,

A RECOMMENDED CANADIAN AEROSPACE POLICY

A Submission to The Minister of Industry Canada
The Honourable Tony Clement P.C., M.P.

by

The Canadian Society for Senior Engineers
(CSSE)

February, 2009

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CSSE President's Message

The Canadian Society for Senior Engineers (CSSE) is indeed privileged and honoured to offer the following contributions to the formulation of a new Canadian Aerospace Policy to match the economic, social and strategic interests of Canada in the 21st century.

Canada has pioneered many innovations in aviation/aerospace and now partners with the world in this advanced technology to explore outer space. It is important that Canadians be made aware that our Aerospace industry is a key sector driving Canada's future competitiveness, national security and sovereignty through the important related supporting technologies of avionics, military and space-hardened microelectronics, advanced manufacturing and robotics. These are priority areas for research, development, systems integration, demonstration and commercialization.

This strategically-important industry not only consists of a few large enterprises with strong reputations, but also of a large cohort of small and medium-sized enterprises that form the backbone of a wider spectrum of high value-added Canadian engineering, manufacturing and servicing capabilities. Aerospace products and parts manufacturing employs over 40,000 highly trained personnel making an increasingly important contribution to Canada's economy in the competitive global market.

With an influence extending into all regions and endeavours of Canada, The Canadian Society for Senior Engineers considers the Aerospace sector a vital strategic national resource. In the half century since Canada lost its aerospace leadership with the cancellation of the Avro Arrow and more recently, the loss of the whole of the Canadian Uninhabited Aerial Vehicles (UAVs) and associated surveillance capabilities developed by Canadair (and Bombardier Aerospace), Canada has regained its hard fought and highly regarded reputation and position in the Aerospace international market. Canada has many achievements to build on and to support in both Aerospace and Airspace industry programs.

The fact that the Canadian Aerospace sector commands a highly skilled workforce with advanced post-secondary capabilities and specialized technical expertise to serve this industry cannot be overemphasized. This highly sought after capability has in the past demonstrated very high mobility across our border in times of economic or politically-induced downturns; as witnessed in Canada's not too distant past and which might happen again in the current economic recession.

Canada's achievements and challenges must be viewed through the prism of history rather than specific events. Canada has the good fortune to be part of the North American continent, but this comes with the challenge of living next to the world's largest economy. To maintain Canada's political, social and economic independence remains a delicate task in all our endeavours, as seen in trade disputes, tariffs and more recently potentially protectionist stimulus measures and other border issues, affecting our sovereignty. The question of maintaining Canadian Arctic

sovereignty continues to emerge as one of the most important policy challenges facing our nation from friendly and not so friendly nations alike

International competitive and protectionist pressures in the export sectors of the Aerospace market demand a strongly supported approach by various levels of government through international multilateral and bilateral agreements; this goes hand in hand with supportive business development/innovation policies, practical commercialization, and financing support programs. A firm and clear regulatory/policy framework would provide and ensure the continuity and sustainability of this national resource: with far-reaching impact on Canada's economic, social and strategic well-being. The current global economic downturn and recession, which spawns national tendencies towards unilateral protectionist trade measures associated with stimulus packages, stress Canada's need for renewed vigilance and strong assurances of access to international markets to protect Canada's Aerospace industries.

The ongoing efforts by the key and enabling players in this industry must be supported by a stable strategic framework to advance Canadian sovereign and economic interests and facilitate continuing growth and value added contributions for Canada's long-term benefit.

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President, Canadian Society for Senior Engineers

Who is the CSSE?

The Canadian Society for Senior Engineers (CSSE), a Member Society of the Engineering Institute of Canada (EIC), is a Canada-wide organization of Senior Engineers, representing a broad spectrum of engineering disciplines. Many of our members have held senior leadership positions in industry, academia, government (including DND) and are Fellows of the Engineering learned societies. As part of our advocacy mandate, the CSSE maintains an active role in expressing carefully considered opinions, either alone or in concert with other Canadian engineering organizations, on issues of sovereign national or important regional interest relating to Canadian engineering.

Key Principles

Whereas CSSE believes:
in the freedom of fair and open trade between sovereign nations, and
in the freedom and open exchange of thoughts and cultural ideas, and
in the freedom of movement of people between sovereign nations, and
in the freedom of development of scientific knowledge, technical know-how and intellectual property, and
in the freedom of development and exchange of information on issues of global concern, and
in the freedom to democratically elect governments to uphold our Canadian values, to defend our rights and to preserve our heritage and traditions.

CSSE resolves that:
Canada, as an equal among the nations of the world, with its many faceted cultures and ethnical background of its people, is a sovereign nation who's territorial, social, cultural, scientific and economic rights form an integral and undeniable part of it existence.

Canada, as a sovereign nation, will defend and protect against any incursion, threat or challenge or adverse influences from any foreign power(s) that is deemed to undermine Canada's existence in whole or in part of any of Canada's legitimate realms of existence.

Canada, as a sovereign nation, will participate in the legitimate endeavours of the nations of the world to encourage and bring about the betterment of economic, social and environmental conditions of Canadians specifically and human kind more generally.

Executive Summary

This submission is a statement by the Board of Directors of the Canadian Society for Senior Engineers (CSSE). Many members of the CSSE have held senior positions in industry, academia and government including several who have been associated with the Canadian Aerospace industry.

The CSSE herein ranks the various Canadian Aerospace program areas, and gives its reasoning for those rankings.

It is strongly recommended that Canada's investment in Aerospace be increased, in cost-effective increments, with special attention to the Space sector.

The CSSE recommends that Industry Canada, in concert with other departments of the Canadian Government, formulate and implement a firm and clear regulatory and policy framework to ensure the continuity and sustainability of this national resource, and to increase it's impact on Canada's economic, social and strategic well-being.

The CSSE recommends that this Canadian Aerospace regulatory and policy framework will guide and otherwise support training, research and development, supplemented by government contracts that lever their unique expertise niches via the proposed (and needed) Canadian Aerospace Policy framework and complementary "Canada First" Procurement Strategy.

The CSSE recommends that Canada increases its Research and Development efforts in the area of defence related technologies to protect the lives of our military personnel and civilians in the conflict zones.

The CSSE recommends that Industry Canada increase its efforts to promote the importance of Canada's Aerospace policy and programs to Canadians, and suggests how this might be done.

The CSSE recommends further that the Government of Canada take steps to encourage more Canadians to pursue Aerospace careers, and to attract more university graduates to seek employment in Aerospace engineering.

In this context, Canada has many achievements to build on and to support in both Aerospace and Airspace industry programs for both civilian and defence related applications. The recent Government of Canada decision to disallow the sale by MacDonald Dettwiler and Associates of its Information Systems and Aerospatial Services unit to a foreign power is seen as a positive one for Canada. It serves as a case of 'political jurisprudence' in dealing with future cases where the retention of taxpayer funded Canadian technology and know-how, essential to Canada's economic interests and sovereignty, are of paramount importance.

Introduction

"Canada's Aerospace" could be defined as comprising two "Sectors", namely:
(a) "The Airspace Sector", and
(b) "The Space Sector".

(a) The Airspace Sector comprises "Canadian Airspace" and "International Airspace".

"Canadian Airspace" is the part of the atmosphere that lies over Canada's territory and territorial waters, extending to an altitude of about 100 kilometers (the outer boundary of Earth's Mesosphere). "Canadian Airspace" amounts to about 7% of the total "Airspace" of the 200-or-so countries of the world. Yet Canada's estimated population of 33,331,000 is but 0.5 % of the world's estimated population of 6,684,000,000. So, on a per capita basis, each Canadian has an average of 14 times as much "Airspace" as everyone else.

"International Airspace" is that part of the atmosphere lying over the international waters, also extending to an altitude of 100 kilometers.

(b) "Space" is the space beyond 100 kilometers altitude, "lying over" the surface of Earth, and extending to the edge of The Solar System and beyond.

This CSSE submission outlines the reasons for its conviction that Canada should invest a greater proportion of its resources in Aerospace research and development programs and identifies the programs that should be considered.

To explain the underlying basis for the CSSE's recommendations:

Part 1 of the submission begins with a statement of Canada's long-term national objective, a list of the four "policy areas" over which our Federal Government pursues its responsibilities in cooperation with the Provinces and the Territories and describes the Aerospace program areas that the CSSE believes to be important to Canada.

Part 2 of the submission outlines CSSE's assessment and evaluation of the relative importance of these program areas in the context of achieving Canada's long-term national objective.

Part 1. What is Important?

1.1 CANADA'S LONG-TERM NATIONAL OBJECTIVE

What is Canada's long-term national objective? It is probably something like "To maximize the well-being of its citizens."

However one articulates Canada's long-term national objective, it follows that investments of Canadians' tax dollars should be *most relevant* to that objective, i.e. should be invested in such a way as to maximize the probability of achieving that objective.

1.2 ACHIEVING CANADA'S NATIONAL OBJECTIVE

CSSE has identified four policy areas relevant to Canada's Aerospace Industry. To achieve its long-term national objective Canada pursues its achievement by investing in these four "policy areas", shown in order of relative importance as follows:

(1) improving the economic well-being of Canada
(including sustainable development and education);
(2) maintaining Canadian sovereignty;
(3) improving the security of Canadians;
(4) improving the health and safety of Canadians
(including bettering health education and protecting the environment).

Federal, Provincial and Territorial government departments, agencies and other tax-funded organizations invest a very large proportion of Canadians' tax dollars in these four policy areas, allocating moneys among numerous programs. One such government department is Industry Canada, which provides the regulatory and policy framework for, as well as supporting, several Canadian industries, including the aerospace, defence, fisheries, agriculture, pharmaceutical, broadcasting, shipbuilding, metal products, forest products, tourism, textiles and energy industries. Each of those industries contributes, to varying extents, to each of the policy areas.

This submission is focused on Canada's Aerospace industry programs.

1.3 CANADA'S AEROSPACE PROGRAM AREAS

Canada pursues the above-cited four policy areas, in part, by investing in two sets of Aerospace program areas, namely:

(1) "Airspace" program areas, and
(2) "Space" program areas.

1.3.1 Canada's Achievements in Airspace Technologies

There are some notable achievements in the Airspace sector that are contributing to Canada's respected reputation on the international scene. Here are some examples.

An innovative partnership has been established between Canada's leading aerospace company, Bombardier, and Government of Canada in the field of training military pilots from Canada and NATO/non NATO countries at the NATO Flying Training in Canada (NFTC) in Moose Jaw, Saskatchewan and Cold Lake, Alberta. This builds upon the history of 15 Wing Moose Jaw as Canada's pilot training centre

Through the University of Saskatchewan College of Engineering programs (i.e. Microgravity lab, fluid controls lab) and College of Arts & Science Department of Physics and Engineering Physics (space physics) the Canadian Light Source Synchrotron was established. It is Canada's biggest science project in 30 years with capabilities for aerospace, i.e. Micro electrical mechanical (MEMS) beam line partnered with Rockwell Collins, an international avionics manufacturer.

The National Institute for Nanotechnology (NINT) is an integrated, multi-disciplinary institution involving researchers in physics, chemistry, engineering, biology, informatics, pharmacy and medicine. Established in 2001, it is operated as a partnership between the National Research Council and the University of Alberta, and is jointly funded by the Government of Canada, the Government of Alberta and the university.

NINT researchers are focused on the revolutionary work being done at the nano-scale, the world of individual atoms or molecules. The main focus of nanotechnology research is the integration of nano-scale devices and materials into complex nanosystems that are connected to the outside world. The long-term objective is to discover 'design rules' for nanotechnology, and develop platforms for building nanosystems and materials that can be constructed and programmed for a particular application.

NINT's Business Development Office will assist Edmonton-based nanotechnology firms. The goal is to develop a cluster of nanotechnology companies using and producing nanotech. NINT will be the nexus of this cluster by fostering collaboration, providing access to the facility and researcher expertise, and assisting companies with commercialization, licensing and other business activities.

Located in Edmonton, Alberta on the University of Alberta campus, NINT's 20,000 square-metre building is one of the world's most technologically advanced research facilities and houses the quietest laboratory space in Canada.

Canada has achieved demonstrated success in the development, manufacturing and operation of Canadian built Search and Rescue (SAR) aircraft with proven ability to meet the specific mission demands of Canada's remote locations under difficult flying conditions in the Canadian Arctic and rugged coastal areas.

Canada has demonstrated that it has core aerospace technology and capabilities to best meet Canada's airborne search and rescue missions and surveillance operations. Refer to Appendix D. Search and Rescue and Airborne Surveillance Operations.

Canada's Airspace program areas, designed to derive the maximum benefits from Airspace research, each involving technological research, market research, engineering development, marketing, production and delivery, financing and cost-recovery include:

(i) commercial flight simulators (80% share of the world market),
(ii) visual simulation (70%),
(iv) new large aircraft landing gear (60%),
(iv) transport aircraft environmental control systems (60%),
(v) 20-130 seat regional aircraft (47%),
(vi) uninhabited aerial vehicles (UAV, drones)
(vii) small gas turbine engines (34%),
(viii) other landing gear (31%),
(ix) civil helicopters (14%),
(x) Search and Rescue (SAR) Systems
(xi) other Airspace-related equipment/systems, and
(xii) atmospheric environmental endeavours.

1.3.2 Canada's Achievements in Aerospace Technologies

Some notable early technical space successes are the Alouette and Isis satellites and the STEM antennae. In addition to a wealth of scientific data concerning the ionosphere new knowledge was acquired concerning the propagation and generation of electromagnetic waves-in the ionosphere at both radio and VLF frequencies. As well, spectacular results were achieved with the optical experiments on ISIS 2, which for the first time provided snapshots of the full auroral oval. The performance of Alouette 1 exceeded by far the most optimistic expectancies and its 10-year life established a longevity record. The other Canadian spacecraft of the program, Alouette 2, ISIS 1 and ISIS 2, have matched and surpassed this record.

The Alouette-ISIS program was a joint undertaking between Canada and the United States. Canada provided the Alouette and ISIS spacecraft, data acquisition, and satellite control. The USA provided the launch capability, tracking, and data acquisition. Satellite instruments and data processing support were provided by both countries. The USA also provided the Explorer 20 and Explorer 31 spacecraft that are considered part of the Alouette-ISIS program. During the course of the program these countries contributed telemetry support and collaborative data analysis: Australia, Finland, France, India, Japan, New Zealand, Norway, and the United Kingdom.

Serving Canada's Telecommunications and television broadcast industries are Telesat's Anik and Nimiq series satellites, Canada's "little brothers" in space. They link Canada with the world and transmit television programs in Canada. Fifteen Anik series satellites have been launched since 1972 with four remaining in service. Three Nimiq satellites are in service with a fourth and fifth to follow. These satellites provide a wide range of broadcasting, business communications

and Internet services to users across North America. The new satellites will provide advanced services, such as high-definition television, specialty channels and foreign language programming.

The Aerospace Manufacturing Technology Centre (AMTC), one of five laboratories at the NRC Institute for Aerospace Research (NRC Aerospace), is a new initiative resulting from a partnership between the NRC and Canada Economic Development for Québec regions. Located on the campus of the Université de Montréal, its aim is to develop core competencies and demonstrate modern aerospace manufacturing technologies that have the potential for significant cost savings, while also maintaining high levels of quality, reliability and performance.

AMTC R&D activities mobilize existing facilities and programs at NRC Aerospace and at other related NRC institutes and programs across Canada to help industry implement advanced, cost-effective, manufacturing methods for aerospace. A major focus is to facilitate the transition to next-generation manufacturing, particularly among small and medium-sized enterprises (SMEs).

The Centre accommodates approximately 100 people (including staff and guest workers from industry and universities) who investigate technologies in four major research areas:
Canada's Space current program areas, designed to derive the maximum benefits from Space research, which could involve technological research, market research, engineering development, marketing, production and delivery, financing and cost-recovery include:

(xiii) Canadarm I and II,
(xiv) Earth observation RADARSAT II satellite (performing terrestrial and space environmental monitoring and mapping),
(xv) civil Space research, and
(xvi) other Space-related endeavours.

1.3.3 Canada's Achievements in Defence Technologies

There are some notable achievements in the Defence Technologies sector that contribute to Canada's respected reputation on the international scene. Here are some examples.
Partnering with Defence R&D Canada with Defence Industrial Research Program links Canada's research capabilities with its defence needs. The Defence Industrial Research (DIR) Program strengthens and supports the Canadian Defence Industrial Base through the provision of financial and scientific support for eligible industry-initiated research projects relevant to the defence of Canada and/or its allies. The objective is to stimulate research and innovation to enhance Canada's ability to share in the development of technologies to meet Canadian, NATO, and other allied defence requirements.

The Canadian Centre for Uninhabited Vehicle Systems (CCUVS) - Le Centre Canadien des Systèmes de Véhicules Télépiloté (CCSVT) is a not for profit company that provides unbiased, joint use facilities to meet test and evaluation or research and development needs. It operates from offices in Medicine Hat Alberta and accesses range space and facilities at Canadian Forces Base Suffield and Defence Research and Development Canada also at Suffield. With access to other ranges across the nation CCUVS is a one stop solution in Canada. It is an international hub for the design, development, testing, evaluating and commercialization of uninhabited vehicle

systems. These include uninhabited aerial vehicles, uninhabited ground vehicles and uninhabited underwater vehicles and uninhabited surface vehicles. The CCUVS builds on the solid advancements of the Canadian UVS sector that has technology clusters in southern Alberta and across the nation.

Part 2. How Important?

2.1 ASSESSING RELATIVE IMPORTANCE

The CSSE has assessed the relative importance of each of Canada's Aerospace program areas in the context of the above four policy areas. Each of the program areas were then weighted in accordance with their above relative importance to arrive at an overall ranking of each of Canada's Aerospace program areas, (i.e. the relative importance of each program area to the achievement of Canada's long-term national objective) (Please refer to accompanying document entitled: Appendix A. Rationale for the CSSE Rankings).

In the foregoing manner, the CSSE arrived at its rankings of Canada's Aerospace program areas. The program area ranked "1" is the program area which the CSSE considers to be the most important to Canada.

Rank	Program Area
1	Earth observation RADARSAT II satellite
2	uninhabited aerial vehicles (drones)
3	Search and Rescue (SAR) systems
4	civil helicopters
5	commercial flight simulators
5	20-130-seat regional aircraft
5	visual simulations
8	Canadarm I and II
8	transport aircraft environmental control systems
10	new large aircraft landing gear
10	small gas turbine engines
10	other Space-related endeavours (besides civil Space research)
10	civil Space research
13	other landing gear
13	other Airspace-related equipment/systems (besides landing gear)
13	atmospheric environmental monitoring

Conclusions

3.1 SPACE PROGRAMS

Canada's Space program areas, notably RADARSAT and CANADARM, are key elements of Canada's Aerospace program.

Canada's Space companies have world-leading capabilities in niche areas such as communications and navigation, Earth observation sensors, ground stations, services and applications, space robotics and scientific instruments.

Satellite communications continue to be a large revenue generator, accounting for around two billion dollars of revenue annually.

Other key segments include satellite navigation and space science, in which fields Canada exports over one billion dollars' worth annually.

In this context, Canada has many achievements to build on and to support in both Aerospace and Airspace industry programs. The recent Government of Canada decision to disallow the sale of MacDonald Dettwiler and Associates' Information Systems and Aerospatial Services unit to a foreign power is seen as a positive one for Canada. It serves as a case of 'political jurisprudence' in dealing with future cases where the retention of taxpayer funded Canadian technology and know-how, essential to Canada's economic interests and sovereignty, are of paramount importance.

3.1.1 Economic Impact and Multiplier Effect

Manufacturing including aerospace/defence drives the Canadian economy. For every $1 invested in manufacturing, $3 plus is generated in economic spin off. Support for the industry is crucial especially as manufacturing faces significant pressures from offshore manufacturing, highly variable Canadian dollar versus the U.S. dollar and diminished productivity growth vis-à-vis international competitors.

The recently reported increase of $6 Billion in new funding for two American Granting Councils will likely attract many of Canada's best academic and industrial scientists leaving for the US. To prevent long term damage from the current economic recession and its inevitable reduction of Canada's highly skilled workforce, national and regional economic stimulus packages must include increased funding for research and development of aerospace technologies, materials and manufacturing processes. This will enable the industry to retain its expertise and be better prepared to meet international competition in the global economic recovery.

3.2 AIRSPACE PROGRAMS

Canada also continues to be a world leader in Airspace program areas, notably civil helicopters, commercial flight simulators, 20-130-seat regional aircraft and visual simulation.

3.3 "PUNCHING ABOVE ITS WEIGHT"

Canada receives enormous strategic and international leverage by investing in International Space programs. The "paybacks" from incremental investments in NASA and the European Space Agency programs far exceed the amounts of those investments. Equally important are collateral investments such as in RADARSAT and Canadarm because of their significance in strengthening Canada's national sovereignty and security.

3.4 AN EXPANDED AEROSPACE "PORTFOLIO"

There is no doubt that the Aerospace business is a profitable business for Canada, and that Canada should be investing more in it. Failure to do so would mean economic losses to Canada akin to the cancellation of some important programs in the past, which did and would have placed Canada at the forefront of aviation engineering and technology. With those politically-induced losses, Canada also lost its ability to effectively protect and defend its Northern regions with the loss of its long range air patrol capability. It seemed not important at that time, but times and priorities have changed in the more than one half century it has taken Canada to recover and rebuild this strategically important industry to its current state of competency and world leadership role in some of these technologies. It would be easy to gloss over past history. Understanding and applying the lessons of history are the sine qua non of successful societies. Canada must guard against losing any of its hard-won industrial capacity in these technologies by supporting and building on its current strengths and business development initiatives.

Anticipated increased shipping activity through the Northwest Passage in the coming decades will have an impact on the future northern resource and mining development in minerals such as uranium and diamonds, to name but two, as well as the exploration and extraction of oil and gas in the Arctic. In the face of increasing international interest by the United States, Russia, Denmark, Japan and Norway, as well as the European Union, Canada will need to be more than vigilant. Canada's sovereignty claims will be challenged and we must have the scientific and legal resources to defend our legitimate sovereignty position. UAV's will certainly play a major role for sovereignty operations on the West Coast, North West Passage and the East Coast.

As to how much more Canada should invest in Aerospace, will depend on the number and size of cost-effective incremental investments that can be identified among the 15 Aerospace program areas cited above. If a comprehensive review of currently identified cost-effective incremental investments were to be carried out it would not be surprising to find that the total increase in investment in Aerospace would be distributed among the 15 Aerospace program areas roughly in accordance with the above rankings. Over time, more civil Space research and other Space-related endeavours could well provide Canada with great rewards. There is much to learn about

the Solar System and beyond, and much to be exploited (in interplanetary Space, on Earth's moon, on other planets and their moons, and beyond).

3.5 THE RELEVANCE OF DEFENCE R & D

It is well recognized that aerospace and national defence research and development "feed" on one another, together strengthening the Canadian economy and Canada's national sovereignty and security. Canadian-based research and development of technologies would lead to 'capability-oriented' decisions on purchases to meet Canada's needs, rather than 'resource-oriented' selections of foreign technologies designed to meet other countries' needs.

Numerous academic and aerospace enterprises across Canada, including provinces not widely known for their Aerospace involvement, such as Saskatchewan, yearn for a Canadian Aerospace policy that will guide and otherwise support training, research and development, supplemented by government contracts that lever their unique expertise niches via the proposed (and needed) Canadian Aerospace Policy framework and complementary "Canada First" Procurement Strategy. This strategy ensures that for large defence contracts, the winning contractor (usually an international contractor) is required to spend the contract equivalent in Canada on R&D and advanced manufacturing.

3.6 AEROSPACE ENGINEERING GRADUATES

There appears to be too few Canadians pursuing a career in Aerospace engineering; in particular, too few Canadians are graduating in Aerospace Engineering from Canadian universities. Support for aerospace activities at the university level should be based on their current agendas. In every province there should be a drive to engage university-level students. This will not only aid in research and development, but also the training and supply of qualified highly trained personnel for this emerging sector.

3.7 THE IMPORTANCE OF PUBLIC AWARENESS

Among Canadians there is a serious lack of awareness of Aerospace and Canada's opportunities in Aerospace, which doubtless accounts in part for Canada's current under-investment in Aerospace. (See Supporting Document Appendix B - The Importance of Public Awareness.)

3.8 SURVEILLANCE THROUGH UNINHABITED AERIAL VEHICLES (UAV)

There is a growing need for uninhabited aerial vehicles (UAV) to conduct critical surveillance functions for reasons of national security and safety, without placing personnel in harm's way, as well as for reducing operating expenses. (See Supporting Document Appendix C - Surveillance through Uninhabited Aerial Vehicles.).

Serious questions are being raised about effective surveillance, detection and destruction of Improvised Explosive Devices (IED's) increasingly being used in the asymmetric war by insurgents in different parts of the world's trouble spots:

"If we can detect and destroy incoming missile systems at about Mach 7, why are we not able to locate IEDs in support of our operations?? Are our soldiers not worth as much to protect as civilians in built up areas? With all the R & D focused on military science and technology - should we not be able to locate and destroy emplaced IEDs?"

The Canadian public is increasingly frustrated by the number of casualties inflicted by the IED's and the apparent lack of detection capability to avoid them. Much more research needs to be done to enhance the capability of UAV's to detect emplacement and the subsequent destruction of IED's to protect the lives of our military personnel and civilians in the conflict zones. This is urgent, not only to save lives and loss of equipment, but also to maintain political and public support for Canada's overseas commitments.

Recommendations

- **The CSSE recommends that Industry Canada formulate a firm and clear Aerospace regulatory and policy framework.**

- **The CSSE recommends that the regulatory and policy framework will guide and otherwise support training, research and development and advancement of Canadian Aerospace engineering.**

- **The CSSE recommends that Canada increase its investment in Aerospace, particularly in Research and Development.**

- **The CSSE recommends that Industry Canada increase promotion of Aerospace to the Canadian tax payer.**

- **The CSSE recommends that the Government of Canada take steps to encourage more Canadians to pursue Aerospace careers.**

Rationale

Industry Canada, in concert with other departments of the Canadian Government needs to formulate a firm and clear regulatory and policy framework to ensure the continuity and sustainability of this national resource, impacting on Canada's economic, social and strategic well-being.

Canadian Aerospace regulatory and policy framework will need to guide and otherwise support training, research and development, supplemented by government contracts that lever their unique expertise niches via the proposed (and needed) Canadian Aerospace Policy framework and complementary "Canada First" Procurement Strategy.

Canada needs to increase its investment in Aerospace to the extent that cost-effective incremental investments can be identified, with due regard to strengthening national sovereignty, security, and overwhelming national interest; specifically the economic well-being of Canada's Aerospace industry.

Canada needs to increases its Research and Development efforts in the area of defence related technologies to protect the lives of our military personnel and civilians in the conflict zones.

Industry Canada needs to increase its efforts to explain to Canadians the fundamental importance of Canada's Aerospace policy and programs, perhaps along the lines of Parts 1. and 2. above.

The Government of Canada needs to take steps to encourage more Canadians to pursue Aerospace careers, one such step being to attract more university graduates to seek employment in Aerospace engineering.

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Appendix A - Rationale for the CSSE Rankings of Canada's Aerospace Programs

ACHIEVING NATIONAL OBJECTIVES

The CSSE has concluded that the relative importance of each of the policy areas, to the achievement of Canada's long-term national objective, is as follows:

(1) improving the economic well-being of Canada (including sustainable development and education); ……..	0.40
(2) improving the health of Canadians (including bettering health education and protecting the environment); ……..	0.10
(3) improving the security of Canadians; ……	0.20
(4) maintaining Canadian sovereignty; ……	0.30
	1.00

ASSESSING RELATIVE IMPORTANCE

The CSSE has assessed the relative importance of each of Canada's Aerospace program areas in the context of the above four policy areas. Each of the program areas were then weighted in accordance with their above relative importance to arrive at an overall ranking of each of Canada's Aerospace program areas, (i.e. the relative importance of each program area to the achievement of Canada's long-term national objective). (Please refer to Strategic Policy Areas (1) to (4) above.)

1. The CSSE recommends that the relative importance of each of Canada's Aerospace program areas, in improving the economic well-being of Canada, be accepted as follows:

(i)	commercial flight simulators, …….	0.14
(ii)	visual simulation, …….	0.12
(iii)	new large aircraft landing gear, ……...	0.09
(iv)	transport aircraft environmental control systems, ……..	0.08
(v)	20-130 seat regional aircraft, …….....	0.09
(vi)	uninhabited aerial vehicles (UAV, drones) …….	0.09
(vii)	small gas turbine engines, ……	0.08
(viii)	other landing gear, ……...	0.05
(ix)	civil helicopters, ……...	0.06
(x)	search and rescue (SAR) systems, ..…….	0.05
(xi)	other Airspace-related equipment/systems, …….	0.03
(xii)	atmospheric environmental endeavours, ……..	0.02
(xiii)	Canadarm I and II, ……	0.02
(xiv)	Earth observation RADARSAT II satellite (agricultural, marine, pollution, etc. monitoring and mapping), …….....	0.05
(xv)	civil Space research, …….	0.02
(xvi)	other Space-related endeavours, …….....	0.01
		1.00

2. The CSSE recommends that the relative importance of each of Canada's Aerospace program areas, in improving the health of Canadians, be accepted as follows:

(i)	commercial flight simulators, ……..	0.00
(ii)	visual simulation, …….	0.00
(iii)	new large aircraft landing gear, ……	0.00
(iv)	transport aircraft environmental control systems, …….....	0.05
(v)	20-130 seat regional aircraft, …….....	0.00
(vi)	uninhabited aerial vehicles (UAV, drones) …….	0.35
(vii)	small gas turbine engines, …….....	0.00
(viii)	other landing gear, …….....	0.00
(ix)	civil helicopters, ……	0.00
(x)	Search and Rescue (SAR) systems, ……	0.10
(xi)	other Airspace-related equipment/systems, …….....	0.00
(xii)	atmospheric environmental endeavours, ……...……...	0.10
(xiii)	Canadarm I and II, ……..……..	0.00
(xiv)	Earth observation RADARSAT II satellite (agricultural, marine, pollution, etc. monitoring and mapping), ……..….....	0.35
(xv)	civil Space research, ……..……..…….	0.04
(xvi)	other Space-related endeavours, ……	0.01
		1.00

3. The CSSE recommends that the relative importance of each of Canada's Aerospace program areas, to improving the security of Canadians, be accepted as follows:

(i)	commercial flight simulators, ……..	0.00
(ii)	visual simulation, …….	0.00
(iii)	new large aircraft landing gear, ……	0.00
(iv)	transport aircraft environmental control systems, ……	0.00
(v)	20-130 seat regional aircraft, ……	0.00
(vi)	uninhabited aerial vehicles (UAV, drones) ……..	0.25
(vii)	small gas turbine engines, …….	0.00
(viii)	other landing gear, ……	0.00
(ix)	civil helicopters, ……	0.15
(x)	Search and Rescue (SAR) Systems ……	0.20
(xi)	other Airspace-related equipment/systems, …….	0.05
(xii)	atmospheric environmental endeavours, …….	0.00
(xiii)	Canadarm I and II, ……..	0.00
(xiv)	Earth observation RADARSAT II satellite (agricultural, marine, pollution, etc. monitoring and mapping), …….	0.30
(xv)	civil Space research, …….....	0.00
(xvi)	other Space-related endeavours, …….	0.05
		1.00

4. The CSSE recommends that the relative importance of each of Canada's Aerospace program areas, for maintaining Canadian sovereignty, be accepted as follows:

(i)	commercial flight simulators, ……..	0.00
(ii)	visual simulation, …….	0.00
(iii)	new large aircraft landing gear, ……..	0.00
(iv)	transport aircraft environmental control systems, ……..	0.00
(v)	20-130 seat regional aircraft, ……...	0.05
(vi)	uninhabited aerial vehicles (UAV, drones) …….	0.20
(vii)	small gas turbine engines, ……	0.00
(viii)	other landing gear, ……	0.00
(ix)	civil helicopters, ……	0.15
(x)	Search and Rescue (SAR) systems, ……	0.15
(xi)	other Airspace-related equipment/systems, …….	0.00
(xii)	atmospheric environmental endeavours, …….	0.00
(xiii)	Canadarm I and II, ……	0.10
(xiv)	Earth observation RADARSAT II satellite (agricultural, marine, pollution, etc. monitoring and mapping), ……	0.25
(xv)	civil Space research, ……..……	0.05
(xvi)	other Space-related endeavours, ……..…….	0.05
		1.00

5. The table below summarizes the CSSE's recommendations regarding the relative importance (R_i) of each of Canada's Aerospace program areas to the achievement of Canada's long-term national objective.

R_i is calculated by weighting the relative importance of Canada's Aerospace program areas to the Canada's policy areas (1. to 4. above) with the applicable relative importance of Canada's policy areas to the achievement of Canada's long-term national objective {2.1 (1) to 2.1 (4) in Part 2. of the submission}.

For example, R_{iv}, the relative importance of Earth observation RADARSAT II satellite to the achievement of Canada's long-term national objective, is

R_{iv} = 0.05 {1.} x 0.40 {2.1(1)} + 0.35 {2.} x 0.10 {2.1(2)} + 0.30 {3.} x 0.20 {2.1(3)} + 0.25 {4.} x 0.30 {2.1(4)} = 0.20 (rounded)

		R_i
(i)	commercial flight simulators, …….	0.05
(ii)	visual simulation, ……..……	0.05
(iii)	new large aircraft landing gear, ……	0.03
(iv)	transport aircraft environmental control systems, ……	0.04
(v)	20-130 seat regional aircraft, ……...	0.05
(vi)	uninhabited aerial vehicles (UAV, drones) ……..	0.18
(vii)	small gas turbine engines, ……	0.03
(viii)	other landing gear, ……	0.02
(ix)	civil helicopters, ……	0.10

(x)	Search and Rescue (SAR) systems, ……	0.11
(xi)	other Airspace-related equipment/systems, ……..	0.02
(xii)	atmospheric environmental endeavours, ……..…….	0.02
(xiii)	Canadarm I and II, ……..……	0.04
(xiv)	Earth observation RADARSAT II satellite (agricultural, marine, pollution, etc. monitoring and mapping), …….……	0.20
(xv)	civil Space research, ……..…….	0.03
(xvi)	other Space-related endeavours, …….……..	0.03
		1.00

In the foregoing manner, the CSSE arrived at its rankings of Canada's Aerospace program areas. The program area ranked "1" is the program area which the CSSE considers to be the most important to Canada.

Rank	Program Area
1	Earth observation RADARSAT II satellite
2	uninhabited aerial vehicles (UAV, drones)
3	Search and Rescue (SAR) systems
4	civil helicopters
5	commercial flight simulators
5	20-130-seat regional aircraft
5	visual simulations
8	Canadarm I and II
8	transport aircraft environmental control systems
10	new large aircraft landing gear
10	small gas turbine engines
10	other Space-related endeavours (besides civil Space research)
10	civil Space research
13	other landing gear
13	other Airspace-related equipment/systems (besides landing gear)
13	atmospheric environmental monitoring

Appendix B - The Importance of Public Awareness

Most Canadians are unaware that Canada owes much of its success in the development of new, internationally-marketed, technologies to the participation by Bombardier, CAE Inc., Canadian Pratt & Whitney and many other Canadian "high tech" companies in Canadian / U.S. aerospace and related defence initiatives.

For example, CAE Inc. has sold over 900 flight simulators and training equipment to more than 100 airlines, aircraft manufacturers and training centres. It conducts commercial and military flight training on 115 of its full flight simulators at its 24 aviation training centres under contracts with 3,500 airlines, aircraft operators and manufacturers around the globe.

Similarly, although Canadians are increasingly concerned about national sovereignty and security many may not be aware of the extent to which developments such as RADARSAT and CANADARM have strengthened Canada's ability to assert itself in defending its rights in international fora.

A very "back-home" example of the benefits of Canada's participation in national and international commercial and defence-related aerospace research and development programs is the discovery over 50 years ago of the Kidd Creek mineral deposits around Timmins, Ontario. The discovery was made by an exploration and mining company using a helicopter-towed Magnetic Anomaly Detection (MAD) device developed by the U.S. Navy in cooperation with Canada's Defence Research Board to hunt for submarines. It would be safe to say with certainty that less than one tenth of one percent of the population of this northern city is aware that its main source of income was established as a result of DRB research in the field of submarine detection.

The CSSE believes that it is essential that the Government of Canada undertake to enhance public awareness of the very significant technological achievements that have resulted from Canada's investments in national, bilateral and multilateral aerospace research and development programs. These achievements and those that most assuredly will result from ongoing activities will continue to be fundamental to maximizing the well-being of Canadians. Enhanced public awareness of these achievements will inevitably result in greater support for future aerospace research and development initiatives of the Government of Canada.

The use of our successful research developments not only gives us the opportunity to assert ourselves in international forums, but it gives access to the related developments of our allies and international customers.

Appendix C - Surveillance through Uninhabited Aerial Vehicles (UAV)

And now we are in a great rush in order to get some uninhabited aerial vehicles (UAV) into service to conduct critical surveillance capabilities. It is interesting to note that Canadian industry had an excellent UAV facility at Canadair, Montreal (later Bombardier Aerospace) to develop, test and manufacture a full UAV capability. A series of UAVs had been designed, developed and produced for other countries (Germany, France, UK, and Italy). Advanced testing with a NATO standard UAV (CL227) for the US Navy was completed. It is just unfortunate that the Canadian Government through the Canadian military did not take an interest in an existing Canadian capability. For example, the CL 289 is in service with Germany and France. It was flown with great success in Bosnia, and is under further advanced development by Dornier Aerospace in Germany.

However, with no interest from Canada the whole of the Canadian UAV and associated surveillance capability developed by Canadair (and Bombardier Aerospace) was lost. So now Canada is seeking this capability from non-Canadian sources.

Several options are possible and UAVs will certainly play a major role for Sovereignty operations on the West Coast, NorthWest Passage and the East Coast.

Appendix D - Search and Rescue and Airborne Surveillance Operations

Synopsis and Overview

Canada has the appropriate core aerospace technology and capabilities to best meet Canada's airborne search and rescue (SAR) needs in the Canadian Arctic and rugged coastal areas.

Sovereignty Operations
Canada has achieved demonstrated success in the development, manufacturing and operation of Canadian built Search and Rescue (SAR) aircraft with proven ability to meet the specific mission demands of Canada's remote locations under difficult flying conditions. Further, with the on-going changes to the environment, particularly to the Arctic Ocean, which may now be claimed as "Blue water," a strategic review needs to be developed to ensure Northern SAR and sovereignty operational requirements are updated and complementary. Canada's claim to sovereignty over its Arctic Regions will be strengthened by being able to operate effective Search and Rescue missions in addition to airborne surveillance of the waterways and surrounding regions.

DND/CF Proposal
The DND/ Canadian Forces (CF) proposes to procure the C27 Spartan transport aircraft from an off shore manufacturer to meet SAR requirements. The intention is to modify the Spartan pressurized airframe and fuselage to add surveillance windows for operational purposes along with other special to SAR system requirements. These significant changes and modifications are required to meet the SAR surveillance role, including type re-certification. These changes will be expensive and time consuming; they are viewed as "difficult" to achieve. Is the CF prepared to accept the risks of substantial cost overruns and possible delivery time delays in meeting the SAR requirements?

If the C27 Spartan transport is desired for other CF applications, a limited number could be acquired (bought or preferably leased) for those applications while a mix of Canadian-upgraded, Canadian-designed Buffalo and newly-ordered C-130J Hercules aircraft along with supplemental new-order CH47 Chinook helicopters better suited to Canada's SAR applications should be specified.

C27 Spartan
The following is a good description of the C-27 Spartan, as provided from the manufacturer's web site:

"The C-27J is a mid-range, multifunctional and interoperable aircraft able to perform logistical re-supply, MEDEVAC, troop movement, airdrop operations, humanitarian assistance and homeland security missions for the U.S. Army and U.S. Air Force. The C-27J will replace the U.S. Army's C-23 Sherpa and portions of the US Army's C-12 and C-26 fleet. The C-27J will

augment the U.S. Air Force's existing fleet of intra-theatre airlifters. The aircraft will play a key role in providing responsive aerial sustainment and critical re-supply support for the manoeuvre force to maintain operational momentum."

There are no references in the descriptive materials to the SAR function. If the air force has a requirement for a heavy or mid lift transport aircraft, then they should not hang their requirement just on the SAR function. In addition, a preliminary assessment is that the C27 Spartan will be on the "heavy" side to conduct the very difficult Search and Rescue missions in the Rocky and Coastal Mountains of British Columbia. This aircraft has not demonstrated the versatility and capability required for this type of mission.

Canadian Built SAR Aircraft

The in-service Canadian designed and Canadian built Buffalo has demonstrated this SAR mission capability for the last 40 years! The DND website states:

"***One of Canada's primary search and rescue (SAR) aircrafts, the CC-115 Buffalo will fly in almost any weather. The agile Buffalo can take off and land on even the most rugged terrain and in areas as short as a soccer field.***

Canadian-updated and newly Canadian-produced Buffalo will meet or exceed SAR mission requirements. It will also serve as an excellent short to medium haul transport aircraft as well as an excellent potential contributor to Canada's foreign trade exchange by being an aircraft with considerable export sales potential for Viking Air Limited, its Canadian de Havilland design-owner and Canadian manufacturer

For new production, the CC- 115 Buffalo will require installation of new engines, expected to be Canadian designed and built Pratt & Whitney turbines, as well as avionics, cockpit upgrades, amongst the most significant engineering changes. Integration and proofing of these systems will require type re-certification much as has been successfully done by Viking Air recently for the Twin Otter DHC-6 Series 400. Sensors and electronics defined special to SAR system requirements[1] will also have to be installed and integrated

New Buffalo production can be started with these changes introduced.[2] This will not be as difficult as the major fuselage changes required for the C27 Spartan system, which has not demonstrated SAR mission capability for Western Canada. The CC-130 Hercules is similarly task-proven in SAR applications, noted below from the DND website:

The CC-130 Hercules now performs many of Eastern Canada's SAR operations, but the short take-off and landing (STOL) capabilities of the CC-115 have kept it in use in the Rocky and Coastal Mountain ranges. At 24 m long, the Buffalo is small enough to service the rough and mountainous terrain on Canada's West Coast".

[1] Systems such as FLIR, ILRS, or SLAR along with updated systems and advanced communications, and special rescue gear as described later. Rigging for transport pallets will also be updated to current standards.

[2] The recently completed updating to the Twin Otter will bring the right experience to bear for the similar process for the Buffalo work.

The CC130J Hercules fleet should be expanded and standardized for long haul and special SAR missions off the East Coast of Canada. To lever this standardization, the Government of Canada has recently awarded a $329 million contract to CAE Inc. to lead a Pan-Canadian team of C-xwave, Bombardier, Atlantis Systems International and Cascades Aerospace to help build state-of-the-art flight simulators and training systems and services for Canada's new tactical airlift (CC-130J) aircraft.

Mid haul logistics transport will also be enhanced for special operations with the forthcoming arrival of the new medium range CH47 Chinook helicopter fleet.

DND appears to have missed the mark in defining performance requirements for other special missions to SAR aircraft; it looks like transportation and SAR have been combined to diminish the functionality of the unspecified special use(s) to SAR aircraft needs. Performance standards for SAR should be stated as a first priority, not as an afterthought. System requirements to meet advanced SAR functionality are addressed; integration of these systems will have to be included and trade-offs established between transport and SAR requirements.

Other Options

Other options relating to Bombardier Limited Dash 8 (Q Series) aircraft would acknowledge many variations have been used in international SAR and surveillance applications with different mission specifications from Canada's. In their current configuration the Q Series lack some essential and required capabilities, such as the versatility to conduct SAR operations in the very difficult Rocky and Coastal Mountain Ranges and none have rear ramps, stated as essential for all around functional SAR performance requirements.

The appropriate procurement strategy to best meet Canada's economic, safety and security needs would seem to be: Contract Canadian design owner and manufacturer Viking Air to update the Buffalo aircraft as described. A possible option to spread the work further within Canada's aerospace industry would be to consider having it specially outfitted by Bombardier to meet the SAR and sovereignty capabilities required for the system specified. Any contracts resulting from this approach would have to be carefully developed to meet full system requirements at optimum cost.

Canada has the appropriate core aerospace technology and capabilities to best meet Canada's airborne search and rescue (SAR) needs, especially for rugged coastal and arctic applications.