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CANADIAN ARMED FORCES OPEN-SOURCE SOFTWARE STRATEGY PROPOSAL

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Service Paper

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Canadian Armed Forces Open-Source Software Strategy Proposal

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CANADIAN ARMED FORCES OPEN-SOURCE SOFTWARE STRATEGY PROPOSAL

AIM

1. The aim of this service paper is to investigate the benefits of open-source software (OSS), analyse potential adoption strategies, and to provide recommendations to implement an OSS Strategy within the CAF.

INTRODUCTION

2. As the CAF moves towards a fully digitalized future, the financial cost and operational risk due to its complete dependency on proprietary software is increasing. To break this reliance on expensive, static, potentially insecure proprietary software, a different approach is required to transition from procuring proprietary software, to fully open-source software. The CAF should enact an OSS strategy for software that is in line with the GoC's future adoption of digitalization and open software requirements. OSS is cost effective, customizable, interoperable, secure, and would provide the CAF with a more resilient and longer lasting software ecosystem.

CONTEXT

3. OSS can be simply defined as software that is free to access, to distribute, and to modify.[1] More to the point, OSS uses open licences which require that the source code be provided to the customer and released broadly. On the other hand, proprietary software is developed under private licences, restricting access to its source code, and preventing other entities from copying it, changing it, or using it outside of its originally intended purposes. Proprietary software developers make customers dependent on their companies for support, maintenance, and upgrades.[2] This is what is referred to as vendor lock-in, where customers find themselves paying ongoing costs to the vendor and are unwilling or unable to invest in modernization or replacement software projects.[3] Vendor lock-in favours the companies, where they see the software as a product not unlike a piece of equipment the military would buy. Companies know that the CAF will pay for software, then continue paying for years for support, maintenance, and upgrades, so they are economically incentivized to only offer proprietary software solutions for CAF requirements. Proprietary software reduces the CAF's bargaining power, gives companies outsized competitive advantages when modernization projects are tendered, and increases costs for the CAF.[4] According to Lock-in *Strategy in Software Competition*,

> A software vendor can lock in customers in several ways: (1) by designing a system incompatible with software developed by other vendors; (2) by using proprietary

[1] Zhu, Kevin Xiaoguo and Zhou Zach Zhizhong. "Lock-in Strategy in Software Competition: Open-Source Software Vs. Proprietary Software." Information Systems Research 23, no. 2 (2012): 537.
[2] Ibid.
[3] Simon Forge. "The Rain Forest and the Rock Garden: The Economic Impacts of Open Source Software." Info Cambridge, England 8, no. 3 (2006). 23.
[4] Ibid., 536; Bjorn Lundell, Simon Butler, Thomas Fischer, Jonas Gamalielsson, Christoffer Brax, Jonas Feist, Tomas Gustavsson, et al. "Effective Strategies for using Open Source Software and Open Standards in Organizational Contexts: Experiences from the Primary and Secondary Software Sectors." IEEE Software 39, no. 1 (2022). 85.

> standards or closed architectures that lack interoperability with other applications; (3) by licensing the software under exclusive conditions.[5]

4. There are many pieces of software that exist in the CAF today that suffer from vendor lock-in, including and not limited to CFPAS, DRMIS, and HRMS. These programs and many others are essential to the conduct of administration within the forces. The CAF purchased these proprietary pieces of software, which remain static have quickly become outdated as the CAF's requirements have evolved. Since they are proprietary, the CAF is locked-in without committing to another expensive procurement project. The CAF and the GoC are not alone in their challenges with software procurement, where software is quickly outdated and clumsy with the rapid rate of technological advancement. Many world governments are enacting open-source software standards, for the many benefits that will be outlined below. [6] With the drafting of the *Government of Canada's Digital Playbook,* a guide to software development of the GoC, governmental policy on open-source standards is the future.[7] From the *GoC Digital Playbook*, the guideline to leverage open standards states:

> Our choices for hosting infrastructure, databases, software frameworks, programming languages and the rest of the technology stack should seek to avoid vendor lock-in and match what successful modern consumer and enterprise software companies would choose today. In particular, digital services teams should consider using open source [sic] software, cloud-based, and commodity solutions across the technology stack, because of their widespread adoption and support by successful consumer and enterprise technology companies in the private sector.[8]

5. Open-source projects, communities, and companies are continuing to increase in scale, scope, and popularity. According to the article *Takeoff of Open Source Software*, in September 2020 the open-source community "now boasts over 430,000 projects and 3.7 million registered developers"[9] If the CAF were to start using open-source requirements when procuring software, it would not limit available developers; if anything it would increase competition and lower costs.

DISCUSSION AND ANALYSIS

6. There are many reasons to switch to open-source software and away from the CAF's reliance on proprietary software. In this section, the benefits of open-source software will be explored, followed by an analysis of an open-source software strategy for the CAF. The benefits of open-source software are the cost, security, customizability, and interoperability. The strategy could be summarized as: software must be procured using open-source standards and licences ensuring the continued utility, interoperability, and security of the CAF's software ecosystem.

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[5] Zhu, Kevin Xiaoguo and Zhou Zach Zhizhong. "Lock-in Strategy in Software Competition…" 536.
[6] Osden Jokonya. "Investigating Open Source Software Benefits in Public Sector," *2015 48th Hawaii International Conference on System Sciences*, 2015, 2244.
[7] Government of Canada. *Government of Canada Digital Playbook*. Accessed 19 Jan 2022. https://canada-ca.github.io/digital-playbook-guide-numerique/en/overview.html
[8] Ibid., 4.1.
[9] Pankaj Setia, Barry L. Bayus, and Balaji Rajagopalan. "The Takeoff of Open Source Software: A Signaling Perspective Based on Community Activities." MIS Quarterly 44, no. 3 (2020): 1439.

7. The first benefit of open-source software is in its lifetime cost. Open-source software is cheaper than proprietary software, but in most cases, it is not free.[10] Open-source software would still necessitate the cost of development and the cost of purchase from a provider. In many ways, the initial cost of open-source and proprietary software would be similar. With open licences and provided source code, open-source software provides flexibility and cost savings over its lifetime. Open-source software would increase the CAF's bargaining power. With open-source code, CAF could conduct competitive procurement processes for the maintenance or upgrades to the software.[11] This is because a bid winning software company could use and modify the existing source code, drastically reducing its development costs, passing those savings onto the CAF. Open-source software would make replacement software projects much less likely. Replacing outdated and vendor locked software with a new software procurement project is expensive and time consuming. With proprietary software, it is required because the original software provider (OSP) holds the rights to the source code and licences. Either the OSP wins the new replacement software contract, undercutting the competition, or another company must start from scratch to build the replacement. Both options are expensive propositions for the CAF. Open-source software does not require ongoing usage or licensing fees. Software licences are a significant cost to any organization, and for the CAF the most obvious is the Microsoft licences used on DWAN systems. Open-source software would not require these ongoing licencing costs; instead, it would only incur the support and maintenance costs. Open-source software is cheaper, but it would require rethinking how the CAF does software procurement.

8. The next benefit that open-source software provides is in security. The first question that is asked when thinking of security and open-source software is, how can software be secure while the source code is widely known? If there are flaws and bugs that can be exploited in the source code, they will be easier to find in open-source software. The easier the bugs are to find, the quicker they are patched and fixed. Compared this to proprietary software where the source code is secret. Bugs and flaws that can be exploited are unknown to the customer, exposing the organization to unknown risk.[12] For either type of software, it is the data that needs to be protected. It is important that the access, distribution, and generation of data is done in a secure manner but obfuscating 'how' it is done is not necessary nor does it provide security benefits. Using CFPAS as a simple hypothetical example, the PDRs and PERs generated are Protected A or B once the member's information is written into the form. The software itself just creates the standardized forms for the user to fill out. How the software generates the form does not need to be kept secret. Since this software is proprietary, the source code could be insecure and be leaking information online or vulnerable to attack, and the CAF would be unaware. There is no incentive for the company to patch these vulnerabilities quickly, even when the customer is happy with the software while unaware of the flaws. Open-source software's bugs and flaws are patched quickly, because with many eyes on the problem the flaws are easily identifiable.

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[10] Bruno Rossi, Barbara Russo, Giancarlo Succi, (2012),"Adoption of free/libre open source software in public organizations: factors of impact", *Information Technology & People*, Vol. 25 Iss: 2. 157; OpenSource.com, "What is Open Source" Last Accessed 20 Jan 2022, https://opensource.com/resources/what-open-source; Osden Jokonya. "Investigating Open Source Software Benefits in Public Sector,"… 2244.

[11] Zhu, Kevin Xiaoguo and Zhou Zach Zhizhong. "Lock-in Strategy in Software Competition…" 537.

[12] Osden Jokonya. "Investigating Open Source Software Benefits in Public Sector," *2015 48th Hawaii International Conference on System Sciences*, 2015, 2243; Lorraine Morgan and Pat Finnegan, "How Perceptions of Open Source Software Influence Adoption: An Exploratory Study" (2007). ECIS 2007 Proceedings. 976.

9. OSS is more customizable than proprietary software. Since OSS's source code is readily available, that code can be modified at any point without paying for the right to do so. As requirements evolve, the CAF would be free to change their software ecosystem to meet their current needs, without spending significant resources.[13] Forced obsolescence can be avoided with OSS, where useful features can be added, bugs patched, or entirely changing the software from what the OSP provided.[14]

10. OSS will provide more interoperability within the CAF software ecosystem, and potentially with allied forces. By using open-source licensing, standards, and source code, software will be readily integrated into an ecosystem of like-programs.[15] New software can be developed to work with existing software easily, as the source code and standards are open. New software providers will not have to jump through legal and developmental hoops to get access to closed and proprietary software for integration purposes. Another challenge that faces many allied countries is inter-military interoperability when it comes to software compatibility. As militaries become more and more digitalized, they increasingly rely on software to process, distribute, and present data. Often the software militaries use is proprietary, with closed source code and communication standards. Working with other militaries is difficult with the current makeup of this island chain-like software ecosystem. More often than not, systems used by militaries are not compatible at all with other militaries, increasing complexity and reducing operational effectiveness. Using OSS would allow for allied systems to work together, especially if open (or at least shared) digital communications standards could be agreed upon and implemented. As stated before, it is the data that needs to be protected and the 'how' it is accessed and presented by software is not nearly as important. OSS would provide interoperability within our own software ecosystem, and potentially interoperability between partner militaries in the future.

11. The first step towards a CAF OSS strategy is understanding that vendor lock-in is by design and is not required for a software provider to be profitable. Vendors will trade short term profits for a long-term monopoly over provided software.[16] A CAF OSS Strategy should address this by requiring OSS in its procurement process, and incentivizing OSPs with long-term, performance-based support contracts. These support contracts would include services such as customer support, software maintenance, software customization, and software upgrades. They need to be performance based to allow the CAF to utilize the power of OSS to switch providers if the OSP cannot or will not meet its contractual performance obligations. This step will require policy coverage, forcing the issue to get as many software providers as possible to the table during software procurement.

12. Potential CAF Software Policy. All unclassified CAF software will be procured in a manner that will:

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[13] Osden Jokonya. "Investigating Open Source Software Benefits in Public Sector,"… 2243-4.
[14] Simon Forge. "The Rain Forest and the Rock Garden: The Economic Impacts of Open Source Software."… 22.
[15] Bjorn Lundell et al. "Effective Strategies for using Open Source Software and Open Standards in Organizational Contexts: Experiences from the Primary and Secondary Software Sectors."… 85; Osden Jokonya. "Investigating Open Source Software Benefits in Public Sector,"... 2245.
[16] Zhu, Kevin Xiaoguo and Zhou Zach Zhizhong. "Lock-in Strategy in Software Competition…" 537.

a. ensure all software source code is open, available, and reusable;[17]

b. ensure all software is developed under open distribution and open modification licences, with open standards; and

c. ensure all software has appropriate support, maintenance, and modification contract coverage.

13. The next step towards a CAF OSS strategy would be to investigate the various types of open licences that software could be developed under. This step would necessitate consultation with ADM(IM), ADM(DIA), and industry, including open-source software developers who may have not participated in bids for government software contracts up to this point. This consultation would inform the CAF on what industry would be able to provide with open licences. It would force a re-examination of the CAF software procurement process and result in a more open and competitive bidding process when including open-source software developers. For the CAF, the most beneficial type of licence would be one with a significant "copyleft" effect, where it is open to the highest degree possible.[18] An example of a copyleft licence would be one of the GNU General Public Licenses (GPL).[19] Another comes from the Government of Canada itself, with the Open Government Licence – Canada.[20] Understanding licences and consultation with industry will be essential in developing CAF OSS Strategy.

14. Potential CAF OSS Strategy. The rate of technological change is ever increasing. In order to fully implement the Department of National Defence and Canadian Armed Forces Data Strategy,[21] the CAF will need to transition from outdated and inflexible proprietary software to an open-source model that promotes increased utility, interoperability, and security. The CAF needs to adopt an open-source model of software procurement that will enable the forces to quickly adapt software to changing situations and requirements. The CAF's future software ecosystem needs to be secure, robust, and mutable, with interoperability between software and between systems as a central feature.

CONCLUSION

15. Although the world of open-source software development may be new to the CAF, it is a thriving community of projects and developers who are leveraging the strengths of OSS to great effect. The CAF faces many challenges including its reliance on outdated proprietary software, its move towards a fully digitalized future, and the continually restricted procurement competition resulting from vendor lock-in. The CAF should move to an open-source model of

[17] Government of Canada. *Government of Canada Digital Playbook*. Accessed 19 Jan 2022. 3.2.
[18] Bjorn Lundell et al. "Effective Strategies for using Open Source Software and Open Standards in Organizational Contexts: Experiences from the Primary and Secondary Software Sectors."… 86.
[19] GNU Operating System. "GNU General Public License" Accessed 20 January 2022. https://www.gnu.org/licenses/gpl-3.0.en.html
[20] Government of Canada. *Open Government Licence - Canada*. Accessed 20 Jan 2022. https://open.canada.ca/en/open-government-licence-canada
[21] Department of National Defence. *The Department of National Defence and Canadian Armed Forces Data Strategy*. Accessed 21 Jan 2022. https://www.canada.ca/en/department-national-defence/corporate/reports-publications/data-strategy/introduction.html

software procurement resulting in more economical, secure, customizable, and interoperable software. The resulting CAF software ecosystem would be robust and allow for adjustments to be made as requirements change and as technology advances. In order to accomplish a move to OSS, the CAF needs to implement both an OSS Policy and Strategy, in partnership with industry and key stakeholders within government.

RECOMMENDATIONS

16. There are many recommendations that result from this brief examination of a potential OSS policy and strategy. These recommendations will fall under three categories: further investigation, consultation with stakeholders, and the development of an OSS Policy and Strategy. The recommendations can be found below.

a. Further investigation is required into OSS integration into the CAF, and how the procurement process will have to change.

b. Further investigation will be required into what project requirements would need to be implemented for OSS procurement.

c. Further investigation into the appropriate licences and standards for use across the CAF's software ecosystem.

d. Consultation with key government stakeholders.

e. Consultation with software developers, including OSS developers.

f. Development and implementation of an OSS Policy.

g. Development and implementation of an OSS Strategy.

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