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## COMMERICALIZATION OF SPACE: HOW CAN THE RCAF BENEFIT

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### JCSP 45

#### Service Paper

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DS 545 Service Paper – Etude Militaire

## COMMERCIALIZATION OF SPACE: HOW CAN THE RCAF BENEFIT

By Major S.R. Lattemore

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## **AIM**

1. The aim of this service paper is to provide the Director General (DG) of Space with some options that the Royal Canadian Air Force (RCAF) should consider with the nascent reduced cost of space technology. By leveraging commercial opportunities, the RCAF will be able to provide the Canadian Armed Forces (CAF) with the required capabilities that are necessary to complete both domestic and expeditionary operations during a time when exploiting and defending space capabilities is not only the norm but absolutely necessary.

## **INTRODUCTION**

2. In February 2018, SpaceX successfully launched satellites into space at the fraction of the cost that the current rocket companies had in the past. The rate for launching a satellite into space used to range from approximately \$5,000 to \$9,000/lbs. Using their Falcon 9 boosters, a “launch costs an average of \$57 million, which works out to less than \$2,500 per pound to orbit.”<sup>1</sup> SpaceX only hopes to decrease this price in the future, which will make space travel and space exploration more affordable for all.

3. According to Canada’s new defence policy Strong Secure Engaged (SSE), the RCAF is required to “modernize its space capabilities and will take steps to protect these critical assets against sophisticated threats, while continuing to promote the peaceful use of outer space.”<sup>2</sup> With the development of less costly space launch capabilities, it is imperative that the RCAF take full advantage of this opportunity in order to fulfill its SSE mandate, but also to prepare for the repercussions this will have on the space domain as a whole.

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<sup>1</sup>Andrew Chaikin, “Is SpaceX Changing the Rocket Equation,” *Air & Space Magazine*, last accessed 12 October 2018, <https://www.airspacemag.com/space/is-spacex-changing-the-rocket-equation-132285884/>.

<sup>2</sup>Department of National Defence, *Strong, Secure, Engaged: Canada's Defence Policy* (Ottawa: Government of Canada, 2017), 15.

4. Research and development in the space business has grown exponentially in the commercial sector. Historically, national space agencies were the primary entities who could afford and support any space advancements. Moving away from relying primarily on government sponsored launch facilities, infrastructure, and propulsion capabilities is now the future of space. The private sector has taken on the challenge of designing and reinventing space capabilities which will have a greater impact on the industry than government would have had in the same amount of time. Now that private companies have ventured into this realm, the competition contributes to further developments and the continued reduction of overall costs.

5. As a result, conducting operations in space will become more common, because the “high cost of reaching orbit [was] the major factor preventing the large-scale exploration and exploitation of space.”<sup>3</sup> As a result, our allies and our adversaries will have easier access to the space domain. This not only encourages exploration, invention, research, but it also opens up the possibility of using space to preposition weapons to defend one’s own assets and as a deterrence. “ULCATS [ultra-low-cost-access-to-space] could enable entirely new military space missions that are currently impractical or unaffordable due to the high cost of launch and could result in more robust commercial space capabilities the military could leverage.”<sup>4</sup> Although we may not be at war in space, we certainly aren’t in a time of peace. Canada would still like to uphold the ideal of maintaining space as a peaceful area, however we must invest in capabilities to ensure this remains so.

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<sup>3</sup>Jonathan Coopersmith, “Affordable Access to Space,” *Issues in Science and Technology* 29, no. 1 (Fall 2012): 57.

<sup>4</sup>Todd Harrison *et al*, *Implications of Ultra-Low-Cost Access to Space*, (Washington D.C.: Center for Strategic and International Studies, 2017), 32, <https://aerospace.csis.org/implications-ultra-low-cost-access-space/>.

## DISCUSSION

### Space Launch Location

6. The idea of Canada developing its own space launch capabilities has been considered in the past. Canada decided that an investment in that type of research would not be necessary as we could rely on our allies to launch our satellites. “When Canada’s first satellite Alouette 1 was launched in 1962, it sat atop an American Thor-Agena launch vehicle, and since then, every Canadian satellite has flown on launch vehicles built and launched elsewhere.”<sup>5</sup> However in 2014 the sanctions against Russia, due to the country’s actions in Ukraine, impacted the launch of a Canadian satellite. This brings to mind again whether Canada is too reliant on other nations for this capability. A former director at the Canadian Space Commerce Association, Chuck Black, says that “a homegrown Canadian rocket would spur on the country’s space industry sector, as well as guarantee that Canada has assured access to space at least for smaller satellites.”<sup>6</sup> However, according to former Canadian astronaut and former president of the CSA, Marc Garneau, “Unless you are going to triple the budget of the space agency, it is better for us to focus on building the payloads.”<sup>7</sup>

7. Perhaps an option for the RCAF to consider is providing a launch location to all those companies with launch capabilities, similar to the Vandenberg facility operated by the United States Air Force (USAF). With the ongoing concern with national security in the Arctic, the need for satellites to be able to conduct persistent intelligence, surveillance and reconnaissance and communications in that region is becoming an imperative need. Establishing a launch facility further north would enable satellites to be launched into orbit at an inclination allowing for it to

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<sup>5</sup>Chris Gainor, “Searching for the Elusive Canadian Launch Vehicle – In the Archives”, *SpaceQ*, last accessed 11 October 2018, <http://spaceq.ca/searching-for-the-elusive-canadian-launch-vehicle/>.

<sup>6</sup>David Pugliese, “Does Canada need its own rockets to launch satellites,” *Ottawa Citizen*, last modified 27 July 2014, <https://ottawacitizen.com/news/national/does-canada-need-its-own-rockets-to-launch-satellites>.

<sup>7</sup>*Ibid.*

pass over the North Pole and require less propellant to reach the inclination of its final orbit.

“Happily, there are several ideal sites available on the southeast coast of Nova Scotia. An ideal site for launches to polar orbit has both open ocean and tracking stations straight to the south or the north.”<sup>8</sup> Now that commercial enterprises have developed a cheaper way to conduct business in space, they will continue to search for ways to reduce the cost of reaching orbit. Offering launch locations within Canada supported by the RCAF will provide another means to reduce the expense of doing business in space with a cost-effective option for space launch. This would also provide an indigenous location for the RCAF to launch future satellites.

### **Exchanges or Internships**

8. The RCAF needs to determine what its requirements and goals are for the space program. This will stem from a RCAF Space Policy, and will guide many decisions. However, regardless of the policy, we need to clearly articulate to industry where the technology gaps exist and work closely with them to aid in the development of those capabilities. Conversely, technologies currently exist which we could already exploit. “More so than most space-faring countries, Canada’s space industry [has] been highly influential and successful in leading technological developments that have provided the CAF with exceptional space capabilities.”<sup>9</sup> With the fast pace of changing technology, the RCAF needs to be at the forefront and gain access to those new technologies before they become old and perhaps obsolete. Using commercial off the shelf equipment should be the norm and not the exception.

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<sup>8</sup>Michael Byers, “There’s great potential for a SpaceX hub in Canada,” *Globe and Mail*, last modified 15 April 2017, <https://www.theglobeandmail.com/report-on-business/rob-commentary/theres-great-potential-for-a-spacex-hub-in-canada/article34554659/>.

<sup>9</sup>Kiernan McClelland, “Innovation of Defence Excellence Needs Start-Ups,” *SpaceQ*, last accessed 11 October 2018, <http://spaceq.ca/innovation-of-defence-excellence-needs-start-ups/>.

9. With that goal in mind and knowing that the RCAF currently leverages its relationships with other government departments, universities, the Canadian Space Agency (CSA) and its allies, we should take further advantage of commercial capabilities to improve the support available to the CAF members. With the promulgation of more space businesses and the ongoing competition that spurs development, the RCAF should create exchange positions or internships imbedded with these businesses at all levels. Members should be integrated with the research, development, design, construction, operations, and use of space assets. Only with continued exposure to these aspects, will members be aware of the future capabilities and uses of space assets. More importantly they will know how to leverage these capabilities for the CAF. In conjunction with these learning opportunities, the member should be encouraged and supported in their findings and recommendations to the RCAF upon their return.

10. Strategic placement of exchanges and internships may have a secondary positive impact on recruitment and retention within the CAF. Targeting future members who want to serve their country but yearn to have a career within the space field, may now consider the RCAF as a career option. We need to be conscious of the needs of future prospective employees. “There’s also the optics of how students in universities today see government support. The signal the government continues to send with respect to the space program is such that many will leave Canada to work in the U.S. and elsewhere.”<sup>10</sup> Knowing that there are space opportunities with exposure to cutting edge technology developments, may be sufficient to attract a new generation of RCAF members.

## **Small Satellites**

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<sup>10</sup>Mark Boucher, “New Canadian Space Strategy Not Ready- Exclusive,” *SpaceQ*, last accessed 11 October 2018, <http://spaceq.ca/new-canadian-space-strategy-not-ready/>.

11. Although the Department of National Defence possesses only one military satellite to protect and monitor, Sapphire, the CAF still remains responsible for the security of the nation and all its interests. This would include all Canadian satellites, governmental, commercial, private, industry, and with which we have international agreements and partnerships. Since access to space opens up doors for all, including those who will exploit it, the military needs to be prepared for defending our own assets and those we leverage. Although a space-based kinetic ground attack system, kinetic missile defense system and anti-satellite capability will continue to be less expensive and therefore more feasible, the political and legal repercussions are beyond the scope of this paper.

12. The RCAF is challenged with the responsibility of protecting Canadian space assets and interests. As a nation, we have become reliant on the capabilities of space not only for military use but for our nation's economy and security. "Telecommunications, the internet, weather forecasting, banking, aerial monitoring all depend on satellites that Canada has either sent into space or, in the case of the United States-operated Global Positioning System constellation, depends on."<sup>11</sup> As a result, we must take steps to prepare for and prevent an attack by our adversaries in orbit. "The SSE policy, though not comprehensive in addressing how Canada will defend against such counter-space threats, sets the tone for increased co-operation with the United States and allies in deterring such conflict."<sup>12</sup> Not only do our adversaries understand our reliance on space capabilities, but with the dawn of increased commercialization of space, it has become easier to launch satellites which may or may not be a threat to our own. "China and

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<sup>11</sup>Daniel Lang and Canada. Parliament. Senate. Standing Committee on National Security and Defence, *Military Underfunded: The Walk Must Match the Talk* (Ottawa: Standing Senate Committee on National Security and Defence, [2017]), 29, [https://sencanada.ca/content/sen/committee/421/SECD/Reports/DEFENCE\\_DPR\\_FINAL\\_e.pdf](https://sencanada.ca/content/sen/committee/421/SECD/Reports/DEFENCE_DPR_FINAL_e.pdf).

<sup>12</sup>Charity Weeden, *Strong, Secure, Engaged in a Threatened Space Domain* (Calgary: Canadian Global Affairs Institute, 2018), 5, [https://www.cgai.ca/strong\\_secure\\_engaged\\_in\\_a\\_threatened\\_space\\_domain#Filling](https://www.cgai.ca/strong_secure_engaged_in_a_threatened_space_domain#Filling)



Russia have been conducting highly sophisticated on-orbit activities that could enable them to maneuver their satellites into close proximity of ours, posing unprecedented new dangers to our space systems.”<sup>13</sup> Additionally, those nations can take advantage of the recent reduction of cost for space launches by placing more assets in space under the auspices of a commercial satellite company when in fact it has an alternative mission set. Therefore, the RCAF should leverage commercially designed satellites to aid in preparing for this threat.

13. There are two ways the RCAF could contribute to defending our space assets, both using small satellites: designing satellites specifically for on-orbit training and designing fixer satellites. First, we need to recognize that there are satellites that have been designed to maneuver in space however their intent is not always known. “The problem is that any satellite that can maneuver itself very close to another one, and may have small arms or probes to physically interact with its target, is inherently capable of being a weapon.”<sup>14</sup> Knowing that this is a major threat to military and commercial assets, operators of current satellites need to know how to identify, mitigate and deter on-orbit threats. In keeping with our current partnerships with the United States, the RCAF could provide a valuable commodity to the current training in this domain conducted by Air Force Space Command (AFSPC) and Air Combat Command (ACC). Their current training model for defence against an on-orbit threat is through live, virtual and constructive simulation. The live aspect can only be conducted by satellites that are available for this use, so providing satellites that have reached the end of their life cycle has been the solution. However, leveraging commercial advancements in both small satellite research and development

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<sup>13</sup>RadioFreeEurope, “U.S. Unveils Plans for Space Force to Counter Russia, China ‘Threat’,” last accessed 11 October 2018, <https://www.rferl.org/a/u-s-unveils-plans-for-space-force-to-counter-russia-china-threat-/29422750.html>.

<sup>14</sup>Joseph Trevithick, “Russia Has Four Potential “Killer Satellites” In Orbit, At Least That We Know About,” *The Drive*, 16 August 2018, <http://www.thedrive.com/the-war-zone/22941/russia-has-four-potential-killer-satellites-in-orbit-at-least-that-we-know-about>.

and the nascent reduced launch costs, the RCAF could provide these necessary satellites to allow the operators to train as we fight. Knowing that Canada wants to promote the peaceful use of space, this would contribute to the training required to defend against adversarial actions and we would ultimately benefit from the skills earned by the USAF satellite operators.

14. Another way that the RCAF should leverage the commercialization of space is through the development of small fixer satellites, or space-based repair satellites. As mentioned previously, with the decreased cost of space launch comes increased access to space. This would allow for the launch of spare satellites and parts as well as satellites dedicated to the maintenance of other satellites. “Sending manned missions to examine satellites and other space objects and potentially make repairs or modifications has historically been costly and complicated.”<sup>15</sup> Capitalizing on the success of the Canadarm and Canadarm 2, using robotics to assess issues and replace parts would prolong the life of satellites at a fraction of the price. This would guarantee that satellites could continue to provide the capabilities to support the CAF and the Canadian population.

## CONCLUSION

15. The RCAF needs to remain relevant and realistic in the way it approaches the use of space especially now that space is rapidly becoming easily accessible and a more commercialized domain. With the recent dramatic reduced cost of space launches by SpaceX, comes the increased access to space for all. The development of space capabilities will only increase as the private sector takes on a more prevalent role, ultimately creating a more congested and contested domain. This increased access will create challenges which the RCAF

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<sup>15</sup>*Ibid.*

and CAF must be prepared to address but also capitalize on in order to remain relevant and realistic.

16. “The reduced cost of launching into orbit opens a new frontier to every single corner of exploration.”<sup>16</sup> This is good news for space research and development and the advancement to improve the future of humankind. However, “[the] disruptive forces that drive the need for change to our space architectural strategy are already evident...Space is too important to the national security of our nation for us not to adapt until after change is upon us.”<sup>17</sup> As a result, SSE has challenged and empowered the RCAF to ensure the safety and security of our space capabilities. With the mission to “defend and protect military space capabilities, including by working closely with allies and partners to ensure a coordinated approach to assuring continuous access to the space domain and space assets,”<sup>18</sup> the RCAF needs to posture itself so that it can accomplish this goal now.

## **RECOMMENDATIONS**

17. DG Space should consider leveraging the commercialization of space to guarantee future use of space capabilities by the CAF by contributing to advancements, and capitalizing on opportunities and partnerships. This will improve our ability to defend our assets. This can be accomplished by creating launch locations within Canada, increasing the number of exchange positions or internships with commercial enterprises, and investigating the opportunities that small satellites could provide in both on-orbit training or space-based repair satellites.

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<sup>16</sup>Jonathan Coopersmith, “Affordable Access to Space,” *Issues in Science and Technology* 29, no. 1 (Fall 2012): 60.

<sup>17</sup>Ellen Pawlikowski, “Space Disruptive Challenges, New Opportunities, and New Strategies,” *Strategic Studies Quarterly* 6, no. 1 (Spring 2012): 52, <https://search-proquest-com.cfc.idm.oclc.org/docview/926974740?accountid=9867>.

<sup>18</sup>Department of National Defence, *Strong, Secure, Engaged: Canada's Defence Policy* (Ottawa: Government of Canada, 2017), 111.



## BIBLIOGRAPHY

- Boucher, Mark. "New Canadian Space Strategy Not Ready – Exclusive." *SpaceQ*. Last accessed 11 October 2018, <http://spaceq.ca/new-canadian-space-strategy-not-ready/>.
- Byers, Michael. "There's great potential for a SpaceX hub in Canada." *Globe and Mail*. Last modified 15 April 2017. <https://www.theglobeandmail.com/report-on-business/rob-commentary/theres-great-potential-for-a-spacex-hub-in-canada/article34554659/>.
- Canada. Department of National Defence. *Strong, Secure, Engaged: Canada's Defence Policy*. Ottawa: Government of Canada, 2017.
- Chaikin, Andrew. "Is SpaceX Changing the Rocket Equation." *Air & Space Magazine*. Last accessed 11 October 2018. <https://www.airspacemag.com/space/is-spacex-changing-the-rocket-equation-132285884/>.
- Coopersmith, Jonathan. "Affordable Access to Space." *Issues in Science and Technology* 29, no. 1 (Fall 2012): 57-62. <https://search-proquest-com.cfc.idm.oclc.org/docview/1284606780?accountid=9867>.
- Gainor, Chris. "Searching for the Elusive Canadian Launch Vehicle – In the Archives." *Space Q*. Last accessed 11 October 2018. <http://spaceq.ca/searching-for-the-elusive-canadian-launch-vehicle/>.
- Harrison, Todd, Andrew Philip Hunter, Kaitlyn Johnson, and Thomas G. Roberts. *Implications of Ultra-Low-Cost Access to Space*. Washington D.C.: Center for Strategic and International Studies, 2017.
- Lang, Daniel and Canada. Parliament. Senate. Standing Committee on National Security and Defence. *Military Underfunded: The Walk Must Match the Talk: Report of the Standing Senate Committee on National Security and Defence*. Ottawa: Standing Senate Committee on National Security and Defence, 2017. [https://sencanada.ca/content/sen/committee/421/SECD/Reports/DEFENCE\\_DPR\\_FINAL\\_e.pdf](https://sencanada.ca/content/sen/committee/421/SECD/Reports/DEFENCE_DPR_FINAL_e.pdf).
- McClelland, Kiernan. "Innovation of Defence Excellence Needs Start-Ups." *SpaceQ*. Last accessed 11 October 2018. <http://spaceq.ca/innovation-of-defence-excellence-needs-start-ups/>.
- Pawlikowski, Ellen, Doug Loverro, and Tom Cristler. "Space Disruptive Challenges, New Opportunities, and New Strategies." *Strategic Studies Quarterly* 6, no. 1 (Spring 2012): 27-54. <https://search-proquest-com.cfc.idm.oclc.org/docview/926974740?accountid=9867>.

Pugliese, David. "Does Canada need its own rockets to launch satellites?" *Ottawa Citizen*. Last modified 27 July 2014, <https://ottawacitizen.com/news/national/does-canada-need-its-own-rockets-to-launch-satellites>.

RadioFreeEurope. "U.S. Unveils Plans for Space Force to Counter Russia, China 'Threat'." Last accessed 11 October 2018. <https://www.rferl.org/a/u-s-unveils-plans-for-space-force-to-counter-russia-china-threat-/29422750.html>.

Stockdale, Philip, Scott Aughenbaugh, and Nickolas J. Boensch. "Low-Cost Access to Space: Military Opportunities and Challenges." *Defense Horizons* no. 83 (2018): 1-16. <https://search-proquest-com.cfc.idm.oclc.org/docview/2012832183?accountid=9867>.

Trevithick, Joseph. "Russia Has Four Potential "Killer Satellites" In Orbit, At Least That We Know About." *The Drive*. Last accessed 11 October 2018. <http://www.thedrive.com/the-war-zone/22941/russia-has-four-potential-killer-satellites-in-orbit-at-least-that-we-know-about>.

Weeden, Charity. *Strong, Secure, Engaged in a Threatened Space Domain*. Canadian Global Affairs Institute, 2018. [https://www.cgai.ca/strong\\_secure\\_engaged\\_in\\_a\\_threatened\\_space\\_domain#Filling](https://www.cgai.ca/strong_secure_engaged_in_a_threatened_space_domain#Filling)