ESTIMATES

Canadian Space Agency

Performance Report

For the period ending
March 31, 2000

Canada

Improved Reporting to Parliament
Pilot Document

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.

The *Report on Plans and Priorities* provides additional detail on each department and its programs primarily in terms of more strategically oriented planning and results information with a focus on outcomes.

The *Departmental Performance Report* provides a focus on results-based accountability by reporting on accomplishments achieved against the performance expectations and results commitments as set out in the spring *Report on Plans and Priorities.*

Available in Canada through your local bookseller or by mail from

Canadian Government Publishing — PWGSC

Ottawa, Canada K1A 0S9

Catalogue No. BT31-4/30-2000
ISBN 0-660-61424-3

Foreword

On April 24, 1997, the House of Commons passed a motion dividing on a pilot basis the *Part III of the Estimates* document for each department or agency into two separate documents: a *Report on Plans and Priorities* tabled in the spring and a *Departmental Performance Report* tabled in the fall.

This initiative is intended to fulfil the government's commitments to improve the expenditure management information provided to Parliament. This involves sharpening the focus on results, increasing the transparency of information and modernizing its preparation.

The Fall Performance Package is comprised of 83 Departmental Performance Reports and the President's annual report, *Managing for Results 2000*.

This ***Departmental Performance Report,*** covering the period ending March 31, 2000 provides a focus on results-based accountability by reporting on accomplishments achieved against the performance expectations and results commitments as set out in the department's *Report on Plans and Priorities* for 1999-00 tabled in Parliament in the spring of 1999.

Results-based management emphasizes specifying expected program results, developing meaningful indicators to demonstrate performance, perfecting the capacity to generate information and reporting on achievements in a balanced manner. Accounting and managing for results involve sustained work across government.

The government continues to refine its management systems and performance framework. The refinement comes from acquired experience as users make their information needs more precisely known. The performance reports and their use will continue to be monitored to make sure that they respond to Parliament's ongoing and evolving needs.

This report is accessible electronically from the Treasury Board 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, 2000

John Manley
Minister of Industry

Canadian Space Agency

EXECUTIVE SUMMARY

The Canadian Space Agency (CSA) coordinates the space-related investments, policies and programs of the Government of Canada. It manages the Canadian Space Program (CSP), which includes research, science and technology, industrial development and international co-operation programs. By securing Canada's role in new and growing fields, the CSA obtains economic, social, and environmental benefits for Canada.

The third country to have a satellite in orbit, Canada has a long-standing reputation among space-faring countries. Today the Canadian space sector is internationally competitive, export-oriented, and positioned at the leading edge of the shift of Canada's economy from natural resources to information and high technology. This sector includes some 250 firms from across Canada, with over 5,500 employees. Some 45% of its $1.2 billion annual revenues are from exports - the highest percentage in the world. It builds on areas of industrial and technological competency, notably in satellite communications, Earth observation, space robotics, sounding rockets and instrument payloads, and telemetry tracking and control equipment.

The CSA coordinates the use of space technologies to understand, monitor, and protect the Earth and its environment.

The CSA's vital partners include industry, universities, and other public sector agencies across Canada. They participate in the work of researching new knowledge from space, in developing new space-based technology, and in finding new applications for this knowledge and technology here on Earth. The Agency and its partners contribute to the sustainable development of Canada by linking Canadians from coast to coast, by enhancing the management of our environment and natural resources, and by learning how phenomena in space affect life on Earth.

Canada's space activities are usually combined with international efforts that include the United States, Europe, Japan and others. Sharing costs and benefits helps Canada achieve more, while maximizing spin-offs for the Canadian space industry and the economy. In 1999-2000, Canada renewed a valuable co-operation agreement with the European Space Agency (ESA), first signed in 1978.

The CSA contributes to international efforts for establishing a human presence in space.

A new space plan. The key policy accomplishment in 1999-2000 was the launching of a new Space Plan pursuant to the government decision to provide the CSA with additional funding of $430 million over the next three fiscal years and a stable envelope of $300 million annually thereafter. This decision gives the Agency, for the first time, the financial flexibility to plan and manage an aggressive space program in today's rapidly changing environment:

The Agency is organized under a single business line called "Space Knowledge, Applications and Industry Development". Under this single business line are seven service lines:

- **Space Science**, which advances scientific knowledge in areas of strategic importance for Canada by providing Canadian scientists access to the unique environment of space.
- **Earth and Environment**, which uses space technologies to understand, monitor, and protect the Earth and its environment.
- **Human Presence in Space**, which provides Canada's contribution to international efforts to establish a human presence in space.
- **Satellite Communications**, which ensures that all Canadians have access to new communications technologies and services and positions Canadian industry to capture a significant part of the new global communications markets.
- **Generic Space Technologies**, which develops innovative and emerging technologies to ensure the growth and competitiveness of the Canadian space industry.
- **Space Qualification Services**, which provides a world-class space qualification facility capable of meeting the current and emerging needs of Canadian industry and the world space community.
- **Comptrollership and Awareness**, which ensures that the Agency performs its role as the leader of the Canadian Space Program.

The CSA's performance is presented in this report on the basis of the following key results commitments:

- **Economic benefits**. CSA programs have enabled Canadian industry to develop leading positions in niches with great growth potential, from space robotics to satellite communications and Earth observation. The Canadian space industry reached $1.5 billion sales in 1999-2000, and employed 5,500 people.

- **Understanding of the environment and contribution to sustainable development**. Canada's flagship radar satellite, *RADARSAT-1*, has proven itself in resource management, environmental monitoring such as oil spills, and other environmental protection roles. Canadian scientific instruments are active on satellites of other nations to monitor atmospheric pollution. The years1999-2000 were notable for the launch and successful operation of MOPITT, a Canadian instrument to measure greenhouse gas in the Troposphere.

- **Contributions to the quality of life**. Microgravity research, which is possible in space, has the potential to improve medical knowledge, treatments and drugs. Results of Canadian space-based osteoporosis research were presented in 1999-2000. Advanced communications capabilities will be extended across Canada by a new cooperative project with industry, begun in 1999-2000, to develop Ka-band multimedia satellite technology.

- **Technological development and diffusion**. Through contracting out and in-house research, a range of new technologies, materials, processes and products were developed in 1999-2000. Some 48 active patent files, 59 licenses and 10 loan agreements were under CSA management, and over 60 papers and formal presentations were made at various conferences and events around the world.

- **World-class space research**. Canada has developed internationally recognized excellence in a number of areas notably, space robotics, space science disciplines such as solar-terrestrial relations, civilian space-borne radar satellites and applications, and space qualification services with the David Florida Laboratory (DFL).

- **Social and educational benefits**. Space inspires youth to enroll science and technology careers; in 1999-2000 CSA programs helped train 71 qualified space scientists, engineers and technicians.

- **Promotion of the CSP**. Considering the low awareness level of the CSP with the general public, the CSA is committed to raising the profile of the space-related achievements and the benefits they bring to Canada. In 1999-2000, the Agency has put in place an ambitious communications strategy focused on key events such as astronaut flights and on building national pride as a result of the public awareness of Canada's achievements in space.

Challenges. The CSA's key challenges in 1999-2000 arose from the delays and cost increases in the Canadian Space Station and *RADARSAT-2* programs, which led the Agency to postpone significantly the implementation of new space science and technology initiatives provided for in the Space Plan. The Agency remains dedicated to meeting these challenges and ensuring that Canada continues to achieve the maximum benefits from its investment in space.

SECTION 1: MESSAGE

1.1. Minister's Portfolio Message

Canada stands at the threshold of the new century as a world leader in the new economy, an economy fundamentally different from that of even ten years ago. In the past decade we have seen unprecedented changes around the world, and Canada has moved quickly to take advantage of the opportunities offered. The forces of globalization mean that we are no longer competing locally, or even regionally, but with economies around the globe. And the pace of change has accelerated at a dizzying speed. New electronic communications and information technologies have hastened our transformation into a knowledge-based economy, where skilled workers are our most significant resource and innovation is the key to success. Canada is in the vanguard of this, and our economy is strong and dynamic.

The Industry Portfolio is …

Atlantic Canada Opportunities Agency
Business Development Bank of Canada*
Canadian Space Agency
Competition Tribunal
Copyright Board Canada
Canada Economic Development for Quebec Regions
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*

The Government of Canada identified the challenges and opportunities of the new economy at an early stage, and we have been following a clear plan to capture its benefits for all Canadians. A key element of this agenda is investing in research and knowledge, and strengthening Canada's capacity for innovation, in order to increase productivity and to create well-paying jobs to improve our standard of living. We are also investing heavily in human resources, developing the knowledge workers we will need for the economy to continue to thrive, and fostering an entrepreneurial business climate. And we are working to make Canada the most connected country in the world, to maintain our position as a leader in the use of the Internet.

As Minister of Industry, I am responsible for the Industry Portfolio which consists of fourteen departments and agencies that play a key role in delivering on the government's agenda. With over 40% 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 represents a powerful toolkit for the government as it leads Canada's transition to the new knowledge-based economy and society.

I am pleased to present this Performance Report for the Canadian Space Agency, which shows its contribution to the government's agenda by setting out the commitments made in its Report on Plans and Priorities, and its success in meeting them over the 1999-2000 fiscal year.

The Canadian Space Agency continues to support the Canadian space industry. Today, the Canadian space sector is internationally competitive, export-oriented and positioned at the leading edge of the shift of Canada's economy from natural resource to information and high technologies. The key accomplishments of the past year were the launching of a new space plan adapted to the 21st Century, the renewal of the Canada/European Space Agency Cooperation Agreement for the next ten years, the delivery of the Space Station Remote Manipulator System to NASA, the new procurement approach for *RARDARSAT-2* bus and launch services, the successful operations of a Canadian scientific instrument to measure pollution in the Troposphere (MOPITT) on U.S. Terra satellite and finally, the flight of Canadian Astronaut Julie Payette.

Working together to invest in our people and our future, we are making our country a stronger and more prosperous place for all Canadians. I am proud of the Industry Portfolio's significant contributions toward meeting these government priorities.

The Honourable John Manley

SECTION 2: AGENCY PERFORMANCE

2.1. Societal Context

2.1.1. Objectives

The country's unique geographic and demographic character has inspired Canadians to use space activities to meet domestic needs and to develop an internationally competitive space industry.

2.1.2. Strategic Priorities

To implement the Canadian Space Program (CSP), the CSA pursued the following priorities in 1999-2000:

- Complete the development of the Mobile Servicing System (MSS) for the *International Space Station* (ISS) and initiate the activities required for its ongoing operations and maintenance.
- Operate *RADARSAT-1* and commence construction of its successor *RADARSAT-2*.
- Commence the construction of SCISAT-1 for launch in 2002.
- Implement the Microgravity and Life Sciences programs to prepare Canada's scientific community and industry to utilize effectively the *International Space Station.*
- Complete the development of advanced satellite communications multimedia technologies and services.
- Continue the development of innovative technologies and the provision of space qualification services to support the CSP and the Canadian space industry.
- Strengthen domestic and international partnerships to support the implementation of the CSP and industry's international marketing efforts.
- Enhance the image and visibility of the CSA as Canada's leader in the application of space to meet Canadian needs, through ongoing strategic communications programming.
- Successful support to STS-96 mission with Julie Payette.
- Ensure Y2K compliance, implement the Universal Classification Standard (UCS) and enhance financial services to sectors.

2.1.3. Key Co-delivery Partners

International co-operation is critical to the implementation of the CSP and the promotion of a competitive space industry. Our principal international partners are the U.S. National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA), which has 14 Member States. Canada also maintains significant bilateral co-operation 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 specialized in the development of space and ground hardware, universities and provinces. The following chart outlines the links between the CSA and its key partners.

The Canadian Space Agency's Main Partners and Stakeholders

Canada's space program involves many agencies, departments, companies, institutions and organizations across Canada. The following chart provides an outline of how the CSA works with them.

CANADIAN PROVINCES

- Alberta Economic Development and Tourism
- British Columbia Ministry of Employment and Investment
- Manitoba Department of Industry, Trade and Tourism
- New Brunswick Department of Economic Development and Tourism
- Newfoundland & Labrador Department of Industry and Technology Development
- Nova Scotia Economic Development and Tourism
- Ontario Ministry of Economic Development and Trade
- PEI Department of Economic Development and Tourism
- Ministère de l'Industrie, du Commerce, de la Science et de la Technologie du Québec
- Saskatchewan Economic Development

INTERNATIONAL PARTNERS

- ESA (European Space Agency)
- CNES (France)
- NASDA (Japan)
- NASA (United States)
- Russia
- Sweden

CANADIAN SPACE INDUSTRY

- Private companies
- Research centres
- Universities
- Industry associations

OTHER FEDERAL DEPARTMENTS AND AGENCIES

- Industry Canada
- Communication Research Centre (CRC)
- Canada Centre for Remote Sensing (CCRS)
- Environment Canada
- Department of National Defence (DND)
- Fisheries and Oceans Canada
- National Research Council of Canada
- Natural Sciences and Engineering Research Council of Canada
- Atlantic Canada Opportunities Agency
- Canada Economic Development for Quebec Regions
- Western Economic Diversification Canada

2.1.4. Social and Economic Factors

The approval of a new space plan and the resolution of *RADARSAT-2* issues were the most challenging policy endeavours of 1999-2000.

The key policy accomplishment of the past year was the approval of a new Space Plan pursuant to the government decision to provide the CSA with additional funding of $430 million over the next three fiscal years and a stable envelope of $300 million annually thereafter. This decision gives the Agency, for the first time, the financial flexibility to plan and manage aggressive space programs in today's rapidly changing environment.

However, the re-allocation of significant financial resources to *RADARSAT-2* has impacted CSA's ability to implement some of the new programs included in the Space Plan. This reallocation was required because of two important events, which generated additional costs and seriously delayed the construction of *RADARSAT-2*. First, NASA informed CSA that it would not launch *RADARSAT-2* in exchange for data as agreed in 1994. This decision created major budget pressure. Second, there was a contractual force majeure in Spring 1999, when the U.S. Government did not provide the necessary Technical Assistance Agreement (TAA) required by MacDonald Dettwiler & Associates (MDA) to procure the satellite bus from a U.S. supplier.

Several non-US bus suppliers were considered and Alenia (Italy) was finally selected in December 1999. An international competition was also conducted to procure launch services, and the Canadian Government recently endorsed a recommendation for a US launch aboard a Delta II rocket. A Remote Sensing Satellite Access Control Policy is being developed to support Canada's national security and foreign affairs interest in the context of the commercial objectives of *RADARSAT-2*. The launch of *RADARSAT-2* is now planned for Spring 2003.

Bilateral and multilateral co-operation is growing ever more important to the CSP, requiring greater collaboration with the world's leading space agencies. In this context, the Canada/ESA Co-operation Agreement was renewed for another ten years. In addition, the rapid evolution of technology and international co-operation in many space fields (notably satellite telecommunications and remote sensing) is generating both new opportunities and greater competition for Canadian companies. As a result, the CSA is facing growing demands from industry and other government bodies to help Canadian firms seize strategic opportunities.

The establishment of a stable budget at the CSA required major changes in business practices, notably new frameworks for risk and project management and related policies and processes to meet the requirements of central agencies.

The implementation plan for the Financial Information Strategy (FIS) and Y2K compliance demanded major efforts from CSA's limited human and financial resources in Information Technology. In the Human Resources area, significant challenges arose from the implementation of the Universal Classification Standard (UCS) combined with an important increase in staffing and the salary equity decisions. The recruitment of engineers in some specialized disciplines continues to be difficult.

2.2. Performance, Expectations and Key Results Commitments

The following table shows the key expectations, results commitments, and accomplishments of the Canadian Space Program.

Provides Canadians with	Key Results	Key 1999-2000 Accomplishments
Significant economic, social and environmental benefits from the application of space technology and space-based research and knowledge and core competencies in space sciences.	• Economic benefits to Canadian industry.	$1.5 billion sales and 5,500 jobs, delivery of Space Station Remote Manipulator System to NASA, and continued successful operations of *RADARSAT-1* (see page 6).
	• Understanding of the environment and contribution to sustainable development.	Successful operation of the Canadian instrument to measure greenhouse gas in the Troposphere (see page 14).
	• Contributions to the quality of life.	Life and Microgravity research with potential to improve medical knowledge, treatments and drugs (see page 16).
	• Technological development and diffusion.	Renewal of the Canada/ESA Cooperation Agreement for 10 years (see page 18).
	• World-class research.	Successful operation of Fine-Error Sensors (FES), a Canadian made space astronomy instrument (see page 19).
	• Social and educational benefits.	Qualified scientists, engineers and technicians trained for high technology industries (see page 21).
	• Promotion of the CSP.	Increased profile of Canadian space activities (see page 22).

The following table presents an overview of the CSA's financial performance in 1999-2000. The variance between planned spending and total authorities results from the government decision, announced in Budget 1999, to increase space expenditure.

Space Knowledge, Applications and Industry Development

Planned Spending	**$**	**304,026,000**
Total Authorities	**$**	**351,855,484**
Actual	**$**	**334,591,144**

Notes: 1) Planned Spending corresponds to Main Estimates Budget.
2) Total Authorities are Main Estimates plus Supplementary Estimates and other Authorities.
3) Difference between Planned Spending and Total Authorities is due to the increase in the CSA's funding to support the implementation of the Canadian Space Program and is due to supplementary budgets obtained during the fiscal year for the Canadian Space Station Program.
4) Difference between Total Authorities and Actual Spending is mostly due to the reprofiling of funds in 2000-2001 in the Canadian Space Station Program.

2.3. Performance and Accomplishments

This section presents the Agency's performance achieved in 1999-2000 for each of the key results commitments mentioned above in Section 2.2.

2.3.1. Economic Benefits

The Canadian space industry has evolved rapidly in the past decade as part of the world-wide 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. Now employing over 5,500 Canadians in all regions of the country, the industry is made up of some 250 firms from across Canada. It generates approximately $1.5 billion per year (an increase of 25% over 1997), of which 45% are exports - the highest percentage in the world. Mostly small and medium-sized enterprises, Canadian firms have captured a significant share of world markets in the following space niches:

- Satellite and ground communications antennas (EMS Technologies), switches & multiplexers (ComDev), terminals (Nortel and Spacebridge).
- Earth observation ground stations (MDA) and commercialization of radar satellite and other satellite data (RSI).
- Space robotics (MacDonald Dettwiler Space and Advanced Robotics - MDR).

- Sounding rockets and instrument payloads (Bristol Aerospace).
- Telemetry, tracking and control equipment (SED Systems).

The programs under the Satellite Communications, Earth & Environment, Human Presence in Space, and Generic Space Technologies Service Lines generate economic benefits by supporting the development of a competitive industry in Canada's traditional space niches. Space Science also generates significant economic and industrial benefits, which are presented in sections 2.3.2., 2.3.3. and 2.3.5.

Economic Benefits - Satellite Communications

The Satellite Communications programs help position Canadian industry as a supplier of sub-systems and components for the satellite-based international multi-media and personal and mobile communications markets. The following table outlines how this was pursued in 1999-2000:

Planned Expectations	Accomplishments
Program Description: The Advanced SatCom program supports the development of state-of-the-art technological products through a public/private sector partnership under which companies (e.g., ComDev, Nortel, EMS Technologies, and Telesat) are providing 25% and the government 75% of total funding ($60 million).	
• The Canadian satellite communications industry is positioned as a supplier of multi-media products and services on the international market. • A 50% increase in the sales of the Canadian satellite communications industry through participation in international consortia. • Increased employment in the satellite communication industry.	• 12 design reviews were held in various technology areas, which have reached, the stage where payload flight demonstration is now required. • Nortel, along with subcontractors EMS Technologies and Norsat, won a $25 million contract to develop a Ka-band return channel system for the new ASTRA-NET multimedia satellite system in Europe. • Norsat won a contract of $5 millions 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.

Planned Expectations	Accomplishments
Program Description: The new Advanced Payload Flight Demonstration Program is an $80 million contributions initiative, with $60 million repayable, to develop and fly a Ka-band multimedia payload on the Anik F2 satellite.	
• Canadian industry positioned as a manufacturer of Ka-band payloads by space qualifying technologies on Anik F2.	• Approval of the program in November 1999. • Negotiations and signatures of the Contribution Agreements with Telesat, ComDev and EMS Technologies.
Program Description: The SatCom International Mobile program positions industry in the fast-growing market for mobile personal satellite communications services through co-funded industry / Government projects.	
• Canadian industry positioned as a supplier of sub-systems to international consortia. • Canadian industry positioned as a service provider to Canadians.	• The ten contracts awarded under the International Mobile program totalling $3.8 million in government funds have all been successfully completed. • Spin-offs derived from contracts awarded to EMS Technologies, Narrowband, Skywave Mobile Communications and ITS Electronics are estimated by these companies at $15 million to March 2000.
Program Description: Participation in ESA satellite communications programs (e.g., Advanced Systems and Technology Program, Payload and Spacecraft Development and Experimentation, Advanced Research in Communications Systems.	
• An enhanced technology base for Canada's industry. • Industry positioned for participation in European consortia.	• Continued investment in ARTES programs of interest to Canadian industry such as broadband and mobile communications and participation in ARTES-3. • Participation in satellite navigation and positioning programs that support Canadian industry participation in the Galileo global system to be operational in 2008.

Economic Benefits - Earth and Environment

The Earth & Environment programs 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. This was accomplished in 1999-2000 as follows:

Planned Expectations	Accomplishments
Program Description: *RADARSAT-1* operations continue until full commissioning of its successor; RADARSAT International (RSI) markets the data in return for royalties.	
• Continuing *RADARSAT-1* operations with the same high performance level for satellite reliability, product quality, timely delivery and responsive follow-up to customer requests; achieving an imaging performance index greater than 95%.	• Delivery of RADARSAT data to clients in 57 countries; 20,755 user requests met for acquisition and processing utilizing 37,516 minutes of data; improved speed of service delivery to clients; more than 62 terabytes of data in CCRS archives and 100 RADARSAT based products and services available in the market. • Production of 4,000 images meeting the Canadian Ice Service (CIS) requirements. • Average end-to-end system performance of 96.7% obtained in 1999-2000; resolution of a serious anomaly with one of the satellite's momentum wheels. • Better than 99% performance reached by CCRS ground stations.
• Adding foreign RADARSAT data reception ground stations to the international network.	• Certification of the tenth international network station in Puerto Rico; achievement of product certification by stations in Saudi Arabia, South Korea, Australia and the Canadian mobile station SENTRY.
• Increasing the sales of data and associated royalty payments to CSA by 10%.	• Sale target not reached with revenues at the level of the previous year.

***RADARSAT-2* will be operational in 2003.**

Program Description: *RADARSAT-2* ensures continuity of radar data and Canadian leadership in the world-wide remote sensing business. The satellite will incorporate advanced technologies such as higher resolution and polarimetric modes, which would open a new international market.

Planned Expectations	Accomplishments
The key milestones are: • Mission critical design review scheduled for April 2001. • Integration and testing at DFL in 2002 and operations validation review scheduled for November 2002. • Launch planned for April 2003.	• Owing to the situation outlined in section 2.1.4. there is a slippage in the *RADARSAT-2* Master Schedule. Launch is now planned for April 2003. • Conclusion of the procurement of the satellite bus with Italy's Alenia Aerospazio. • Negotiations on the procurement of a commercial launch.

Program Description: Earth Observation programs enhance Canada's ground receiving and data processing systems at CCRS and develop value-added applications using SAR, hyper-spectral, and other satellite data through contracts to Canadian industry.

• Creation of a competitive Canadian value-added industry on the international remote sensing markets.	• Earth observation emerging as a major Canadian knowledge industry with some 175 companies selling products and services for an estimated $350 million, of which about 40% are derived from export. Employment and revenues growing at a sustained rate of 20% annually.
• Improved access to satellite data and real-time access to databases through the development of CEONet.	• CCRS ground stations upgraded to enable reception of data from new satellites. • A 100% increase in the number of databases connected to CEONet.
• New applications for radar data in areas of great market potential.	• Projects under the RADARSAT User Development Program achieved a 1.8 return on investment with cumulative sales of $35 million in products and services such as: a computer-based training system for interpreting sea ice conditions from Radarsat data, the use of Radarsat imagery for hydro-geological exploration and for evaluating the risk of agricultural land flooding due to excessive surface water run-off.
• Supply of Earth Observation (EO) data sets to researchers.	

Planned Expectations	Accomplishments
• Use of remote sensing data in operational systems for resource management and environmental protection.	• Development of new algorithms and extraction of information from image data products. • Demonstration of real-time emergency management via satellite to improve communication between fire fighting crews in the field and control centres. • Development of a CD-ROM to provide RADARSAT application examples (e.g., ice reconnaissance and interpretation) for researchers and educators.

Program Description: Participation in ESA Remote Sensing programs (e.g., ERS-1, ERS-2, Earth Observation Preparatory Program and Envisat).

• Enhanced technology base of Canada's space industry. • Industry positioned for participation in European consortia.	• Continuation of the work on Envisat with MDA, Bomem and MPB Technologies contracts. • Bomem's work led to the selection of the company to build a series of components for polar-orbiting weather satellites in U.S with $20-30 million expected in revenues over the next 10 years. • Work begins on two new missions: Cryosat / Gravity Field and Steady State Ocean Circulation (GOCE).

Economic Benefits - Human Presence in Space

The Human Presence in Space programs fulfill Canada's commitment to build and operate the *International Space Station* (ISS) while developing advanced automation and robotics technologies and creating high quality jobs. This was accomplished in 1999-2000 as follows:

Planned Expectations	Accomplishments
Program Description: The Canadian Space Station program develops and operates a robotic system, called the Mobile Servicing System (MSS), used for the assembly and maintenance of the *International Space Station*. The MSS includes the Space Station Remote Manipulator System (SSRMS) designed to handle large loads on-board the Station, the Mobile Base System and the Special Purpose Dextrous Manipulator (SPDM) to take care of more delicate work.	
Key milestones are: • SSRMS Delivery to NASA in May 1999. • Shipment of MBS to NASA in August 2000. • SPDM Acceptance in April 2001. • Launch of SSRMS to ISS in April 2001. • Launch of MBS to ISS in February 2002. • Launch of SPDM to ISS in September 2004.	• Delivery of SSRMS to Kennedy Space Center and cargo integration in progress for launch in April 2001. • Acceptance of MBS with conditions from MDR on March 2000. • Progress in SPDM manufacturing with some schedule delays. • Acceptance of the SPDM Task Verification Facility (STVF) Robot but preliminary STVF capacity delayed due to late acceptance of the robot.
Program Description: MSS Operations include the fulfilling of maintenance responsibilities such as: sustaining engineering (e.g., software upgrade), integrated logistics (e.g. spares for critical components) and MSS repair & overhaul.	
Key milestones are: • First mission controllers and Astronauts qualified by the CSA in March 2000. • Launch of SSRMS in April 2001. • Assume real-time operations of the system at CSA for mission ISS-9A.1 in October 2002.	• On-going MSS Operations Complex (MOC) Operations readiness with the completion of Mobile Operations Training Simulator (MOTS) Phase 2; implementation of Phase 3A and Space Operations Support Centre (SOSC) Phase 2. • Negotiations with NASA led to increased responsibilities for MSS repairs and overhaul in exchange for offsets. • Completion of the negotiations on the contract with industry for the implementation of the MSS Sustaining Engineering. • Training of mission crews and controllers, qualification of 18 controllers and 2 astronauts.

The SPDM, a two-arm robot designed for delicate Space Station operations, is under construction.

Program Description: Management of the utilization of Canada's share of ISS resources.

- Utilization of the ISS research facilities by Canadian scientists and industry.
- Commercial utilization of the ISS research facilities to generate revenues through sales to the private sector and abroad.
- Continued implementation of the scientific programs (e.g., Microgravity and Life Sciences) to prepare Canada to utilize its share of ISS capabilities.
- Completion of a draft Commercialization Policy on ISS Utilization.

Economic Benefits - Generic Space Technologies

Canada's penetration of emerging space markets requires active government support for the development of new technological capabilities by Canadian space industries, particularly high technology SMEs, in the face of stiff world competition resulting from globalization. This was accomplished in 1999-2000 as follows:

Planned Expectations	Accomplishments
Program Description: CSA provides industry with contracted R&D projects, awarded through competitive procurement; this includes programs like Strategic Technologies for Automation and Robotics (STEAR), Strategic Space Technologies and ESA.	
• Leapfrog technologies for maintaining Canadian industry competitiveness in international markets.	• Development of some fifty new technologies, materials, processes and products for enhancing Canadian industrial competitiveness, for example:
• Technological capabilities and infrastructure of Canada's industry enhanced for future Canadian space missions.	• A new smart structure that suppresses vibration and maintains surface shapes of large flexible space-based hardware, with terrestrial applications in transportation and tool precision industries.
• New products or services developed.	• Micro-electromechanical microwave switches offering very high reliability at a substantial mass reduction.
• Participation of SMEs from all regions of Canada in space technology development programs increased.	• A novel method using all optical means for maintaining a tracking and communication link between two satellites.
	• A prototype of a rotor suspended by magnetic bearings to fabricate an electromechanical battery for replacing existing chemical batteries.
	• Renewal of the Canada/ESA Co-operation Agreement for another ten-year period.

Program Description: CSA provides industry with contracted R&D projects, awarded through competitive procurement; this includes programs like STEAR, Strategic Space Technologies and ESA.

	• Completion of the STEAR program under which 94% of the $55 million funding was allocated to 150 SMEs across Canada.

2.3.2. Understanding of the Environment and Contribution to Sustainable Development

The CSP contributes to better understanding, monitoring and predicting of the Earth's environment and global climate change and improves information for managing natural resources and disasters. This was accomplished in 1999-2000 as follows:

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 in support of research of Canadian scientists to understand space environment phenomena through advanced models.	
• Successful development and operations of Canadian instruments on NASA and other space agencies' satellites. • Use of space environment data from the Canadian ground-based network of instruments (CANOPUS, considered the best source of correlative ground-based measurements available, according to NASA).	• Continued support for participation in international missions with NASA (Image), ESA, Russia (Interball) and Japan (Akebono, Nozomi). • Continued operations of the CANOPUS providing a wealth of data in support of numerous space physics missions. • Continued successful acquisition and delivery of space-based environment data to science teams from international missions (e.g., SMS, UVAI, Image).

Planned Expectations	Accomplishments

Program Description: The Atmospheric Environment programs study the dynamics of the atmosphere, greenhouses gas sources, depletion of the stratospheric ozone layer and other global climate change phenomena with space-based instruments.

- Successful development and operation of Canadian instruments on NASA and other space agencies' satellites to monitor air pollution from space.

- Launch of MOPITT on NASA's Terra satellite on December 18, 1999; successful instrument check out and early operations. First scientific results on the measurement of carbon monoxide and methane in the Troposphere presented at international conferences (e.g., American Geophysical Union in June 2000, International Geoscience and Remote Sensing Symposium in July 2000).

The MOPITT instrument on-board the NASA satellite Terra.

- Improved techniques for the understanding, monitoring and prediction of global climate and atmospheric pollution problems through the use of data produced by the Canadian instruments on international missions.

- Scientific knowledge to help develop policies for control of emissions of atmospheric pollutants to meet Canada's international commitments (e.g., Montreal protocol and Kyoto agreement), following research on data produced by space-based international missions.

- Further delay in the construction of Sweden's Odin satellite, which will carry the Canadian OSIRIS instrument on-board, an instrument to analyse stratospheric ozone chemistry; the launch is scheduled for Fall 2000.

- Continued support to the Canadian Wind Imaging Interferometer (WINDII) instrument aboard NASA Upper Atmospheric Research Satellite (UARS) launched in 1991 to acquire data on the upper atmosphere dynamics.

- Implementation of the Small Payloads program with the development of the micro-satellites, sounding rockets and balloon experiment.

- Successful flight and operations of space physics GEODESIC sounding rocket in February 2000.

- Definition of mission concept for re-flights of MANTRA high altitude balloons.

- Development of the SCISAT-1 program.

- SCISAT-1 instrument and bus PDR held in the Fall; re-profiling of $1.5 million from 1999-00 to 2000-01, due to delays in completing the negotiations with NASA.

SCISAT-1: Canada's next scientific satellite mission.

Planned Expectations	Accomplishments
Program Description: *RADARSAT-1* can operate in total darkness and penetrate clouds. This gives it a unique capability for 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.	
• Space-based techniques for improving the management of natural resources and disasters through the use of RADARSAT data and products	• Production of Canada 3-D mosaic providing the first complete near-instantaneous view of Canada; production of the Antarctic mosaic very favourably received throughout the world. • Significant progress in collecting global land stereo data with coverage over Australia, China and Saudi Arabia. • Continuation of the Global Disaster Watch program supplemented by hurricane watch campaign over the West Atlantic and along the Gulf Coast. • Responses to new requirements for environment protection such as monitoring of oil leakage. • Response to 85 disaster related urgent requests from around the globe.

2.3.3. Contribution to the Quality of Life

The CSP contributes to a better quality of life through the improvement of medical procedures and by making advanced multi-media and personal mobile communications services accessible to all Canadians wherever they live in our vast country. The satellite communications programs described in section 2.3.1 also contribute to quality of life by making advanced communications services (e.g., tele-medicine, tele-education) accessible to all Canadians. This was accomplished in 1999-2000 as follows:

Planned Expectations	Accomplishments
Program Description: The CSA maintains an astronaut corps capable of responding to the needs of human space flights such as testing 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.	
• Opportunities for research in space for Canadian scientists. • Implementation of an Operational Space Medicine program at CSA.	• Successful flight of STS-96 Mission with Julie Payette in May 1999, the first Canadian Astronaut on board ISS. • Hosting of a multilateral medical operations panel at CSA, participation in working groups related to radiation, tele-medicine and Extravehicular Activity (EVA) countermeasures.
Program Description: The Life Science programs consist of discovering the changes and adaptations of human physiology and other forms of life to the weightlessness through the use of the Space Shuttle and eventually ISS.	
• Advanced knowledge on the cardiovascular system, bone research, neurology, early development and radiation effects on living organisms. • Improved medical knowledge, treatment, and drugs from experiments using the effects of microgravity.	• Development of international facilities in Canadian industry (e.g., Insect Habitat/ and Aquatic Research Facility, H-Reflex, EVA/Radiation) for Shuttle flights and ISS. • Publication of results on osteoporosis research from Shuttle experiment onboard STS-90 and STS-95.
Program Description: The Microgravity Science programs consist of scientific investigations performed in weightless environment of space laboratories through the use of the Space Shuttle and eventually ISS.	
• Advanced knowledge related to proteins and biotechnologies, fluid and combustion, advanced material, fundamental physics and chemistry. • Development of instruments and facilities for carrying out experiments.	• Completion of conceptual design studies for the development of a Canadian ISS furnace facility by Canadian industry; approval of the Canadian participation in the Microgravity Vibration Isolation System (MVIS) of the ESA Fluid Science Laboratory project. • Publication of results on Protein Crystal Growth from Canadian Shuttle experiment onboard STS-95.

Life science research involves studying the effects of microgravity on human physiology and other living organisms as well as investigations in biotechnology.

2.3.4. Technological Development and Diffusion

Considerable investments of funds, time and effort are required to develop, demonstrate and diffuse the technologies needed for current and future space programs. Strategic contracting-out programs (e.g., Strategic Space Technologies, STEAR, and ESA) (see section 2.3.1.) also allow CSA to acquire the technologies required to deliver its own space projects. This was accomplished in 1999-2000 as follows:

Planned Expectations	Accomplishments
Program Description: In-house R&D programs maintain a base of expertise within the Agency to support the implementation of the CSP, to acquire intelligence on technology advances world-wide, and to explore along with industry the potential of emerging technologies.	
• Solid foundation of knowledge and expertise built up through conducting internal technology development projects and reviewing contractor work to support the CSP. • Acquisition and management of technologies of strategic importance to CSA.	• In-house development of several new technologies, materials, processes and products. • The SPDM Task Verification Facility for the ISS, a simulator to support training of crew and mission planning. • A compact portable laser 3D-acquisition instrument for space operations such as ISS assembly and maintenance. • A multi-channel laser vibrometer for testing large flexible space structures. • A space-based computer software and hardware suitable for space qualification. • Over 60 papers and formal presentations published at various conferences around the world.
Program Description: Technology Demonstration programs provide opportunities to space-qualify technologies developed internally or by industry, often on micro-satellites, in collaboration with other national and international programs and agencies.	
• Advancement of new space technologies into operational use through space flight qualification.	• Testing of QuickSat, a Canadian built micro-satellite platform to space-qualify technologies.

Planned Expectations	Accomplishments
Program Description: Commercialization programs support technology transfer and diffusion, promote the use of CSA-funded technologies for non-space commercial markets, and manage intellectual property licences and patents.	
• Commercialization of CSP activities through technology transfer and intellectual property management.	• Management of 48 active patent files, 59 licences and 10 loan agreements.

The CSA Technology Diffusion Program (TDP) promotes the application of space technologies to non-space products and services. The program supports the objective to maximize the CSP socio-economic benefits.

2.3.5. World-Class Research

Canada has developed international excellence in a number of areas, notably space robotics (where Canada is recognized as a world leader because of the MSS, our contribution to building and operating the *International Space Station*), certain space science disciplines (e.g., solar-terrestrial relations, space astronomy), in-house technology development programs, civilian space-borne radar satellites and applications, space qualification services using the David Florida Laboratory (DFL), and certain satellite communications sub-systems. This was accomplished in 1999-2000 as follows:

Planned Expectations	Accomplishments
Program Description: Space Astronomy programs enable our scientific community to contribute to international efforts aimed at understanding the universe and predicting its evolution. Solar Terrestrial Relations and Atmospheric Sciences improve the understanding of the plasma surrounding the Earth.	
• Better understanding of space, the universe, physical and chemical make-up of our solar system. • Provision of opportunities to enable Canada's scientific community to participate in international space science missions.	• Successful acquisition, processing and delivery of data to the international astronomy science team in relation to Japan's Very Long Baseline Interferometry Space Observatory Project (VSOP).

Planned Expectations	Accomplishments
	• Successful operation of the Canadian built Fine-Error Sensors (FES) onboard NASA Far Ultraviolet Spectroscopic Explorer (FUSE) observatory launched June 24, 1999. • Pre-feasibility analyses of possible Canadian instrument contribution to future international missions such as Next Generation Space Telescope, Far-Infra-Red Space Telescope (FIRST)/Far Infra Red and Submillimeter Telescope.

Program Description: The David Florida Laboratory is a world-class facility providing environmental space qualification services for the assembly, integration and testing of spacecraft systems and sub-systems.

• Timely and accurate testing of space and ground based hardware. • Market David Florida Laboratory (DFL) services to external customers. • Improved DFL capability to meet customers' requirements through the development and acquisition of state-of-the-art test technologies.	• Space qualification of Canadian Space Program hardware: SSRMS, SPDM, and Space Vision System, various Space Science and Space Technology experiments/instruments. • Space environment testing of industry hardware amounting to $1.8 million with $1.1 million in revenues paid to the Consolidated Revenue Fund. (e.g., EMS Technologies' CALTRAC Star Tracker and GEOLITE UHF antenna, ComDev's multiplexers, Allied Signal's X-33 Program, INMARSAT aeronautical antennas, MDR's Japanese Space Station Experimental Module, and Novatel Communications GPS antennas). • Establishment of DFL as an ISO certified Space Qualifications Service provider; Y2K issues addressed with no anomalies in DFL data processing or control systems. • Completion of the DFL Phase V Building Mid Life Refit Project within schedule and budget. • Addition of new technical capabilities such as improved combined environment testing, RF facilities upgrades in the areas of spherical near field and EHF measurements, and planning for a photogrammetry measurement facility.

A technician of the DFL sets up a reflector mesh sample in the thermal/PIM chamber.

2.3.6. Social and Educational Benefits

The unique appeal of space serves to improve scientific literacy among students and educators, encourage youth to pursue careers in science and technology, and promote 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 (already mentioned in section 2.3.3.) 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. This was accomplished in 1999-2000 as follows:

Planned Expectations	Accomplishments
Program Description: Advanced Space Studies Sponsorship programs delivered in co-operation with NSERC supports students pursuing advanced studies in science and engineering. Various student employment programs of the Public Service Commission allow undergraduate and graduate students to be trained at the CSA.	
• Availability of qualified Canadian scientists, engineers, and technicians for high technology and space related industries.	• Training for 9 postdoctoral fellows and 40 undergraduate co-op students through involvement in internal CSA projects. • Training for over 22 PhD and Master level students from 14 different universities benefiting from a CSA scholarship supplement to carry out space technology research.
Program Description: The Youth Awareness Programs encourage youth to undertake careers in Science &Technology, through rewards and recognition activities, distributing space-related materials and public information campaigns across Canada. The program has been re-positioned to increase its reach to youth.	
• Improved scientific literacy among students and educators. • Increased numbers of students interested in pursuing careers in science and engineering.	• Participation of 13 Canadian science centres and museums, creation of a space dedicated section for youth on the SRC/CBC web sites, greater participation for STS-96 across Canada. • Implementation of an electronic classroom distance learning opportunity with participation of fifty students (grade 3-5) from Iqaluit (Nunavut). • CSA's CD-ROM on the thermodynamics of the ISS has reached 1,000 teachers to date. • Clear guidelines and more effective program monitoring established subsequent to internal audit of the Youth Grants and Contributions program.

Julie Payette signs autographs after a presentation to students. Canadian astronauts significantly contribute to fostering education and space awareness.

2.3.7. Promotion of the Canadian Space Program

Considering the low awareness level of the CSP with the general public[1] the CSA is committed to raising the profile of the space-related achievements and the benefits they bring to Canada. The Agency also places great emphasis on building national pride as a result of the public awareness of Canada's achievements in space, and on understanding the role of the CSP in Canada's future by Parliament and the general public. In 1999-2000, this was accomplished as follows:

Planned Expectations	Accomplishments
Program Description: Implementation of an ambitious communications strategy, by focusing on the promotion of key space events, such as Canadian astronauts' flights, and by organizing special events.	
• Increased profile of the Canadian Space Program and its achievements with the general public.	• Media reports on public activities conveyed positive messages to public and resulted in a greater than 10% increase in media requests for information on CSA programs. • Increase of 8% in the level of public interest and awareness in the CSP. • Successful CSA-stakeholder partnership for a Canadian Pavilion made up of 11 different government and non-government participants in UNISPACE III. • Expectations surpassed for John H. Chapman Award with 10 submissions representing 14 different contributions to the CSP. • A new coin and stamp issue depicting Canadian achievements in Space. • Positive media feedback received from the Antarctic Mapping Mission, which is identified as one of the Top 10 Science Stories of the 1990's by Discovery Channel. • Long-term plan prepared to support the CSA visit program including the RADARSAT near real-time display; there was an increase of 70% in the number of groups touring the CSA HQ from 1998/99, with 4,474 visitors and an additional 400 visitors touring DFL.

1) National Public Opinion Surveys of Canadians and Focus Group Testing held in September 1999 and March 2000 respectively indicated that 36% of Canadians show moderate interest in the space program (an increase of 7% since March 99), 75% of Canadians are very or moderately proud of their space programs, and 44% of Canadians are aware of the former (an increase of 8% since March 99).

Planned Expectations	Accomplishments
Program Description: Implementation of an ambitious communications strategy focusing on the promotion of key space events such as Canadian Astronauts' flights, and by organizing special activities.	
	• A merchandising program was developed to enhance CSA visibility. • Sponsorships from IBM for Mission STS-96 post-flight and NorthWest Tel for the Electronic Classroom in Nunavit.

Space contributes to developing Science and Technology awareness with youth.

Canadian Space Agency

SECTION 3: CONSOLIDATED REPORTING

3.1. Modernizing Comptrollership

The CSA made significant progress towards implementing modern comptrollership. The Planning and Performance Assessment cycle has been fully integrated into the CSA Management Framework, giving the Agency an improved capacity for reporting to Parliament and the public.

A new approach to risk management was formulated to minimize the probability and effects of unexpected adverse program developments. The new approach emphasizes the identification and accurate assessment of risks that may impact on-going program schedule, cost and performance; it provides for the establishment of a commitment planning and control process so as to ensure that existing programs and their associated risks are fully funded within approved Reference Levels, before launching new initiatives.

An enhanced Project Approval and Management Framework was approved, conforming to the principles of modern comptrollership. The Framework provides that projects will be implemented according to state-of-the-art management practices such as the appointment of an accountable project manager; the preparation of a detailed work plan, schedule and cost breakdown; the development of performance standards and indicators to help monitor performance; and, the preparation of periodic reports to review progress. As a result, the CSA's delegation of project approval authority was increased to $5 million.

Finally, financial service delivery was improved via a re-organization and the addition of financial officers located in the sectors.

3.2. Transfer Payments

The principal transfer payment is the contribution to the European Space Agency ($33 million in 1999-2000) to cover Canada's membership (General Budget) and participation in the following optional programs: Polar Orbit Earth Observation Satellite (Envisat), the European Remote Sensing Satellite (ERS-2), the Advanced Research in the Telecommunication Systems (ARTES), and the Data Relay and Technology Mission (DRTM).

An independent evaluation of the benefits derived from the past Canada/ESA Co-operation Agreement shows that participation in ESA programs allowed companies in all regions of Canada to develop strategic technologies and products, in support of the CSP and in pursuit of global market opportunities. For example, the experience gained from participation in ERS-1 &-2 contributed to the development of the RADARSAT satellite program. Participation in ESA also allowed Canadian

companies to develop strategic alliances and supplier agreements with European prime and sub-contractors. For example, ComDev and EMS Technologies have concluded such an agreement with Alcatel Espace, Aerospatiale, and Matra Space Systems. A new ten-year Agreement (2000-2009) was approved in November 1999, the objectives of which are to:

- Diversify Canada's international space partnerships by fostering close collaboration with Europe, complementing its long-standing priority relationship with the United States.
- Support implementation of CSP priorities in satellite communications, satellite navigation and positioning, Earth observation and technology development.
- Sustain the competitiveness of Canadian space industry through the development of leading edge technologies and products for global markets.
- Position Canadian space companies with large European prime contractors, and facilitate strategic alliances between Canadian and European companies to create opportunities for our industry on the European markets.
- Develop and demonstrate advanced systems and technologies by participating in optional programs contributing to CSP priorities including flight opportunities for Canadian technologies, obtain timely information about emerging European technologies, and encourage the two-way transfer of technology between European and Canadian industries.

3.3. Procurement and Contracting

Procurement and contracting-out is the core of CSA program delivery. Most programs are about the procurement of space hardware by Canadian industry, often implemented under international arrangements. In fact, more than 80% of total CSA budget is contracted out to industry through a competitive process; and 90% of contracts over $25,000 were awarded competitively (Request for Proposals and Advanced Contract Award Notices) in 1999-2000.

Implementation of acquisition cards has improved the efficiency of purchase and payment. Information sessions for managers and staff on contracting policies and procedures have enabled the establishment of more effective procurement practices.

SECTION 4: FINANCIAL PERFORMANCE

4.1. Financial Performance Overview

As can be seen in the tables which follow, actual spending for 1999-2000 was $30.6 million more than originally planned as a result of the government decision in Budget 1999 to increase space expenditure and the following factors:

- Increased CSA funding for the implementation of the Canadian Space Station Program.
- Compensation for royalties from the *RADARSAT-1* program lower than originally projected, since sales stabilized at the level of 1998-1999.
- Carry-Forward of funds in 2000-2001 within the Canadian Space Station Program.

The reprofiling of funds in 2000-2001 in the Canadian Space Station Program is due to major schedule slippage in the SPDM and MSS Manufacturing contracts. Also, the integration testing of the SSRMS to the Space Station slipped from April 1999 to July 1999.

4.2. Financial Summary Tables

Table 1 - Summary of Voted Appropriations

Financial Requirements by Authority ($ million)

Vote		1999-2000 Planned Spending	Total Authorities	Actual
	Canadian Space Agency			
30	Operating expenditures	63.7	100.4	98.7
35	Capital expenditures	216.9	221.1	205.6
40	Grants and Contributions	18.9	25.0	25.0
(S)	Contributions to Employee Benefit Plans	4.6	5.3	5.3
	Total	**304.0**	**351.9**	**334.6**

Notes: 1) Planned Spending corresponds to Main Estimates Budget.
2) Total Authorities are Main Estimates plus Supplementary Estimates and other Authorities.
3) Difference between Planned Spending and Total Authorities is due to the increase in the CSA's funding to support the implementation of the Canadian Space Program and is due to supplementary budgets obtained during the fiscal year for the Canadian Space Station Program.
4) Difference between Total Authorities and Actual Spending is mostly due to the reprofiling of funds in 2000-2001 in the Canadian Space Station Program.

In the summer of 1999, a new Planning Reporting and Accountability Structure (PRAS) for the Canadian Space Agency was implemented. The CSA has moved from three to one business line. Through a single business line, the Agency has moved away from a project orientation and can better plan, implement and measure its performance in meeting these challenges. Financial information is presented using the new structure.

Table 2 - Comparison of Total Planned Spending to Actual Spending

Departmental Planned versus Actual Spending ($ million)

Space Knowledge, Applications and Industrial Development	1999-2000 Planned	1999-2000 Total Authorities	1999-2000 Actual
FTEs	363	460	377
Operating	68.3	105.8	104.0
Capital	221.0	225.2	208.5
Grants & Contributions	18.9	25.0	25.0
Total Gross Expenditures	308.1	356.0	337.5
Less:			
Respendable Revenues	(4.1)	(4.1)	(2.9)
Total Net Expenditures	304.0	351.9	334.6
Other Revenues and Expenditures			
Non-respendable Revenues	(0.4)	(0.4)	(1.1)
Cost of services provided by other departments	1.6	1.6	1.5
Total Other Revenues and Expenditures	1.2	1.2	0.3
Net Cost of the Program	**305.2**	**353.1**	**334.9**

Notes: 1) Due to rounding, figures may not add to totals shown.

2) Total Authorities are Main estimates plus Supplementary Estimates and other Authorities.

3) Operating and Capital Expenditures include Employee Benefit Plans.

4) Difference between Planned Spending and Total Authorities is due to the increase in the CSA's funding to support the implementation of the Canadian Space Program and is due to supplementary budgets obtained during the fiscal year for the Canadian Space Station Program.

5) Difference between Total Authorities and Actual Spending is mostly due to the reprofiling of funds in 2000-2001 in the Canadian Space Station Program.

6) The decrease in FTE between the Total Authorities and Actual is due to delay in the staffing process in 1999-2000.

Table 3 - Historical Comparison of Total Planned Spending to Actual Spending

Historical Comparison of Departmental Planned versus Actual Spending ($ million)

Space Knowledge, Applications and Industrial Development	Actual 1997-98	Actual 1998-99	1999-2000 Planned Spending	1999-2000 Total Authorities	1999-2000 Actual
Canadian Space Agency	228.9	341.3	304.0	351.9	334.6
Total	**228.9**	**341.3**	**304.0**	**351.9**	**334.6**

Notes: 1) Planned Spending corresponds to Main Estimates Budget.
2) Total Authorities are Main Estimates plus Supplementary Estimates and other Authorities.
3) Difference between Planned Spending and Total Authorities is due to the increase in the CSA's funding to support the implementation of the Canadian Space Program and is due to supplementary budgets obtained during the fiscal year for the Canadian Space Station Program.
4) Difference between Total Authorities and Actual Spending is mostly due to the reprofiling of funds in 2000-2001 in the Canadian Space Station Program.

Table 4 - Resource Requirements by Organization and Business Line

Comparison of 1999-2000 (RPP) Planned Spending and Total Authorities to Actual Expenditures by Organization and Business Line ($ million)

Space Knowledge, Applications and Industrial Development

Organization	1999-2000 Planned Spending	1999-2000 Total Authorities	1999-2000 Actual
President's Office	1.7	0.7	0.7
Space Systems	187.7	205.3	190.0
Space Technology	53.9	68.5	67.2
Space Science	21.4	27.3	27.2
Canadian Astronaut Office	3.5	6.3	6.3
Space Operations	16.3	16.7	16.6
Corporate Functions	10.5	13.8	13.6
Executive Functions	8.9	13.0	12.9
TOTAL	**304.0**	**351.9**	**334.6**
% du TOTAL			**100.0%**

Notes: 1) Due to rounding, figures may not add to totals shown
2) Planned Spending corresponds to Main Estimates Budget.
3) Total Authorities are Main estimates plus Supplementary Estimates and other Authorities.
4) Difference between Planned Spending and Total Authorities is due to the increase in the CSA's funding to support the implementation of the Canadian Space Program and is due to supplementary budgets obtained during the fiscal year for the Canadian Space Station Program.
5) Difference between Total Authorities and Actual Spending is mostly due to the reprofiling of funds in 2000-2001 in the Canadian Space Station Program.

Table 5 - Respendable Revenues

Respendable Revenues ($ million)

Space Knowledge, Applications and Industrial Development	Actual 1997-1998	Actual 1998-1999	1999-2000 Planned Revenues	1999-2000 Total Authorities	1999-2000 Actual
Canadian Space Agency	6.5	2.1	4.1	4.1	2.9
Total Respendable Revenues	**6.5**	**2.1**	**4.1**	**4.1**	**2.9**

Note: Variance between total Authorities and Actual Revenues is mostly due to adverse external market forces affecting RADARSAT revenues.

Table 6 - Non-Respendable Revenues

Non-Respendable Revenues ($ million)

Space Knowledge, Applications and Industrial Development	Actual 1997-1998	Actual 1998-1999	1999-2000 Planned Revenues	1999-2000 Total Authorities	1999-2000 Actual
Canadian Space Agency	1.4	1.1	0.4	0.4	1.1
Total Non-Respendable Revenues	**1.4**	**1.1**	**0.4**	**0.4**	**1.1**

Note: Variance between Total Authorities and Actual Revenues is due to an increase in testing services provided to other space programs.

Table 7 - Transfer Payments

Transfer Payments ($ million)

Space Knowledge, Applications and Industry Development

Canadian Space Agency	Actual 1997-1998	Actual 1998-1999	1999-2000 Planned Spending	1999-2000 Total Authorities	1999-2000 Actual
GRANTS					
Grants for Space Research Partnerships	0.1	0.3	1.5	0.2	0.2
Grants for Scholarships for space-related research	0.1	0.1	0.2	0.1	0.1
Grants for postdoctoral Fellowships	0.0	0.1	0.1	0.1	0.1
International Space University	0.2	0.2	0.2	0.2	0.2
Grants for the Youth Awareness Program	0.0	0.0	0.1	0.0	0.0
Grants to Ryerson Polytechnical University	0.2	0.0	0.0	0.0	0.0
Total Grants	**0.6**	**0.6**	**2.0**	**0.7**	**0.6**
CONTRIBUTIONS					
Space Science Enhancement Program	0.0	0.2	0.8	0.8	0.8
Contribution to the Earth Observation Preparatory Program of ESA (EOPP)	1.2	1.3	0.0	1.7	1.7
Contribution to the Preparatory Program of the First Polar Orbit Earth Observation Mission Program of ESA (POEM/EN'	5.1	6.7	8.1	5.4	5.4
Contribution to Data Relay and Technology Mission Program of ESA (DRTM)	0.6	0.2	0.3	0.6	0.6
Contribution to the Advanced Research in the Telecom. Systems Program of ESA (ARTES)	4.9	4.5	4.7	7.5	7.5
Contribution to the general budget of the European Space Agency (ESA)	5.5	6.0	0.7	6.3	6.3
Contribution for the Youth Awareness Program	0.3	0.5	0.4	0.5	0.5
Contribution to the European Remote Sensing Satellite Program II of ESA (ERS-02)	3.5	2.5	1.8	1.5	1.5
Contribution to the General Support Technology Program of ESA (GSTP)	0.4	0.6	0.0	0.0	0.0
Contribution to the Advanced Systems and Technology Program of ESA (ASTP-4)	3.3	0.0	0.0	0.0	0.0
Total Contributions	**24.7**	**22.5**	**16.9**	**24.4**	**24.3**
Total Transfer Payments	**25.3**	**23.2**	**18.9**	**25.0**	**25.0**

Notes: 1) Due to rounding, figures may not add to totals shown.
2) Difference between Planned Spending and Total Authorities is due to the increase in the CSA's funding to support the implementation of the Canadian Space Program.

Table 8 - Capital Spending

Capital Spending ($ million)

Space Knowledge, Applications and Industrial Development	Actual 1997-1998	Actual 1998-1999	1999-2000 Planned Spending	1999-2000 Total Authorities	1999-2000 Actual
Canadian Space Agency	140.0	243.6	222.3	226.4	209.8
Total Capital Spending	**140.0**	**243.6**	**222.3**	**226.4**	**209.8**

Notes: 1) For the Major Crown Projects, the sums include contributions to Employee Benefit Plans
2) Difference between Total Authorities and Actual Spending is mostly due to the reprofiling of funds in 2000-2001 in the Canadian Space Station Program.

Table 9 - Capital Projects

Capital Projects ($ million)

Space Knowledge, Applications and Industrial Development	Current Estimated Total Cost	Actual 1997-1998	Actual 1998-1999	1999-2000 Planned Spending	1999-2000 Total Authorities	1999-2000 Actual
Canadian Space Agency						
Space Science Projects		26.5	20.3	18.6	24.3	**24.2**
Canadian Space Station Program (1)	1,396.7	70.1	121.0	91.3	91.9	**76.6**
RADARSAT-1 (1)	645.4	14.0	12.1	14.0		
RADARSAT-2 (2)	409.6	3.1	69.1	82.3		
EO Support Program	53.8	14.8	12.0	6.1	8.1	**8.0**
STEAR		6.1	5.2	1.5	1.7	**1.7**
Building Refit/DFL	8.0	2.6	2.1	1.0	2.0	**1.2**
Other Capital Projects		2.2	1.6	7.4	4.0	**5.0**
Miscellaneous Capital Projects		0.5	0.0	0.0	0.0	**0.0**
Total Capital Projects		140.0	243.6	222.3	226.4	**209.8**

Notes: 1) For the Major Crown Projects, the sums include contributions to Employee Benefit Plans.
2) Due to rounding, figures may not add to totals shown.
3) Difference between Total Authorities and Actual Spending is mostly due to the reprofiling of funds in Canadian Space Station Program.

Table 10 - Status Summary of Major Crown Projects

The CSA is managing the following three Major Crown Projects (MCPs). Further information is available on its Web site.

Canadian Space Station Program

On January 25, 1984, the President of the United States directed NASA to develop and place into orbit a permanently staffed space station. Friends and allies of the United States were invited to participate in its development and use, to share the benefits, and to promote peace, prosperity and freedom through this co-operative venture. In September 1988, Canada signed a formal agreement with the governments of the United States, member states of the European Space Agency, and

Japan to participate in the International Space Station program. Canada's contribution includes the design, construction, and operation of the Mobile Servicing System (MSS), plus responsibilities for the MSS operations during the ten-year planned life of the Space Station. Canada has the right to utilize up to 2.3% of the Station's capabilities for scientific and technological research.

The Mobile Servicing System (MSS) consists of equipment and facilities located on the Space Station and on the ground. The on-station elements include the Space Station Remote Manipulator System (SSRMS) - a sophisticated space "arm" - and its Mobile Remote Servicer Base System (MBS), a mobile platform to support the SSRMS. Canada will also be providing the Special Purpose Dextrous Manipulator (SPDM) - a robotic "hand" that works in conjunction with the SSRMS.

The SSRMS was delivered to the Kennedy Space Center (KSC) in May 1999. Its launch is scheduled for April 2001. The MBS is being completed with a launch planned for February 2002. The manufacturing of the SPDM is progressing according to the schedule, and its launch is scheduled for September 2004.

RADARSAT-1

RADARSAT-1 is a Canadian-led project involving the private sector, all of the provinces, and the United States. It is the only fully operational civilian remote sensing satellite that carries Synthetic Aperture Radar. Launched in November 1995, it is intended to operate for up to eight years. It covers most of Canada every 72 hours, and the Arctic every 24 hours. It operates day and night, in all weather, regardless of cloud cover, smoke, haze and darkness, to acquire high quality images of the Earth. *RADARSAT-1* can gather the data needed for more efficient resource management as well as ice, ocean and environmental monitoring, disaster management and Arctic and offshore surveillance.

Routine operations of the satellite commenced in April 1996, following a commissioning period. *RADARSAT-1* has supplied timely and high quality data to Radarsat International Inc. (RSI), the private sector company that sells this data world-wide, and to the program partners (federal and provincial government departments, NASA and the National Oceanic and Atmospheric Administration). RSI pays CSA royalties on data sales.

RADARSAT provides images to the Canadian Ice Service (CIS) for producing ice charts for the Canadian Coast Guard. They have generated an estimated $7 million per year in savings to the CIS in its

data acquisition costs. The first mapping of Antarctica by *RADARSAT-1*, the Antarctic Mapping Mission, has been a resounding success, far exceeding NASA's expectations both in completeness of coverage and in the quality of the images. The data is being used to study the effects of climatological, glaciological, geological and human activity processes on the Antarctic continent. Finally, a new Disaster Watch has been also created in order to prepare a database for possible disasters in Canada and abroad.

RADARSAT-2

In June 1994, the government directed the CSA to develop "an arrangement with the private sector for the development and operation of a RADARSAT follow-on program to maintain continuity of data following *RADARSAT-1*." In 1998, MacDonald Dettwiler and Associates (MDA) was selected to construct and manage *RADARSAT-2*. The CSA and MDA signed a Master Agreement in December 1998 to build *RADARSAT-2* under a firm price contract with a government contribution of $225 million, in exchange for data. MDA is to invest $80 million. The company is also responsible for spacecraft operations and business development, while the CSA is responsible for arranging the launch and maintaining the long-term national archive of *RADARSAT-2* data. The Master Agreement was revised in January 2000 to reflect the latest cost estimates and changes in the schedule. Total project cost, including the launch, is estimated at $515 million, with the government contributing $424.1 million and the balance of $90.9 million provided by MDA. A *RADARSAT-2* launch is now planned for Spring 2003.

Table 11 - Contingent Liabilities

Contingent Liabilities ($ million)

List of Contingent Liabilities	Amount of Contingent Liability		
	March 31, 1998	March 31, 1999	Current as of March 31, 2000
Claims, Pending and Threatened, Litigation :			
T-1452/97	0.7	0.0	0.0
500-05-042325-98	0.0	6.0	6.0
Respendable Revenues			
Total	**0.7**	**6.0**	**6.0**

Notes:
1) An out-of-court settlement has occurred on March 2nd 1999 concerning file T-1452/97. The cost of this settlement was $1,573,188.
2) Legal proceeding damages to the amount of $6,000,000 was initiated in June 1998 for rights infringement on an invention (file 500-05-0423525-98). Defense to the amended declaration was produced by the Crown on 29 January 1999. The amount of the Contingent Liability is estimated to $6,000,000. File Pending.

SECTION 5: AGENCY OVERVIEW

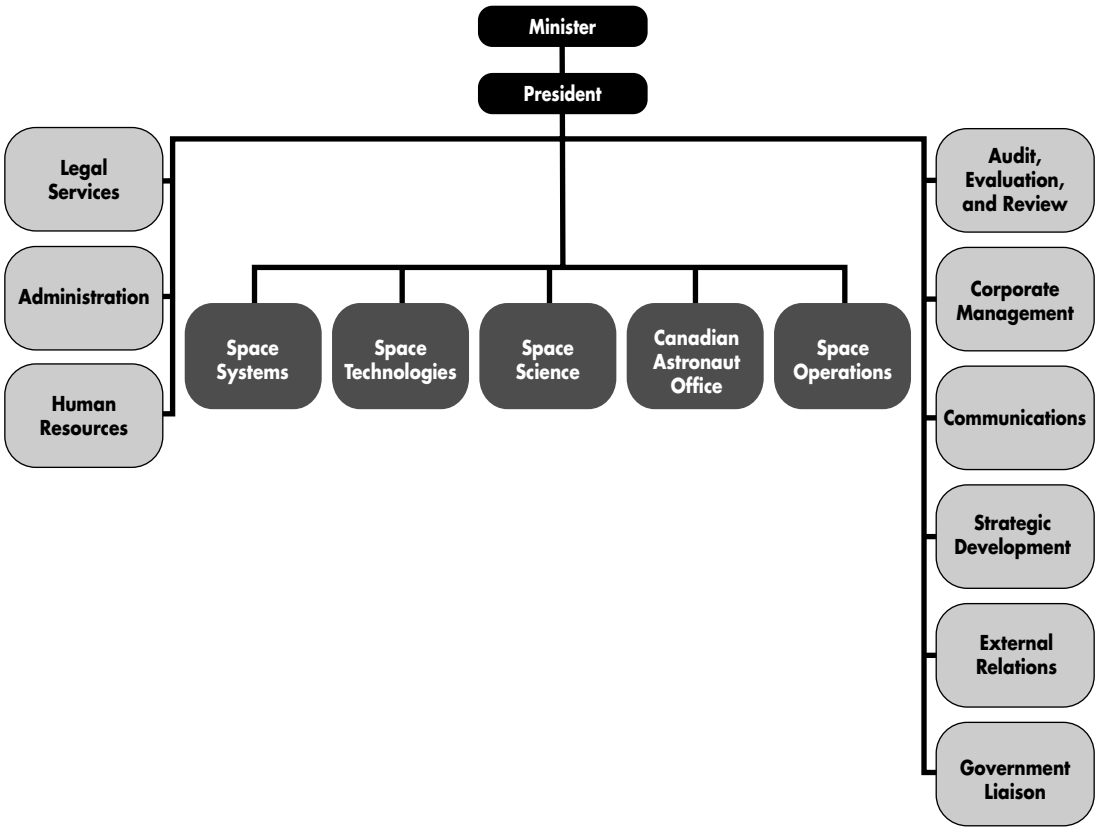
5.1. Mandate, Mission and Objectives

The legislated mandate of the CSA, from the Canadian Space Agency Act (SC. 1990, c. 13) 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 Agency is committed to achieving this mandate by managing the CSP to meet Canadian needs and aspirations, and foster an internationally competitive space industry. The mission of the CSA is to pursue excellence, advocate a client-oriented attitude, support employee-oriented practices and open communications, promote both empowerment and accountability, and co-operate and work with partners to our mutual benefit.

5.2. Agency Organization

The CSA is a relatively small organization of about 350 employees, some 220 contractuals and 50 students. Most of them (540 people) work at the John H. Chapman Space Centre - CSA headquarters in Saint-Hubert, Quebec. The others (80 people) work at three locations in Ottawa. Reporting to the Minister of Industry, the Chief Executive Officer of the CSA is the President, under whom there are five core functions: Space Systems, Space Technologies, Space Science, Canadian Astronaut Office, and Space Operations; six executive functions: Audit, Evaluation and Review, Corporate Management, Communications, Strategic Development, External Relations and Government Liaison; and three corporate functions: Legal Services, Administration, and Human Resources.



5.3. 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.

• ***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.

• ***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.

• ***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.

• ***Generic 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.

• ***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.

• ***Comptrollership and Awareness*** - the CSA is the national leader of the CSP. It develops strategic directions, coordinates program development, furnishes management, financial and other administrative support services, and ensures the necessary integration of all activities of the Canadian Space Program.

Canadian Space Agency

SECTION 6: OTHER INFORMATION

6.1. Contacts for Further Information

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Space Qualification Services
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Comptrollership and Awareness
Jacques Bruneau
Director, Corporate Management
(450) 926-4407

Web Site: www.space.gc.ca

6.2. Legislation Administered and Associated Regulations

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

6.3. Statutory Annual Reports and Other Agency Reports

Agency Performance Report for the period ending March 31, 2000 and 2000-01 and Report on Plans and Priorities can be found at:
www.space.gc.ca/ENG/Publications/menu.html.

6.4. Abbreviations and Acronyms

ACE	Atmospheric Chemistry Experiment
ARTES	Advanced Research on Telecommunications Systems
CANOPUS	Canadian Auroral Network for the OPEN Program Unified Study
CBC	Canadian Broadcasting Corporation
CCRS	Canada Centre for Remote Sensing
CDR	Critical Design Review
CEONet	Canadian Earth Observation Net
CIS	Canadian Ice Service
CRC	Communications Research Centre
CSA	Canadian Space Agency
CSP	Canadian Space Program
DFL	David Florida Laboratory
DRTM	Data Relay and Technology Mission
EHF	Extremely High Frequency
EO	Earth observation
EOPP	Earth Observation Preparatory Program
ERS	European Remote Sensing
ESA	European Space Agency
EVA	Extravehicular Activity
FES	Fine-Error Sensors
FIRST	Far Infra Red and Submillimetre Telescope
FIS	Financial Information Strategy
FTE	Full Time Equivalent
FUSE	Far Ultraviolet Spectroscopic Explorer
GEODESIC	Geoelectrodynamics and Electro-Optical Detection of Electron and Suprathermal Ion Currents
GOCE	Gravity Field and Steady State Ocean Circulation
GSTP	General Support Technology Program
Image	Imager for Magnetopause-to-Aurora Global Exploration
ISS	International Space Station
KSC	Kennedy Space Center
LTSP	Long-Term Space Plan
MANTRA	Middle Atmosphere Nitrogen Trend Assessment
MBS	Mobile Base System
MCP	Major Crown Project
MDA	MacDonald Dettwiler & Associates
MDR	MacDonald Dettwiler Space and Advanced Robotics
MOC	MSS Operations Complex
MOPITT	Measurement of Pollution in the Troposphere
MOTS	Mobile Operations Training Simulator
MSS	Mobile Servicing System
MVIS	Microgravity Vibration Isolation System

NASA	National Aeronautics and Space Administration (United States)
NOAA	National Oceanic & Atmospheric Administration (United States)
NSERC	Natural Sciences and Engineering Research Council of Canada
OSIRIS	Optical Spectrograph and Infrared Imaging
PDR	Preliminary Design Review
PIM	Passive Intermodulation Measurements
POEM/ENVISAT	Polar Orbit Earth Observation Mission
PRAS	Planning Reporting and Accountability Structure
RF	Radio Frequency
R&D	Research and Development
RSI	Radarsat International Inc.
RUDP	RADARSAT User Development Program
S&T	Science and Technology
SAR	Synthetic Aperture Radar
SME	Small and Medium Sized Enterprise
SMS	Supra Thermal Ion Mass Spectrometer
SOSC	Space Operations Support Centre
SPDM	Special Purpose Dextrous Manipulator
SRC	Société Radio-Canada
SSRMS	Space Station Remote Manipulator System
STEAR	Strategic Technologies for Automation and Robotics
STS	Space Transportation System
STVF	SPDM Task Verification Facility
TAA	Technical Assistance Agreement
TDP	Technology Diffusion Program
UARS	Upper Atmospheric Research Satellite
UCS	Universal Classification Standard
UK	United Kingdom
UVAI	Ultra-Violet Auroral Imager
VSOP	Very Long Baseline Interferometry Space Observatory Project
WINDII	Wind Imaging Interferometer
Y2K	Year Two Thousand

6.5. Index