June 29th 2012

The Aerospace Review
235 Queen Street, Room 141-F
Ottawa, Ontario
K1A 0H5

Canadian Alumni of the International Space University Submission to Aerospace Review

Dear Hon. David L. Emerson P.C, O.B.C.,

The enclosed document represents the submission of the Canadian Alumni of the International Space University (CAISU) organization. CAISU represents over 200 Canadian professionals and supporters throughout government, academia and industry across the global space industry who share their status as alumni of the International Space University over a 25 year history.

Canadians have always been an integral part of the global space industry with a high standard of excellence. Our international peers consider us to be some of the well-respected and dedicated partners in space-related efforts to develop, support, procure, promote and educate. This legacy, amongst others, stands to shatter should the current course of the national space industry continue without a heading.

We appreciate your efforts to consider the opinions of various stakeholders in our national aerospace community – of which the space industry is a significant sub-set. Should there be any further questions regarding our submission, please do not hesitate to contact us so we may help answer your query.

Best Regards,

Mr. Amir Komeily
President

Mr. Tahir Merali
Member-At-Large

For
Canadian Alumni of the International Space University (CAISU) Board of Directors
http://www.caisu.org

Encl/

Canadian Alumni of the International Space University (CAISU)

Official Submission For Government of Canada Review of Aerospace and Space Programs and Policies

June 29th 2012

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List of Acronyms

BRIC	Brazil, Russia, India, and China
CAISU	Canadian Alumni of the International Space University
CCDev	Crew and Cargo Development
CAISU	Canadian Alumni of the International Space University
CFISU	Canadian Foundation for the International Space University
COTS	Commercial Orbital Transportation Services
CSA	Canadian Space Agency
ESA	European Space Agency
GES	Global Exploration Strategy
GPS	Global Positioning System
IADC	Inter-Agency Space Debris Coordination Committee
IRAP	Industrial Research Assistance Program
ISECG	International Space Exploration Committee Group
ISS	International Space Station
ISU	International Space University
ITAR	International Traffic in Arms Regulations
LIDAR	Light Detection and Ranging
NASA	National Aeronautics and Space Administration
NSERC	Natural Sciences and Engineering Research Council
R&D	Research and Development
ROI	Return on Investment
SADI	Strategic Aerospace and Defense Initiative
SAR	Synthetic Aperture Radar
SR&ED	Scientific Research and Experimental Development
SSP	Space Studies Program
UK	United Kingdom
US	United States
USD	US Dollars

Executive Summary

Canada has a unique expertise which it cannot afford to waste. Canada can be a leader in satellite communications, space infrastructure servicing and development, Earth observation, and space science and exploration. Unless significant strides are taken to further enhance our capabilities in these areas, Canada will lose its valued seat as a leader in the global space community. The exploration and development of space is the future. Our shrinking influence and proof of accomplishments on the international stage is a testament to this need. Investing in the Canadian space industry will sustain Canada's technologically advanced work force, foster innovation that will eventually catalyze our nation's economy, and will inspire and benefit generations to come.

Recommendations to the Aerospace Review panel:

1. National Skills Retention and Development, Policy and Programs

- Young Professionals Program for the Canadian Space Industry
- CSA Space Education and Awareness Department to empower and engage youth in Canada's vision for space

2. National Trade Policy and Programs

- Increased ITAR exemptions for Canada to improve market access
- Canadian pursuit of international cooperation agreements and memorandums with non-spacefaring high growth nations in Africa, South America, Central and Southeast Asia to promote space industry commerce

3. National Research and Development Policy and Programs

- Promote innovation through Space Centres of Excellence in Universities across Canada in collaboration with the Canadian Space Agency and Industry
- New federal policy and programs which support the transition of basic aerospace R&D and technology from academia into industry
    - A coherent and well-maintained national policy on strategic focus areas for short-term and long-term research
    - Improved incentives for bringing skilled researchers and advanced R&D into Canadian space industry to maintain Canada's innovation advantage
- Expand funding for international research collaboration, enabling Canadian researchers to access unique facilities and leading edge R&D unavailable in Canada
- Government and commercial space programs for the Canadian industry to maintain Canada's leadership position in space

Background

Canadian Alumni of the International Space University (CAISU) Organization

CAISU is a private and non-profit association dedicated to representing the Canadian alumni of the International Space University (ISU). CAISU is also active in organizing programs and conferences aimed at promoting space awareness among university-level students, professionals and the community in general:

- To provide for the promotion and preservation of contacts between all Canadian alumni of the ISU.
- To inform any interested party in Canada about the affairs of ISU.
- To cooperate with other interested organizations in Canada in promoting the cause of peaceful space activities.
- To represent the members when dealing with the various institutions of ISU and its representatives.
- To advance space education and space research in Canada.

Our organization is comprised of over 200 members. In 2009, a CAISU membership survey of 62 members provided the following demographics:

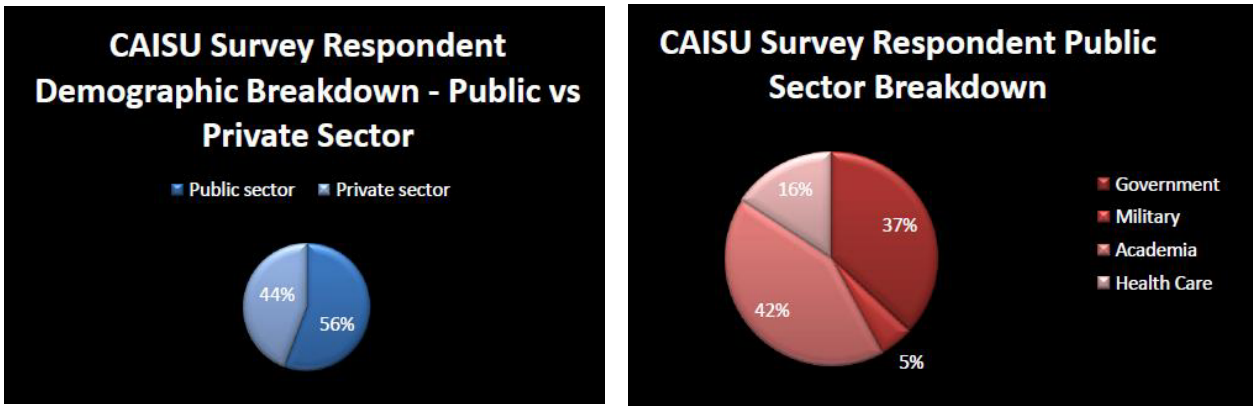

Figure 1 - Demographics of CAISU membership[1]

This highlights a strong presence of alumni in the public sector with a large segment of those in academia. Most significantly, 29% of respondents were Canadians working abroad. 2012 LinkedIn statistics indicate that of 156 members listed, including 2009 respondents, 60% hold senior and executive level positions in their field and 49% of members listed are associated with “Defense & Space” and “Aviation & Aerospace” fields.

[1] CAISU Membership Survey, 2009

Also underscored is the notion that 1/3 of our alumni are currently in, or seek roles abroad, as a result of opportunities lacking in Canada. Many alumni currently hold senior roles in their respective fields, space-affiliated or not. Our country encapsulates incredible skill and talent that should be retained and supported to guide our country into its next era of space sciences and exploration.

Rationale

As per CAISU's mandate, we promote peaceful use of space activities in Canada. We believe the Aerospace Review will significantly assist in shaping the future of our Canadian space industry. With such diverse membership that has provided value-added contributions to respective areas of the industry over the past 25 years, we believe our submission encompasses strong recommendations from decades of participation.

International Space University

The International Space University[2] is a private non-profit institution, formally recognized as an institute of higher education in France. It specializes in providing graduate-level training to the future leaders of the emerging global space community at its Central Campus in Strasbourg, France, and at locations around the world. In its two-month Space Studies Program (SSP) and one-year Masters program (M.Sc), ISU offers its students a unique Core Curriculum covering all disciplines related to space programs and enterprises, space science, space engineering, systems engineering, space policy and law, business and management, and space and society. Both programs also involve an intense student research Team Project providing international graduate students and young space professionals the opportunity to solve complex problems by working together in an intercultural environment.

Since its founding in 1987, ISU has graduated more than 3300 students from over 100 countries. Together with hundreds of ISU faculty and lecturers from around the world, ISU alumni comprise an extremely effective network of space professionals and leaders that actively facilitates individual career growth, professional activities and international space cooperation.

Canada has had significant involvement in ISU. One of the founders of ISU is Canadian and there have been several Canadians in high positions within ISU since its inception. Canada has hosted two previous ISU SSPs in Toronto and Vancouver and is scheduled to host a third SSP in 2014 in Montreal, welcoming the world to our country once more.

[2] http://www.isunet.edu/

A Case for Space - Inspiration and Innovation

In 2008, Canada's space industry was generating approximately $2.5 billion in annual revenues, 50% of which were from exports – the highest ratio in the world[3]. In 2010, Canada had commercial revenues of USD $3.3B ($3.4B Canadian)[4].

A prime example of how Canadian government support has yielded results was in the development of the Canadarm in the 1970s. The Government of Canada paid for the initial arm on Space Shuttle Columbia in 1981 and NASA purchased additional units. This led to the Canadian Space Agency contributing the Canadarm2, Mobile Base System and Special Purpose Dexterous Manipulator (Dextre) to the International Space Station (ISS). Many do not realize that without our Canadian proficiency in space robotics and operations, the ISS would have had serious lapses in construction and operation. Thanks to this critical role, Canada is today entitled to use approximately three percent of the ISS utilization resources. That is surely one of many success stories from our industry and a true return on investment (ROI).

Canadian pride and sovereignty, defense, international visibility and leadership; Canadian innovations in space are a magnet for drawing youth into science and technology. The vision and goal of exploring and developing space attracts the best and brightest into research and development – it drives creativity and a culture of innovation. The Canadian space industry is a key contributor to science and technology innovation in Canada. Several spin-off technologies have evolved from space technologies into other markets such as nuclear, medical, and mining here in Canada.

Space satellites are also used to monitor the environment for the purposes of disaster management, weather management, weather monitoring, search and rescue, ice and maritime surveillance, arctic sovereignty, monitoring wildlife, agriculture, fisheries, forests and military operations.

The exploration and development of space is the future. Investing in the Canadian space industry will sustain Canada's technologically advanced work force, foster innovation that will eventually catalyze our nation's economy, and will inspire and benefit generations to come.

3 Guy Bujold, President, Canadian Space Agency
[4] Joan Harvey, the head of Research & Analysis, Policy and External Relations for the Canadian Space Agency (CSA) in her presentation on the Canadian Space Sector in the Global Context

Current Status of the Canadian Space Industry

Canada's space investment has declined the most, and is one of the lowest compared to any other G8 nation in absolute terms and per GDP[5]. The total value of the commercial space economy in 2010 was between USD $150- $190 Billion. Canada occupies only 1.7% - 2.2% of the global share.[6]

Canada is sought after as a partner in the international community because of its niche areas of expertise. Canadians have been leaders in space robotics, small satellites, Earth observation satellites, telecommunications, LIDAR instruments, terrestrial analogue sites, geomatics and agriculture. The world has noticed Canada's innovation success stories however, and is catching up. Timely investment is required to maintain Canada's leadership position in these areas.

The Canadian space sector is well respected by the world to provide the highest quality space technology including: space robotics for the space shuttle and ISS, Synthetic Aperture Radar (SAR) and nanosatellites, Lunar and Martian rovers, satellite communication equipments, image scanning and processing, satellite ground stations, and space consulting services to name a few. Due to the recent federal budget cuts in government space spending starting from 2012, many space related commercial companies will face downsizing and lay-offs that would eventually erode Canada's competitive edge in the world commercial space arena.

Canada has the special status of an Associate Member State within the European Space Agency, allowing us the opportunity to contribute towards ESA programs and missions. Historically, Canada has been uniquely positioned as a close partner within both the United States and European space programs. Today, between trade restrictions and the US and European trend of reduced investment in space, the Canadian space industry has been greatly impacted. As Canada has also been decreasing its investment in space, there is a lack of innovation and vital skills and know-how are being lost in the industry. In 2008, there were over 220 space organizations across Canada. Today there are only 174[7].

5 Euroconsult and Space Foundation
6 Joan Harvey, the head of Research & Analysis, Policy and External Relations for the Canadian Space Agency (CSA) in her presentation on the Canadian Space Sector in the Global Context
7 http://www5.asc-csa.gc.ca/eng/industry/csd.asp

Issues Facing the Canadian Space Industry

There are many challenges and issues facing the Canadian Space Industry including brain drain, a lack of market access, and the need for skills development and space research and development. These issues are preventing Canada from having a thriving and sustainable space industry which would fuel innovation and as a result the Canadian economy.

Skills Retention and Development

Many young Canadian professionals are seeking development opportunities outside of Canada. As an example, Canadians who are dual-citizens (Canadian-American) are being lured to the burgeoning private space industry in the United States. For those who stay in Canada, even having participated in one of the few Canadian development programs, many end up in unrelated industries with no opportunity to use their expertise in support of the Canadian space industry. Only a very small percentage of Canadian graduates in space-related fields end up with space-related careers in Canada. With little new blood flowing through its veins, Canadian space sector is at risk of stagnation.

Young Professionals Program for the Canadian Space Industry

In order to retain Canadian talent first and foremost in Canada, programs to support professional development among Young Professionals in our country are essential. Providing accessible avenues to train the next generation of highly qualified personnel will produce tangible socioeconomic benefits for Canadians through increasing our competitiveness in the space industry.[8]

Although there are limited Canadian academic opportunities for Canadians, compare this to programs elsewhere in the world that support Young Professionals. Refer to Table 1 and Table 2 in the Appendix. Furthermore, there are limited young professional programs run solely by the CSA (non-academic/non-research), and there are no Canadian players in the space industry that have formal young graduate programs as our US and European counterparts do.

Skills Development

Skills development starts with the engagement and empowerment of youth through education and the media. This can be facilitated by a dedicated space education and awareness department at the CSA.

[8] Lee, R., Bisnath, S., Gavigan, P., Ng., A. *Small is Beautiful: Report From the 1st Canadian Nanosatellite Workshop*, 13 June 2012, p.19.

The Canadian Space Agency mandate states:

"To **promote the peaceful use and development of space**, to advance the knowledge of space through science and to ensure that **space science and technology provide social and economic benefits for Canadians**."[9]

Due to 2012 Budget Cuts, CSA Space Learning and Awareness Department was dissolved. This important branch was ingrained into the CSA mandate of promotion and public engagement, but was significantly reduced with the most recent round of budgetary cuts.

CAISU members have been fortunate to attend the ISU's academic programs, most of whom were funded in-part by grants from the CSA via the Canadian Foundation for the ISU (CFISU). This Canadian support structure is a world-leading example amongst all other nations who have students at and alumni from ISU. Along with the budget cuts went our support structure. Such funding was used to send between 6-9 students annually to participate in ISU's programs.

Opportunities to pursue higher education, more firmly support space science research experiments, and communicate benefits of the space industry to the general public have significantly evaporated. Canadian space awareness is critical towards supporting future programs and missions that provide social and economic benefits to Canadians. A space education and awareness branch, or hybrid offshoot comprised of industry, academia and government, is highly recommended for the future sustainability of our industry.

[9] Canadian Space Agency Act, SC. 1990, c. 13

Market Access and Development

The largest issue surrounding business with the United States are the US International Traffic in Arms Regulations (ITAR). Ultimately this mandate is that of the US Government responsibility, but one that certainly affects its trading partners – including Canada.

Industries outside the US, in some instances, choose not to deal with US and ITAR restrictions simply due to exhaustive clearances and bureaucracy which translate to delays in production and increased costs. While the Canadian space industry has been relatively effective in meeting the challenges imposed by the U.S. International Traffic in Arms Regulations (ITAR), negative impacts remain and continue to affect the Canadian space industry as no near-term relief from the current regulatory environment is on the horizon.[10] The Canadian government must therefore continue to pressure the United States for a comprehensive ITAR exemption. This would allow Canadian companies to establish themselves in the US, improving ties with the US and allowing Canadian companies to compete directly with US companies thereby creating a wealth of opportunity.

Examples of further US exemptions include those with the UK and Australia[11] per bilateral Defense Trade Cooperation Treaties. The new exemption for US-UK defense trade eliminates certain export licensing requirements for eligible exports within "Approved Communities" of companies and government agencies in the United States and the UK for projects where the US and UK Governments are the end users.[12]

If we Canadians are to continue to benefit from future partnerships with our largest economic trading partner, ITAR reforms are required to enhance trade and productivity.

[10]Choi, E. and Niculescu, S., "The Impact of U.S. Export Controls on the Canadian Space Industry", *Space Policy*, Vol. 22, Issue 1, ISSN 0265-9646, February 2006, pp.29-34.
[11] In force late 2012
[12]http://www.mondaq.com/unitedstates/x/171086/International+Trade/USUK+Defense+Trade+Treaty+Implemented+In+ITAR+Will+Soon+Lift+Certain+Licensing+Requirements+For+US+Exporters

Space Research & Development

Commercial Space Programs for Canadian Industry

Akin to NASA's Commercial Orbital Transportation Services (COTS) and Crew and Cargo Development (CCDev) programs, it would be valuable for Canada to implement a program strictly dedicated towards commercial opportunities. The underlying framework behind these types of programs: contract out services and facilities the government can no longer afford, which would result in cost-savings through development and innovation for long-term capital programs.

Future space programs which are commercially driven to meet Government needs can potentially spark new companies like a Canadian version of SpaceX, a game changing American venture, which can significantly reduce the cost of space programs for the Government. The COTS program in the US has been very successful in promoting new start ups and creating a sustained market. Meanwhile NASA can now focus on deep space missions. In the same way, CSA could promote the technology development for remote sensing and satellite servicing missions, for example, where industry and the science community can collaborate to provide both reliable satellite platforms and science payloads for example. The seed for SpaceX's success is the NASA COTS initiative where the logistics needs for the ISS is serviced by commercial ventures.

Providing a clear goal would not only focus the industry but create a sustainable market. Canada may model itself from this successful initiative by calling for Canadian industry to provide services in a structure similar to the NASA COTS program. With the current state of affairs in Canada however, valuable Government programs are being cut that could be supported by the greater Canadian space industry.

Space Research

Space research goes beyond the development of science instruments or payloads on a space mission. Research in space also includes areas such as space medicine, space life sciences, space agriculture, and space physical sciences.

Space Centres of Excellence

Similar to the structure of NASA, we encourage the development of Centres of Excellence in Universities across Canada in collaboration with the Canadian Space Agency and industry to promote innovation across Canada.

Technology Transition

A key indicator of a thriving industry is the amount of research and development invested by both private companies and government to sustain future growth. The Canadian government to date has successfully supported the development of the Canadian aerospace industry – routinely ranked in the top five among its global peers. Our Canadian achievements in the global aerospace industry are out-sized compared to the size of our population and economy. This support, however, is largely focused on supporting established companies to maintain market share or provide financing to bring new products to market. What is lacking is a rational, end-to-end, sustainable policy supporting basic aerospace R&D and technology transition at national and provincial levels. This support extends from; the insufficient provisions for graduate level research at universities, lack of employment opportunities for recent advanced degree graduates, and lack of support for companies to bring innovative new ideas to market. Furthermore, Canada earned a grade of "D" in innovation, ranked 14th out of 17 countries, and was rated as a below-average performer in its ability to innovate.[13]

Focus on People

Canada's strength is, and will always be, its people. Creative, innovative, and hard-working, Canadians have a strong reputation for their technical talent. The government must continue to find ways to support graduate level research via academia and subsequently support the graduates with meaningful employment in their relevant industry.

Transitioning people is an effective method to transition technology from academia to products in the market. Awards such as the NSERC Synergy Awards for Innovation[14] should be expanded into government policy. This award honors successful university-industry partnerships, with the university receiving a $200,000 research grant, and the industrial partner receiving a plaque and up to $10,000 to support the salary of an NSERC R&D Fellow. The award has the correct spirit and a modified version, which provides significantly more incentive for the industrial partner to employ the recent graduate, could form the basis of an exciting new government technology transition initiative. This type of policy program could be tied-in to the NRC's Industrial Research Assistance Program (IRAP) which has the added benefit of Industry Technology Advisors who additionally provide expertise on how to best use the R&D and transition to market. Such a program would not only advance Canada's technology transition capability, but also bring a whole new generation of young researchers into private industry to lead Canada's corporate R&D efforts. Nowhere is this more important than

[13] How Canada Performs 2011: A Report Card on Canada, The Conference Board of Canada, Sept 2011.
14 NSERC – Synergy Awards for Innovation. 2012. National Sciences and Engineering Research Council of Canada. Accessed June 18, 2012. <http://www.nserc-crsng.gc.ca/Prizes-Prix/Synergy-Synergie/About-Apropos_eng.asp>

the space industry where advanced research jobs in private industry are so few that large numbers of Canadians leave Canada to seek employment.

Focus on Academic Research

Canada continues to enjoy a reputation for having some of the best academic opportunities in the world. This is certainly true at the Bachelor's degree level; however, it is more ambiguous at the advanced post-graduate degree levels where research is a significant component of a candidate's education. The primary issue is the availability of funding to actually perform the research, as well as funding to support graduate students during this time period. The Canada Research Chairs Program is an excellent vehicle by which high-caliber professors and researchers are established at Canadian universities. This program should be continued and the recommendations outlined in the "Tenth-Year Evaluation of the Canada Research Chairs Program"[15] should be given serious consideration. In particular, it was noted that the funding levels have not changed since the program's inception, resulting in a larger and larger fraction of the award simply paying for the researchers' salary, leaving precious little for support for actual research. Similarly, the NSERC post-graduate research grants should be cost-adjusted to reflect actual living expenses and the full 5 to 6 years of a typical Ph.D. program as opposed to the present 4-year maximum where scholars are encouraged to complete their studies in an expeditious manner. Canada must find a way to increase funding to support the actual research activity including any advanced infrastructure that may be required.

One approach could be strong support of research collaborations with other countries that have unique facilities that may be considered too expensive to support in Canada. Ideas could include providing financial support for the researcher to travel to the international facility to conduct their research, provide some limited financial support to pay for the operations of the facility to perform the specific research, or perhaps provide in-kind academic exchange opportunities for researchers from the foreign country to come to Canada. This is of particular relevance to the space industry where facilities are extremely expensive and it is often not feasible to duplicate a facility that may exist in another country.

For the space industry, having Canadian researchers actively participate in international research activities should be a top priority as the ROI is greatly enhanced by leveraging the investments made in R&D by the global community.

[15] Picard-Aitken, M. *et al.*, "Tenth-Year Evaluation of the Canada Research Chairs Program: Final Evaluation Report," Submitted to: The Evaluation Advisory Committee of the Canada Research Chairs Program Social Sciences and Humanities Research Council, Dec 2010.

Focus on Industry Research

The private industry in Canada must continue to perform research but it is important to recognize that government has a key role in providing the appropriate environment to invest in R&D. The first step is clearly defining a coherent national policy on strategic research focus areas. This national policy should:

- Identify the priority topic areas and why they are important to Canada
- What types of end-to-end support will be offered (ie. from academic research to product commercialization)
- What key international partnerships will be pursued with other countries

The latter is absolutely critical for Canada since the very large investments in research can only be recouped if there is access to global markets with clear global customers. This is particularly true for the space industry which is so specialized that there might be very few customers for some of the truly unique and ground-breaking technologies that Canada could develop. At present, government support for research seems to be a hodge-podge of efforts offered by a variety of different departments with little coordination. One department might offer funding for academic research in a given technical area, however there might be no support for commercializing any inventions from that research, and certainly virtually no assistance with foreign trade.

Another key step with regards to R&D is to clearly differentiate research – which has a long-term growth focus – from development, which is much more short-term and focused on the final engineering development to get a product to market. Canada has a long history of supporting R&D through the SR&ED tax credit which studies suggest tends to focus on the latter[16]. If this is indeed the case, then by definition, Canada is focusing its major R&D incentive policy on incremental development activities rather than ground-breaking research. This focus would be consistent with a shocking lack of Ph.D. researchers employed by the private industry in Canada. There is a strong need for policy and incentives for private industry to undertake long-term research and make use of the unique skills of advanced graduate researchers. One approach is to recognize that large global companies often establish corporate R&D facilities at multiple sites around the world. These companies use their corporate R&D centres for long-term 10+ year research efforts to develop a pipeline of innovations to support their products. By definition, these large multi-national firms focus entirely on technology transition. The Canadian government should actively engage these companies and provide incentives to establish R&D facilities in Canada. Conversely, there needs to be stronger incentives for small start-ups. Programs such as the Strategic Aerospace and Defense Initiative (SADI) seem to be positioned to address this gap; however, a review of the project portfolio shows a strong emphasis on aeronautics, with very little focus on the space industry.

[16] Creutzberg, T., "Canada's Innovation Underperformance: Whose Policy Problem Is It?" Mowat Centre, School of Public Policy and Governance at University of Toronto, October 2011.

Space Technology Development

Our expertise is what brings high quality jobs to Canada and keeps Canada visible in the international space community. Currently, Canada does not have complete turnkey space solution capabilities other space-faring nations as the US, Russia or China do. However, this could be developed. We are currently positioned to service niche markets such as space robotics, nanosatellites, communications equipment, ground stations and in-situ resource utilization.

There are many potential space services and programs which can leverage and develop Canadian knowledge and expertise, and also provide a return on investment to Canada.

Some suggestions are listed below:

Support for future development of Canadian prowess in telecommunications

Extending the life of communication satellites through satellite servicing can foster game changing innovation in on-orbit satellite servicing that can be later be sold to other nations as a service – creating high quality jobs in Canada. Canadian heritage in geostationary communication satellites and space robotics puts this initiative well within our reach.

Space debris removal to protect Canadian Space Assets

The growing population of expired satellites and space debris is fast becoming an area of global concern. Space debris threatens Canadian assets, our astronauts on the ISS and in some cases humans on the ground threatened by de-orbiting debris. Many Canadians depend on satellites for communications, GPS and remote sensing data. Nearly 29,000 objects larger than 10 cm have been identified, any of which could cause a catastrophic collision and on-orbit break-up of an operating satellite. An additional estimated 670,000 smaller debris items exist which could seriously damage or disable operating space assets.

Canada is currently a partner in the Inter-Agency Space Debris Coordination Committee (IADC) and can take a leadership role in creating an international organization to administrate and determine funding venues to support removal of space debris. An internationally combined commercial venture including Canadian firms for example can provide for the orbit debris removal service.

The future of the Canadian Astronaut Program

Human exploration of space is one of the most iconic and captivating images of the space industry. However, Canada does not have its own human-rated launch capability. Therefore, traditionally Canadian astronaut flight assignments have been negotiated in exchange for various services, technologies and partnerships. Two key examples highlight this fact:

- Canada's contribution of the Canadarm secured positions for Canadian Astronauts aboard the now retired NASA Space Shuttle
- Through our participation in the ISS program, a 2.3% contribution to the $100-Billion 16-nation program, we were able to secure two Canadian crew member flight slots (1 Flight Engineer, 1 Commander) for long-duration space missions

Russian Soyuz seats alone cost in excess of $50 million CDN on the private market. At a CSA budget estimated at $600 Million CDN, 8.3% of total overall agency budget for a single spaceflight solution is extremely expensive, without much tangible ROI to Canada. Thus our current outlook for future Canadian citizens flying into space is bleak. The Canadian Government should bolster our negotiations with our international partners in preliminary planning of future human spaceflight endeavors, continuing with current participation with working groups such as the International Space Exploration Coordination Group (ISECG) of the Global Exploration Strategy (GES) – a collaboration of numerous international space agencies.[17] Possible areas could include contributing to next generation spacecraft developments by other agencies (NASA and ESA), privatizing spaceflight training, and focusing on Canadian expertise and industries that may have *spin-in* impacts. This will allow us to continue to share with the global community our interests and skills, what we have to offer and how Canada can continue to be a world leader in human spaceflight – ensuring the future of the Canadian Astronaut program to inspire the next generation to enter into science and technology.

Privatization of Arctic Monitoring

With the increasing change of our global climate, the ice sheets in the Northern Arctic will be opened for new shipping routes, resource exploration, and fishing zones. Canada needs to keep a close watch and maintain our arctic sovereignty by monitoring these geographic regions. Satellite data services can be acquired from Canadian companies to gain this monitoring capability. The same industry could also sell the technology to other nations to bring high paying jobs to Canada.

[17] http://www.globalspaceexploration.org/

Space Materials Processing Facility

As developing countries reach the standard of living of the developed world, and as the population of planet explodes past seven billion, humanity will need to look to space for other sources of raw materials so that we do not decimate our planet. In the long term, a space material processing facility on Earth will be required once humanity has the ability to mine space bodies such as asteroids. Canada has much expertise in processing minerals and can become experts in this area by beginning the research and development needed for such a facility along with the infrastructure required.

Fostering the Canadian Commercial Space Industry through International Cooperation

Canada is leading the world in energy and commodity resource development. Western Canadian provinces such as Alberta and Saskatchewan have enjoyed the extensive investment and high commodity demand for oil, natural gas, copper, uranium, potash and many other resource exports. This has created jobs in these resource rich areas and brought much needed tax dollars to better our national infrastructure, health care, and educational systems. Indeed, our nation has reaped the benefits of our business with international partners, improving the livelihood of every Canadian.

Looking into the future, we believe more investment and government encouragement is needed to foster an innovation and technology centric Canadian exporting economy as we further deplete our limited natural resources. This will not only give Canada an edge to secure a better future for Canadians in this increasingly competitive world, it will also give more creditability to Canada as a responsible member of the international community where we show our Canadian ideals to value sustainability and biodiversity for our natural Earth environment.

We believe in the same spirit of the Government's 2007 Global Commerce Strategy (GCS)[18], where Canada concluded a number of free trade agreements with South American and European nations, and aspire to begin deeper trade investment ties with the fastest growing BRIC nations, most notably the recent Northern Gateway Pipeline project currently under review. We recommend that Canada take an active role to help secure partnerships and business deals in space activities with the international community to create high quality space sector jobs and foster entrepreneurship. The CSA may also venture in partnerships with non-space faring nations in high growth regions such as Africa, South America, Central and Southeast Asia.

Examples of this catalytic nation-nation partnership that resulted in a mushroom of economical benefits is the Chinese partnership with Brazil in the building of CBERS land

[18] http://www.international.gc.ca/media_commerce/comm/news-communiques/2012/05/26a.aspx?view=d

observation satellite[19], and the sales of the first African geosynchronous communication satellite NigComSat-1 and subsequent NigComSat-1R to Nigeria by China Great Wall Industry Corporation[20]. In fact, China has signed 16 international space cooperation agreements and memorandums with 13 countries, space agencies, and international organizations[21]. This has not only resulted in a flourishing Chinese space industry, the technology advances from these space development activities have permeated the Chinese economy with high quality technology spin-offs in medicine, communications, high-performance computer, IT, renewable energy, new materials and material processing[20,22]. Just as developments during the American Apollo program led to a transformation in information technology, China's "National Medium- and Long-term Science and Technology Development Plan" has also recognized the Space sector as one of the top five priority hi-tech areas for development along with Biotechnology, IT, Energy and Materials[5].

Taking advantage of profits from our current commodity advantage to advance the Canadian technology sector, including the space sector, will certainly save Canada from being left behind in a world where all nations are racing to secure a better future for its citizens.

[19] CASC "China Centre for Resources Satellite Data and Application (CRESDA) Ground System of Land Observation Satellites", 2007
[20] CASC "Aerospace China", Vol 8 No 1 Spring 2007, ISSN 1671-0940
[21] "China's Space Activities in 2006", Information Office of the State Council of the People Republic of China
[22] Zhang Qingwei, CASC President "The Ongoing Development of China's Space Industry" July 10, 2007

Recommendations

There are certainly multiple issues facing the Canadian space industry today. Drawing from this, CAISU has developed a set of recommendations to assist the Aerospace Review panel on avenues to possibly address these needs.

1. National Skills Retention and Development, Policy and Programs

- Young Professionals Program for the Canadian Space Industry
- CSA Space Education and Awareness Department to empower and engage youth in Canada's vision for space

2. National Trade Policy and Programs

- Increased ITAR exemptions for Canada to improve market access
- Canadian pursuit of international cooperation agreements and memorandums with non-spacefaring high growth nations in Africa, South America, Central and Southeast Asia to promote space industry commerce

3. National Research and Development Policy and Programs

- Promote innovation through Space Centres of Excellence in Universities across Canada in collaboration with the Canadian Space Agency and Industry
- New federal policy and programs which support the transition of basic aerospace R&D and technology from academia into industry
    - A coherent and well-maintained national policy on strategic focus areas for short-term and long-term research
    - Improved incentives for bringing skilled researchers and advanced R&D into Canadian space industry to maintain Canada's innovation advantage
- Expand funding for international research collaboration, enabling Canadian researchers to access unique facilities and leading edge R&D unavailable in Canada
- Government and commercial space programs for the Canadian industry to maintain Canada's leadership position in space

Conclusion

There are many challenges facing the Canadian space industry today including the lack of market access due to unwelcoming state policies from our largest trading partner, and a reduction in federal funding for space projects. As a result, technically skilled Canadian workers are leaving Canada to seek employment elsewhere in the world, and there is further deterioration of public awareness and support for space technology.

CAISU strongly believes Canada's future depends on active participation in the global community, and that the economic welfare of the Canadian people can be better served by reinforcing our capabilities in the space industry. The Canadian Government's leadership is urgently needed in helping to break down trade barriers with strategic partners, enhance public outreach to empower and engage youth, expand our capability in space communication, space science, space exploration and Earth observation.

Canada can achieve these goals through clear objectives and focused policies for space investment for our industry and academic institutions through tax credits, the creation of young professional development programs, and participating in iconic capital-projects.

Canada needs more aggressive trade agreements with all members of the international community that favors exportation of our space technology products. Canadians have the potential to sustain and further our leadership in space. Sustainable investment today will inspire and create a new generation of Canadians in various careers and industries. The technology we invent from our pursuits today will spin-off into new vibrant economies tomorrow.

The choice is ours to make. The time to act is now.

Disclaimer

The CAISU Board of Directors has approved details herein for the purposes of the Aerospace Review. These are the expressed opinions of CAISU, CAISU Board of Directors and its members under the CAISU organization and do not represent opinions of other organizations CAISU members may represent or are affiliated with outside of CAISU.

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Appendix

Below is a short synopsis of programs for Young Professionals offered in Canada and abroad: *Note: Lists not exhaustive*.

Organization	Program	Type (Government / Industry / Academic)	Location
Public Service Commission of Canada[23]	Federal Student Work Experience Program (FSWEP)	Government	Various Government Programs in Canada
	Research Affiliate Program (RAP)	Academic	Various Academic & Research Programs in Canada
NSERC	NSERC CREATE – Technologies and Techniques for Earth and Space Exploration	Government/ Academic	Various Academic Institutions
	NSERC CREATE Canadian Astrobiology Training Program (CATP)	Government/ Academic	Various Academic Institutions
CSA	CSA Capacity Building Program – (may include funding for educational training)	Government/ Academic	Various Academic Institutions
Non-Governmental Organizations	Various space-related academic programs & courses	Academic	Various Academic Institutions

Table 1: Canadian programs currently offered for Young Professionals

[23] http://jobs-emplois.gc.ca/fswep-pfete/index-eng.htm

Organization	Program	Type (Government / Industry / Academic)	Location	Canadian Participation
ESA[24]	Young Graduate Trainee Programme	Government	Various ESA facilities & Directorates	Yes (European Full Member State priority)
	Postdoctoral Research Fellowship Programme	Academic	Various ESA facilities & Directorates	Yes (European Full Member State priority)
	Student Placement Programme	Academic	Various ESA facilities & Directorates	Yes (European Full Member State priority)
NASA	NASA Academy	Government/ Academic	Various NASA facilities & Directorates	Yes (US Citizen priority)
	Aerospace Medicine Rotation Program (MDs)	Government/ Academic	NASA KSC & JSC	Yes (US Citizen priority)
	Collegiate Internships	Academic	Various NASA facilities & Directorates	No (US only)
	High School Internships	Academic	Various NASA facilities & Directorates	No (US only)
JAXA	Promotion office for Collaboration with University and Research Institutes	Government/ Academic	JAXA facilities & affiliate institutions	No
EADS	PROGRESS Management Trainee Programme	Industry	Europe	Yes (European Citizenship preferred)
SES Astra	CONNECT Graduate Programme	Industry	Europe	Yes (European Citizenship preferred)

Table 2: International programs currently offered for Young Professionals

[24] http://www.esa.int/SPECIALS/Careers_at_ESA/SEMYHEITPQG_0.html