



## ENSURING THE RESPONSIBLE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE IN THE CAF AND DND

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### JCSP 50

#### Service Paper

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**ENSURING THE RESPONSIBLE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE  
IN THE CAF AND DND**

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# ENSURING THE RESPONSIBLE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE IN THE CAF/DND

## AIM

1. This service paper recommends actions to ensure the responsible use of Generative Artificial Intelligence (GenAI) by the Canadian Armed Forces and Department of National Defence (CAF/DND).

## INTRODUCTION

2. Since the release of OpenAI's ChatGPT in November 2022, GenAI solutions are being routinely leveraged across nearly every industry in the world due to its ability to process natural language almost flawlessly.<sup>1</sup> Furthermore, GenAI is being leveraged for military applications to increase organizational efficiency, enable workload management, and expedite decision-making.<sup>2</sup> GenAI presents a tremendous opportunity for the CAF/DND to fundamentally modernize and optimize its processes, and is a viable approach to counter-balance ongoing personnel and financial constraints.<sup>3</sup>

3. As stated in the 2022 CAF/DND AI Strategy, the current approach towards adoption of Artificial Intelligence (AI) technologies is “*fragmented*” with each Component Commander independently investing based on their own needs.<sup>4</sup> Like most militaries, the CAF/DND has employed AI technologies for many decades as part of autonomous systems and other data-driven approaches. That said, GenAI presents both unique opportunities and risks that remain generally unknown to the CAF/DND. The readily available nature of commercial GenAI technologies such as ChatGPT for everyday use by CAF/DND members presents additional challenges that require a more comprehensive strategy emphasizing the uniqueness of GenAI.

4. This paper will first explain the unique features of GenAI and identify key risks associated with this technology. Second, by applying the CAF's five operational functions as a framework, this paper will recommend actions to ensure the responsible use of GenAI by the CAF/DND.

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<sup>1</sup> Tianyu Wu et al., ‘A Brief Overview of ChatGPT: The History, Status Quo and Potential Future Development’, *IEEE/CAA Journal of Automatica Sinica* 10, no. 5 (May 2023): 1122–36, p. 1122.

<sup>2</sup> Som Biswas, ‘Prospective Role of Chat GPT in the Military: According to ChatGPT’, preprint, 27 February 2023, p. 1.

<sup>3</sup> Murray Brewster, ‘As 2023 Dawns, Canada's Top Soldier Confronts a Long List of Worst-Case Scenarios’, *CBC*, 3 January 2023, <https://www.cbc.ca/news/politics/wayne-eyre-year-end-interview-1.6695469>; Murray Brewster, ‘Federal Government Looking to Cut \$1 Billion from National Defence Budget’, *CBC*, 29 September 2023, <https://www.cbc.ca/news/politics/department-national-defence-budget-billion-1.6981974>.

<sup>4</sup> Department of National Defence, ‘Artificial Intelligence Strategy’, 2022, p.2.

## DISCUSSION

5. Conventional software is developed by applying rules or algorithms that determine how input data is processed into an output. Comparatively, GenAI utilizes vast amounts of data to train software that self-generates patterns that form the basis for generating an output. In other words, conventional software is rules focused while GenAI is data focused. This latter technique is founded on the principles of deep learning neural networks and recent advancements in computational power and techniques have allowed more complex network models to be developed using vast sets of training data.<sup>5</sup> These models, referred to as Large Language Models (LLMs), essentially serve as a natural language prediction tool where an input such as a question or request can be used to generate an output in the form of text, images or videos.<sup>6</sup>

6. There are several aspects of GenAI technology that are critical to understand so that it can be responsibly employed in the CAF/DND. Due to its design, GenAI uses probabilistic optimization techniques to generate a unique output. This contrasts drastically to other techniques such as discriminative AI which use conditional probability to best determine the output.<sup>7</sup> For example, in a hypothetical scenario supporting the evacuation of NATO-affiliated Afghan refugees, GenAI could be employed to help organize large amounts of data into actionable categories based on evacuation priorities while discriminative AI is better suited to enable face recognition to speed up processing times. In other words, GenAI is distinct in its ability to generate unique outputs while other forms of AI generally reproduce an output from previously trained data (i.e., matching faces on a camera with faces from a database). Ultimately, given its evolutionary nature, it is important to understand the design and purpose of GenAI as it will impact how it can be effectively employed in the CAF/DND.

7. Another consideration related to the design of modern GenAI is in its use of word vectors to build the neural network models. Based on foundational papers written by Google in 2013 and 2017, LLMs apply a multi-dimensional approach to assigning vectors (i.e., coordinates) to each word in the training data.<sup>8</sup> Akin to neural network, words that have similar meanings or relations are placed closer together within the vector space. This enables the software to decipher an input and predict a logical output based on the established relationship (i.e., proximity) between words.

8. For example, requesting a GenAI to produce a recruitment poster for the CAF may generate content based on existing employment diversity data (e.g., male dominated within combat arms trades and female dominated within certain support trades). In other

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<sup>5</sup> Wu et al., 'A Brief Overview of ChatGPT', p. 1.

<sup>6</sup> Federal Office for Information Security, 'Large Language Models: Opportunities and Risks for Industry and Authorities', *Federal Ministry of the Interior (Germany)*, 2023, p. 5.

<sup>7</sup> Christopher M Bishop and Julia Lasserre, 'Generative or Discriminative? Getting the Best of Both Worlds', in *Bayesian Statistics 8*, ed. J M Bernardo et al. (Oxford University PressOxford, 2007), 13–34, p. 5-6.

<sup>8</sup> Tomas Mikolov et al., 'Efficient Estimation of Word Representations in Vector Space' (arXiv, 6 September 2013), p. 1-2; Ashish Vaswani et al., 'Attention Is All You Need' (arXiv, 1 August 2023), p. 1-2.

words, depending on the training or input data, it is likely for the LLM to closely associate the combat arms trades with men and the support trades with women based on the trained relationships between words. In essence, intrinsic bias contained within the selected training data, whether known or unknown, risks being transferred and perpetuated by the LLM. Similarly, even the most advanced LLMs have been found to occasionally produce factual errors, referred to as “hallucinations”.<sup>9</sup> This effect is generally attributed to the probabilistic nature of GenAI and the likely presence of errors or inaccuracies in the training data, leading to occasional errors in relatively known facts. Ultimately, GenAI by its design lacks the ability to apply judgement, reason, creativity, or the strategic foresight that is portrayed by human intelligence and that is critical to the CAF/DND.

9. To more effectively employ GenAI, many experts suggest hybrid intelligence or concepts of human-machine teaming (HMT) as an interactive approach for dealing with complex problems.<sup>10</sup> Rather than replacing human intelligence, the focus shifts on augmenting human intelligence by leveraging the strengths of modern GenAI technology using a mutually evolving and co-learning approach. For example, the US Marine Corps is currently exploring how military planners can work with LLMs during wargaming to enable a deeper understanding of adversarial and regional dynamics, leading to the development of more comprehensive courses of action.<sup>11</sup>

10. Similarly, the Canadian Joint Warfare Centre (CJWC) is experimenting on the use of GenAI as a collaborative and complementary methodology that upholds the integrity of human decision-making.<sup>12</sup> Specifically, using a real-time, task/experience-based methodology, CJWC found GenAI to provide significant value in the areas of planning and content analysis. Given these findings, GenAI could be particularly useful in optimizing the operational planning process or designing a tool to rapidly develop and analyze policies. From an individual user perspective, LLMs can increase productivity by searching through organizational and user information that it has been granted permission to access and subsequently generating an output based on user needs. For example, Microsoft Copilot can auto-generate responses to emails based on information it has collected from other emails, electronic documents, and transcripts from virtual meetings.<sup>13</sup> From a CAF/DND perspective, the necessity for GenAI to collect a vast amount of individual and organizational data to remain effective poses a serious concern

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<sup>9</sup> Wu *et al.*, ‘A Brief Overview of ChatGPT’, p. 1129; Federal Office for Information Security, ‘Large Language Models: Opportunities and Risks for Industry and Authorities’, p. 10.

<sup>10</sup> Emma Van Zoelen *et al.*, ‘Developing Team Design Patterns for Hybrid Intelligence Systems’, in *Frontiers in Artificial Intelligence and Applications*, ed. Paul Lukowicz *et al.* (IOS Press, 2023), p.4.

<sup>11</sup> Tate Nurkin and Julia Siegel, *Battlefield Applications for Human-Machine Teaming: Demonstrating Value, Experimenting with New Capabilities and Accelerating Adoption* (Washington, DC: Atlantic Council, Scowcroft Center for Strategy and Security, 2023), p.5.

<sup>12</sup> Jennifer Whiteley, ‘How the Canadian Joint Warfare Centre Is Utilizing Generative Artificial Intelligence for Organizational Tasks’ (Government of Canada, 10 October 2023), <https://www.canada.ca/en/department-national-defence/maple-leaf/defence/2023/10/canadian-joint-warfare-centre-utilizing-generative-artificial-intelligence.html>.

<sup>13</sup> Zachary Cavanell, ‘How Microsoft Copilot Works’, Microsoft, 16 May 2023, <https://techcommunity.microsoft.com/t5/blogs/blogarticleprintpage/blog-id/MicrosoftMechanicsBlog/article-id/266>.

with regards to security, privacy and other ethical considerations that will be addressed in the second part of this paper.

11. In pursuit of the defence of Canada and Canadian interest, the CAF/DND must also be cognizant of the existing and future adversarial use of GenAI technologies. Specifically, adversaries are employing GenAI in nefarious ways that enable competition below the threshold of armed conflict. For example, the RAND Corporation attributes GenAI as fueling the next generation of social media manipulation.<sup>14</sup> In fact, GenAI solves many of the limitations with previous attempts to manipulate social media in that it can produce seemingly authentic content in various media formats, lower human labour demand, deploy information operations campaigns at lower costs and defeat commonly available AI detection capabilities. Complimentary techniques that can be enabled by GenAI include social media “algorithm gaming” through bot accounts, creation of “cheap fake” media content (an evolution to deepfakes), “meme wars” that target specific demographics and the production of high quality “misinfographics.”<sup>15</sup> As demonstrated during recent election cycles in the US and Canada, these forms of public manipulation pose a real threat and can influence public opinions and erode confidence in government structures, including the CAF/DND.

12. Another adversarial use of GenAI is in the development and execution of cyber-attacks such as malware, denial of service, code injection and redirection attacks.<sup>16</sup> In regard to a GenAI arms race paradigm, LLMs have demonstrated an ability to be particularly useful for developing “polymorphic malware”, a form of malware that can self-evolve to evade security systems such as antivirus software. Malware developed through GenAI can be used to conduct attacks on both conventional IT systems and infrastructure as well as other LLMs. This can result in manipulation of the GenAI output leading to potentially disastrous effects, particularly when unknown to the user or organization.<sup>17</sup> GenAI technology cannot be avoided and the CAF/DND must ensure that this technology is developed and adopted in a responsible and secure manner.

13. Based on the discussion above, the second part of this paper applies the CAF operational functions framework to recommend actions towards ensuring the responsible use of GenAI by the CAF/DND. This framework was selected due to its applicability to the CAF/DND and focus on delivering military effects in alignment with a pan-domain operational approach.<sup>18</sup>

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<sup>14</sup> William Marcellino *et al.*, ‘The Rise of Generative AI and the Coming Era of Social Media Manipulation 3.0: Next-Generation Chinese Astroturfing and Coping with Ubiquitous AI’, *RAND Corporation*, 2023, p. 3-5.

<sup>15</sup> Harvard Kennedy School Shorenstein Center for Media, Politics, and Public Policy, ‘The Media Manipulation Casebook Code Book’, n.d., p. 11-17.

<sup>16</sup> Josh Baughman, ‘China’s ChatGPT War’ (China Aerospace Studies Institute, United States Department of the Air Force, 21 August 2023), p.4.

<sup>17</sup> Federal Office for Information Security, ‘Large Language Models: Opportunities and Risks for Industry and Authorities’, p. 12.

<sup>18</sup> Department of National Defence, ‘Pan-Domain Force Employment Concept’, 2023 (internal only).

14. Command: As a function, Command is responsible for the integration of all other functions.<sup>19</sup> As previously mentioned, many L1s have begun employing both commercial and defence-tailored GenAI under minimal direction from the CAF/DND. Between 2018-2022, the US, UK and Australia have all established Joint AI Centres within their respective defence departments to enable the development and operationalization of GenAI in a responsible and coordinated manner.<sup>20</sup> Although the CAF/DND has identified the need for AI within their 2022 AI Strategy document, there currently exists no roadmap on how to achieve this nor how to address the specific concerns with ethics, accuracy, security, bias, and trust with GenAI.

15. In November 2023, Canada, along with 20 other partner nations, signed onto the UK/US Guidelines for Secure AI System Development.<sup>21</sup> A centralized AI Centre within the CAF/DND would ensure that these guidelines are promulgated across the organization in an effective manner while providing a channel to communicate specific concerns regarding the use of GenAI for defence. Evidently, creation of an AI Centre will require additional personnel that specialize in technology management to respond to the demands across the L1s. The establishment of the Assistant Deputy Minister (Digital Transformation Office) or ADM(DTO) in December 2022 is likely the ideal organization to provide this centralized function while also empowering the L1s to continue to develop their own decentralized GenAI solutions based on evolving responsible development and use guidelines.<sup>22</sup> This centralized command and decentralized execution model is an effective approach for ensuring responsible use of GenAI while optimizing limited resources (**Recommendation 1**).

16. Act/Sense: Whether employed as a decision support tool to integrate effects, provide situational awareness on operations or to modernize administrative processes, a fundamental aspect of employing GenAI in the CAF/DND is in its ability to produce reliable and trustworthy output(s). Evidently, an unreliable or inaccurate output can drastically influence the CAF/DND's ability to Act or Sense. From an organizational perspective, it is the CAF/DND's responsibility to ensure that GenAI for defence purposes is developed using rigorous standards of design, testing and security, and partnerships with academia, industry and other governments enables best practices to be employed (**Recommendation 2**). From an individual or HMT perspective, the lack of transparency and explainability in a generated output continues to pose a serious challenge with GenAI technology. Although many members of the CAF/DND possess a conceptual grasp of GenAI technology, a significant portion of the design remains proprietary and the evolutionary nature of the technology is far too complicated to fully comprehend for most members.

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<sup>19</sup> Canada. Department of National Defence. *Close Engagement: Land Power in an Age of Uncertainty : Evolving Adaptive Dispersed Operations* (Ottawa: National Defence = Défense nationale, 2019), p. 42-43.

<sup>20</sup> Canada. Department of National Defence. 'Artificial Intelligence Strategy', p. 15.

<sup>21</sup> Canadian Centre for Cyber Security. 'Guidelines for Secure AI System Development', *Government of Canada*, 27 November 2023, <https://www.cyber.gc.ca/en/news-events/guidelines-secure-ai-system-development>.

<sup>22</sup> Canada. Department of National Defence. 'Message from the Deputy Minister Regarding the Digital Transformation Office', *Government of Canada*, 6 December 2022, <https://www.canada.ca/en/department-national-defence/maple-leaf/defence/2022/12/message-deputy-minister-digital-transformation-office.html>.

17. To address this, some researchers have begun to develop explainability techniques that force the LLM to explain its approach. This includes having the model identify key input words that contributed to the output, applying example-driven techniques to enable localized understanding, using mapping techniques to provide more comprehensive global explanations, or using a multi-model approach to evaluate the output.<sup>23</sup> For example, to enable target validation during operations, the CAF can create multiple LLMs that specialize in different functions such as operational planning, policy, legal and intelligence. Using multi-model analysis, these LLMs can be tasked to debate various targets allowing for planners and Commanders to evaluate the debate and outcomes. GenAI by design cannot truly replicate human intelligence in terms of judgement and creativity. Therefore, explainability in the output(s) is fundamental to ensuring responsible use within CAF/DND processes and operations to support the Act and Sense functions (**Recommendation 3**).

18. Shield / Sustain: There are two areas where the CAF/DND can invest to effectively shield GenAI technology and sustain its effective use. First, to enable relevancy and accuracy, the CAF/DND will need to invest in data engineers and database librarians to support continuous data integrity as models evolve. Information management has always been a challenge for the DND/CAF; however, the establishment of ADM(DTO) and partnerships with industry can enable a more deliberate approach to data management for GenAI (**Recommendation 4**). Second, in terms of shielding and sustaining human intelligence, guidelines need to be established that promote critical thinking when leveraging GenAI.<sup>24</sup> Ongoing research in critical thinking as it relates to disinformation and social media can likely provide insights into how these guidelines can be developed to support the responsible use of GenAI in the CAF/DND. This includes understanding GenAI learning processes, evaluating output, and reflecting on the intended or expected outcome (**Recommendation 5**).<sup>25</sup>

## CONCLUSION

19. Significant resource constraints have placed the CAD/DND in a vulnerable position as it relates to fulfilling its mandate, and GenAI offers a unique opportunity to modernize and optimize the organization by increasing organizational efficiency, supporting workload management, and expediting decision-making.

20. This paper discusses the unique features of current GenAI technology. GenAI is characterized by its ability to process natural language through word vector mapping and neural network modeling by applying probabilistic optimization techniques to create unique outputs. That said, current GenAI technologies pose several risks that are

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<sup>23</sup> Mohiuddin Ahmed et al., eds., *Explainable Artificial Intelligence for Cyber Security: Next Generation Artificial Intelligence*, Studies in Computational Intelligence (Cham: Springer International Publishing, 2022), p. 17-18.

<sup>24</sup> Jungbae Bang and Gyunyeol Park, 'Uprising of ChatGPT and Ethical Problems', *J-INSTITUTE* 8 (31 August 2023): 1-11, p.6-7.

<sup>25</sup> Marina Bilotserkovets et al., 'Encouraging Students' Critical Thinking Skills in the Midst of Information Wars', *Tréma*, no. 60 (29 September 2023), p. 4-5.



inherent to their design such as their tendency to adopt biases from training data, fabrication of factual errors, security concerns, exploitation from adversaries, and lack of transparency. By design, GenAI generally lacks the ability to apply judgement, reason, creativity, or the strategic foresight that is portrayed by human intelligence.

21. Ultimately, this paper recommends the immediate establishment of a Joint AI Centre within ADM(DTO) to work along our partners in academia, industry and other governments to develop and ensure the responsible use of GenAI.

## **RECOMMENDATION**

22. In line with the CAF/DND 2022 AI Strategy, it is recommended that a Joint AI Centre be stood-up immediately to ensure the responsible use of GenAI by the CAF/DND. Furthermore, this paper recommends the following actions for a Joint AI Centre to undertake:

- a. Provide centralized direction on the use of AI technologies while empowering decentralized development and employment across the L1s;
- b. Ensure that GenAI across CAF/DND is developed using rigorous standards of design, testing and security by facilitating partnerships with academia, industry and other governments;
- c. Research advancements in explainable techniques for GenAI and provide guidance on its effective use within the CAF/DND;
- d. Provide advice to CAF/DND on staffing requirements such as data engineers and database librarians, so that L1s can plan accordingly; and
- e. Research and establish critical thinking models to support CAF/DND members who are working with GenAI technology.

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