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ARTIFICIAL INTELLIGENCE, THE KEY TO UNLOCK CAF BIG DATA

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Solo Flight

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“Perhaps we should all stop for a moment and focus not only on making our AI better and more successful but also on the benefit of humanity.”

- Stephen Hawking in Lisbon, November 2017

INTRODUCTION

The nature of conflict is rooted deep in our Human culture and yet rapidly changing, pulled by globalization and technological advances in a complex future. For the Canadian Armed Forces (CAF) to maintain its capability to best serve the Government of Canada’s interests, it will boil down to hard choices and compromises.¹ Balancing probable future, adjusting advantageous capabilities, structures, doctrine, and professional military education with finite resources is critical to secure CAF’s competitive advantage. Yet, the current CAF Officer Professional Development System (OPDS) is 19 years old, and possibly no longer effectively echoes how CAF leaders should be trained.² Similarly, *Strong, Secure, Engaged: Canada’s Defence Policy* published in 2017, contains only an handful mention of high-tech terms such as Deep Learning, Artificial Intelligence (AI), analytics and Big Data.³ The document is relatively hollow in terms of new system-wide initiatives, limiting the credibility of one of its major themes: “Recruitment, Training and Retention”.⁴

The CAF, being engaged internationally and dedicated to domestic security is increasingly submerged with streams of raw data feeds. Its ability to integrate software’s, algorithms and AI could enable commanders to rapidly extrapolate key information’s from old holdings and new data sources without pulling on the limited human resources available to generate operational successes. Furthermore, the implementation of AI could lead to deductions and analytical correlations that are yet invisible to human analysts. The Ottawa Anti-Personnel Mine treaty and lasting efforts to promote international humanitarian law governing armed conflict makes it pressing for the CAF to clearly identify its Strategy toward the pervasive

¹ Department of National Defence. “The Way We Fight”. Letter dated 10 February 2019. Lieutenant-General Mike Rouleau, CMM, MSC, CD.

² Department of National Defence. “To Train as We Fight”. CJOC study on deployed CAF senior Officers Operational skillsets requirements, signed 15 October 2019. Lieutenant-General Mike Rouleau, CMM, MSC, CD.

³ Department of National Defence. 2017. “Strong, Secure, Engaged”. Canada's Defence Policy. 113 pages.

⁴ Ibid. p. 20.

development of AI, often seen as the key to enable fully autonomous weapon systems.⁵ While a ban on antipersonnel mine did not degrade CAF overall utility, the ethical categorisation of explicit automated tasks will require a clear understanding of AI to avoid unnecessary technological restrictions. Also, the increasing importance for CAF to function within a Joint Interagency Multi-national and Public (JIMP) environment and the United States massive investments to field complex digital battle systems, will force leaders to continuously adjust Canada's comprehensive strategy.⁶ Key developments in the field of AI in China and in the United States will be essential to understand and consider for CAF leaders.

This paper argues that there is value in integrating non weaponised AI system within the CAF. AI integration offers an unmatched capability to timely process commercial and secure data feed into actionable information. The paper begins by delineating key terminology before outlining CAF potential benefits to leverage AI platforms to process data from an increasing range of available sensors. It will next examine the state of military AI amongst the world two dominant powers, the United States and China. To conclude, this paper will review practical issues related to narrow AI implementation such as the institutional challenges to maintain a delicate balance between operational relevancy and core values.

THEORETICAL CONCEPTS

While definitions vary greatly, most agrees that AI refers to an array of software and hardware's that exhibit various degree of human-like intelligence such as logical reasoning, problem solving and learning.^{7 8 9} Based on its evolution, AI platforms are conveniently classified three categories. Kai-Fu Lee (2018) offer a useful frame of reference to understand the

⁵ Department of National Defence, (2014). "The Future Security Environment." Chief of Force Development. 17 Wing Winnipeg Publishing Office. Retrieved August 1, 2019, from http://publications.gc.ca/collections/collection_2015/mdn-dnd/D4-8-2-2014-eng.pdf

⁶ Lieutenant-General Mike Rouleau, Ibid.

⁷ Department of Defense. 2018. "DoD Artificial Intelligence Strategy: Harnessing AI to Advance Our Security and Prosperity". Conference Summary. Last accessed on 05 may 2020: <https://www.nationaldefensemagazine.org/articles/2019/2/12/just-in-pentagon-releases-artificial-intelligence-strategy-to-stave-off-russian-chinese-advancements>

⁸ Department of Defense. 2019. "Artificial Intelligence and National Security". Congressional Research Service. Last accessed on 06 may 2020: <https://fas.org/sgp/crs/natsec/R45178.pdf>

⁹ The Department of National Defence. *Canadian Armed Forces Data Strategy, Annex C — Data-driven advanced technologies*. Last accessed on 05 may 2020: <https://www.canada.ca/en/department-national-defence/corporate/reports-publications/data-strategy/annex-c-data-driven-advanced-technologies.html>

first, labelled as narrow AI: *"Essentially it is improving a lot of human capabilities, one level at a time. It is mostly confined to a given domain. You can't teach a face recognizer to instantly become capable of making loans in banks."*¹⁰ While the outcome is still questioned by influential public figures¹¹ including Microsoft co-founder Paul Allen¹², the development of a General AI or AGI is predicted to be achieved within approximately thirty years.¹³ To reach this technological threshold, AI must be able to equally perform the whole spectrum of humans neural task.¹⁴ Lastly, the development of an AI superior to humans, known as Super Intelligence, is expected to be developed rapidly after AGI, assuming the absence of legal and political constraints. For this essay, only current and near-future narrow AI will be considered for the integration of non weaponised capabilities such as intelligence, surveillance, and reconnaissance applications, information operations, command and control and navigation systems.

The term Big Data refers to datasets that are diverse, complexes, and of a size that goes beyond the ability of commonly used software and tools to capture, curate, manage, and process within a tolerable elapsed time.¹⁵ It refers to the whole spectrum of raw information available from sensors, video imagery, mobile phone, signals intelligence, social media to satellite imagery. This is the steppingstone for CAF and DoD intelligence branches that uses techniques and technologies to reveal information insights, and ultimately the knowledge required to gain advantages from tactical to strategic levels.¹⁶

¹⁰ Kai-Fu Lee. 2018. *"AI SUPER-POWERS, China, Silicon Valley, New World Order"*. Audible. Audiobook narrated by Mikael Naramore. 9 hours 28 minutes.

¹¹ Wiggers, Kyle. 2018. *"Geoffrey Hinton and Demis Hassabis: AGI is nowhere close to be a reality"*. VentureBeat, California. Last accessed on 15 may 2020: <https://venturebeat.com/2018/12/17/geoffrey-hinton-and-demis-hassabis-agi-is-nowhere-close-to-being-a-reality>.

¹² Allen, Paul. 2011. *"The Singularity Isn't Near"*. MIT Technology Review. Last accessed on 15 may 2020: <https://www.technologyreview.com/2011/10/12/190773/paul-allen-the-singularity-isnt-near/>

¹³ Kai-Fu Lee. 2018. Ibid.

¹⁴ Ibid.

¹⁵ Ibrahim and al. (2015). *"big data on cloud computing: Review and open research issues"*. Information Systems. 47: 98–115. Last accessed on 10 may 2020:

<https://www.sciencedirect.com/science/article/abs/pii/S0306437914001288?via%3Dihub>.

¹⁶ Berman, Eli. 2018. *Small Wars, Big Data: "The Information Revolution in Modern Conflict"*. Audible. Audiobook narrated by John McLain. 13 hours 53 minutes.

THE SYNERGY BETWEEN BIG DATA AND AI

There's a mutual relationship between big data and AI, the latter depends heavily on the data for success, while the former often remains unactionable by organizations lacking the resources or technical capability to unlock its potential.¹⁷ Canada's size, CAF domestic obligations and continuous international engagement require the constant collection and acquisition of data. Then, victim of its own functional structure and inflexible network regulations, new data collections are still currently stored hastily according to their initial purpose with limited efforts to include standardised metadata and no reliable mechanism to mitigate duplication of datasets.¹⁸ Facilitated by a steady increase in storage capacity the accumulated sum of errors and omissions makes it impractical for human analyst to establish the structure required for advanced analytics, such as Randomized Controlled Data (RCD)¹⁹. Indeed, the data collected from integral or allied sources such as a single Light Detection and Ranging (LiDAR) mounted on an Unmanned Aerial Vehicles (UAVs) necessitate a daily storage capacity of more than 20 Terabytes (TB).²⁰ Before these raw returns can be transformed, assembled, and corrected in useful information such as inter-visibility and 3D visualisation products, it must first be transferred through narrow and highly demanded network. Fortunately, there are an emergence of new collectors, such as micro UAVs that mitigate this issue by providing live feeds of preformatted simplified imagery. While positive, these developments are mostly effective for limited tactical coverages and when the users remain in close range from the sensor.²¹

Despite numerous attempts by CAF and DoD, a single network domain providing access to Big Data at multiple levels of security classification is not yet available, which leads to limited situational awareness and unreliable command and control systems. For the CAF to effectively contribute to Canada's comprehensive situational awareness, it must therefore increase the timeliness and accuracy of its acquisition and integration of Big Data. The technical complexity is unlikely to decrease considering CAF published strategy to function within Joint Interagency

¹⁷ Kai-Fu Lee. 2018. "AI SUPER-POWERS, China, Silicon Valley, New World Order". Audible. Audiobook narrated by Mikael Naramore. 9 hours 28 minutes.

¹⁸ Canadian Armed Forces Data Strategy, Ibid.

¹⁹ Berman, Eli. 2018. *Ibid.*

²⁰ Canadian Armed Forces Data Strategy, Ibid.

²¹ Ibid.

Multinational and Public (JIMP) environments and its growing access to a wide array of sensors that generates data of heterogeneous technical specifications and that can be coded based on proprietary formats.²² This often constrain CAF decision making processes forcing Commanders to accept unnecessary risks and to take decisions with biased and partial information.

Without new avenues such as AI supported analysis, human analysts will be hard pressed to provide value added analysis such as isolating uncorrelated human behavior factors and to quantify the outcome of multiple operational assumptions.²³ Considering the possibility to locate AI and analytical platform close to the collection platform themselves, the ability to rapidly integrate new commercially available technology could bypass both the constraints of data choke points and limited access to military analysts: *“only the final information is transmitted back to the user. This allows for a massively scalable mesh network of powerful computers to do the number crunching without ever needing to deploy a server farm or command center.”*²⁴ Furthermore, it is recognised that emerging AI technology such as deep learning can now leverage large swath of raw data feed to accelerate its integral processing capacity, reducing the requirement to allocate large sums to finance associated research and studies.²⁵

Rather than giving up to fears that CAF analysts relevance will be challenged by future AIs, it rather appears constructive to seek possible synergies. Identifying processes, such as establishing Common Operating Pictures (COP) and decision making, where human professionals could maximize their time toward creative thinking, vulgarisation and contingency planning. For example, unable to achieve its mandated Full Operating Capability (FOC) in September 2019²⁶, the CAF Joint Targeting Intelligence Center (JTIC) commander submitted a Statement of Capability Deficiency statement (SOCD), highlighting the challenges to generate timely and accurate COP :

“Challenges in dynamically adapting to user needs and cognitive styles; facilitating the passage of information between levels of command, as well as with Domain Intelligence Centres, forward-deployed forces, OGDs, allies and partners supporting

²² Ibrahim and al. (2015).Ibid.

²³ Kai-Fu Lee. 2018. Ibid.

²⁴Department of Defense. 2019. “Artificial Intelligence and National Security”. Congressional Research Service. Last accessed on 06 may 2020: <https://fas.org/sgp/crs/natsec/R45178.pdf>

²⁵ Kai-Fu Lee. 2018. Ibid.

²⁶ Department of National Defence. 2017. “CDS Decision Brief on Targeting”. 25 Jul 2017.

*full-spectrum joint targeting, ... in intelligence domain integration to generate Common Intelligence Picture (CIP) and COP`.*²⁷

With regards to improve Command decision making process, CAF analysts would benefit from an early and automated list of possible outcomes generated by customised AI linked to multiple domains datalinks, increasing the work ratio involved in identifying and testing optimal courses of actions. Furthermore, by shortening the Observe, Orient, Decide, Adjust (OODA) loop commanders can also decide to reinvest the time gained to explore unlikely but yet dangerous scenarios.²⁸

AI AND INTERNATIONAL POWER BALANCE

Key differences of AI development and integration between the United-States and China will be highlighted by comparing their respective access to the four essential success criteria's identified by Kai-Fu Lee; a vast and organised societal database, continued governmental support, qualified technical manpower and a network of competitive start-up businesses.²⁹ Home to technological empires such as Google, Apple, Facebook, Netflix and eBay, Silicon Valley long offered a leading AI edge to the United-States. While it still attracts a large portion of the world scientific leaders across all the fields of AI, there are telltale signs of a rapidly closing gap with China. One of these indicators being the progressive loss of researches published in the United-States in comparison to China. Ignoring other factors, this trend indicates that China would succeed in achieving its world leading role in AI technology. Looking at the Kai-fu's first criteria, the United-States has access to less and more fractured societal datasets. This comparative disadvantage can be explained by its endorsement of liberalism policies, the respect of civil rights and a growing public wariness toward the militarisation of AI technology. For the same reasons, United-States AI policies are often drafted by experience politicians with little technical background to impose ethical and legal considerations to harness the rapid technological progress from a generally younger generation.

²⁷ Department of Defense. 2020. "*JTIC: FULL-SPECTRUM ADVANCED TARGET DEVELOPMENT`*". Statement Of Capability Deficiency. 10 Pages.

²⁸ Berman, Eli. Ibid.

²⁹ Kai-Fu Lee, Ibid.

A culture gap based on generational differences also exists in China, where representatives from the People's Republic of China (PRC) are undeniably older than the young and feisty generation that represent the backbone of the booming software and AI industry.³⁰ However, senior leaders have generally supported regional and industrial initiatives with investments rather than restrictions and encouraged local start-up to accept greater risk than their Silicon valley competitors.³¹ This cultural difference is complex but can be summarised by China's historical valorisation of reverse engineering and a greater tolerance by its citizens to prioritise social obligations over individual liberties.³² For AI specifically, Kai-Fu Lee identify the 2017 AlphaGo AI victory as China's equivalent to the United-States Sputnik moment.³³ Despite a comparative economical and technological losses in comparison with China, United-States selves imposed constraints could harvest long term benefits, such as an increased international credibility. Indeed, this data fragmentation, mostly absent in China, hold the indirect benefit of strengthening the safeguard of national, personal, and industrial databases against both conventional and unconventional threats.³⁴ Furthermore, solid policies are necessary to reassure the international community and the continued support from their traditional allies, including Canada.³⁵ As an example, the newly released USA Department of Defense Artificial Intelligence Strategy in 2018 offers interesting risk mitigations to resolve this technological quandary: “... *The intent is to combine the best from both humans and machines and thus balance imperatives of national security and legitimacy. To that end, the US AI Strategy commits to a human-centered approach to AI, and to developing guiding principles for using AI in a lawful and ethical manner*”.³⁶

Both China's all-in approach and United-States controlled integration already impacted Canada's decisions. The successive Canadian and American spying controversies involving

³⁰ Ibid.

³¹ Ibid.

³² Ibid.

³³ Ibid.

³⁴ Roland, Alex. “*War and Technology*.” Foreign Policy Research Institute, 2009.
<https://www.fpri.org/article/2009/02/war-and-technology/>

³⁵ Ibid.

³⁶ Department of Defense. 2018. “DoD Artificial Intelligence Strategy: Harnessing AI to Advance Our Security and Prosperity”. Conference Summary. Last accessed on 05 may 2020:
<https://www.nationaldefensemagazine.org/articles/2019/2/12/just-in-pentagon-releases-artificial-intelligence-strategy-to-stave-off-russian-chinese-advancements>

Huawei and the Canadian purchase of the F-35 as a component of the United-States 4th Generation digital battle network, are still relevant and influential. For CAF specifically, current military coalitions and interventions, such as Operation ATHENA (NATO) in Afghanistan, are often characterised by early successes and long-term stability difficulties.³⁷ This trend can be attributed to the relative simplicity for Superpower to rapidly establish their conventional superiority compared to the complex sociopolitical ramifications that they must decode for any hope of long-term benefits.³⁸ Leveraging AI to analyse Big Data, CAFs could either gain or maintain its relative capacity to generate strategic decisions. It would be better positioned to identify potential operational traps and identify the optimal regions or missions to deploy its limited armed forces. Moreover, potential time saved could enable Canadian leaders to engage in the required diplomatic negotiations.

PRACTICAL ISSUES TO CONSIDER

Non-weaponized narrow AI offers a range of possible benefits to CAF, such as improved and accelerated intelligence analysis, better cyber security, improved information management, additional logistics avenues, new strategies and tactics, and capable surveillance and reconnaissance autonomous systems. While remaining vigilant to limit our dependence with the US, new AI capabilities is pushing the argument for a CAF specialisation. Improving training and incorporation of new CAF soldier attributes will ensure a Force better positioned for the inevitable adjustments required to integrate narrow AI.³⁹ Improving the average mental resilience, digital dexterity, creativity, and emotional intelligence could facilitate an AI approach based on collaboration rather than defensive.

While beneficial, unfettered access to Big Data by AI could be detrimental to an organization. Trying to emulate China's AI strategy to maximise potential gains would mean a transparency and the greater risk to encourage micromanagement, abuse of authority and compromised individual privacy. CAF leaders must identify a threshold between organisational values and long-term relevancy. To highlight a possible avenue, a recent study National

³⁷ Lieutenant-General Mike Rouleau, Ibid.

³⁸ Berman, Eli. Ibid.

³⁹ Department of National Defense, (2014). "*The Future Security Environment*." Chief of Force Development. 17 Wing Winnipeg Publishing Office. Retrieved August 1, 2019, from http://publications.gc.ca/collections/collection_2015/mdn-dnd/D4-8-2-2014-eng.pdf

Geospatial Agency (NGA) determined that their standard analysts spent more than eighty percent of their workhours looking for the correct data. Amongst the report recommendations, the organisation invested massively in cross network visualisation and narrow AI algorithm accepting the initial risk of reduced accuracy in order to ensure a better return from their highly trained analysts. NGA's institutional leaders also demonstrated courage and audacity, a rare yet required quality for large organisations to successfully integrate AI platforms.⁴⁰ As an example, they accepted a significant and potential lengthy reduction in the quality and accuracy of their rapid topographic mapping to implement unproven algorithms such as automated feature classification. While still vastly inferior to the production generated from NGAs and CAF geospatial technicians, the United-States nevertheless stood up a new unique capability to produce automated map productions from commercial satellite imagery.⁴¹ This functionally narrow example is important to highlight the organisational danger to remain complacent toward a technological culture gap.

Understandably, the technical workforce invested in equivalent CAF map production afflicted concerns and sought to discredit the unproven automation and thus reinforce the current advantages of their existing production workflow. This defensive reaction is natural and should be expected based on the lessons from previous industrial revolutions.⁴² To emulate NGA's innovative approach, CAF senior leadership will be crucial to explain the risk of organisational inertia and the benefits to accept risk in certain areas or military functions to implement high risk, high reward technology such as AI and Big Data analytics. Key charismatic and influential figures must be in turn convinced and convincing. While it may be too early to declare victory, CAF's operation HONNOUR nevertheless demonstrated the amount of sustained effort required across the chain of Command to improve its organisational culture. The important lesson being that yes, the process may requires significant investment in time and resources but its possible for CAF to gradually shape its organisational culture. Through investment and institutional commitment to integrate non kinetic AI platforms across all operational functions,

⁴⁰ Scharre, Paul. 2018. "Army of None, Autonomous Weapons and the Future of War". Audible. Audiobook narrated by Roger Wayne. 13 hours 32 minutes.

⁴¹ Scharre, Paul. 2018. Ibid.

⁴² Schwab, Klaus. 2016. "The Fourth Industrial Revolution". World Economic Forum. Audiobook. 5 hours 32 minutes.

the CAF could develop a stronger and fit for purpose fighting force.⁴³ Fostering the ability to rapidly adopt the technology employed by our allies, limit the time lost in data mining and support leaders with faster and better access to information.

CONCLUSION

While ethical and legal considerations must be considered now for tomorrow's AGI and Super AI, the most difficult challenge for CAF will be to gradually change its culture to facilitate the structural changes required for an efficient integration of narrow AI non-weaponised technologies. In the Expeditionary Forces science fiction novels offer through humour a possible version of an eventual symbiosis between humans and AI's⁴⁴. Through an avalanche of Armageddon like adventures, the "normal guy" Joe Bishop (U.S. Col) and Skippy the Magnificent (Elder level AI) combine their almost symmetrically opposed skills to save the world against all odds. Possessing God like capabilities and an arrogance that translate in a never ending flows of insults, Skippy the Almighty is regularly humiliated by Col Joe Bishop whose only notable skills is to: "dream crazy monkey ideas."⁴⁵ Setting aside the fictional aspect, its interesting to observe that Joe's ability to use creative thinking is only made possible after he discover an AI that takes care of the tasks that used to monopolise all of he's time and attention, a scenario not that different from the 80 percent time lost by NGA analysts. To use well proven change management techniques for CAF specifically, institutional leaders should focus on short term achievable successes as way points to guide the difficult path required to adjust the Force to AGI and Super AI. The use of AI to partially automatize data mining and processes, to identify hidden correlations between data and mission parameters and to optimise the use of human analysts are achievable examples pending audacity and courage from influential defense leaders.

⁴³ United States Senate Hearing. *The Dawn of Artificial Intelligence*. Washington, D.C.: U.S. Government Printing Office, November 30, 2016, <https://www.govinfo.gov/content/pkg/CHRG-114shrg24175/html/CHRG-114shrg24175.htm>.

⁴⁴ Alanson, Craig. 2016. ``*Expeditionary Forces : Columbus Day*``. Audible. Audiobook narrated by R.C. Bray. 16 hours 23 minutes.

⁴⁵ Ibid.

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