

QShift Inc.

# Canadian Space Strategy

Input to the Canadian Space Advisory Board

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## Introduction

### Crisis

The space industry in Canada is in crisis. MDA has become a U.S. company, Honeywell has completed their purchase of ComDev. Telesat has been foreign owned for over a decade. These three companies represent about half of Canada's reported space industry by revenue.

Our procurement process has hamstrung the rest of the players, and is a large barrier to new SMEs. Without vision and national support, investors and entrepreneurs that might choose Canada are instead backing new enterprises in other countries.

Further, over the past couple decades, large employers like Telesat, MDA and ComDev have trimmed workforces and slowed hiring. This has led to an aging workforce that is now on the verge of retirement with not enough mid-level talent to fill the gap. At Telesat some 80% of staff are eligible for retirement within the next 3-5 years.

The "brain-drain" is also rapidly increasing in the space sector. This is partly due to the above mentioned aging work-force. With fewer jobs coming available, bright young engineers are leaving the country to find work. They are also leaving simply for more exciting and innovative opportunities. California based Deep Space Industries has several Canadians in very prominent positions, as does Planet, Space X, Moon Express, Planetary Resources, ESA and others. If Canada cannot offer similarly exciting opportunities, we will continue to lose our most innovative thinkers.

### Differences Among Sectors

Talk of "the space sector" is misleading and is starting to become a challenge of itself. The sector is divided into many subsectors that serve very different requirements and have very different needs. There are some similarities and synergies, but largely the needs of a satcom company for example, are far different from the needs of an astrophysicist.

Even within the commercial sector, the concept of support for industry is quite different if you are considering a satcom operator or an earth observation company or a startup designer of a new instrument.

Three critical sectors within space that the SAB should address:

1. Satcom: representing roughly 80% of the space industry by revenue, satcom is the mainstay of space, and the source of success for Telesat, MDA, ComDev, and many other Canadian space companies. Satcom needs sustainment and incentives to continue innovating. The recently formed Centre of Excellence for digital satellite communications payloads funded by the Government of Quebec is a good example of the type of support required. Satcom needs Canada to make a long term commitment to staying at the forefront of this essential sector.



2. Earth Observation: in an emerging stage, EO is poised to repeat the success of Satcom. MDA, Urthecast and GHGSat, are three examples of companies poised to profit from the EO sector. This industry will benefit from government acting as a customer, and from government investment in supporting development of companies that utilize and commercialize the vast amounts of EO data. As in Satcom, it's not the just data itself, but also the use cases that the data enables that will make the sector a success. EO needs investment in developing and marketing applications for data as much as it needs hardware investment.
3. Space Resources: When Goldman-Sachs starts discussing the profitability of using resources in space, it is safe to say that it is time to consider it carefully. Canada is in the unique position of being a world leader in both terrestrial mining and space utilization, marrying the two should be a simple step for us, and a bold move towards an innovative future. This sector needs stable long term funding, ideally under commercial leadership in a PPP or Crown Corp, or a Luxembourg-style investment. It also requires new legislation to protect commercial interests and investment.

Of course, there are other sectors, but these represent the Big 3 as it pertains to commercialization and potential for innovation.

## Two Success Stories

The stories of Telesat and Space X are useful to examine when attempting to strategize about how to build new successes in space.

### Telesat [1]

Established in 1969, *by an act of Parliament*, Telesat operated as Crown Corporation for most of its history. It enjoyed a Canadian monopoly in satellite communications until March 1, 2000. It wasn't until 2004 that another operator entered the market, and given the high barrier to entry and the long period of infrastructure building and spectrum licensing, it's no surprise that Telesat is still an effective monopoly in Canadian satellite communications.

Despite the monopoly, Telesat was struggling financially in the early years and survived largely on government agency and other Crown Corporation contracts. It was not until the advent of satellite television in the 1990's that Telesat started to enjoy real success, with Bell Expressvu as their anchor customer.

The lesson to be learned is that Telesat took 34 years as a monopoly in the Canadian market to become a global success. It's only through sustained government support that Telesat could endure the early years of the developing satcom industry to make it to a lucrative stage.



## Space X

Space X is the prime example of a new space success. They have accomplished feats that some experts thought were impossible and are capturing market share by offering a disruptive product at a lower price point.

They can be innovative because the control rests with the ownership team. They have and still do struggle financially. The extent to which is unknown as they are not a publically traded company and therefore do not report numbers.

What is known is that the success has come through sustaining losses in the early years and through large investments, such as the \$1B invested by Google in 2016. In April 2017, Space X launched its first US government satellite, opening themselves up to the largest customer in the world. It's still not clear however, whether Space X is profitable or not.

***Telesat and Space X are two examples of space successes. The key is that both successes came from very high initial investment, relentless pursuit of a vision, the corporate agility to pursue that vision, and after more than 10 years of losses. Expecting major space start-ups to be profitable any other way is overly optimistic. Investments must be made for the long term, and the body implementing the goal must have the agility to make “course adjustments” if and as necessary.***

## Action Imperative

Development of a Canadian space policy has been stuck at the consultation stage for over a decade. The 2017 SAB needs to recognize that in this iteration of the process, actions and results are critical – something MUST be done beyond just another policy document.

The Emerson Report was produced after a lengthy analysis of the sector and extensive set of consultations with industry. Very little has changed in that time and industry will have very similar inputs now as they did then. Frankly, I expect most companies will start with their Emerson submissions and rehash those same concerns for this consultations. A thorough review of those submissions would be as beneficial to the process as the current consultations.

With the mind toward action, the remainder of my submission focusses on specific actions that Canada can take to improve our innovativeness in space. The first section deals with smaller scale foundational programs that will prepare the Canadian workforce and signal a pivot to more innovative models for the sector. These sections can all be intermixed in a synergistic way. The subsequent sections are “Bold Ideas”. Annex A was added as a result of discussion at the Youth roundtable on 18 May. It contains some rough suggestions of possible concrete targets to assign to the seven Objectives and Goals.

## Small Ideas that Add Up

The ideas in this section are comparatively low cost ideas that will have long term benefit for the Canadian space industry. All four can be implemented separately (some are currently in the works by various organizations) or combined to maximize economies of scale.



## Space Campus

The International Space University is a prestigious (and expensive) program that Canada has supported through scholarships for a long time. While the goals of ISU are laudable, and the value of having Canadians attend is evident, our support has perhaps been larger than it needs to be, and sends a lot of Canadian dollars out of the country. A collaboration with Canadian universities could offer a similar hi-intensity, incubator-type program, while also helping Canada address the looming experience gap.

The Space Campus would be an innovation hub, and offer high quality space education and research, focused on Canadian challenges. The institute could still invite foreign students and house a space-focused accelerator in addition to the campus. Courses offered could be “for-credit” towards undergraduate or graduate degrees, or for professional development.

The Campus should follow the multi-disciplinary model from the ISU, offering courses that cover law, policy, international agreements, as well as technology that ranges from hands on technical workshops to high level theoretical design. Integration of technical and non-technical students would be a unique feature of the campus.

## Open Innovation

The Canadian Satellite Design Challenge (CSDC) is an opportunity for Canada to establish a national, ongoing Cubesat program. The competition model spurs students’ innovation in technology as well as finance. If the recently announced Canadian Cubesat Program (CCP) can at all be changed, I highly recommend reinventing it as a competitive model based on the CSDC. A letter describing the value that the CSDC model could provide to CCP accompanies this submission.

Moving forward, other space technologies will benefit greatly from competition models, such as:

- Robotics
- Rocketry
- Rovers
- Applications

NASA’s Space Apps Challenge is a particular success, engaging over 20,000 people worldwide in 2017. As an incubator program, the hope is that teams build solutions that eventually become companies. Waterloo’s Skywatch is a prime example in Canada.

For Canada, with an abundance of EO data and as-yet-limited uses, government could launch an inter-agency “Canadian Space Apps” to spur application development and incubate new ideas for EO data.

Open Innovation requires the ability to try, test and refine ideas. Rocketry specifically has an additional challenge to innovating in Canada and that’s the lack of a safe, regulated, designated space launch area.



Open innovation models could be combined with the Space Campus, using the campus as a key training and evaluation facility and eventually as an accelerator hub.

### Space Incubator

It is reported that the CSA is exploring a space focused incubation centre for Canada. Following on similar successes such as the UK's Space Catapult and ESA's Business Incubation Centres (ESA-BIC).

As an ESA member state, Canada is eligible to host an ESA-BIC. ESA-BICs are funded by ESA for 3 years and provides funding for up to 10 startups per year. The startups are given licence to ESA IP and supported in developing a commercial offering using that IP.

Canada may need to contribute the like amount to ESA, but that would allow Canadian startups to access a lot of IP that's currently unavailable to them. Given the right partnerships with space and secondary industries, the additional cost to operate an ESA-BIC would be on the order of 3-4 FTE's plus office space and equipment for the admin team and startups.

ESA-BICs are proliferating throughout Europe. There are currently 16 with more in development. The success rate of startups is also high: 80% of graduating companies are still in operation after a year. An ESA-BIC in Canada could be centralized in a single location, or distributed in various manner.

The ESA-BIC idea meshes very well with the Space Campus as the campus could provide the space for start-ups, mentorship, training, and test facilities. Other incubator models could also be explored that don't leverage the ESA model.

### Progressive Procurement Models

Startups and SME's are hindered by the current procurement process. Large incumbents score very highly on the experience category and nudge small enterprises out. There needs to be a method for entrepreneurial endeavors to get seed funding and have reasonable expectation that success will earn them more funding.

This could be the model adopted by the Space Incubator or CSA in general:

- Accept a certain number of business concepts at "Phase 0"
- Provide funding for feasibility and early R&D
- At subsequent funding rounds, have the companies competing against their own performance rather than broadly within industry
- Each funding level would be more and more stringent and could require greater external investment to advance
- Each funding level should have increasingly flexible timelines and values to address the variability in the business ideas



In a high risk industry, sometimes competition risk is a hindrance to development, rather than a benefit.

### Satcom Research Centre

It is unclear which agency in Canada now owns the national mandate for researching and developing satcom technologies. The CRC has divested itself of satcom, and CSA has little in the way of a structured program. The result is an ailing satcom industry and critically low level of workforce expertise.

For Canada, being so reliant on satellite for critical communications infrastructure, it's mind-boggling that there is no central, national body with a good understanding of the challenges in the industry and the ability to evaluate emerging technologies.

With the advances being made in digital payloads, electronically steered arrays, LEO constellations, quantum encryption and so many other disruptive technologies, it is vital to Canada's security and economic prosperity that we understand these technologies, position our nation to take advantage of them, and provide opportunity for our companies to profit from new developments.

The organization would:

- Collaborate with industry on R&D
- Conduct independent R&D
- Test and validate 3<sup>rd</sup> party equipment and technologies
- Coordinate R&D efforts in Canadian universities
- Provide training for engineers and technicians
- Provide technical support for international spectrum management analysis

The centre could be under NRC, CSA, or re-established under CRC, or created as an entirely new entity, but it is essential for Canada and Canadians. This can also be easily combined with the Space Campus idea and with the Satcom Megaconstellation idea.

### Bold Idea – Satcom Megaconstellation

Telesat has the global priority in non-geosynchronous satellite communications in Ka band. These LEO megaconstellations are promising higher throughput at lower cost and lower latency than traditional satcom. There is a real potential for these systems to provide affordable broadband everywhere on the Earth.

The success of O3b has mitigated many of the major challenges that face the deployment of these megaconstellations. There is still much to be developed, and a great opportunity for Canada to invest in creating new jobs while at the same time revitalizing the critical satcom sector.

The competition in this emerging LEO constellation sector is fierce, with similar initiatives being aggressively pursued by OneWeb/Intelsat, O3b/SES, LEOSat, Space X, Boeing, Huawei and



many others. With the international priority in the most favorable spectrum, Telesat stands to corner the broadband by satellite market.

The venture is still expensive and not absent of risk. Canada's opportunity here is to sufficiently de-risk the venture in a way the most benefits Canada. The processes and approaches required for these LEO constellations will revolutionize the greater satellite industry.

Canada should back a major manufacturing plant such as that being developed for OneWeb in Florida. [2] Canada should also forge the connection between satcom and networking through cluster-type arrangement. The networking portion of megaconstellations is a major challenge to their success and there is potential for collaboration and synergy with terrestrial networking.

There are many potential commercial partners, Canada's MDA, ComDev and Magellan would all be interested. It could be an ideal opportunity for major ITB-owing companies such as Lockheed or Boeing to invest in Canada and still expect significant immediate and future return on investment.

Benefits for Canada include:

- Large state-of-the-art satellite manufacturing capability
- Large number of highly skilled jobs
- Advance satellite manufacturing IP
- Advanced satellite communications development
- Advanced broadband networking capability
- Potential Spin-offs and Spin-ins with terrestrial networking
- Development of intersatellite link technology (RF or optical)

Very few of these constellations can co-exist, and likely only one in each of Ku and Ka band. This makes Telesat's priority licence especially valuable. There is an enormous potential that these constellations replace most satcom systems in current use.

This is Canada's opportunity to re-establish dominance in the Satcom industry. It cannot be stressed enough that Canada's safety and security depends on our country's ability to use Satcom.

## Bold Idea – Redistribute CSA

In keeping with the earlier section that subsectors are very different with widely varying needs, solutions and required engagements, a reorganization of CSA along the lines of the specific space sectors could be beneficial, and easily allow the government to allocate resources to the sectors as they need to.

By aligning CSA's organization with sectors, the sectors can allocate their resources in the way that best improves their sector.

This redistributions would also allow for the creation of regional centres for the CSA. Perhaps Satcom in the Ottawa/Montreal corridor, Human Spaceflight in St. Hubert, Robotics in Toronto,





EO in Vancouver, etc. The emergence of Maritime Launch Services suggest possibility of support for a regional centre in the Maritimes focused on space launch systems.

These regional centres should be open for public viewing and engagement, as it will give Canadians more opportunity to feel that they are part of Canada's space program. St. Hubert is isolated and closed to the public and David Florida Lab is in a military installation. They don't need to be museums, but they do need to allow the public to see what we are doing.

The individual centres could be run as little businesses unto themselves, evaluated on their sector performance. Opportunities for collaboration and cooperation would exist between centres, but the clarity of mandate would avoid them being overly competitive.

## Conclusion

Canada has a number of opportunities to improve the ailing space sector, any of which I am happy to elaborate on.

Most critical for our nation's security is revitalizing our satcom sector. Fortunately, this can be done at a pivotal moment in the industry. Through support for a LEO constellation, Canada can reposition our country as the centre for satcom excellence worldwide.

Thank you for the opportunity to participate in this process.

A handwritten signature in black ink, appearing to read "Ryan Anderson".

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## Annex A: Suggested Specific Goals for Space Strategy Objectives

From a comment during the Ottawa roundtable, the Goals and Objectives are simply directions until they are given specific and measurable criteria and timelines. Below are some suggested starting points. The numbers are educated estimates, not the result of rigorous analysis. The intent is to help the Board with some suggestions of format and order of magnitude.

### Use Space to Drive Broader Economic Growth

#### Grow Canada's Space Sector

- Currently \$5.38B in revenue and 10000 employed.
- By 2030 increase to \$8B and 12500 employed

#### Innovate and Explore Space

- Track number of space startups per year
- By 2030, 5 new SME's per year (that have survived more than 1-2 years)
- Track and increase number of space related patents licensed or in use
- Land a Canadian Astronaut on the Moon by 2035 (within an international partnership)

#### Strengthen Long-Term International Partnerships

- Increase value space-trade value with other nations and agencies by 10% in 5 years

#### Inspire the Next Generation

- Increase number of students in STEM and Space programs by 5% in 5 years, 10% in 10
- Increase involvement in groups like SEDS & SGAC by 5% in 5 years, 10% in 10
- Land a Canadian Astronaut on the Moon by 2035 (within an international partnership)
- Increase CSA/Astronaut social media followings and engagements by 100% in 5 years

### Leverage Space for the Benefit of Canadians

#### Contribute to Enhancing our Understanding of the Earth

- Target a dollar value contribution towards space based earth research

#### Improve Quality of Life for Canadians

- Ensure every Canadian has access to a 20 (50) Mbps internet connection
- Target dollar value increase in funding for life sciences research

#### Ensure a Safe and Secure Nation

- Primary national connectivity can switch to a redundant link within 20 minutes
- Weekly refresh of SAR imagery of Canada to 3m resolution
- Ability to image anywhere in Canada in high resolution optical within 24 hours