ESTIMATES

Canadian Space Agency

Performance Report

For the period ending
March 31, 2001

Canada

Improved Reporting to Parliament
Pilot Document

Each year, the government prepares Estimates in support of its request to Parliament for authority to spend public monies. This request is formalized through the tabling of appropriation bills in Parliament.

The Estimates of the Government of Canada are structured in several parts. Beginning with an overview of total government spending in Part I, the documents become increasingly more specific. Part II outlines spending according to departments, agencies and programs and contains the proposed wording of the conditions governing spending which Parliament will be asked to approve.

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The Estimates, along with the Minister of Finance's Budget, reflect the government's annual budget planning and resource allocation priorities. In combination with the subsequent reporting of financial results in the Public Accounts and of accomplishments achieved in Departmental Performance Reports, this material helps Parliament hold the government to account for the allocation and management of funds.

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Foreword

In the spring of 2000 the President of the Treasury Board tabled in Parliament the document "Results for Canadians: A Management Framework for the Government of Canada". This document sets a clear agenda for improving and modernising management practices in federal departments and agencies.

Four key management commitments form the basis for this vision of how the Government will deliver their services and benefits to Canadians in the new millennium. In this vision, departments and agencies recognise that they exist to serve Canadians and that a "citizen focus" shapes all activities, programs and services. This vision commits the government of Canada to manage its business by the highest public service values. Responsible spending means spending wisely on the things that matter to Canadians. And finally, this vision sets a clear focus on results – the impact and effects of programs.

Departmental performance reports play a key role in the cycle of planning, monitoring, evaluating, and reporting of results through ministers to Parliament and citizens. Earlier this year, departments and agencies were encouraged to prepare their reports following certain principles. Based on these principles, an effective report provides a coherent and balanced picture of performance that is brief and to the point. It focuses on results – benefits to Canadians – not on activities. It sets the department's performance in context and associates performance with earlier commitments, explaining any changes. Supporting the need for responsible spending, it clearly links resources to results. Finally the report is credible because it substantiates the performance information with appropriate methodologies and relevant data.

In performance reports, departments strive to respond to the ongoing and evolving information needs of parliamentarians and Canadians. The input of parliamentarians and other readers can do much to improve these reports over time. The reader is encouraged to assess the performance of the organization according to the principles outlined above, and provide comments to the department or agency that will help it in the next cycle of planning and reporting.

This report is accessible electronically from the Treasury Board of Canada Secretariat Internet site:
http://www.tbs-sct.gc.ca/rma/dpr/dpre.asp
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CANADIAN SPACE AGENCY

Performance Report
for the period ending
March 31, 2001

Brian Tobin
Minister of Industry

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EXECUTIVE SUMMARY

The Canadian Space Agency (CSA) has been successful in delivering a majority of its key commitments this year despite budget challenges. In dealing with many partners in Canada and on the international front, the CSA faces numerous challenges and opportunities. The challenges are reflected in the uncertainty of the world's economy, but the openness to world markets also creates good opportunities for the Canadian space industry and for Canadian scientists.

In 2000-01, the CSA continued with its major long-term projects, such as the development of the Mobile Servicing System (MSS) for the International Space Station (ISS) and the RADARSAT-2 spacecraft. Testing of Canadarm2, the first major element of the MSS, and its installation on the Space Shuttle was completed. Canadarm2 was launched and successfully installed on the ISS in April 2001. The second major element of the MSS, the Mobile Base System (MBS) was delivered to the Kennedy Space Centre and integration testing with other elements of the ISS was also completed. The third major element, the Special Purpose Dexterous Manipulator (SPDM), progressed through its manufacturing phase. The CSA successfully completed a major restructuring of the RADARSAT-2 project, securing the establishment of new partnership arrangements between Canadian and European firms. Meanwhile, RADARSAT-1 delivered images to clients in 57 countries and produced 17,000 scenes for the Canadian Ice Centre.

The CSA took significant steps towards commercialization of the ISS by creating an ISS Commercialization Policy, which encourages participation of the private sector in commercialization efforts. Implementation of this policy will continue in the following years.

A Canadian instrument, OSIRIS, was launched on the Swedish Odin satellite to measure global concentrations of ozone depleting pollutants. The SCISAT-1 spacecraft, the first Canadian scientific satellite for over 30 years, is in its final design phase and, when launched in late 2002, will monitor ozone and several additional greenhouse gases on a global scale. The Canadian instruments, WINDII and MOPITT, continue to provide quality atmospheric observational data to the Canadian and international scientific communities.

World-class research and industrial capability development was also stimulated with the study of scientific instruments and spacecraft components for Canadian participation in the Next Generation Space Telescope, which is being designed to replace the Hubble Space Telescope. A Canadian life sciences experiment, H-Reflex, is being used by the first crews to inhabit the International Space Station (ISS), and the development of experimental hardware for the Microgravity science use of the ISS was initiated.

As a result of CSA initiated activities and programs in the area of Satellite Communications, the Canadian space industry received contracts valued at over $100 million to supply international and other non-governmental sources with space equipment. These programs also generated technologies, which will enable Canada's

remote communities to access many valuable services, such as tele-medicine, more efficiently and in real time.

Several new technologies were developed which will help Canadians, not only by improving their quality of life, but also by resulting in significant economic benefit. These technologies range from smart structures to miniaturization of space hardware to smart batteries. The Canadian Space Agency has catalogued 52 discreet inventions, with 16 of those now patented. These technologies are licenced to industries for commercial exploitations, with sixty (60) such licences issued in 2000-2001.

Canadian astronauts continued to take an active role in the exploration of space. One mission for the installation of Solar panels on the ISS, in November 2000, included Canada's space veteran, Marc Garneau. At the end of the period, Chris Hadfield was getting ready for a mission to ISS to install Canadarm2.

The CSA and its astronauts continued to promote the Canadian Space Program actively, and used the unique appeal of space missions involving Canadian astronauts and technology to increase national awareness of Canada's achievements in space. Major information campaigns were launched across the country to foster scientific literacy among our nation's youth and encourage young Canadians to pursue careers in science and technology.

The Canadian Space Program benefited from the DFL's certification to the ISO 9002 standard. ISO 9002 is the internationally accepted technical standard for managing all processes that affect an organization's ability to meet client requirements for quality service, and further demonstrates the DFL's commitment to provide the best service possible to all its users.

In 2000-01, the CSA successfully implemented the Financial Information Strategy, which will help the Agency report to the public on its activities. The Risk Management Framework was also implemented as a means to strengthen the CSA's overall management framework.

Section 2 explains the strategic context of the Agency. It gives an overview of its environment, its partners, objectives and priorities. It also explains the challenges facing the CSA. Section 3 reports on the accomplishments made by the CSA in the period and their impact on Canadians. Finally, Section 4 presents the financial performance of the CSA and other relevant information.

SECTION 1: MESSAGE

1.1 Minister's Portfolio Message

The Government of Canada is committed to making Canada a world leader in the global knowledge-based economy of the 21st century. To meet this goal, the government has set out a very bold vision: to have Canada recognized as one of the most innovative countries in the world.

Why this emphasis on innovation? Innovation is one of the most powerful sources of competitive advantage in modern economies. It fuels productivity and economic growth and that translates into greater prosperity and a better quality of life for all Canadians. Our ability to acquire, adapt, and advance knowledge will determine how well Canadian businesses and Canada as a nation innovate, and in turn, how well Canada competes in the global arena.

The Industry Portfolio is …

Atlantic Canada Opportunities Agency
Business Development Bank of Canada*
Canada Economic Development for Quebec Regions
Canadian Space Agency
Canadian Tourism Commission*
Competition Tribunal
Copyright Board Canada
Enterprise Cape Breton Corporation*
Industry Canada
National Research Council Canada
Natural Sciences and Engineering Research Council of Canada
Social Sciences and Humanities Research Council of Canada
Standards Council of Canada*
Statistics Canada
Western Economic Diversification Canada

** Not required to submit Performance Reports*

Promoting innovation, research and development is a cornerstone of our government's agenda, and we have made progress. Canadian businesses have boosted their research and development (R&D) spending at the second fastest rate among G-7 countries. We have the fastest rate of growth in R&D jobs. And the government is committed to doubling its R&D investments and catapulting Canada into the ranks of the top five countries in the world for research and development performance by 2010.

When it comes to embracing the Internet revolution, or what has come to be known as connectivity, Canada's record is the envy of the world. Our country is one of the most connected countries in the world. We connected all of our schools and libraries to the Internet over two years ago. We have the highest percentage of our population on-line of any country in the world. Furthermore, the National Broadband Task Force has advised the government on how Canadians together can achieve the critical goal of making broadband access widely available to citizens, businesses, public institutions and to all communities in Canada by 2004.

As Minister of Industry, I am responsible for the Industry Portfolio, which consists of fifteen departments and agencies that play a key role in delivering on the government's agenda. With over 40 percent of federal government spending on science and technology, and a wide range of complementary programs to help businesses both large and small thrive and prosper, the Industry Portfolio has a national reach, regional depth and community presence across the country.

I am pleased to present this Performance Report for the Canadian Space Agency, which shows its contribution, during 2000-2001, to the government's agenda. The Canadian Space Agency continued to implement the Canadian Space Program and support the Canadian space industry and science. The participation of the CSA with the RADARSAT Program and the International Space Station, namely the development of the Mobile Servicing System (Canadarm2) and participation of Canadian astronauts and scientists in the utilization of the ISS facilities, also remained constant. Research continued in many high-potential fields to develop opportunities for Canadian industry. Also, 2000-01 set the stage for the third mission of astronaut Marc Garneau and the preparation of Chris Hadfield's mission.

The government's strategy has been to strengthen Canada's capacity for innovation by investing in research and knowledge, and by fostering a nation of highly skilled people. We are assisting all Canadians with life-long access to the tools and skills they need for success. We are laying the foundation of a state-of-the-art research environment in which our best and brightest can make their ground-breaking discoveries right here at home. And we are working with our researchers and entrepreneurs to make sure that Canada is the place where new products and processes get to market first and fastest.

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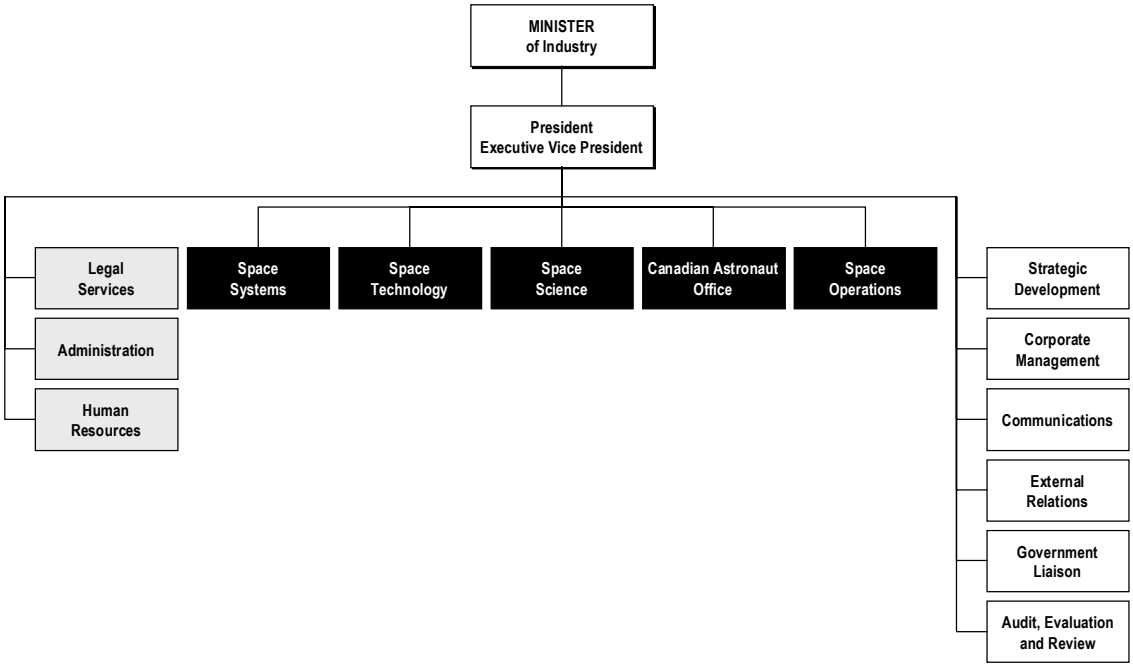
The Honourable Brian Tobin

SECTION 2: STRATEGIC CONTEXT

2.1 Overview of the Canadian Space Agency

The Canadian Space Agency (CSA), established in 1989, derives its authority from an Act of Parliament, the *Canadian Space Agency Act, S.C. 1990, c.13*. Its mandate is "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."

The CSA is a relatively small organization. In 2000-2001, personnel added up to 420 full-time equivalent employees and some 100 students on training (including post-doctoral fellows); also, approximately 250 persons worked as contractuals. Most of them (90%) work at the John H. Chapman Space Centre, the CSA headquarters in Saint-Hubert, Quebec. The others are located in Ottawa. Reporting to the Minister of Industry, the Chief Executive Officer of the CSA is the President, assisted by the Executive Vice President. Reporting to the President, five core functions (black in the Organisation Chart below): Space Systems, Space Technologies, Space Science, Canadian Astronaut Office, and Space Operations; six executive functions (white in the chart): Strategic Development, Corporate Management, Communications, External Relations, Government Liaison and Audit, Evaluation and Review; as well as three Corporate functions (grey in the chart): Legal Services, Administration, and Human Resources.



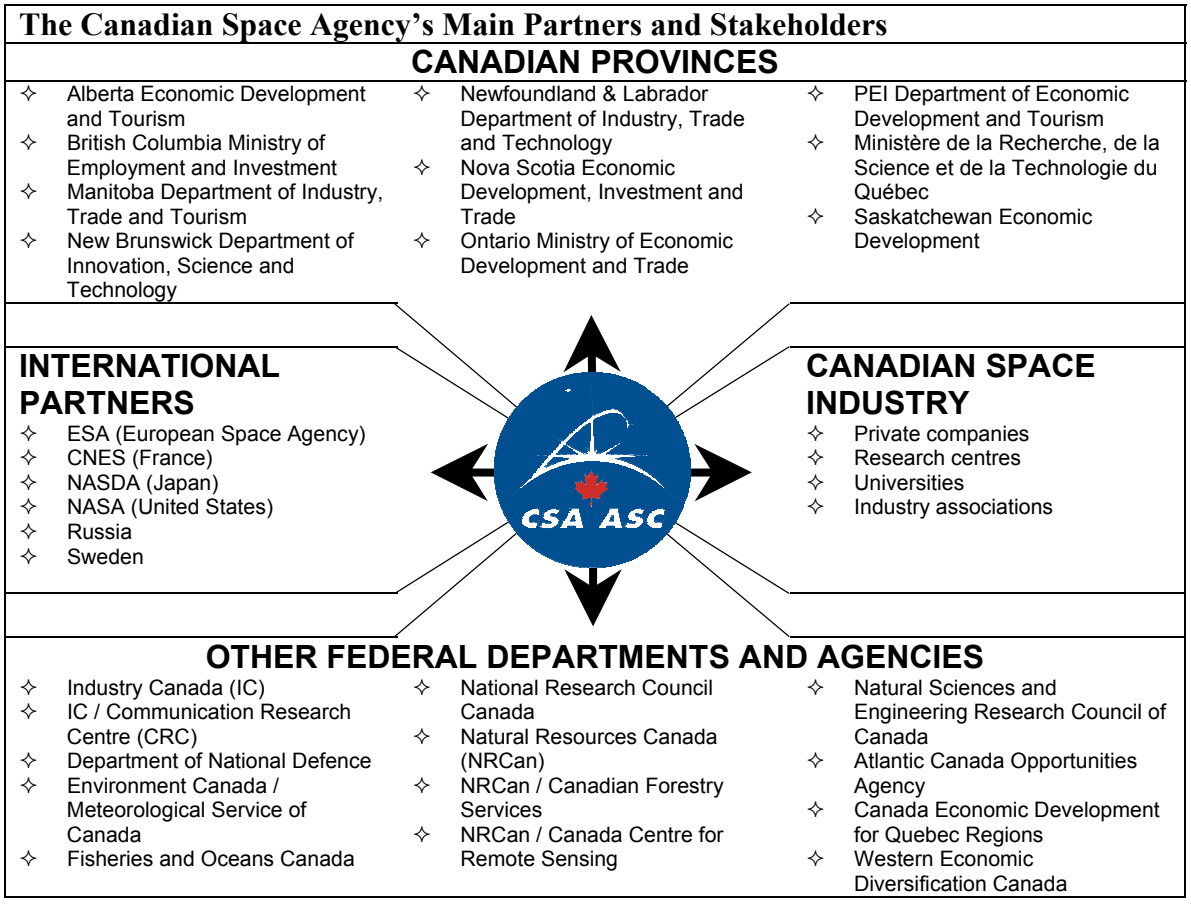
In addition to delivering its own programs, the CSA is responsible for co-ordinating all federal civil space-related policies and programs pertaining to science and technology research, industrial development and international cooperation. This role was set by the Space Policy Framework approved by the Government in 1994.

2.2 KEY CO-DELIVERY PARTNERS

International cooperation is critical to the implementation of the Canadian Space Program (CSP) and the promotion of a competitive space industry. Canada's principal international partners are the U.S. National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA). Canada also maintains significant bilateral cooperation with the national space agencies of Japan, Russia, France, Sweden, Germany, and China.

The CSA works closely with several government departments and agencies, notably with the Canada Centre for Remote Sensing (CCRS) of Natural Resources Canada, which operates satellite data ground receiving stations in Quebec and Saskatchewan, and the Communications Research Centre (CRC) of Industry Canada, which manages satellite communications programs on behalf of the Agency. Other partners are companies specializing in the development of space and ground hardware, universities and provinces.

Canada's space program involves partnerships with many agencies, departments, companies, institutions and organizations across Canada, as shown in the following chart.



2.3 CSA Long-Term Objectives

Canada's unique geographic and demographic character has inspired Canadians to adapt space to meet national needs in the areas of communications, the environment, and natural resource management. Hence, the CSA's overriding objectives are to develop space science and technology so as to meet domestic needs and support an internationally competitive space industry. The Agency is achieving these two objectives by implementing the Canadian Space Program (CSP) in accordance with the following principles:

- Development of technologies and applications in the fields of Earth and Environment and Satellite Communications;

- Leverage of federal funding through partnerships with industry for ensuring commercial success;

- Participation of a growing number of firms, particularly small- and medium-sized enterprises (SME), in space-related activities;

- Pursuit of sustainable industrial regional development through the use of regional distribution targets as guidelines;

- Promotion of greater synergies between civil and defence space activities for optimizing federal space funding;

- Implementation of national communications programs to take advantage of the unique appeal of space for improving scientific literacy among the general public and promoting careers in science and technology among students.

2.4 CSA Priorities for 2000-01

The program priorities pursued by the CSA in 2000-01 were:

- Completion of the construction of significant portions of the Mobile Servicing System (MSS) for the International Space Station (ISS) within budget and schedule, initiation of MSS operation and maintenance activities, and development of a CSA ISS Commercialization Policy;

- Operations of RADARSAT-1 at a high performance level for satellite reliability, image quality and responsive follow-up to customer requests, as well as continuation of the design and development of RADARSAT-2 proceeding within budget and schedule;

- Development of SCISAT-1, the first Canadian-built scientific satellite since Alouette in 1962, scheduled to be launched in 2002, and implementation of Microgravity and

Life Sciences Programs to prepare our scientific community and industry to utilize the ISS effectively;

- Development of an advanced Ka-band payload to demonstrate multimedia communications services on Telesat's Anik F2 satellite, scheduled for launch in 2002;

- Promotion and successful completion of two Canadian astronaut missions;

- Development of innovative technologies to enhance industry competitiveness and prepare Canada for future space missions, provision of space qualification services to support the Canadian space programs and industry;

- Implementation of domestic and international partnership arrangements (e.g., Canada/ESA Cooperation) to support the CSP and industry's international marketing efforts;

- Implementation of the Financial Information Strategy (FIS) and the Risk Management Framework.

2.5 CHALLENGES

The following sections briefly discuss the challenges that affected Canada's space programs in 2000-01 by service line.

2.5.1 Earth and Environment

In addition to the worldwide concern for the global environment, the international scene was dominated by an intensified competition to commercialize Earth Observation (EO) satellite data from the U.S. and Europe, the need to control access to satellite data better for national security reasons, and a growing interest in using hyper-spectral technologies for remote sensing from space. In response to those challenges, the CSA took measures to support Canadian industry's competitiveness on the international remote sensing markets. The essential elements of the strategy are: the strengthening of programs supporting satellite data applications development, such as the implementation of the Earth Observation and Applications Development Program (EOADP), the definition of a Canadian hyper-spectral program, the incorporation of data encryption into RADARSAT-2, and the potential inclusion of stereoscopic capabilities into RADARSAT-2 for a future RADARSAT-2/3 tandem mission at minimal additional cost to open up many new remote sensing products (e.g., digital elevation models and defence applications). RADARSAT-1 royalty revenue shortfalls over the original expectations (data sales realized by RSI in the last two years have been stable), combined with the requirement to operate the satellite beyond its design lifetime so as to ensure continuity in the supply of data until RADARSAT-2 is launched, raised significant operational and budgetary challenges.

2.5.2 Space Science

Canada's Space Science programs have been founded on international cooperation since the very beginning in 1962. The CSA is continuing to participate in international space science activities to provide our scientific community with exciting opportunities. Canada must take up significant challenges to maintain a position of excellence in the worldwide exploration of space and to benefit from current international opportunities, notably the new era soon to be opened by the utilization of the ISS, the human quest for space knowledge, and the growing interest in planetary exploration as witnessed by the numerous planned missions to Mars. For instance, in the past year, the CSA was challenged to define a contribution capable of bringing scientific and technical excellence to large international projects such as NASA's Next Generation Space Telescope (NGST), the ESA's Hershel/Planck space astronomy mission, and NASA's Planetary Exploration missions, with limited funding flexibility. Similarly, the development of facilities, payloads and experiments to prepare Canada for the scientific utilization of the ISS is a major long term endeavour, whose success depends on an adequate level of resources, cost-effective arrangements with our international partners and a suitable sharing of ISS resources among scientific and commercial activities.

2.5.3 Human Presence in Space

The management of programs encompassing this service line (i.e., the Canadian Space Station and Astronauts) is quite challenging. The long-term scope and international dimension of these programs limit the ability of any one country to control fully the schedule, design and cost changes. Moreover, the uniqueness of the space hardware being developed necessitates very stringent quality control requirements within a rapidly developing technology. For example, the decision to defer launch dates for the Canadian elements of the MSS (e.g., the Space Station Remote Manipulator System (Canadarm2) and Mobile Base System) resulted in changes in plans, budgets and schedules. Another recurring challenge pertaining to the delivery of the Canadian Space Station Program has been the management of significant risks associated with both the manufacture and operation of the MSS. The CSA's new Risk Management Framework does facilitate proper risk evaluation and mitigation processes, but significant cost increases in MSS Operations still had to be absorbed within the existing CSA envelope.

The establishment of a scientific community capable of conceiving experiments justifying the costs associated with their testing on the ISS has been a major objective for several years. So as to benefit fully from Canada's rights to utilize up to 2.3% of non-Russian laboratories and crew on-board the ISS, the CSA intends to allow the private sector to utilize a portion of those rights. The interest shown by the business community has encouraged the CSA to take a leadership role in the formulation of an ISS Commercialization Policy.

2.5.4 Satellite Communications

Globalization of the economy has reached the space and defence sectors, which used to enjoy a large degree of protection for national security reasons. Globalization has driven

a restructuring of the world's space industry around a few giant firms capable of producing complete satellite systems and associated services, from design through to launch and operations. Most of those systems are designed to provide worldwide coverage. This situation has generated significant challenges for Canada's satellite communication industry, which traditionally built satellites to meet domestic market needs. As a result, Canadian industry has adopted a strategy to re-deploy itself as a supplier of sub-systems and components in the growing international market for space-based multimedia and mobile personal communications. Research and Development (R&D) investments are a major condition for making this strategy a success by maintaining Canadian industry's competitiveness in traditional market niches and developing the advanced products required to join international consortia.

2.5.5 Space Technologies

Globalization has resulted in stronger competition for the Canadian space industry. In response to this challenge, the CSA strengthened both its external and in-house R&D programs to help industry develop and demonstrate innovative technologies and advanced systems. However, those efforts have been somewhat hindered by difficulties in recruiting engineers in some specialized disciplines.

2.5.6 Space Qualification Services

The David Florida Laboratory (DFL) provides an environmental test facility capable of meeting the current and emerging needs of Canada's space community. This facility contributes to the development of a competitive domestic space industry and the recognition of Canada's leadership in space. Issues that have continued to affect the DFL are: the International Trade in Arms Regulations (ITAR) restrictions which hinder the use of DFL services by potential U.S. clients, and the allocation of annual budgets at levels enabling the DFL to cover both its on-going operations and capital equipment replacement.

2.5.7 Comptrollership and Awareness

The establishment of a stable budget combined with the government-wide objective of modernizing the comptrollership function led the CSA to undertake major changes in its business practices, such as: the implementation of risk contingency mechanisms to ensure program delivery within approved envelopes; the integration of project planning and performance reporting into the annual work plan process; the establishment of a new Planning and Reporting Process to support strategic planning of the CSA programs; the implementation of the Financial Information Strategy (FIS) for applying full accrual accounting practices; and, the renewal of consultation structures with stakeholders through the creation of the CSA Advisory Council and Service Line Advisory Boards. Other horizontal factors that significantly impacted the CSA performance were the growing demands from industry to support their international marketing efforts, the increased workload in the Human Resources sector due to staffing actions, the salary equity decisions, and the difficulties in attracting highly qualified specialists.

SECTION 3: PERFORMANCE BY OUTCOME

3.1 Overview

The government investment in space provided Canadians with significant economic, social and environmental benefits through the fulfilment of the following overriding priorities for each Key Results Commitments in 2000-01:

Key Results Commitments	Overriding Priorities
Economic benefits to Canadian industry	Continuation of MSS manufacturing and RADARSAT-2 development
Understanding of the environment and contributions to sustainable development	Development of SCISAT-1, the first Canadian-built scientific satellite since Alouette in 1962
Contributions to the quality of life	Preparation of the Canadian scientific and medical communities to utilize the ISS research facilities and astronaut expertise
Technological development and diffusion	Development and demonstration of space technologies to enhance industry competitiveness and prepare for future space missions
World-class space research	Development of scientific instruments for participation in the Next Generation Space Telescope (NGST) and the FIRST/Planck missions
Social and educational benefits to Canadians	Training of qualified scientists, engineers, and technicians for the high technology industries
Effective promotion for greater awareness of the Canadian Space Program	Increase the profile of Canadian space activities, particularly missions of Canadian astronauts to the ISS, and installation of the Canadarm2 on the ISS

Total actual CSA expenditures added up to $318.8 million compared to a budget of $342.8 million in 2000-01. More information on the CSA's financial performance is presented in Section 4 of the Report.

The following seven sections present the Agency's performance in 2000-01 for each of the Key Results Commitments.

3.2 Economic Benefits

The Canadian space industry has evolved rapidly over the last few years as part of the worldwide restructuring prompted by globalization. It has largely realigned itself as a premium supplier of high quality niche products and services to large foreign prime contractors, mainly in the area of Earth Observation, Telecommunications and Space Robotics.

With yearly revenues of approximately $1.8 billion, the Canadian space industry, made up of some 250 firms, has positioned itself well in this unpredictable environment and continues to grow in influence and stature on the world stage. It is now employing close to 7,000 people in all regions of the country and exports 40% of its production (see the following chart).

Canadian Space Industry		
Sector	**Revenue ($ in millions)**	**Employees**
Space Segment	$487	2721
Ground Segment	$190	1191
Applications and Services	$1,100	2593
Space Research	$37	406

The CSA, in cooperation with its partners, seeks to maintain Canada's world leadership in its traditional industrial space niches mainly through the programs comprised in the service lines: Satellite Communications, Earth and Environment, Human Presence in Space. Note that Space Science activities support industry through technological capabilities gained in developing unique scientific instruments; several Space Technology programs also focus on the development of Canadian industry's international competitiveness.

3.2.1 Economic Benefits – Satellite Communications

Telecommunications constitute by far the largest space-sector activity in Canada. Last year, firms active in this area generated $1.16 billion in sales, representing 63% of the total space revenues and employed 2,800 people.

The CSA Satellite Communications programs helped position Canadian industry as a supplier of sub-systems and components for the satellite-based international multimedia and mobile communications markets. With expenditures of $23.8 million in 2000-01, the following programs contributed to achieving this outcome:

Planned Expectations	Accomplishments
Program Description: The *Payload Flight Demonstration Program* (expenditures of $14.2 million, including the final phase of the preceding *Advanced SatCom Program* in 2000-01) is a private/public sector partnership to which the CSA contributes $80 million (with $60 million repayable) to develop a Ka-band multimedia payload for launch on Anik F2 satellite in 2002. The *Ground Segment Technology and Applications Development Program* co-funds with industry the development of satellite-based	

Planned Expectations	Accomplishments
multimedia applications such as tele-education and tele-medicine (expenditures of $0.4 million).	
• To position Canadian industry as a supplier of multimedia sub-systems (e.g., on-board processing, multi-beam antennas and high rate data transmission) and as a service provider for the next generation of satellite communications on international markets. • To increase sales by 50% for the Canadian satellite communications industry through participation in international consortia. • To increase employment in the satellite communication industry.	• Contracts were awarded to Telesat (Ottawa, Ont.), COM DEV (Cambridge, Ont.), and EMS Technologies (Montreal, Que.) for the development of a Ka-band payload to demonstrate broadband multimedia services on the Anik F2 satellite. • Contracts were placed with ISE (Coquitlam, BC.), Questar Tangent (Victoria, BC.), and Memorial University (St John's, Nfld.) for the development of satellite communications applications for the marine sector. • Contracts awarded to industry generated the following spin-offs: - Norsat won a contract of $5 million to develop Ka-band outdoor user terminals for Koreasat. - EMS Technologies won a $2.3 million contract to develop a multimedia satellite demultiplexer, in partnership with Italy's Alenia Aerospazio, and a $75 million contract from Kokua Communications of the UK for 15,000 Ka-band user terminals. • Successful demonstrations of space technologies in applications were achieved, including: - Real-time management of forest fire fighting by satellite (REMSAT) with MDA and the BC Forest Service was established. The ESA will apply the same technologies and methods to other emergency situations in Europe (floods, earthquakes, etc.).

Planned Expectations	Accomplishments
	- Tele-education and tele-medicine were applied using satellite multimedia in Canada's remote northern communities (Telesat). - The Harsh Environments Initiative, led by C-CORE (Newfoundland), has entered its 3rd Phase to apply space technologies to the operational needs of the mining and oil & gas industry.
Program Description: Canada participated in the following ESA satellite communications programs: *Advanced Research in Telecommunications Systems* (ARTES 1,3,5,9), ARTEMIS and *GalileoSat Definition Program* (expenditures of $9.0 million including the associated share of the General Budget).	
• To enhance Canadian industry technological capabilities by accessing the most advanced European satellite communications technologies. • To develop and demonstrate advanced services and systems in optical communications, on-board processing, portable ground stations, and mobile communications to access international markets for interactive multimedia and Internet by satellite. • To position Canadian companies as suppliers of sub-systems to the European global navigation satellite systems to be operational in 2008. • To contribute, through Canadian industry, to the development of state-of-the-art expertise in ESA programs.	• Contracts were awarded to industry for conducting feasibility studies on new communication services (ARTES-1), developing advanced systems and technology equipment on future European broadband and mobile communications systems (ARTES-3,-5), and supporting Canadian industry participation in the future European Global Navigation Satellite System (ARTES-9). • During the Definition Phase of Galileosat, Canada obtained the leadership for the search and rescue payload; study contracts were awarded to signal structure for satellite navigation receivers (NovaTel) and network integrity (Telesat).

3.2.2 Economic Benefits - Earth and Environment

Earth Observation (EO) makes up the second largest space sector activity with annual revenues of $261 million and close to 1,600 employees last year. Over the last 4 years, EO revenues rose an impressive 144%, which bodes well for Canada's evolving remote sensing community.

CSA programs in Earth and Environment helped maintain Canadian leadership in space-based radar technologies and develop an internationally competitive value-added industry for products and services derived from satellite-based Earth Observation data. With expenditures of $100.7 million in 2000-01, the following programs contributed to achieving this outcome:

Planned Expectations	Accomplishments
Program Description: *RADARSAT-1* is planned to operate until the full commissioning of its successor (expenditures of $11.9 million in 2000-01); the data is marketed by RADARSAT International (RSI) in return for royalties.	
• To continue to operate RADARSAT-1 with the same high performance level for satellite reliability, product quality, timely delivery and responsive follow-up to customer requests. • To add foreign *RADARSAT* data reception ground stations to the international network. • To increase sales of data and associated royalty payments to the CSA by 10%.	• *RADARSAT* image quality was maintained within specifications, and data was delivered to clients in 57 countries; 25,712 user requests for acquisition and processing were met (bringing the total to over 97,000 requests to date); 17,000 scenes were produced in response to Canadian Ice Service (CIS) requirements; more than 73 terabytes of data were archived and 100 *RADARSAT*-based products and services are available in the market to date. • An average system performance of 96.8% was achieved (over the 95% specification); 98% data reception was reached by CCRS ground stations. • Thailand, Brazil, and two U.S. portable stations received product certification; another station in Japan achieved both operation and product certifications. This brought the total to 14 international network stations. • Sales target was not reached;

Planned Expectations	Accomplishments
	revenues were $2.1 million, at the level of the previous year.
Program Description: RADARSAT-2 aims to ensure continuity in radar data supply and Canadian leadership in the worldwide remote sensing market; it will incorporate advanced technologies, such as higher resolution and polarimetric modes, to open up new international markets (expenditures of $74.2 million).	
• To maintain Canada's position as the world leader in commercial space-borne radar technology and applications. • To achieve key milestones, including: mission critical design review scheduled for Winter 2001-2002; satellite integration and testing at the DFL to be completed in 2003; launch in late 2003; and transition to routine operations in early 2004.	• Major restructuring of the RADARSAT-2 program to cover the inclusion of a commercial launch and a new spacecraft bus supplier was successfully completed in March 2001. • Modifications to RADARSAT-2 spacecraft to include capabilities to encrypt RADARSAT–2 data and allow for a possible RADARSAT-2/3 tandem mission were completed.
Program Description: *Earth Observation Support Programs* help enhance Canada's ground receiving and data processing systems, develop value-added commercial and operational applications based on data from *RADARSAT* and other satellites through contracts to industry, and develop hyper-spectral technologies for the next generation of EO missions.	
• To create a competitive Canadian value-added industry able to develop products and services based on EO satellite data for the international market. • To enhance the reception and processing capabilities for accessing data from new satellites of interest to Canada. • To use remote sensing data in operational systems for resource management and environmental protection. • To make advanced technologies available for the next generation of satellites (e.g., RADARSAT-3).	• CCRS reception processing and transcription system capabilities were upgraded to receive advanced SAR data from ENVISAT. • Implementation of the new *EO Application Development Program* (EOADP) was achieved, with the awarding of 30 contracts (valued at $3.5 million) to industry for developing commercial and operational applications, value-added products and services, and promoting the use of EO data and technologies, namely in geology, forestry, and oceanography. • The new *Government Department-*

Planned Expectations	Accomplishments
	Related Initiatives, with the support of some 15 operational initiatives valued at $1.6 million on climate change, cryosphere, forest cover, inland waters and oceans, were implemented. • The *Hyper-spectral Program* activities (12 contracts to industry valued at about $1.5 million) were directed toward the development of an ISS experiment (e.g., preliminary feasibility analysis for an experimental hyper-spectral instrument on board the ISS), and the development of hyper-spectral imagery applications and technologies. • RADARSAT-2 applications to agriculture, oceans, geology and hydrology were simulated from airborne SAR data. • Demonstration of real-time emergency management via satellite (REMSAT) to improve communications between fire-fighting crews located in the field with the control centres was completed.
Program Description: Canada participated in the following ESA Remote Sensing programs: *Envisat*, ERS-2, *EO Preparatory Program*, and *EO Envelope Program* (expenditures of $9.6 million including the associated share of the General Budget). *Envisat* is complementary to *RADARSAT* and ensures the availability of C-Band SAR data. The satellite is scheduled for launch in November 2001 on-board Ariane 5.	
• To enhance Canadian EO industry technological capabilities by acceding the most advanced European remote sensing technologies. • To access European and other international markets in areas such as space-borne radar	• The provision of 300 ERS-2 products per year to Canadian users was reached. • Development and construction of space hardware by EMS, Bomem and COM DEV was completed. MDA

Planned Expectations	Accomplishments
instruments, ground segments and applications. • To contribute, through Canadian industry, to the development of state-of-the-art expertise in ESA programs.	and MPB are contributing to the ground segment. • Bomem's contract led to the selection of the company to build a series of components for polar-orbiting weather satellites in the U.S with $20-30 million expected in revenues over the next 10 years. Bomem expands its space group from 12 to 60 people in 6 years, thanks to the expertise gained on *Envisat*. • Implementation of the new *EO Envelope Program* ($22 million over the next 6 years) was completed to open up strategic Canadian industrial and scientific participation in new research-targeted (Earth Explorer) and commercially-oriented (Earth Watch) missions. • Canada's participation in the EOEP has resulted in the selection of the SWIFT instrument for the ESA Earth Explorer Opportunity Mission.

3.2.3 Economic Benefits - Human Presence in Space

With the Mobile Servicing System (MSS) project and Canada's contribution to the International Space Station (ISS), Robotics represent a major element of this business line. Last year, space companies involved in Robotics generated revenues of $224 million with a workforce of more than 1,100 employees. Combined with terrestrial opportunities in such fields as inspection, mining, surveillance, manufacturing and healthcare, the commercial viability of robotic activity in the industry as a whole should gain momentum.

The CSA's *Human Presence in Space Programs* fulfil Canada's commitment to complete the development and operate the Mobile Servicing System (MSS) while developing advanced automation and robotics technologies and creating high quality jobs. With expenditures of $79.7 million in 2000-01, the following programs contributed to achieving this outcome:

Planned Expectations	Accomplishments
Program Description: The *Canadian Space Station Program* develops and operates a robotic system, the Mobile Servicing System (MSS), used for the assembly and maintenance of the ISS. The MSS includes the Space Station Remote Manipulator System (SSRMS), mounted on a Mobile Base System (MBS) and designed to handle large loads on-board the Station, and the Special Purpose Dextrous Manipulator (SPDM), a second robot designed to perform more delicate tasks (expenditures of $33.1 million in 2000-01).	
• To continue Canada's contribution to international efforts for establishing a permanent human presence in space. • To position Canada as a world leader in space robotics by successfully completing the development and on-orbit commissioning of the MSS. • To develop advanced technologies by industry in high reliability software, life critical software, artificial vision, expert systems, force movement sensors, simulation, and object oriented software.	• SSRMS (Canadarm2) successfully launched on April 19, 2001. • MBS Acceptance Review was successfully completed, and the MBS was delivered to NASA's Kennedy Space Center in August 2000. Multi-Element Integration testing at the KSC was completed in March 2001. • SPDM manufacturing was completed, as well as assembly and testing in progress towards a successful Acceptance Review. • Flight version of Operations Control Software for Canadarm2 was delivered and accepted. • Artificial Vision Unit (AVU) was launched for orbit and installed on the ISS in March 2001.

Planned Expectations	Accomplishments
Program Description: The *MSS Operations Program* fulfils the following responsibilities: maintaining MSS hardware and software, performing repair and overhaul work on the MSS, operating MSS training facilities in Canada, and planning and operating MSS missions (expenditures of $45.3 million).	
• To position Canada as a world leader in space robotics by exercising full responsibilities for MSS Operations. • To fulfil Canada's international commitments by ensuring adequate and safe functioning of the MSS over the planned ISS lifetime.	• The MSS Operations Complex (MOC) infrastructure (located at the CSA HQ) for mission planning and monitoring was completed. • Agreement with NASA was reached (signed after year-end) to assume increased responsibilities for MSS repairs and overhaul in exchange for a portion of the CSA's astronaut training, payload launch and communication services. • Engineering contracts with industry (MD-Robotics) were completed to provide Logistics and Sustaining Engineering Support to the MSS. • The MSS Operations training was provided to twenty mission controllers, six astronauts and some NASA instructors. A robotics instructor was exchanged with Japan. • The MSS Operations at the CSA were initiated. • The MSS Sustaining Engineering Facility and Engineering Support Centre were activated.
Program Description: Management of the utilization of Canada's share of ISS facilities and resources (expenditures of $1.3 million).	
• To optimize utilization of ISS research facilities by Canadian scientists. • To allow partial use of Canada's share of ISS research facilities by the private sector.	• The scientific programs (e.g., *Microgravity and Life Sciences*) were continually implemented to prepare Canada to utilize its share of ISS facilities. • Canadian flight surgeon support and

Planned Expectations	Accomplishments
	Canadian astronaut support to all ISS flights were implemented to prepare Canada to utilize its share of ISS facilities. • A Commercialization Policy on ISS Utilization was established, following extensive consultations with stakeholders.

3.3 Understanding of the Environment and Contribution to Sustainable Development

The CSP contributed to better understanding, monitoring and prediction of the Earth's environment and global climate change, as well as enhancing the management of natural resources and disasters, through space-based technologies and data. With expenditures of $25.2 million in 2000-01 (this amount excludes RADARSAT-1 operations costs shown in Section 3.2.2), the following programs contributed to achieving this outcome:

Planned Expectations	Accomplishments
Program Description: The *Space Environment Programs* develop small payload missions for in-situ studies of space plasma and Earth's electromagnetic field to support Canadian scientists in order to enhance understanding of space environment phenomena (expenditures of $2.7 million in 2000-01).	
• To understand space environment phenomena through the use of space-based scientific instruments and advanced models. • To understanding the near-Earth environment and ability to forecast space weather through the use of space-based scientific instruments and advanced models.	• Initial instrument feasibility studies for the Polar Outflow Probe in preparation for a Canadian led micro-satellite mission for the study of the near-Earth environment and the establishment of a space weather forecasting facility in partnership with NRCan were conducted. • The acquisition, processing and delivery of space-based environment data to science teams were produced by Canadian-built instruments operating on international missions such as: Supra Thermal Ion Mass Spectrometer (SMS) and GEODESIC sounding rocket. • Continued operation of the Canadian network of ground-based instruments for the study of upper atmosphere and ionosphere phenomena (CANOPUS) provided a wealth of data in support of numerous space physics missions.
Program Description: The *Atmospheric Environment Programs* study the dynamics of the atmosphere, greenhouse gas sources, depletion of the stratospheric ozone layer and other global climate change phenomena with space-based instruments (expenditures of $20.4 million).	
• To achieve a better understanding, monitoring and prediction of global	• SCISAT-1 instruments and satellite hardware, as well as key radar

Planned Expectations	Accomplishments
climate and atmospheric pollution problems through space-based data gathered from Canadian instruments and improved modelling techniques. • To gain scientific knowledge to help develop policies for emission control of atmospheric pollutants to meet Canada's international commitments (e.g., Montreal Protocol and Kyoto Agreement), based on data produced by space-based international missions with Canadian participation.	components for Cloudsat, were developed with international partners, the Meteorological Service of Canada and CCRS. • Space-based atmospheric data were acquired, processed and delivered to science teams, as produced by Canadian-built instruments operating on international missions, to understand global climate changes better: WINDII (an instrument aboard NASA's *UARS* satellite to acquire data on the upper atmosphere dynamics), MOPITT (an instrument to measure carbon monoxide and methane in the troposphere on NASA's Terra satellite), OSIRIS (an instrument to analyse stratospheric ozone chemistry on Sweden's ODIN satellite).
Program Description: RADARSAT-1, with its unique capabilities of operating in total darkness and penetrating clouds, contributed to the understanding of the environment by supplying data for several environment-based applications such as: the monitoring of ice and sea conditions in the Canadian Arctic and coastal waters, the management of natural resources, and the operational management of natural disasters around the world.	
• To use *RADARSAT* data and products for improving environment, natural resources, and disasters management.	• The production of high-resolution mosaics of Antarctica, Canada, the continental U.S. and Australia provided the first complete near-instantaneous view of those areas. Significant progress was made in collecting land stereo data towards global coverage for mapping and surveys under the Background Mission. • The *Global Disaster Watch Program* supplemented by the hurricane watch campaign, continued over the West Atlantic and along the Gulf Coast, in cooperation with the CCRS and the NOAA; wide images of Hurricanes Alberto, Debby, Florence, Gordon, Isaac and Joyce were acquired. • Responses to urgent disaster requests

Planned Expectations	Accomplishments
	from around the globe continued (e.g., monitoring oil leakage, including a major oil spill off the coast of Ecuador near the Galapagos Islands, crop damage in Kazakhstan, flooding of the Lena River in Siberia, the Mount Etna eruption, landslides in Indonesia, a typhoon in China). • The 2nd Antarctic Mapping mission for NASA/NOAA was completed, as part of the original MOU, mapping ice flow and impact of climate change on Antarctica.
Program Description: The *Government Department-Related Initiatives* aim to develop and use space-borne technologies in fulfilling their mandate with respect to management of natural resources and disasters (expenditures of $2.1 million).	
• To utilize data and technologies derived from RADARSAT and other EO satellites in government department and/or agency operations and activities.	• Applications for managing disasters, studying the cryosphere, monitoring the sustainable development of Canadian forests, understanding the interaction between land-based ecosystems and climate change, mapping near-shore changes, studying the evolution of coastal zones with their ecosystems, and monitoring northern offshore marine environment and its interaction with global climate were developed.

3.4 Contribution to the Quality of Life

The CSP contributed to better quality of life through the contributions of space science and technologies towards improving medical procedures, and making advanced multimedia and personal mobile communications services accessible to all Canadians, wherever they live in our vast country. With expenditures of $16.7 million in 2000-01 (this amount excludes Satellite Communications program costs shown in Section 3.2.1), the following programs contributed to achieving this outcome:

Planned Expectations	Accomplishments
Program Description: The CSA maintains an astronaut corps to respond to the needs of manned space flights by conducting Canadian space material and life science experiments and supporting studies in health technologies. In addition, a space medicine program is being developed to prevent, diagnose and treat astronaut health problems (expenditures of $7.0 million in 2000-01).	
• To contribute to the international efforts on International Space Station assembly. • To make capabilities for research in space available to Canadian scientists. • To make operational space Medicine capabilities available in Canada.	• Canadian astronaut, Marc Garneau, participated on Mission STS-97 to install Solar Panels on the ISS. Canadian astronaut, Chris Hadfield, participated on Mission STS-100 to install SSRMS (Canadarm2) on the ISS. • First operational activities of the Payloads Telescience Operations Center located in Saint-Hubert with the H-Reflex experiment were completed. For the first time, a Canadian scientist was able to conduct a real-time experiment on the ISS from Canada. • ISS Medical Boards and Multilateral Medical Operational Panel Working Groups on Human Performance and Behaviour, Nutrition and Radiation actively participated in seeking opportunities for Canadian Industry.
Program Description: The *Space Life Sciences Programs* enable the Canadian scientific community and industry to advance our knowledge of the changes in the cardiovascular, bone and nervous systems, as well as the adaptation of humans and other life forms to the weightless environment through Space Shuttle flights, and eventually, the use of ISS ficilities (expenditures of $6.1 million).	
• To advance knowledge on the	• International facilities were developed

Planned Expectations	Accomplishments
cardiovascular, bone and nervous systems, and radiation effects on living organisms. • To improve medical knowledge, treatment, and drugs through experiments using the effects of micro-gravity. • To ensure the utilization by Canadian scientists of our share of the ISS research facilities.	in Canadian industry for the ISS and Space Shuttle flights (e.g., Insect Habitat, OSTEO-2 and EVARM). • Canada's first scientific experiment on the ISS (H-Reflex) was conducted.
Program Description: The *Microgravity Sciences Programs* enable the Canadian scientific community and industry to advance our knowledge of basic physical and chemical processes in the weightless environment by developing instruments and facilities for carrying out experiments on Space Shuttle flights and eventually, the ISS (expenditures of $3.6 million).	
• To advance knowledge on proteins and biotechnologies, fluid and combustion, advanced materials, fundamental physics and chemistry through experiments using the effects of micro-gravity. • To improve material processing techniques. • To ensure the utilization by Canadian scientists of our share of the ISS research facilities.	• Conceptual design studies were completed for the development of a Canadian Microgravity Isolation Mount Base Unit (MIMBU) and an ISS furnace facility. • Canadian participation in the development of the Microgravity Vibration Isolation System (MVIS) for the ESA Fluid Science Laboratory was noted.

3.5 Technological Development and Diffusion

In the face of stiff world competition, Canada's penetration of emerging space markets requires that the government actively support the development of the technological capabilities of Canadian space firms, particularly high technology SMEs. The CSA focused its efforts to develop, demonstrate and diffuse the technologies required to deliver its own space projects, support the growth and competitiveness of Canadian industry and prepare for future space programs. With expenditures of $24.3 million in 2000-01, the following programs contributed to achieving this outcome:

Planned Expectations	Accomplishments
Program Description: Through a competitive process, the CSA contracted out to industry the development of emerging technologies required for future space missions and the application of advanced technologies to prototype sub-systems/components with high commercial potential; the Commercialization Office supported technology transfer and diffusion, promoted the application of CSA-funded technologies to non-space markets, and managed intellectual property patents and licences to industry (expenditures of $15.0 million in 2000-01).	
• To enhance Canadian space industry's international competitiveness through the development and space-qualification of innovative technologies and products. • To make available the technologies required for future Canadian space missions. • To develop participation of SMEs from all regions of Canada in space technology development programs. • To commercialize Canadian space technologies and applications to non-space industrial sectors.	• Application of new concepts and emerging technologies to space were achieved (e.g., Radio-Frequency micro-machined systems, phase conjugation mirrors for Optical Inter-satellite Links, Hyper-spectral reflectance). • Prototype technology concepts, components and sub-systems with high commercial potential were demonstrated in the fields of structural analysis software, energy storage, robot vision and high-performance antennas. • Performance requirements, implementation plans and cost estimates for RADARSAT-3 were developed. • Catalogue of CSA patents was completed, 52 discrete inventions for which 16 patents have now been issued, as well as 60 licences, 17 equipment loan agreements, and 7 R&D collaboration agreements. • The *Technology Diffusion Program*

Planned Expectations	Accomplishments
	supported 6 new initiatives from Dynacon, Thinkspace, COM DEV, Crestech, Atlantis and PCI, for the commercialization of space technologies in non-space markets; socio-economic studies were completed for Space Station and Advanced Satcom programs; market studies for space technologies were completed for the nuclear, medical and harsh environment sectors. • The *Space Technology Development Program* awarded 36 contracts valued at $10 million to industry for technology development (e.g., new materials, processes and products). Contracts to industry resulted in the development of components, sub-systems or processes with promising market potential, such as: - Active laser camera system successfully tested on the Space Shuttle; - Object recognition and pose estimation system for space servicing operations; - Lidar-based automated planetary landing system; - High-capacity Li-Ion batteries for large high-power geostationnary satellites; - Micro Electromechanical Switches (MEMS) for communications satellites.
Program Description: In-house R&D programs maintained a base of expertise within the Agency to support the implementation of the CSP, to acquire intelligence on technology advances worldwide and to explore along with industry the potential of emerging technologies (expenditures of $9.3 million).	
• To acquire knowledge and expertise on	• New processes and tools were

Planned Expectations	Accomplishments
leading-edge technologies, applicable to spacecraft, payload and ground systems, built up through conducting internal R&D projects and reviewing contractor work. • To develop and manage the technologies of strategic importance to implement the CSP.	developed to meet CSP requirements in the areas of: data compression techniques and applications, optical inter-satellite link techniques, non-analytical control, laser ranging, infrared vision, nano-structured materials, and inflatable structures. • Scientific and engineering expertise, as required to meet CSP requirements, became available in the fields of: space exploration and servicing, advanced robotics, micro-electronic circuitry, radars, bus electronics and power systems, optical phase conjugation, and interferometry. • Over 60 papers and formal presentations were published at various conferences around the world, and two patent applications were submitted.

3.6 World-Class Research

Canada has developed international excellence in a number of areas, notably space robotics (where Canada is recognized as a world leader with the MSS), certain satellite communications sub-systems (e.g., radio frequency multi-plexing and antennas), civilian space-borne radar satellites and applications (e.g., *RADARSAT* family of satellites), certain space science disciplines (e.g., solar-terrestrial relations, space astronomy, atmospheric sciences), and space qualification services with the David Florida Laboratory (DFL). Considering that most of those areas are addressed in the preceding sections, the following table focuses only on space astronomy/exploration and the DFL program (expenditures of $12.7 million in 2000-01).

Planned Expectations	Accomplishments
Program Description: The *Space Astronomy and Exploration Programs* enabled our scientific community to contribute to international efforts aimed at understanding the universe and predicting its evolution (expenditures of $5.4 million in 2000-01).	
• To develop a better understanding of space, the universe, and the physical and chemical make-up of our solar system. • To provide opportunities to enable Canada's scientific community to participate in international space science missions.	• Studies on the development of scientific instruments for determining Canada's participation in NGST (Hubble Telescope replacement led by NASA) and the Herschel/Planck mission led by the ESA were completed. • The Microvariability and Oscillations of Stars (MOST) micro-satellite was developed. • Data was acquired, processed and delivered to international astronomy science teams, as produced by Canadian-built instruments, including: ground systems for Japan's Very Long Baseline Interferometry Space Observatory Program, and Fine-Error Sensors on-board NASA's Far Ultraviolet Spectroscopic Explorer. • Studies to identify space exploration projects of interest to Canadian scientists and possible robotic contributions to future international missions were completed.

Planned Expectations	Accomplishments
Program Description: The David Florida Laboratory (DFL) is a world-class facility providing space qualification services including the assembly, integration and testing of spacecraft systems and sub-systems on behalf of the CSP. The facilities and services available through the DFL are unique in Canada (expenditures of $7.3 million).	
• To ensure timely and accurate testing of space and ground based hardware. • To market DFL services to external customers. • To improve the DFL's capability to meet customers' requirements through the development and acquisition of state-of-the-art test technologies.	• The Facility was loaded at more than two-thirds of potential utilization time. A total of 257 test reports were generated for 30 different clients and 58 separate programs. Client satisfaction surveys indicated a 98% approval rating with the services provided by the DFL. • Space qualification of the SSRMS (Canadarm2) was completed, and the SPDM and Space Vision System are underway. Testing was also performed on various Space Science and Space Technology experiments/instruments. • Space environmental/qualification testing for Canadian and foreign industries was completed (including multiplexers for COM DEV, antennas and CALTRAC Startracker for EMS, aeronautical antennas for INMARSAT, SICRAL Program for Alenia Spazio from Italy, OPTUS UHF antenna for MELCO, Japan, SS Loral, U.S., EMS, Canada, and BSAT 2A spacecraft for Orbital Sciences from the U.S.). • Total value of testing performed at the DFL amounted to $3.0 million with $1.3 million contributed to the CRF and an additional $1.7 million in testing performed for internal CSA Programs. • The acquisition and development of new Environmental/Qualification Testing capabilities to meet current and emerging requirements were achieved (e.g., photogrammetry/non-contact measure-ment test capability, mini express rack for testing of ISS payloads, RF testing in

Planned Expectations	Accomplishments
	higher frequency bands, operational cylindrical near field antenna measurement capability). • The DFL successfully achieved ISO 9002 certification.

3.7 Social and Educational Benefits to Canadians

The unique appeal of space serves to improve scientific literacy among students and educators, encourages youth to pursue careers in science and technology, and promotes awareness of the importance of science and technology to Canada's future. The nature of space hardware development, which involves meeting exceptional technical requirements, very stringent quality controls and mastering advanced technologies, constitutes an excellent vehicle for training highly qualified scientists, engineers and technicians for Canada's high technology industries. Canadian astronauts significantly contribute to fostering education and space awareness. Their active participation in various public events instils a sense of pride among all Canadians and promotes scientific literacy as well as careers in science and technology among the younger generations. With expenditures of $3.5 million in 2000-01, the following programs contributed to achieving this outcome:

Planned Expectations	Accomplishments
Program Description: The joint CSA/NSERC *Research Partnership and Supplement Scholarship Programs* supported the training of skilled personnel and fostered collaborations among industry, universities and the Agency. Various student employment programs of the Public Service Commission allowed undergraduate and graduate students to be trained at the CSA (expenditures of $2.3 million in 2000-01).	
• To make available qualified Canadian scientists, engineers and technicians for high technology and space-related industries.	• A review of the performance of the 1995-2000 generation of joint CSA/NSERC programs brought out the following outcomes: - The *Industry Research Partnership Program* supported 17 projects in all Canadian space areas (14 projects completed) for a total investment of $3.3 million, involving 15 different universities and 14 firms from across the country over the last five years. A total of 63 students were trained

Planned Expectations	Accomplishments
	(24 Masters, 31 PhD, 8 Postdoctoral). - The *Scholarship Supplements and Fellowships Programs* supported 87 students who completed their Masters (44), PhD (36) and Postdoctoral (7) degrees in 15 different universities from all regions of Canada.
Program Description: The *Youth Awareness Programs* encourage youth to undertake careers in Science and Technology, through rewards and recognition activities, distributing space-related materials and public information campaigns across Canada (expenditures of $1.2 million).	
• To improve scientific literacy among students and educators. • To increase the number of students interested in pursuing careers in science and engineering.	• 3300 educators, 130,000 students and 8 Science Centres participated in CSA designed classroom projects for the promotion of youth activities for STS-97 (Marc Garneau) and STS-100 (Chris Hadfield). • 12 new youth space awareness projects from across Canada were developed, and 500 educators participated in a pilot-learning project initiated in collaboration with the Canadian Wildlife Service and the Canadian Wildlife Federation. • 3 Webcast learning presentations were implemented in collaboration with Industry Canada's Schoolnet (total access by more than 1000 individual computers). • The CSA's Kidspace website hosted 149,798 visitors over a 12-month period.

3.8 Promotion of the Canadian Space Program

Considering the general public's low awareness and interest level in the CSP, the CSA is committed to raising the profile of space-related achievements and their benefits for Canada. The Agency placed great emphasis on building national pride through public awareness of Canadian achievements in space, the understanding of the role of space programs in Canada's future, and the development of partnerships with international and domestic stakeholders for the delivery of the CSP. With expenditures of $5.5 million in 2000-01, the following programs contributed to achieving this outcome:

Planned Expectations	Accomplishments
Program Description: Implementation of an ambitious communications strategy focusing on the promotion of key space events such as Canadian astronauts' flights, the planned installation on the ISS of Canadarm2, and the organization of special activities (expenditures of $3.2 million in 2000-01).	
• To increase the profile of the Canadian Space Program and its achievements with the general public and Parliamentarians.	• Positive media coverage of the CSA and Canada's accomplishments in space with the CSA key events was achieved (Canada-ESA signing, John Glenn Visit/Embrace Space, Marc Garneau in Ottawa and Chris Hadfield in Toronto, Mission STS-97 with Marc Garneau on board). • Astronauts John Glenn and Dave Williams were presented to approximately 300 MPs in the House of Commons. • The John H. Chapman Award recognizing and raising the profile on accomplishments of a strong Canadian Space Program, was implemented. Excellent feedback was received from the 101 guests attending the Gala Award Ceremony, during which a total of 17 people were nominated for 11 major contributions. • The CSA and Science and Technology museums across the country (30 organizations) agreed to develop the first Canadian Space Awareness Alliance, increasing opportunities for collaborative

Planned Expectations	Accomplishments
	initiatives and greater outreach for Canadian Space Program messaging and visibility. • RADARSAT-1, released at the IGARSS Conference in Honolulu, was well received by both media and international conference participants. *RADARSAT* scientific mission news releases (Antarctic Mapping and the U.S. Mosaic Missions) resulted in positive international media exposure and a 415% increase in RADARSAT-1 website visitors in Summer 2000.
Program Description: The CSA performed a wide range of activities to satisfy the needs of the CSA, the government, the Minister and space stakeholders related to Canada's international cooperation agreements, and to support international marketing strategies pursued by our industries (expenditures of $2.3 million).	
• To improve international cooperation with our traditional partners, notably the U.S., Europe, and Japan. • To maintain effective and open relations between the CSA and its domestic stakeholders, notably industry, OGDs, the provinces and universities.	• Negotiations with NASA and NOAA on various joint programs with the CSA, including Cloudsat and SCISAT-1, were concluded. • Negotiations with the ESA on the implementation of Radarsat-3 within the framework of Earth Watch are ongoing.

SECTION 4: OTHER INFORMATION

4.1 Financial Performance

4.1.1 Financial Performance Overview

As can be seen in the following tables, actual 2000-01 spending amounted to $318.8 million, $24.0 million less than the authorized budget of $342.8 million. This variance was essentially due to delays in the development of the SPDM for the ISS and funds kept frozen as risk contingency. However, $20 million was re-profiled to the next Fiscal Year, and actual lapses added up to only $4 million. The reduction in spending (from $334 million in 1999-2000 to $318.8 million in 2000-01) is explained by these two factors, combined with the decreasing profile of CSA long-term funding, to reach a stable annual budget of $300 million.

4.1.2 Financial Summary Tables

4.1.2.1 Summary of Voted Appropriations

Financial Requirements by Authority ($ in millions)

Vote	Canadian Space Agency	2000-2001 Planned Spending	2000-2001 Total Authorities	2000-2001 Actual
30	Operating expenditures	114.2	115.1	111.4
35	Capital expenditures	188.2	188.4	168.1
40	Grants and contributions	32.2	32.6	32.6
(S)	Contributions to Employee Benefit Plans	6.0	6.7	6.7
	TOTAL	**340.7**	**342.8**	**318.8**

Notes:

- Planned Spending corresponds to Main Estimates Budget.
- Total Authorities are Main Estimates plus Supplementary Estimates and other Authorities.
- Difference between Total Authorities and Actual Spending is mostly due to the re-profiling of funds in 2001-2002 in the Canadian Space Station Program.

4.1.2.2 Comparison of Total Planned Spending to Actual Spending

Departmental Planned versus Actual Spending ($ in millions)

Space Knowledge, Applications and Industrial Development	2000-2001 Planned Spending	2000-2001 Total Authorities	2000-2001 Actual
FTEs	426	426	419
Operating	119.4	120.9	117.2
Capital	189.0	189.3	169.0
Grants and contributions	32.2	32.6	32.6
Total Gross Expenditures	**340.7**	**342.8**	**318.8**
Less:			
Respendable revenues	0.0	0.0	0.0
Total Net Expenditures	**340.7**	**342.8**	**318.8**
Other Revenues and Expenditures			
Non-respendable Revenues	(0.5)	(0.5)	(3.1)
Cost of services provided by other departments	2.2	2.2	1.8
Total Other Revenues and Expenditures	**1.7**	**1.7**	**(1.3)**
Net Cost of the Program	**342.4**	**344.5**	**317.5**

Notes:

- Due to rounding, figures may not add to totals shown.
- Total Authorities are Main Estimates plus Supplementary Estimates and other Authorities.
- Operating and Capital Expenditures include Employee Benefit Plans.
- Difference between Total Authorities and Actual Spending is mostly due to the re-profiling of funds in 2001-2002 in the Canadian Space Station Program.

4.1.2.3 Historical Comparison of Total Planned Spending to Actual Spending

Historical Comparison of Departmental Planned versus Actual Spending by Business Line ($ in millions)

Space Knowledge, Applications and Industrial Development	Actual 1998-1999	Actual 1999-2000	2000-2001 Planned Spending	2000-2001 Total Authorities	2000-2001 Actual
Canadian Space Agency	341.3	334.6	340.7	342.8	318.8
TOTAL	**341.3**	**334.6**	**340.7**	**342.8**	**318.8**

Notes:

- ✧ Planned Spending corresponds to Main Estimates Budget.
- ✧ Total Authorities are Main Estimates plus Supplementary Estimates and other Authorities.
- ✧ Difference between Total Authorities and Actual Spending is mostly due to the re-profiling of funds in 2001-2002 in the Canadian Space Station Program.

4.1.2.4 Revenues

Revenues ($ in millions)

Respendable Revenues

	Actual 1998-1999	Actual 1999-2000	2000-2001 Planned Revenues	2000-2001 Total Authorities	2000-2001 Actual
Canadian Space Agency	2.1	2.9	0.0	0.0	0.0
Unplanned	0.0	0.0	0.0	0.0	0.0
Total Respendable Revenues	**2.1**	**2.9**	**0.0**	**0.0**	**0.0**
Non-Respendable Revenues					
Canadian Space Agency	1.1	1.1	0.5	0.5	3.1
Unplanned	0.0	0.0	0.0	0.0	0.0
Total Non-Respendable Revenues	**1.1**	**1.1**	**0.5**	**0.5**	**3.1**
Total revenues	**3.2**	**4.0**	**0.5**	**0.5**	**3.1**

Notes:

- ✧ Variance between Total Authorities and Actual Revenues is due to an increase in testing services to other space programs.
- ✧ Royalties are no longer under Respendable Revenues but deposited in the Consolidated Revenue Fund as Non-Respendable Revenues.

4.1.2.5 Resource Requirements by Organization and Business Line

Comparison of 2000-2001(RPP) Planned Spending and Total Authorities to Actual Expenditures by Organization and Business Line ($ in millions)

Space Knowledge, Applications and Industrial Development			
	2000-2001		
Organization	**Planned Spending**	**Total Authorities**	**Actual**
President's Office	1.1	0.8	**0.7**
Space Systems	172.3	172.2	**154.9**
Space Technologies	67.4	67.0	**66.7**
Space Sciences	46.1	43.0	**39.7**
Canadian Astronauts Office	8.2	7.0	**7.0**
Space Operations	16.0	16.1	**19.7**
Corporate Functions	13.3	15.0	**13.8**
Executive Functions	16.3	21.8	**16.4**
TOTAL	**340.7**	**342.8**	**318.8**
% of Total			**100 %**

Notes:

- ✧ Due to rounding, figures may not add to totals shown.
- ✧ Planned Spending corresponds to Main Estimates Budget.
- ✧ Total Authorities are Main estimates plus Supplementary Estimates and other Authorities.
- ✧ Difference between Total Authorities and Actual Spending is mostly due to the re-profiling of funds in 2001-2002 in the Canadian Space Station Program.

4.1.2.6 Capital Projects

Capital Projects ($ in millions)

Space Knowledge, Applications and Industrial Development	Current Estimated Total Cost	Actual 1998-1999	Actual 1999-2000	2000-2001 Planned Spending	2000-2001 Total Autho-rities	2000-2001 Actual
Canadian Space Agency						
Canadian Space Station Program (MCP)	1 396.7	121.0	76.6	50.1	48.1	33.1
RADARSAT-1	645.4	12.1	10.8	13.0	12.2	12.0
RADARSAT-2	414.6	69.1	82.3	53.6	75.3	74.2
MOST	6.5	0.8	1.5	2.3	2.3	1.9
Insect Habitat	10.4	0.2	0.6	2.3	2.3	2.5
Cloudsat	15.7	0.0	0.6	6.5	6.0	1.9
SciSat-1	34.5	2.3	7.1	12.0	13.0	15.4
MIM Base Unit (MIMBU)	6.3	0.0	0.0	0.4	0.9	0.2

Notes:

- The sums include contributions to Employee Benefit Plans.
- Due to rounding, figures may not add to totals shown.
- Difference between Total Authorities and Actual Spending is mostly due to the re-profiling of funds in Canadian Space Station Program.

4.1.2.7 Contingent Liabilities

Contingent Liabilities ($ in millions)

List of Contingent Liabilities	Amount of Contingent Liability March 31, 1999	March 31, 2000	Current as of March 31, 2001
Claims, Pending and Threatened Litigation:			
Litigation:			
500-05-042325-98	6.0	6.0	14.4
Total	**6.0**	**6.0**	**14.4**

Note:

- Legal proceedings for damages in the amount of $6,000,000 were initiated in June 1998 for rights infringement on an invention. Defence to the amended declaration was produced by the Crown on 29 January 1999. Response by the Plaintiff to the Defence to Counterclaim, on February 26, 2001, raised the amount claimed to $14,375,000. The amount of the Contingent Liability is estimated to $14,375,000. File pending.

4.1.2.8 Transfer Payments

Transfer Payments ($ in millions)					
Space Knowledge, Applications and Industrial Development			**2000-2001**		
Canadian Space Agency	**Actual 1998-1999**	**Actual 1999-2000**	**Planned Spending**	**Total Authorities**	**Actual**
Grants					
Joint CSA / NSERC Programs	0.4	0.4	0.6	0.4	0.4
International Space University	0.2	0.2	0.2	0.2	0.2
Youth Awareness Program	0.0	0.0	0.1	0.0	0.0
CSA / Networks of Centers of Excellence Research Program	0.0	0.0	0.0	0.4	0.4
Total Grants	**0.6**	**0.6**	**0.8**	**1.0**	**1.0**
Contributions					
Canada / ESA Programs					
General Budget	6.0	6.3	5.4	5.0	5.0
Satellite Communications Programs	4.7	8.1	6.1	6.3	6.2
Earth Observation Programs	10.4	8.6	6.7	7.6	7.6
General Support Technology Program	0.6	0.0	0.0	0.0	0.0
Payload Flight Demonstration Program	0.0	0.0	12.2	12.0	12.0
Space Science Enhancement Program	0.2	0.8	0.5	0.4	0.4
Youth Awareness Program	0.5	0.5	0.4	0.5	0.5
Total Contributions	**22.5**	**24.3**	**31.4**	**31.7**	**31.6**
Total Transfer Payments	**23.2**	**25.0**	**32.2**	**32.6**	**32.6**

Note:

✧ Due to rounding, figures may not add to totals shown.

4.1.2.9 Status Summary of Major Crown Projects

Information on the Canadian Space Station Program, RADARSAT-1 and RADARSAT-2 Major Crown Projects is reported on the CSA website at the following address: http://www.space.gc.ca/about/default.asp

4.2 Procurement and Contracting

Procurement and contracting is the core of the CSA program delivery. Most programs objectives are achieved through the procurement of space hardware and services from Canadian industry, often implemented under international arrangements. 96% of the total dollar value of contracts over $25,000 was awarded competitively (Request for Proposals and Advanced Contract Award Notices) in 2000. This represents 75% of the number of contracts awarded.

4.3 Business Line Description

The CSA has a single business line called "Space Knowledge, Applications and Industry Development" that comprises all initiatives making up the CSP. The business line is subdivided into seven service lines:

Space Science **–** advancing scientific knowledge in areas of strategic importance for Canada by providing our scientists access to the unique environment of space (Contact: Barry Wetter, Director General, Space Science at 613-990-0799).

Earth and Environment **–** using space technologies to understand, monitor, predict and protect the Earth and its environment, and to ensure that Canadian industry maintains its world leadership in capturing the emerging global Earth Observation market (Contact: Hugues Gilbert, Director, Strategic Development at 926-4304).

Human Presence in Space **–** providing a meaningful and visible contribution to international efforts to establish a human presence in and beyond low Earth orbit, and ensuring that this contribution will bring tangible benefits to Canada (Contact Savi Sachdev, Director General, Space Systems at 450-926-4461).

Satellite Communications – ensuring that all Canadians have access to new communications technologies and services, and positioning Canadian industry to participate significantly in the new global communications business (Contact: Virendra K. Jha, Director General, Space Technology at 450-926-4600).

Space Technologies – developing innovative and emerging technologies to ensure the growth and competitiveness of the Canadian space industry, to meet future needs of the CSP, and to maximize commercialization of space technologies in both space and non-space applications (Contact: Virendra K. Jha, Director General, Space Technology at 450-926-4600).

Space Qualification Services – providing an environmental test facility capable of meeting the current and emerging needs of Canada's space community and the nation's space related objectives. (Contact: Rolf Mamen, Director General, Space Operations at 613-998-2873/450-926-6530).

Comptrollership and Awareness **–** the CSA is the national leader of the CSP. It develops strategic directions, co-ordinates program development, furnishes management, financial and other administrative support services, and ensures the necessary integration of all activities of the Canadian Space Program (Contact: Jacques Bruneau, Director, Corporate Management at 450-926-4407).

4.4 Further Information

The CSA website (**www.space.gc.ca**) can be visited for additional information on the following topics:

For information on the different CSA activity sectors:

www.space.gc.ca/csa_sectors/default.asp

For information on the Canadian space Industry:

www.space.gc.ca/business/default.asp

For more information on the CSA Programs and Services:

www.space.gc.ca/about/csaproser/default.asp

4.5 Legislation Administered and Associated Regulations

Canadian Space Agency Act (S.C. 1990, c. 13).

4.6 Statutory Annual Reports and Other Agency Reports

Agency Performance Report for the period ending March 31, 2001 and the Report on Plans and Priorities can be found at:

http://www.space.gc.ca/space/publications/default.asp#parliament

4.7 Abbreviations

ARTEMIS	Advanced Relay and Technology Mission Satellite
ARTES	Advanced Research on Telecommunications Systems
AVU	Artificial Vision Unit
CANOPUS	Canadian Auroral Network for the Observation of Plasmas in the Upper-atmosphere and Space
CCRS	Canada Centre for Remote Sensing
CIS	Canadian Ice Service
CNES	Centre national d'études spatiales (France)
CRC	Communications Research Centre
CRF	Consolidated Revenue Fund
CSA	Canadian Space Agency
CSP	Canadian Space Program
DFL	David Florida Laboratory
EO	Earth observation
EOADP	EO Applications Development Program
EOEP	Earth Observation Envelope Program
ERS	ESA Remote Sensing Satellite
ESA	European Space Agency
EVARM	ExtraVehicular Activity Radiation Monitors
FIRST	far infrared and submillimetre space telescope
FIS	Financial Information Strategy
FTE	Full Time Equivalent
GALA	Major study, part of the Galileo definition phase, that will focus on the detailed definition of the Global Architecture of the Galileo System
GEODESIC	Geoelectrodynamics and Electro-Optical Detection of Electron and Suprathermal Ion Currents
HQ	Head Quarters
IC	Industry Canada
IGARSS	International Geoscience and Remote Sensing Symposium
ISS	International Space Station
ITAR	International Trade in Arms Regulations
KSC	Kennedy Space Center
MBS	Mobile Remote Servicer [MRS] Base System
MCP	Major Crown Projects
MDA	MacDonald Dettwiler & Associates
MDR	MacDonald Dettwiler Space and Advanced Robotics
MEMS	Micro Electromechanical Switches
MIMBU	Microgravity Isolation Mount Base Unit
MOC	MSS Operations Complex
MOPITT	Measurement of Pollution in the Troposphere
MOST	Microvariability and Oscillations of Stars (MOST) micro-satellite
MOU	Memorandum of Understanding
MP	Member of Parliament
MSS	Mobile Servicing System
MVIS	Microgravity Vibration Isolation System
NASA	National Aeronautics and Space Administration (United States)
NASDA	National Space Development Agency (Japan)
NGST	Next Generation Space Telescope
NOAA	National Oceanic & Atmospheric Administration (United States)
NRCan	National Resources Canada

NSERC	Natural Sciences and Engineering Research Council
OGD	Other Government Departments
OSIRIS	Optical Spectrograph and Infrared Imaging
R&D	Research and Development
REMSAT	Real-time management of forest fire fighting by satellite
RF	Radio-Frequency
RPP	Report on Plans and Priorities
RSI	Radarsat International Inc.
SAR	Synthetic Aperture Radar
SME	Small and Medium Sized Enterprise
SMS	Supra Thermal Ion Mass Spectrometer
SPDM	Special Purpose Dextrous Manipulator
SSRMS	Space Station Remote Manipulator System
STS	Space Transportation System
SWIFT	Stratospheric Wind Interferometer For Transport studies
UARS	Upper Atmospheric Research Satellite
UK	United Kingdom
U.S.	United States
WINDII	Wind Imaging Interferometer