP rights of industry. This means that foreign actors likely have more knowledge of the weaknesses and vulnerabilities in the hardware and software of Canadian systems than the CAF members operating them.

A better IP management construct would be for all IP to be owned by Canada. This would allow for Canada to license IP to the defence industry on a case-by-case basis. It would also allow for better cooperation and integration between trusted defence contractors and allied governments. Recently, Canada has made progress in retaining some defence IP and has begun to recognize how important it is to the sustainment of CAF.⁴⁴ However, simply owning IP will not result in transformational innovation. The CAF must also provide the expertise and human resources to effectively manage IP and take on a leadership role in R&D to build the collaborative and cooperative environment needed to foster innovation. In addition to managing IP and helping to protect the CAF from cyber threats, the proposed cadre of CAF experts would work directly with defence contractors to build better and more robust designs.

CAF engineers, scientists, and technologists have the unique combination of knowledge in both how technology works through their formal education and how it is and

⁴² Nakashima, Ellen, "China Hacked a Navy Contractor And Secured a Trove of Highly Sensitive Data on Submarine Warfare" *Washington Post*, 8 June 2018.

⁴³ Rogin, Josh, "NSA Chief: Cybercrime Constitutes the Greatest Transfer of Wealth in History" *Foreign Policy*, 9 July 2012.

⁴⁴ Brewster, Murray, "Backroom Battle Underway Over New Frigate Design Data" *CBC News*, 28 July 2016.

can be employed in conflicts as a result of their military training and experience. Having CAF members involved as part of an integrated design team will benefit both DND and industry, and it would likely result in a superior and more cost-effective product. The design team would benefit from the CAF members' insights into the specific harsh operational conditions, how equipment is operated in practice, the various challenges of maintenance, and the observed failures on previous platforms. Reciprocally, the CAF would also benefit from design-level insights in order to develop better maintenance and training packages, and would gain visibility of some design vulnerabilities found during prototyping and initial testing that can then be addressed by adjusting inspections and maintenance in service.

During the design phase, there will be discretionary opportunities to make SRAM improvements that would exceed the minimum contracted requirements but provide significant gains in service. Without intervention, defence contracts will not usually exceed the contracted requirements.⁴⁵ The embedded CAF members could liaise with the DND project managers to have project contingency funding released to make these changes early in the design process when they are the least expensive. Early engagement is key, since the later that modifications are made in the design process, the harder and more expensive they become.⁴⁶ Having to raise new contracts after delivery to address issues is more cost-prohibitive and requires removing the platforms from service to make the modifications.

⁴⁵ Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York, NY: Hachette Books, 2020), 50.

⁴⁶ Boyd Paulson, "Designing to Reduce Construction Costs." *Journal of the Construction Division* 102 (1976):158.

Embedded CAF members can also create new opportunities for innovation.

Gaining a technological advantage over competitors is not limited to only new equipment; some of the most meaningful and readily-available innovation is found in learning to use existing equipment differently or by integrating new technologies with old.⁴⁷ A cadre of CAF technological experts would excel at this type of innovation because of the duality of their experience with the limitations of current equipment and their understanding of the potential of emerging technologies. That being said, the greatest opportunity for game-changing capabilities will more likely come from these CAF experts leading the development of entirely new technologies.⁴⁸

Developing new weapons of violence and new fighting platforms is one possible outcome of defence innovation. However, there are several other ways of creating deterrents to war.⁴⁹ Non-platform-centric options for military research include information warfare, economic warfare, and cyber warfare. The CAF will still require a traditional military to include fighting platforms, but those could be purchased as “military off-the-shelf” equipment from allies. Instead of investing in Canadian industry by paying them to redesign and build Canadian variants of proven foreign platforms, Canada could instead invest in their industry partners to create entirely new capabilities to include both new platforms and non-platform deterrents. These new and unique capabilities could then be built and sold to Canadian allies to create equivalent economic

⁴⁷ Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York, NY: Hachette Books, 2020), xxviii.

⁴⁸ Stephanie Carvin, “Canadian Defence and new Technologies.” in *Canadian Defence Policy in Theory and Practice*, ed Thomas Juneau, Philippe Lagasse, and Srdjan Vucetic (Cham; Palgrave Macmillan, 2020), 389.

⁴⁹ Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York, NY: Hachette Books, 2020), xviii.

growth in a way that is not redundant with what our allies do and that would directly help NATO maintain a technological advantage over their “great power” competitors.

Military innovation needs to reside primarily within the CAF, and although industry has vital contributions to make, they cannot take the lead nor do it alone. Canada has programs such as IDEaS, which specifically channels funding to industry to promote innovation for defence⁵⁰. However, this program is unlikely to bring about transformational changes without significant buy-in from the CAF.⁵¹ The first reason that innovation cannot be effectively outsourced to industry is that they do not want to do it. The largest and most innovative companies avoid defence research for ethical⁵² or business reasons, such as wanting to avoid the slow pace and bureaucracy of government contracts.⁵³ Sadly, this means that industry is more likely to harness the power of artificial intelligence and quantum computing in order to connect more people to videos about cats than to help protect Canada and its allies from foreign aggression.

The second reason that industry is not a likely source for transformational innovation is the nature of government contracts. In order to survive, industry pioneers need to be bold in their innovations to stay ahead of competitors or they risk losing their customer base and sources of revenue.⁵⁴ Conversely, companies working for governments

⁵⁰ National Defence, “IDEaS – Innovation for Defence Excellence and Security” last accessed 25 May 2022, <https://www.canada.ca/en/department-national-defence/programs/defence-ideas/how-ideas-works.html>

⁵¹ Stephanie Carvin, “Canadian Defence and new Technologies.” in *Canadian Defence Policy in Theory and Practice*, ed Thomas Juneau, Philippe Lagasse, and Srdjan Vucetic (Cham; Palgrave Macmillan, 2020), 65.

⁵² Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York, NY: Hachette Books, 2020), 43.

⁵³ *Ibid.*, 51

⁵⁴ Burton Grummer, “Innovate or Die: The Necessity for Change in Contemporary Organizations.” *Administration in Social Work* 25, no. 3 (2001): 65.

make money by fulfilling contract milestones. Therefore, contractors are more likely to focus on only what is needed to fulfill the milestone than to be bold, chase leads, present new theories, and take risks, since those activities move them further away from being paid.⁵⁵

While industry is ill-suited to lead defence innovation, the CAF is ideal. Innovation should not be outsourced, as it is far less likely to have the intuitional buy-in required to bring about the transformational changes needed.⁵⁶ The military has a strong culture, and it is very difficult for those outside the military to impose transformational changes.⁵⁷ Consider Admiral Hyman Rickover, who overcame opposition to create a miniaturized nuclear reactor that could be fitted into a submarine.⁵⁸ Also, consider General Bernard Schriever, who developed the Thor, Atlas, and Titan intercontinental ballistic missiles.⁵⁹ These “military mavericks” worked from within the military and were highly successful in both innovating and making the subsequent institutional, financial, and organizational changes to see their game-changing visions become a reality.⁶⁰

Another, and more important reason for the CAF to take ownership of defence innovation is because it has the potential to directly or indirectly do harm to the public. Even non-kinetic technologies, such as those that enable the influence activities, can still

⁵⁵ Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York, NY: Hachette Books, 2020), 50.

⁵⁶ Alfred E. Thal Jr., and David E. Shahady, “Is your organization ready for innovation?” in *defence Innovation Handbook Guidelines, Strategies, and Techniques*, edited by Adedeji B. Badiru, and Cassie B. Barlow (Boca Raton, FL; CRC Press, 2019), 193.

⁵⁷ Norman Dixon, *On the Psychology of Military Incompetence* (New York: Basic Books, 1976), 159.

⁵⁸ Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York, NY: Hachette Books, 2020), 43.

⁵⁹ *Ibid.*

⁶⁰ *Ibid.*, 83

result in revolutions, riots, and multiple deaths. The CAF is the only federal organization with the mandate to carry violence or harm to other countries on behalf of Canada. Although most service members are not directly involved in violence, they understand that, as a part of the organization, their supporting roles enable lethal means. Also, CAF members are the end users of these technologies and will rely upon them to complete their missions and get them home safe.

All of this is to say that transformational innovation should reside first and foremost with CAF members because no one is more invested in the outcomes than they are.⁶¹

It is important that this proposed cadre of military technology experts span all elements and extend up to Level 1 (L1) of the CAF hierarchy. The relatively poor recent advancement in military innovation in the U.S. was not due to a lack of money or technology; it was due to decision-makers choosing the wrong technology to invest in.⁶² Which technologies to invest in should not be decided based on articles written by lobbyist-backed “think-tanks”, nor should investment decisions be based on the quality of the sales pitch delivered to senior leaders by their former colleagues who are now representing defence contractors. Military leadership should choose which technologies to invest in and which to abandon based upon the underlying science itself. Having a technological expert in the room when these decisions are being made is vital to making better decisions going forward. Representation at the L1 will not only send a clear message of the importance of innovation, but this is the level where interaction occurs

⁶¹ *Ibid.*, xx

⁶² *Ibid.*, 77

most with other government departments, such as Innovation, Science and Economic Development Canada; the Assistant Deputy Minister (Finance); and Public Services and Procurement Canada. Given that the intent is to treat military innovation differently than other government policies for Canadian economic development, there must be someone at the table with the authority to make sure the right distinctions are made.

All three initiatives presented herein for Canada to lead innovation and support NATO in reasserting technical superiority are complementary. CAF members who are experts and have regular exposure to emerging technologies can improve both Canada's current equipment and that which is under development. The same CAF experts are also able to lead industry and defence scientists into cooperative innovation and be the first to discover and develop new capabilities. Additionally, these CAF experts can effectively use and manage IP in order to maximize collaboration with allies and between industry partners, while simultaneously providing the necessary protections against cyber-threats.

To conclude, this paper offers three recommendations and one area for further research. The first recommendation is for the Canadian government to change their default position on IP for national defence contracts such that, in almost all instances, Canada retains IP ownership. The second recommendation is to immediately implement changes to add a significant number of new defence researcher positions cascading up to a L1 for technically capable engineers, operators, and technicians. The process for selection into these new positions should be competitive and similar to how people are currently selected for sponsored post-grad positions. The third recommendation is to divest away from building particularized versions of proven platforms and instead divert funding for industry to focus on unique platforms and non-platform-centric capabilities.

An area of proposed further research is to develop a new basis of payment and an economic growth model for Canadian industry partners that does not focus on IP as a mechanism for long-term revenue and sustainment. The new model should promote collaborative innovation across defence partners while still providing equivalent levels of job-generation and regional economic benefits. The model should also be compatible with the R&D of non-platform-centric capabilities.

BIBLIOGRAPHY

- Babcock Canada. "SRAM Dashboard Report: 140KW Motor Gen & Assoc. Equip" Report ID: GG-BI-CAN00018. 26 April 2022.
- Billing, Daniel C., Graham R. Fordy, Karl E. Friedl, and Henriette Hasselstrom. "The Implications of Emerging Technology on Military Human Performance Research Priorities." *Journal of Science and Medicine in Sport* 24, no. 10 (10, 2021): 947-953.
- Brewster, Murray. "Backroom Battle Underway Over New Frigate Design Data" *CBC News*. Last Modified 28 July 2016. <https://www.cbc.ca/news/politics/frigate-replacement-data-1.3697942>
- Brose, Christian, *The Kill Chain: Defending America in the Future of High-Tech Warfare*, New York, NY: Hachette Books, 2020.
- Canada. Canadian Intellectual Property Office. "What is a Patent?" Last accessed 25 May 2022. <https://www.ic.gc.ca/eic/siTe/cipointernet-internetopic.nsf/eng/wr03716.html>
- Canada. Innovation, Science and Economic Development Canada. "Policy on Title to Intellectual Property Arising Under Crown Procurement Contracts" Last Modified 1 April 2015. <https://ised-isde.canada.ca/site/policy-title-intellectual-property-crown-procurement/en/policy-title-intellectual-property-arising-under-crown-procurement-contracts>
- Canada. National Defence. "Crown copyright protected works managed by National Defence and the Canadian Armed Forces" Last accessed 25 May 2022. <https://www.canada.ca/en/department-national-defence/corporate/intellectual-property/crown-copyright.html>
- Canada. National Defence. "IDEaS – Innovation for Defence Excellence and Security" Last accessed 25 May 2022. <https://www.canada.ca/en/department-national-defence/programs/defence-ideas/how-ideas-works.html>
- Canada. Office of the Auditor General of Canada, *Supplying the Canadian Armed Forces – National Defence*. Ottawa: Reports of the Auditor General of Canada, 2020.
- Canada. Public Services and Procurement Canada. "Supply Manual Chapter 3.95 Intellectual Property" Last Modified 12 May 2022. <https://buyandsell.gc.ca/policy-and-guidelines/supply-manual/section/3#section-3.95>
- Carvin, Stephanie. "Canadian Defence and new Technologies." In *Canadian Defence Policy in Theory and Practice*, edited by Thomas Juneau, Philippe Lagasse, and Srdjan Vucetic, 383-397. Cham; Palgrave Macmillan, 2020.

- Chambers, John Whiteclay, and Fred Anderson, *The Oxford Companion to American Military History*, New York: Oxford University Press, 1999.
- Chapnick, Adam and Craig Stone. "From Policy and Strategy to Outcomes." In *Canadian Defence Policy in Theory and Practice*, edited by Thomas Juneau, Philippe Lagassé and Srdjan Vucetic, 81-97. Cham, Switzerland; Palgrave Macmillan, 2020.
- Curry, Andrew, and Anthony Hodgson. "Seeing in Multiple Horizons: Connecting Futures to Strategy." *Journal of Futures Studies* 13, no. 1 (August 2008): 20 p.
- Dixon, Norman, *On the Psychology of Military Incompetence*, New York: Basic Books, 1976.
- Dobias, P., D. Hotte, J. Kampman, and B. Laferriere. "Modeling Future Force Demand: Force Mix Structure Design Proceedings" from the *36th International Symposium on Military Operational Research*. London; University of London, 22 July 2019.
- Dundord, General Joseph. Speech, Testimony Before the Senate Armed Services Committee, Washington, DC., June 13, 2017. Last accessed 26 May 2022. <https://www.armed-services.senate.gov/hearings/17-06-13-department-of-defence-budget-posture>
- Editorial. "How Tanks Can Survive Against Cheap, Shoulder-Fired Missiles" *The Economist*. Last modified 2 April 2022. <https://www.economist.com/science-and-technology/2022/04/02/how-tanks-can-survive-against-cheap-shoulder-fired-missiles>
- Editorial. "What are MANPADS, The Portable Missiles Bringing Down Russian Aircraft?" *The Economist*. Last modified 6 April 2022. <https://www.economist.com/the-economist-explains/2022/04/06/what-are-manpads-the-portable-missiles-bringing-down-russian-aircraft>
- Finn, Peter. "Chinese Citizen Sentenced in Military Data-Theft Case" *Washington Post*. Last Modified 25 March 2013. https://www.washingtonpost.com/world/national-security/chinese-citizen-sentenced-in-military-data-theft-case/2013/03/25/dc4567fa-9593-11e2-ae32-9ef60436f5c1_story.html
- Gummer, Burton. "Innovate Or Die: The Necessity for Change in Contemporary Organizations." *Administration in Social Work* 25, no. 3 (2001): 65-84.
- Harrison, Richard M. "Welcome to the Hypersonic Arms Race" Last accessed 26 May 2022. <https://nationalinterest.org/blog/buzz/welcome-hypersonic-arms-race-42002>
- IP Osgoode. "Canada Should Not Be Left Behind as the US Moves Towards a Right to Repair" Last modified 22 December 2022.

<https://www.iposgoode.ca/2021/12/canada-should-not-be-left-behind-as-the-us-moves-towards-a-right-to-repair/>

L3 Harris. “Air China Selects L3Harris Technologies for Three Full Flight Pilot Training Simulators” Last accessed 26 May 2022.

<https://www.l3harris.com/newsroom/trade-release/2021/01/air-china-selects-l3harris-technologies-three-full-flight-pilot>

Nakashima, Ellen. “China Hacked a Navy Contractor And Secured a Trove of Highly Sensitive Data on Submarine Warfare “ *Washington Post*. Last Modified 8 June 2018. https://www.washingtonpost.com/world/national-security/china-hacked-a-navy-contractor-and-secured-a-trove-of-highly-sensitive-data-on-submarine-warfare/2018/06/08/6cc396fa-68e6-11e8-bea7-c8eb28bc52b1_story.html?noredirect=on

Nathan, Andrew J. "The Chinese World Order." *The New York Review of Books* 64, no. 15 (Oct 12, 2017): 31-34.

Naval Technology. “L-3 MAPPs Integrated Platform Management Systems“ Last accessed 26 May 2022. <https://www.naval-technology.com/contractors/soles/l-3-mapps2>

Naval Technology. “L-3 MAPPs Selected to Design the Integrated Platform Management System for the Royal Canadian Navy’s Arctic/Offshore Patrol Ship Project “ Last accessed 26 May 2022. <https://www.naval-technology.com/contractors/simulators/l-3-mapps/pressreleases/pressl-3-mapps-design-system-navys>

Ochmanek, David, Peter Wilson, Brenna Allen, John Speed Meyers, and Carter C. Price, U.S. *Military Capabilities and Forces for a Dangerous World*, Santa Monica, CA: RAND Corporation, 2017.

Paton, Callum. “World's Largest Economy in 2030 Will be China, Followed by India, With U.S. Dropping to Third, Forecasts Say” *Newsweek*. Last Modified 1 Oct 2019. <https://www.newsweek.com/worlds-largest-economy-2030-will-be-china-followed-india-us-pushed-third-1286525>

Paulson, Boyd. “Designing To Reduce Construction Costs.” *Journal of the Construction Division* 102 (1976): 587-592.

Pherson, Randolph H. “Leveraging the Future with Foresight Analysis.” *The International Journal of Intelligence, Security, and Public Affairs* 20, no. 2, 2018: 102-131.

Pugliese, David. “Canada To Require New Tech, IP as Offsets” *defence News*. Last Modified 16 June 2015.

<https://www.defencenews.com/industry/2015/06/16/canada-to-require-new-tech-ip-as->

[offsets/](#)

Rechtschaffen, Daniel. “How China’s Legal System Enables Intellectual Property Theft” *The Diplomat*. Last modified 11 November 2020.

<https://thediplomat.com/2020/11/how-chinas-legal-system-enables-intellectual-property-theft/>

Rogin, Josh. “NSA Chief: Cybercrime Constitutes the Greatest Transfer of Wealth in History” *Foreign Policy*. Last modified 9 July 2012.

<https://foreignpolicy.com/2012/07/09/nsa-chief-cybercrime-constitutes-the-greatest-transfer-of-wealth-in-history/>

Sardarizadeh, Shayan and Sands, Leo. “Ukraine War: Dramatic Images Appear to Show Sinking Russian Warship Moskva” *BBC News*. Last Modified 18 April 2022.

<https://www.bbc.com/news/world-europe-61141118>

Thal, Alfred E. Jr. and David E. Shahady. “Is your organization ready for innovation?” In defence *Innovation Handbook Guidelines, Strategies, and Techniques*, edited by Adedeji B. Badiru, and Cassie B. Barlow, 189-207. Boca Raton,FL; CRC Press, 2019.

United States Department of State, *Commodity Jurisdiction Determination for: 140 KW 60Hz Motor-Generator Set, Model A/CS/1106 Rev 5*, Case: CJ 0285-17, 20 July 2017

United States. National Science and Technology Council. *Maintaining Military Advantage Through Science and Technology Investment*, Washington, DC: Office of Science and Technology Policy, 1995.

Ward Leonard CT LLC and Babcock Canada Inc. *Technical Assistance Agreement*, Babcock File No: WLCanadaBabcockJune2017(Rev 1), 12 June 2018

World Nuclear News. “L-3 MAPPs to Update Hongyanhe Simulator“ Last accessed 26 May 2022. <https://world-nuclear-news.org/Articles/L-3-MAPPs-to-update-Hongyanhe-simulator>