



ESTIMATES

Canadian Space Agency

**2000-2001
Estimates**

Part III – Report on Plans and Priorities

Canada

The Estimates Documents

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, which are tabled in the House of Commons by the President of the Treasury Board, consist of three parts:

Part I – The Government Expenditure Plan provides an overview of federal spending and summarizes both the relationship of the key elements of the Main Estimates to the Expenditure Plan (as set out in the Budget).

Part II – The Main Estimates directly support the *Appropriation Act*. The Main Estimates identify the spending authorities (votes) and amounts to be included in subsequent appropriation bills. Parliament will be asked to approve these votes to enable the government to proceed with its spending plans. Parts I and II of the Estimates are tabled concurrently on or before 1 March.

Part III – Departmental Expenditure Plans which is divided into two components:

- (1) **Reports on Plans and Priorities (RPPs)** are individual expenditure plans for each department and agency (excluding Crown corporations). These reports provide increased levels of detail on a business line basis and contain information on objectives, initiatives and planned results, including links to related resource requirements over a three-year period. The RPPs also provide details on human resource requirements, major capital projects, grants and contributions, and net program costs. They are tabled in Parliament by the President of the Treasury Board on behalf of the ministers who preside over the departments and agencies identified in Schedules I, I.1 and II of the *Financial Administration Act*. These documents are to be tabled on or before 31 March and referred to committees, which then report back to the House of Commons pursuant to Standing Order 81(4).
- (2) **Departmental Performance Reports (DPRs)** are individual department and agency accounts of accomplishments achieved against planned performance expectations as set out in respective RPPs. These Performance Reports, which cover the most recently completed fiscal year, are tabled in Parliament in the fall by the President of the Treasury Board on behalf of the ministers who preside over the departments and agencies identified in Schedules I, I.1 and II of the *Financial Administration Act*.

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 public funds.

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THE CANADIAN SPACE AGENCY

2000-2001

Estimates

REPORT ON PLANS AND PRIORITIES

THE CANADIAN SPACE AGENCY

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Report on Plans and Priorities

John Manley
Minister of Industry

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1.1 Minister's Portfolio Message

In the global economy, innovation is an essential determinant of long-term economic growth, improved productivity and, ultimately, our quality of life. Preparing Canadians for the knowledge-based economy remains one of the government's top priorities in the years ahead. My portfolio of government organisations is promoting the growth of a strong, dynamic Canadian economy and helping Canadians take advantage of the opportunities offered by the global knowledge-based economy. We have laid a solid foundation through our continuing investments in knowledge and innovation.

An essential ingredient for our knowledge-based growth, both as an economy and as a society, is Connecting Canadians, an initiative designed to make Canada the most connected country in the world. Leading-edge applications will create jobs and growth, and strengthen productivity performance. Connecting Canadians also allows us to reach out to all citizens, and redefine and enhance how we provide services to, and interact with, Canadians.

I am pleased to present the Report on Plans and Priorities for the Canadian Space Agency (CSA) which sets out for Canadians the planned activities, priorities and resources over the course of the next three years. These plans illustrate how the CSA is contributing to building a strong and dynamic Canadian economy. This will be achieved through the implementation of three key strategies: the advancement of knowledge with programs such as Space Science and Canadian Space Station to position Canada in the world-wide exploration and utilization of space; the development of satellite-based advanced multi-media and mobile communications products and services to position our industry on this expanding international market; and the development of Earth Observation technologies to maintain Canadian leadership in the emerging market for satellite-based environment monitoring and resource management products and services.

As we look ahead we must define excellence by global standards. Innovation, science, research and development, and connectedness will profoundly change the world we face in the next decade. To maintain and improve our quality of life, we must be more skilled, more productive, more entrepreneurial and more innovative than any other country in the world and we can be all of these things.

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
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 Reports on Plans and Priorities*

The Honourable John Manley

2.1 Mandate, Role and Responsibilities

2.1.1 Mandate

The Canadian Space Agency (CSA), established in 1989, derives its authority from an Act of the Parliament of Canada, the Canadian Space Agency Act, S.C. 1990, c. 13, which states that the purpose of the Agency 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."

Reporting to the Minister of Industry, the Chief Executive Officer of the CSA is the President, to whom five core functions report: 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.

2.1.2 Mission

The Canadian Space Agency is committed to leading the development and application of space knowledge for the benefit of Canadians and humanity.

To achieve this, the CSA promotes an environment where all levels of the organization will:

- pursue excellence collectively;
- advocate a client-oriented attitude;
- support employee-oriented practices and open communications;
- commit to both empowerment and accountability; and,
- pledge to cooperate and to work with partners to our mutual benefit.

2.2 Objectives

2.2.1 Agency objectives

The principal objectives of the Canadian Space Agency are:

- To advance knowledge and develop core competencies in space science.
- To ensure that Canadians and Canadian industries in all regions of Canada benefit from the development and application of space knowledge.
- To contribute to the sustainable development of Canada and the world.
- To perform its role as the leader of the Canadian Space Program; manage its business line with a focus on results and accountability; and contribute to the increased awareness of the Canadian Space Program throughout the world.

2.2.2 Program Objectives

The overriding objectives of the Canadian Space Program are:

- The development and application of space science and technology to meet Canadian needs.
- The development of an internationally competitive space industry in Canada.

The Agency has reorganized under a single business line called "Space Knowledge, Applications and Industry Development". Its new structure moves away from project-oriented business lines and reflects a more service-oriented space sector, with a greater emphasis on terrestrial applications and benefits of space activities. Many space activities are becoming more service-oriented, with programming often tied to end-users, and their returns boosted by the adaptation of their technology to terrestrial applications. CSA investment will ensure that the needs and aspirations of Canadians are met, that key manufacturing capabilities in Canadian technological niches remain in Canada, and increasingly, will seek significant business opportunities for Canadian industry. Furthermore, the globalization of world space efforts means that most of today's needs – whether commercial, humanitarian or environmental -- are typically met by international entities. Accordingly, Canadian space programs are predicated upon a range of vital roles in global partnerships and consortia. Under this single business line, there are seven service lines: Earth and Environment, Space Science, Human Presence in Space, Satellite Communications, Generic/Enabling Space Technologies, Space Qualification Services and Comptrollership and Awareness.

2.3 External Factors Influencing the Department

Economic growth and development in Canada is increasingly driven by science and technology, innovation, and a well-educated work force. The space sector is strategic to the growth and development of knowledge-based economic activity in Canada, as it stimulates R&D, fosters the development of advanced technologies, and creates fulfilling, high-quality work for Canadians. It brings unique and essential contributions to achieving the social, security and foreign policy objectives of the government. The Space Policy Framework makes the Canadian Space Agency responsible for coordinating all federal civil space-related policies and programs, and for applying the following principles:

- Give priority to Earth & Environment and Satellite Communications initiatives including terrestrial applications of space technology.
- Design programs to maximize the leverage of federal funding and ensure commercial success through partnerships with industry.
- Encourage participation in space programs by small and medium-sized enterprises.
- Pursue sustainable regional industrial development through the use of regional distribution guidelines.
- Promote synergy between civil and defence space activities to optimize the effectiveness of federal space funding.
- Implement national communications and space awareness programs to take advantage of the unique appeal of space for improving scientific literacy among the general public and for promoting careers in science and technology among students.

The CSA consults its stakeholders to identify the priorities and objectives for Canada's space activities. The Agency has defined a new management framework to formalize its partnerships with stakeholders and ensure ongoing consultations in major resource allocation decisions with federal departments, provincial governments, industry and academia.

2.3.1 External Environmental Factors Influencing the CSA

The dominant trends affecting the world's space sector represent both opportunities for new growth and development and challenges to the Canadian space sector. These trends are outlined below:

- **Globalization of the Economy**

Globalization is now reaching sectors of the economy like space and defence that used to have a greater degree of protection for strategic reasons. Globalization increases industry concentration, and is driving a restructuring of the world's space industry around a few giants capable of producing complete satellite systems and associated services, from design through launch and operation. As many of these systems are designed to provide world-wide coverage, this situation creates significant challenges for Canada's space industry, particularly in satellite communications where our industry has traditionally provided systems to meet domestic market needs. Globalization also creates greater international competition and interdependency among trade partners. International cooperation and specialization are effective responses to globalization for which Canada is well positioned.

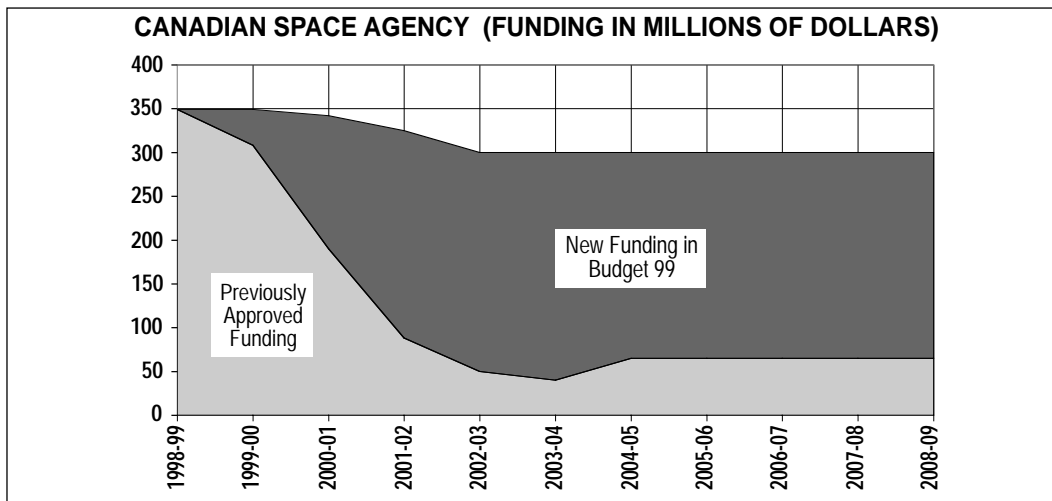
- **Growing Concern for the Planetary Environment**

Population growth and the accelerating industrialization of many developing countries are generating spiralling demands for energy and natural resources. These trends, which are unlikely to revert in the foreseeable future, add even more pressure on the environment. In the 21st century, protecting the environment and managing natural resources will become increasingly important in government agendas. These concerns are leading to mounting demand by governments for the capability to monitor the Earth's environment from space (the most effective way to look at the Earth as a whole) and to better understand climate change and other vital planetary issues. Canada's space sector is very well positioned to support this need.

- **Changing Role of Government in Space**

Canada has been a leader in commercializing space activities, starting with the creation of Telesat Canada to market satellite-based communications. More recently, Radarsat International (RSI) was set up to market data from RADARSAT-1 and other sources, and RADARSAT-2 has been privatized. The development of advanced technology for government space programs not only ensures that Canadian needs for space systems are met but also that government funding of advanced technology helps to position domestic industry to supply competitive solutions, goods and services for large multi-national projects.

- **New Funding Base for CSA**



The government retains a critical role in adapting the Canadian Space Program (CSP) to the new realities. Budget 1999 provided the CSA with stable, ongoing funding and a solid base for planning and adjusting programs to the rapidly evolving environment. The cash flow chart above displays the resultant long-term funding envelope for the CSA approved in Budget 1999.

The risks of investing in space are implicit in the long-term scope of the space programs, the international dimension of most of Canada's space programs (which limits the ability of any one country to fully control schedule, design and cost changes), the uniqueness of the space hardware to be developed, the very stringent quality control requirements and the rapidly advancing technology. In the face of these risks, cost control and funding flexibility are dominant concerns for the CSA. With the change in its funding base, the CSA has revised its risk management practices to make them consistent with the new budget environment. The new Risk Management Framework of the Canadian Space Agency improves risk evaluation and mitigation processes, including timely identification of risks affecting projects, development of strategies to significantly reduce risks or avoid them, and allocation of funds to cover risks.

2.3.2 Opportunities and Challenges Influencing the CSA

Along with the above trends, other factors intrinsic to the Canadian space environment heavily influence the future of the CSP. The following briefly discusses the challenges and the opportunities affecting Canada's space programs by its seven service lines.

- **Space Science**

The Space Science Program has been a cornerstone of the CSP from the very beginning with *Alouette* in 1962. Founded on cooperation with both Canadian and international scientific communities, the Program allows our universities to contribute to the global knowledge base and our industries to enhance their technologies and productivity through the development of unique scientific instruments.

Budget 1999 will enable the CSA to provide new exciting opportunities for the space science community and to maintain a position of excellence in the world-wide exploration and utilization of space, to fully benefit from participation in international research activities. The human quest for knowledge about space, the growing interest in planetary exploration and the new era soon to be opened by the *International Space Station* (ISS) will provide new challenges to the Canadian scientific community in the years to come.

The early utilization of payloads onboard the ISS is dependent on achieving cost-effective arrangements with our international partners for the use of ISS facilities and on maintaining an adequate level of resources. Participation in the Next Generation Space Telescope (NGST) and FIRST/Planck international space astronomy missions requires that Canada brings scientific and technical excellence to these large projects and has the required funding flexibility, as NASA and ESA drive the projects, respectively. Possible participation in the NASA Mars Sample Return Missions 2003 and 2005 requires undertaking technical studies on a robotics contribution or other systems before confirmation of participation in these missions.

- **Earth and Environment (E&E)**

A world-wide emphasis on global environmental monitoring and natural resource protection, and a trend towards the commercialization of satellite data and products are major factors influencing E&E. Canada is exceptionally well positioned in this emerging international market with the development of an innovative technologically-advanced industry, the privatization of satellite data marketing with Radarsat International (RSI), the modernization of its data reception infrastructure, and the development of products and services demanded by world markets.

Moreover, the development of the high performance *RADARSAT-2* by industry (MacDonald Dettwiler and Associates - MDA) will further enhance Canada's competitive position. Two important recent events have delayed the construction of this satellite and may generate additional costs. First, NASA

informed CSA that it would not launch *RADARSAT-2* in exchange for data as agreed in 1994. Second, the US government was unable to provide the necessary authorizations required to permit the US supplier of the satellite bus to participate in the program. As a result of these events, the CSA has conducted an international competition for the satellite bus and the launcher. In December 1999, a European bus supplier was chosen to replace the American supplier. The selection of the winner of the launch competition is expected to be complete in early 2000. As a result, the *RADARSAT-2* launch is now planned for the fall of 2002 rather than early 2002. To ensure continuity of data, this also meant that *RADARSAT-1* will need to be operated for an additional year.

The approval of additional funding in Budget 1999 will allow for the strengthening of the Earth observation data ground station infrastructure at the Canada Centre for Remote Sensing (CCRS) and the development of satellite data applications by industry with other government departments and other users. This is an essential element of the strategy to maintain Canadian industry's competitiveness on the emerging international remote sensing markets, a position threatened by competitors from the USA and Europe, and the globalization of the space industry.

- ***Human Presence in Space***

Canada has established itself as a vital partner in international human space flights and our astronauts are being trained to participate in the assembly of the *International Space Station (ISS)*. The space and microgravity environments have enormous potential to advance Science & Technology (S&T) and enhance quality of life. Public fascination with humans in space provides an excellent opportunity to leverage S&T education messages.

Design and schedule changes to the ISS are likely to produce requests for modifications to the Canadian contribution to the ISS program, i.e., the Mobile Servicing System (MSS). Also, the multi-element integration and testing of the MSS may reveal problems. The CSA is striving to minimize adverse effects on the MSS schedule and costs.

Budget 1999 will enable the Canadian Astronaut Program to continue at the same level of activity as in the 1990s. The new funds will also enable the Canadian Space Station Program to continue its MSS Operations (Phase E), including taking additional responsibilities (MSS Repair and Overhaul Option) in exchange for offsets.

The Canadian Space Agency has implemented an *International Space Station* commercialization program to generate revenues from Canadian rights to use and exploit ISS. This is one step toward the privatization of ISS utilization.

- ***Satellite Communications***

While space-based communications are expected to expand considerably, to meet the growing demand for advanced multi-media and mobile personal services, there is also global consolidation underway in the satellite communications industry. As a result, this sector offers tremendous market opportunities at the sub-system and component level for Canadian industry, provided that our companies keep enhancing their product lines. This is the aim of the Advanced Satellite Communications Initiatives Program. The demand for wider bandwidth for multimedia applications will require missions to employ higher frequency bands, e.g. Ka band. The plan is to demonstrate Ka band multi-media payloads built by Canadian industry to improve its positioning for future domestic and international markets.

- ***Generic/Enabling Space Technologies***

Globalization is driving a restructuring of the space sector, with individual companies amalgamating to create a small group of very large players with end-to-end system capabilities serving global markets. Maintaining Canadian manufacturing capabilities during this process is a challenge.

The trend towards smaller, shorter and less expensive space missions among the world's space faring nations is based on rapid and far reaching development of new space technologies. It offers promising opportunities for industrial growth in Canada, if we adapt to this mode of international operations. Generic/Enabling Space Technology Programs help industry develop strategic technologies in specific niches, establish links with foreign firms and improve access to international markets. In close cooperation with industry, the CSA identifies and supports R&D projects that support the development of space companies across Canada. The renegotiated ESA/Canada Cooperation Agreement will nurture partnerships between the Canadian and European industry.

- ***Space Qualification Services***

Ongoing delays in the arrival at the David Florida Laboratory (DFL) of the Special Purpose Dexterous Manipulator (SPDM) and RADARSAT-2 Programs are presenting challenges to Space Qualification Services. International Traffic in Arms Regulations (ITAR) restrictions are causing difficulties on a number of fronts. Both programs and potential clients considering the use of DFL for space qualification testing are affected.

- ***Comptrollership and Awareness***

International cooperation is growing ever more important to the optimum delivery of the Canadian Space Program.

The implementation of the Universal Classification Standard within CSA and its impacts on the work force, and the devolution of authorities and service delivery responsibilities from central agencies in the Human Resources area will create some resourcing challenges within the CSA.

With Budget 1999, CSA will experience major changes in business practices such as the implementation of the risk and project management frameworks, and related policies and processes to meet central agency requirements. The implementation of the CSA Management framework will also strengthen consultation with stakeholders through a planned Board of Advisors and Service Line Advisory Board. CSA compliance with the Financial Information System (FIS) will generate an increased workload with a very tight schedule for implementation and review of our practices.

The following table illustrates the Canadian Space Agency's planned spending, spendable revenues and full-time equivalents.

2.4 Departmental Planned Spending

Business Line				
Space Knowledge, Applications & Industry Development (\$ millions)	Forecast Spending 1999-2000	Planned Spending 2000-2001	Planned Spending 2001-2002	Planned Spending 2002-2003
Budgetary Main Estimates (Gross)	308.1	344.7	329.4	304.6
Less: Spendable revenue	4.1	4.0	4.1	4.1
Total Main Estimates	304.0	340.7	325.3	300.5
Adjustments to Planned Spending	30.1	10.8	0.0	0.0
Net Planned Spending	334.2	351.5	325.3	300.5
Less: Non-spendable revenue	0.5	0.5	0.5	0.0
Plus: Cost of services received without charge	1.6	2.2	2.2	2.2
Net Cost of the Program	335.3	353.2	326.9	302.6
Full Time Equivalents (FTEs)	388	426	429	416

Nota:

- 1) Forecast Spending for 1999-00 reflects best forecast of total planned spending to the end of the fiscal year.
- 2) Adjustments are to accommodate approvals obtained since the Annual Reference Level Update (ARLU) exercise and to include Budget initiatives.
- 3) Due to rounding, figures may not add to totals shown.
- 4) The increase in FTE from 1999-2000 to 2000-2001 is due to the impact of moving from large to smaller projects involving additional stakeholders, contracts and workload. The CSA has also implemented a strategy to replace contractuels by indeterminate and term civil servant employees following the new on-going funding approach.

3.1 Business Line Objective

The Agency is organized under a single business line called "Space Knowledge, Applications and Industry Development" and its objectives are achieved through seven service lines that are governed by the program objectives stated in Section 2.2.2 above.

3.2 Crosswalk from Old Structure

The Canadian Space Agency has moved from three to one business line. The new structure reflects a changing environment for space programs and it also responds to the increasing globalization of space efforts, in which Canadian space programs have strategic roles in global partnerships and consortia. Under this single business line, there are seven service lines: Earth and Environment, Space Science, Human Presence in Space, Satellite Communications, Generic/Enabling Space Technologies, Space Qualification Services and Comptrollership and Awareness. 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.

3.3 Business Line Description

The Canadian Space Agency works with universities and industry across Canada to contribute to and facilitate the advancement of space knowledge; the development of new processes, technologies and applications; and the use and application of space science and technology. This leads to an internationally competitive, export-oriented Canadian space equipment and services sector. In collaboration with other public sector organizations, or on its own, the Canadian Space Agency contributes 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.

The business line also creates better awareness of the importance of space technology in all regions of Canada and improves cooperation and relationships with space sector organizations throughout the world. The business line also involves all initiatives that ensure that the Agency performs its role as the leader of the Canadian Space Program.

3.3.1 Overriding Priorities

This section presents the overriding priorities pursued by the CSA over the fiscal years 2000-01 to 2002-03:

- Complete the development of the MSS (on-orbit commissioning of SSRMS, acceptance of the MBS flight equipment and SPDM space qualification and functional testing) and initiate its ongoing operations and maintenance.
- Develop *RADARSAT-2* by Canadian industry and continue *RADARSAT-1* operations until the launch of its successor in 2002.
- Development of *SCISAT-1* for launch in 2002.

- Implement the Microgravity and Life Sciences programs to enable our scientific community and industry to effectively utilize the *International Space Station*.
- Develop and demonstrate innovative technologies and continue to provide space qualification services to support the growth and competitiveness of Canadian space industry.
- Support the development and demonstration of advanced satellite communications multimedia technologies and services.
- 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 and development of space to meet Canadian needs by strategic communications' programming.
- Implement the FIS, new Executive (EX) performance pay regime and Pay Equity Decision.

3.4 Key Results Commitments, Planned Results, Related Activities and Resources

The Canadian Space Agency plans to spend \$344.7 million in 2000-2001. This includes spendable revenues of \$4.0 million. This investment is intended to provide Canadians with significant economic, social, and environmental benefits from the application of space technology and space-based research and knowledge and core competencies in space sciences. Results will be shown in the following key areas:

- Economic benefits to Canadian industry.
- Understanding of the environment and contribution to sustainable development.
- Contributions to the quality of life.
- Technological development and diffusion.
- World class space research.
- Social and educational benefits to Canadians.
- Effective promotion for greater awareness of the Canadian Space Program.

The following subsections highlight the key planned results or targets that are expected to be achieved over the planning period along with the key activities and the resources that will be employed to achieve them.

3.4.1 Economic Benefits

The CSA and its government partners seek to maintain Canada's world leadership in its traditional space niches (e.g., civilian Earth observation radar technology, space robotics, advanced telecommunications services), transfer relevant expertise to the private sector, and support industry development through commercial applications of space technologies. The key results expected in this category include:

- Participation of Canadian SMEs from all regions of Canada in space technology development and application programs.
- Participation of Canadian industry in S&T programs on an international scale.
- Improved technical capabilities, competitiveness and economic benefits to Canadian industry in all regions of Canada, from the use and application of space science and technology.
- International recognition of Canada's leadership in space technology and research.
- Improved relationships with governmental, academic and private sector space organizations throughout the world.

The table shows the manner in which space programs with their associated resources will contribute to the achievement of economic benefits over the fiscal years 2000-2001 to 2002-2003.

Planned Results:

- An expected 50% increase in sales for the Canadian satellite communications industry through participation in international consortia.
- Increased employment in satellite communications industry.
- Enhanced regional distribution of satellite communications activities.
- An enlarged Canadian Earth observation industry capable to develop products based on satellite data for the international market.
- A 10% annual increase in the sales of RADARSAT data and associated royalty payments to CSA by RSI.
- The successful manufacture of *RADARSAT-2* and continued operations of *RADARSAT-1* until *RADARSAT-2* launch in 2002.
- The development of the Mobile Servicing System (MSS) for the ISS and expansion of our responsibilities in its Operations.
- Advance technology by industry over the remaining life of the Canadian Space Station Program (CSSP) in fields such as high reliability software, life critical software, artificial vision, expert systems, force movement sensors, simulation, and object oriented software.
- Enhanced competitiveness of the Canadian space industry on international markets.
- 100 contracts valued at \$55M will be awarded to industry and research institutions for the development and testing of space technology prototypes and about ten space technology products and subsystems will be demonstrated in space.
- Increased participation of Canadian SMEs from all regions of Canada in the CSP.

Economic Benefits	Resources in \$' M		
Key Contributing Activities	00-01	01-02	02-03
<p>The programs contributing to these results in a significant way over the three fiscal years are the following:</p>			
<p>Satellite Communications</p>			
<ul style="list-style-type: none"> • The Payload Flight Demonstration program supports the development and demonstration of an advanced multimedia payload for launch in 2002, which will position Canadian industry as a supplier of advanced technological products such as on-board processing, multibeam antennas and high data rate inter-satellite links for the next generation of multimedia satellite communications. 	13.8	26.2	21.9
<ul style="list-style-type: none"> • SatCom Technology Applications Programs demonstrate satellite-based cost-effective multimedia applications in tele-education and tele-medicine for the benefit of remote communities. 	3.0	3.0	4.0
<ul style="list-style-type: none"> • ESA programs contribute to enhancing Canada's industry technological basis and positioning it for participation in European consortia. 	8.4	9.8	10.1
<p>Earth and Environment</p>			
<ul style="list-style-type: none"> • Ground Infrastructure and Applications programs enhance ground receiving and data processing systems at Canada Centre for Remote Sensing (CCRS) and develop and demonstrate value-added land, coastal and aquatic resource applications using Synthetic Aperture Radar (SAR), hyper-spectral and other satellite data through contracts to Canadian industry. 	9.7	9.7	10.2
<ul style="list-style-type: none"> • Advanced Imager Missions will develop the next generation of space-based Earth observation missions for natural resources management, environment monitoring and surveillance. Specific activities include electro-optical (hyper-spectral) technologies to be flown on foreign or joint satellite missions, development of advanced SAR technologies for future Radarsat missions, and the CSA participation in the ESA Earth observation Programs such as Envisat, Earth Watch and Earth Explorer programs. 	13.4	27.4	30.4
<ul style="list-style-type: none"> • RADARSAT-1 Operations will be continued with the same high performance level until full commissioning of RADARSAT-2; this means over the next 3 years, for example, achieving an imaging performance index greater than 97%, meeting the Canadian Ice Service requirement for 4,000 images per year, updating the Canadian landmass coverage as part of the Background Mission, and adding three foreign stations to the international station network. 	13.0	12.0	12.0
<ul style="list-style-type: none"> • RADARSAT-2 Development Program will be completed on time for a launch in the fall 2002; this involves that the bus and launch arrangements with foreign partners will be completed in 2000-01, the domestic ground infrastructure for receiving RADARSAT-2 data will be updated by May 2002, agreements with four foreign stations to receive data will be concluded by March 2002, and new applications based on its unique capabilities will be developed by March 2003. 	53.6	21.7	2.3

Economic Benefits	Resources in \$' M		
Key Contributing Activities	00-01	01-02	02-03
<p data-bbox="272 342 568 373"><i>Human Presence in Space</i></p> <ul data-bbox="272 405 1068 846" style="list-style-type: none"> <li data-bbox="272 405 1068 531">• The Canadian Space Station Program (CSSP) includes our contribution to the <i>International Space Station</i>. Over the next three years, the MSS hardware development will be completed and the ongoing operation and maintenance of the MSS will be underway. <li data-bbox="272 562 1068 657">• MSS hardware development activities include the on- orbit commissioning of SSRMS, the acceptance of SPDM and the MBS flight equipment, MSS mission operations and astronaut training facilities in St-Hubert, Quebec. <li data-bbox="272 688 1068 846">• MSS Operations activities 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, as well as managing the utilization of Canada's share of ISS resources, part of which will be used to generate revenues through sales to the private sector and abroad. 			
<p data-bbox="272 909 698 940"><i>Generic/Enabling Space Technologies</i></p> <ul data-bbox="272 972 1068 1287" style="list-style-type: none"> <li data-bbox="272 972 1068 1098">• The Leapfrog Technologies programs develop technologies for the next generation spacecraft sub-systems. Specific activities include projects in areas of micro-miniaturization of instruments, high temperature superconductivity, space servicing systems, smart structures, and attitude control sensors and actuators. <li data-bbox="272 1161 1068 1287">• The Flight Technology Demonstration program develops international cooperation ventures to flight demonstrate new Canadian space technologies. A key project is the joint development of a small satellite platform with a foreign partner, such as France, Australia or the U.K. 			

3.4.2 Understanding of the Environment and Contribution to Sustainable Development

The Canadian Space Program contributes to better understanding, monitoring and predicting of the Earth's environment and global climate change, as well as enhancing the management of natural resources and disasters. This is accomplished through the application of space-based technologies and research based on unique scientific data provided by Earth observation satellites. The table shows how space programs with their associated resources will contribute to the achievement of environmental benefits over the fiscal years 2000-01 to 2002-03.

Planned Results

- Improved techniques for understanding, monitoring and predicting of global climate and atmospheric pollution problems such as greenhouse gases' sources and the thinning of the stratospheric ozone layer through the use of data produced by Canadian instruments on the *MOPITT* and *OSIRIS* missions.
- Development of policies on the control of emissions of atmospheric pollutants for meeting Canada's international commitments (e.g. Montreal Protocol and Kyoto Accord), following research on data produced from the above-mentioned missions.
- Improved space-based techniques for the management of natural resources and disasters; the demonstration of forest land management techniques based on Earth observation data with participation of at least 4 provinces/territories; the demonstration of new Earth observation products to measure the role of Canadian forests as a CO₂ source/sink in support of government policies and obligations.

Understanding of the Environment and Contribution to Sustainable Development	Resources in \$' M		
Key Contributing Activities	00-01	01-02	02-03
<p>The programs contributing to these results in a significant way over the fiscal years are the following:</p>			
<ul style="list-style-type: none"> The Space Environment programs develop small payload missions for in-situ studies of space plasma and Earth's electromagnetic field in support of research by Canadian scientists to understand space environment phenomena through advanced models. Principal activities include: participation in international missions with NASA (Image), ESA, Russia (Interball) and Japan (Akebono, Nozomi); development of a Canadian-led microsatellite mission; use of space environment data from the Canadian ground-based network of instruments (CANOPUS); and, support to the University of Alberta's data assimilation facility. 	3.8	4.2	5.7
<ul style="list-style-type: none"> The Atmospheric Environment programs study the dynamics of the atmosphere, the ozone layer, greenhouse gases and other global climate change phenomena. Specific activities include: development of key instruments for participation in international missions with NASA (<i>WINDII</i>, <i>MOPITT</i>, <i>CLOUDSAT</i>) and Sweden (<i>OSIRIS</i>); completion of the <i>SCISAT-1</i> satellite; and development of another instrument for participation in a future international mission or a Canadian-led microsatellite mission or high-altitude balloon projects. 	19.1	16.7	16.5
<ul style="list-style-type: none"> The Surface Environment programs develop and/or use space-borne technologies for studying the cryosphere, monitoring the sustainable development of Canadian forest, understanding the interaction between land-based ecosystems and climate change, mapping near-shore changes and studying the evolution of coastal zones with their ecosystems, and monitoring northern offshore marine environment and its interaction with global climate. Specific activities include: participation in international missions; development of value-added applications; and implementation of the Canadian-led CEOS Global Observation of Forest Cover Project with national and international partners. 	2.7	4.7	6.9
<ul style="list-style-type: none"> The Disaster Management and Surveillance programs develop and demonstrate technologies and applications to better predict, mitigate, manage, and assess natural disasters, as well as technologies for near real-time surveillance, particularly the marine environment. 	1.1	3.1	4.5

3.4.3 Contribution to the Quality of Life

The Canadian Space Program improves the quality of life through the contributions by space science and technologies to improvements in medical procedures and the health of Canadians, and by making advanced multi-media and personal mobile communications services accessible to all Canadians wherever they live in our vast country. The table below shows how space programs and their associated resources will contribute to improving quality of life over the fiscal years 2000-01 to 2002-03.

Planned Results

- Improved health of Canadians from the applications of space science and technology.
- Improved medical knowledge, treatments and drugs from experiments using the effects of micro-gravity.
- Cost-effective access to new multi-media communications services like tele-medicine to all Canadians.

Contribution to the Quality of Life	Resources in \$' M		
Key Contributing Activities	00-01	01-02	02-03
<p>The programs contributing to these results in a significant way over the three fiscal years are the following:</p>			
<ul style="list-style-type: none"> • The Canadian Astronaut Program ensures that the CSA maintains an astronaut corps capable of responding to needs for human space flights such as, for instance, the use of the space environment to advance S&T and enhance our quality of life. In the upcoming years, the program will focus on: training the Canadian astronauts for participation in Space Station assembly and operations; developing a strong space medicine program through R&D related to preventing, diagnosing and treating astronaut health problems and maintaining their well-being and productivity; testing Canadian space material and life science experiments; and supporting studies in health technologies. 	7.7	8.5	8.7
<ul style="list-style-type: none"> • The Life Science programs enable our scientific community and industry to use the Space Shuttle and the ISS to advance knowledge on the cardiovascular system, bone research, neurology, early development and radiation effects on living organisms. The main activities include: gravitational biology projects such as Canada's Insect Habitat and Aquatic Research Facility; human performance and adaptation to micro-gravity and space; and osteoporosis research such as the Canadian-led OSTEO-2 project. 	6.3	8.0	8.8
<ul style="list-style-type: none"> • The Microgravity Science programs enable our scientific community and industry to use the Space Shuttle and the ISS to advance knowledge related to proteins and biotechnologies, fluid and combustion, advanced material, fundamental physics and chemistry as well as the development of instruments and facilities for carrying out microgravity experiments. 	6.4	8.9	9.6
<p>The Satellite Communications programs described in the section dealing with economic benefits also contribute to quality of life by making advanced communications services (e.g., tele-medicine) accessible to all Canadians.</p>			

3.4.4 Technology Development and Diffusion

Canada's penetration of emerging space markets requires the development of the technological capabilities of Canadian space industries particularly high technology SMEs, in the face of stiff world competition resulting from globalization. Over the next three fiscal years, CSA will focus its efforts on the development of niche technologies needed to support the growth and competitiveness of Canadian industry, establish partnerships with foreign firms and thereby benefit from technological transfer, and improve access to foreign markets, particularly through the renewal of the Canada/ESA Cooperation Agreement. The table shows how space programs with their associated resources will contribute to technology development and diffusion over the fiscal years 2000-01 to 2002-03.

Planned Results

- Improved technical capabilities of Canadian industry in traditional market niches of space robotics, Earth observation and communications.
- Increased participation of SMEs from all regions of Canada in space technology development programs.
- Commercialization of funded R&D .

Technology Development and Diffusion	Resources in \$' M		
Key Contributing Activities	00-01	01-02	02-03
The programs contributing to these results in a significant way over the three fiscal years are the following:			
<ul style="list-style-type: none"> • Generic Technology Development programs and Strategic Technology programs- Through a competitive process, Space Technology program develops new technologies both for enhancing industrial competitiveness and also for future space programs. Effectiveness of the technology development program is also enhanced through partnership with ESA and other international partners. 	13.5	14.8	14.8
<ul style="list-style-type: none"> • Development of about 50 new leapfrog technologies, materials, processes and products for enhancing Canadian industrial competitiveness (*see Economic Benefits under Leapfrog Technologies). 	0.3	1.7	1.7
<ul style="list-style-type: none"> • Demonstration in space of about ten technology products and sub-systems through Canadian smallsat and microsat flights (*see Economic Benefits under Flight Technology Demonstration). 	*	*	*
<ul style="list-style-type: none"> • The Technology Commercialization program protects, diffuses and commercializes intellectual property generated by government investments. Over 50 license agreements will be negotiated and several business opportunity studies will be realized in support of Canadian industry over the next three fiscal years. 	1.0	2.5	2.5

3.4.5 World Class Research

Canada has developed internationally recognized excellence in a number of areas, notably space robotics, space science, civilian space-borne radar satellites and applications, space qualification services with the David Florida Laboratory, and certain satellite communications sub-systems. The table shows how selected space programs with their associated resources will contribute to maintaining world class research in Canada over the fiscal years 2000-01 to 2002-03.

Planned Results

- A better understanding of space, the universe and our solar system, basic physical and chemical processes.
- International recognition of Canada's leadership in space robotics and space qualification services.

World Class Research	Resources in \$' M		
Key Contributing Activities	00-01	01-02	02-03
The programs contributing to these results in a significant way over the three fiscal years are the following:			
<ul style="list-style-type: none"> • Space Astronomy and Space Exploration programs enable our scientific community to contribute to international efforts aimed at understanding the universe and predicting its evolution. Upcoming key activities include participation in international missions such as the Next Generation Space Telescope (<i>Hubble</i> replacement), led by NASA, the FIRST/Planck mission led by ESA and the Mars Sample Return Missions led by NASA. 	12.6	17.8	19.0
<ul style="list-style-type: none"> • Solar Terrestrial Relations and Atmospheric Sciences continue to lead to more than 50 scientific papers published or presented at conferences and peer reviewed each year through participation in several international projects (CANOPUS ground-based network, SMS (Japan), UVAI (Russia), WINDII (NASA), MOPITT (NASA), OSIRIS (Sweden). (*see understanding of the Environment and Contribution to Sustainable Development under Atmospheric Environment). 	*	*	*
<ul style="list-style-type: none"> • 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. 	6.7	6.7	6.7
<ul style="list-style-type: none"> • Canada's contribution (the Mobile Servicing System) to the International Space Station program is essential to its construction and operations. Future activities will aim to preserve our world leadership in space robotics and establish Canada as a vital partner in the scientific and commercial utilization of ISS capabilities. (*see Economic Benefits under Canadian Space Station). 	*	*	*

3.4.6 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. Space hardware development, which involves meeting exceptional technical requirements and 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. The table shows how selected space programs with their associated resources will contribute to achieving social and educational benefits over the Fiscal Years 2000-01 to 2002-03.

Planned Results

- Canadian youth pursuing careers in S & T as demonstrated by surveys and studies.
- Availability of qualified Canadian scientists, engineers, and technicians for high tech and space related industries.

Social and Educational Benefits	Resources in \$'M		
Key Contributing Activities	00-01	01-02	02-03
The programs contributing to these results in a significant way over the three fiscal years are the following:			
<ul style="list-style-type: none"> • Advanced Space Studies Sponsorship programs delivered in cooperation with NSERC support students pursuing advanced studies in science and engineering. Over 30 Phd and Master level students benefiting yearly from financial support or from projects awarded to universities for space technology research training. 	0.3	0.3	0.3
<ul style="list-style-type: none"> • Youth Awareness initiatives, through an established collaborative network of outreach, supports the development and implementation of Canadian space-related material and campaigns targeting youth to encourage youth to embrace science and technology and develop a keen interest in the Canadian Space Program. 	.6	.6	.6
<ul style="list-style-type: none"> • Canadian Astronauts significantly contribute to fostering education and space awareness. Their active participation in various public events helps instil a sense of pride among Canadians and promote scientific literacy as well as careers in science and technology among young people. (*see Contribution to Quality of Life under Canadian Astronaut). 	*	*	*

3.4.7 Promotion of Canadian Space Program (CSP)

The Canadian Space Agency ensures that Canadians know about their country's space-related achievements and the benefits they bring to Canada. The Agency places great emphasis on the level of interest and scientific literacy among the general public and youth, on building national pride through public awareness of Canada's achievements in space, and on promoting understanding of the role of the CSP in Canada's future by Parliament and the general public. The table shows how selected communications activities with their associated resources will contribute to the promotion of the CSP over the fiscal years 2000-01 to 2002-03.

Planned Results

- Communications strategies and activities that satisfy the needs of the CSA, the government, the Minister and space stakeholders.
- Increased awareness, understanding and support of the CSP and its benefits by the general public, Parliament and youth in particular.
- Improved international space cooperation with our traditional partners, notably U.S., Europe, and Japan.
- New bilateral space cooperation agreements with Brazil, Argentina, and Morocco are planned.
- Effective and open relations between CSA and its domestic stakeholders, notably industry, OGDs, provinces and research organizations.

Promotion of Canadian Space Program (CSP)	Resources in \$'M		
Key Contributing Activities	00-01	01-02	02-03
<p>The programs contributing to these results in a significant way over the three fiscal years are the following:</p> <ul style="list-style-type: none"> • The CSA Communications Directorate implements on-going strategic planning and awareness initiatives in cooperation with the sectors, stakeholders and special interest groups concerned by the subjects to be announced or promoted as well as overall for the positioning of the Canadian Space Agency as Canada's leading agency for the development and application of space. Special communications activities to increase awareness over the long term include: Embrace Campaign, <i>Speaking about Space Program</i>, CSA branded Merchandise program, Internet and interactive publishing, Corporate Image Program, ISS Assembly mission flights including Canadian astronauts and SSRMS installation, launch of SCISAT and RADARSAT-2. • Establishment and coordination of a Communications external advisory committee involving stakeholders provides for citizen participation in the communications of the Canadian Space Program and ongoing consultation and collaborative relations. Ongoing and strategic dialogue with the Agency's stakeholder are vital to the enhancement of the Canadian Space Program. • The External Relations Directorate performs a large array of activities to effectively manage strategic and policy aspects related to CSA's international cooperation agreements as well as to support international marketing strategies pursued by our industries. Discussion on potential cooperation with newly emerging space-faring nations have been initiated. 	3.0	3.0	3.0
	.23	.23	.23
	2.1	2.1	2.1

3.5 Service Lines

Under the single business line (Space Knowledge, Applications and Industry Development), CSA objectives and results are achieved through seven service lines as follows:

Space Science - the Canadian Space Agency advances scientific knowledge in areas of strategic importance for Canada by providing Canadian scientists access to the unique environment of space. This contributes to the achievement of CSA results in the following areas:

- Major advances in astronomy and astrophysics.
- Better understanding of our solar system in relation to the origins of life and the Earth's environment.
- Improved public health through advances in life sciences and biotechnologies.
- Internationally competitive industries through new materials and improved manufacturing technologies.

Earth and Environment - the Canadian Space Agency uses 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. Using space-based applications to respond successfully to the challenges of a changing planet contributes to the achievement of CSA results in the following areas:

- Understanding, monitoring and predicting the Earth's environment and global climate change in accordance with international commitments.
- Maintenance of Canada's position as the world leader in commercial sales of space borne radar technologies, products and services.
- Enhanced management of Canada's natural resources using radar and hyperspectral data.
- Use of satellite information services for disaster management and marine surveillance.

Human Presence in Space - the Canadian Space Agency provides a meaningful and visible contribution to international efforts aimed at establishing a human presence in and beyond low Earth orbit and ensures that this contribution will bring tangible benefits to Canada. The following results are sought:

- Maintenance of Canada's world leadership in space robotics.
- International recognition of Canada's essential role in *International Space Station*.
- Commercial exploitation of the knowledge and technologies developed.
- Canadian participation in future human space missions.

Satellite Communications - the Canadian Space Agency 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. This contributes to the achievement of CSA results in the following areas:

- Strategic niche technologies for next-generation satellite services.
- Increased revenues for the Canadian satellite communications industry.

Generic/Enabling Space Technologies - the Canadian Space Agency develops innovative and emerging technologies to ensure the growth and competitiveness of the Canadian space industry, to meet potential needs of the Canadian Space Program and to maximize commercialization of space technologies in both space and non-space applications. This contributes to the achievement of CSA results in the following areas:

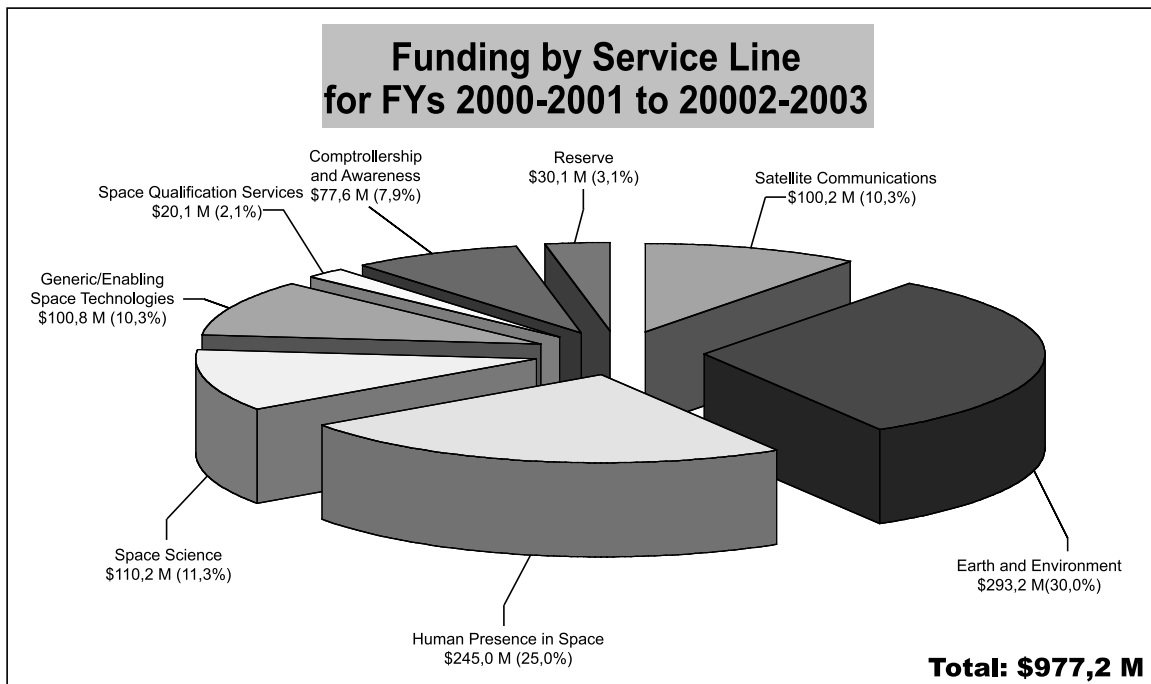
- Innovative technological leaps essential to meeting future Canadian needs and for ensuring an internationally competitive space industry.
- Technologies that reduce the risk and cost of future programs.

Space Qualification Services – the Canadian Space Agency provides an environmental test facility capable of meeting the current and emerging needs of Canada's space community and the nation's space related objectives. This contributes to the achievement of CSA results in the following areas:

- Recognition of Canada's leadership in space technology and research.
- Provision of solutions to meet the demands of space clients.
- Operation of a cost effective national test facility contributing to the development of a competitive domestic space industry in Canada.

Comptrollership and Awareness – the Canadian Space Agency is the national leader of the Canadian Space Program (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. This contributes to the achievement of CSA results in the following areas:

- A Space Program that is responsive to the needs of the Canadian public.
- Accountability to Parliament and ultimately to the Canadian public for the management of government resources directed to the Space Program.
- Effective decision-making through a focus on results, flexible control systems, objectives performance assessment and thorough risk identification, assessment and management.
- Awareness of the importance of space related activities in all regions of Canada.
- Domestic and foreign partnerships to support the implementation of the CSP.
- Support for the space industry's domestic and export development efforts.
- Equitable regional industrial development.
- Canadian public and stakeholders better informed about Canadian Space Program activities.
- Human resources managed effectively through the Management Framework.



SECTION IV:

FINANCIAL INFORMATION

4.1 Summary of Capital Spending by Business Line

Financial Information				
(\$ millions)	Forecast Spending 1999-2000	Planned Spending 2000-2001	Planned Spending 2001-2002	Planned Spending 2002-2003
Business Line				
Space Knowledge, Applications & Industry Development	213.8	203.9	138.8	117.9
Gross Total	213.8	203.9	138.8	117.9
Less: Respendable revenue	2.9	4.0	4.1	4.1
Net Total	210.9	199.9	134.7	113.8
Nota: 1) The business line includes contributions to Employee Benefit Plans for the Canadian Space Agency. 2) Due to rounding, figures may not add to totals shown.				

4.2 Details on Major Capital Projects Spending

Financial Information						
(\$ millions)	Current Estimated Total Cost	Forecast Spending to March 31, 2000	Planned Spending 2000-2001	Planned Spending 2001-2002	Planned Spending 2002-2003	Future Year Spending Req'ment
Space Knowledge, Applications & Industry Development						
Space Science projects (Ontario)			48.4	57.3	61.5	
Canadian Space Station Program (Quebec)	1,415.4	1,329.6	62.0	12.2	2.7	8.9
RADARSAT-1 Major Crown Project (Quebec)	635.5	598.5	13.0	12.0	12.0	0.0
RADARSAT-2 Major Crown Project (Quebec)	242.2	164.6	53.6	21.7	2.3	0.0
Earth Observation Support Program			17.3	25.8	24.4	
Miscellaneous capital projects			9.6	9.8	15.0	
Total Gross Capital Expenditures			203.9	138.8	117.9	8.9
Less: Respendable revenue			4.0	4.1	4.1	
Total Net Capital Expenditures			199.9	134.7	113.8	8.9
Nota: 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.						

4.3 Status Report on Major Crown Projects

Canadian Space Station Program

1. Overview

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 cooperative 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 facility and use of the Space Station.

The Canadian Space Station Program received Effective Project Approval in February 1990. The program defines all the activities necessary to discharge Canada's obligations, including completion of the on-orbit testing and commissioning of the Mobile Servicing System (MSS), and its operation and utilization for the life of the International Space Station. By contributing the MSS to the *International Space Station* (ISS), Canada gains the right to use the station for scientific and technological research.

2. Lead and Participating Departments

Sponsoring Agency:	Canadian Space Agency
Contracting Authority:	Public Works and Government Services Canada
Participating Departments:	None

3. Prime and Major Sub-Contractors

Prime

MDA Space and Advanced Robotics (MDR) (formerly Spar Aerospace)	Brampton, Ontario
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Sub-Contractors

EMS Technologies (formerly Spar Aerospace)	Ste. Anne de Bellevue, Quebec
MDA	Richmond, British Columbia
SED Systems	Saskatoon, Saskatchewan
IMP	Halifax, Nova Scotia
CAE	St-Laurent, Québec
Calian	Kanata, Ontario

4. Major Milestones

The following table outlines the international milestones driving the Canadian Space Station Program:

Major Milestones	
<i>Canadian Space Station</i>	<i>Date</i>
First Space Station element launch (FGB)	Nov 1998
SSRMS delivery to NASA	May 1999
Three person permanent international human presence capability	June 2000
First MSS element launch (SSRMS)	Nov 2000
Second MSS element launch (MBS)	Aug 2001
Third MSS element launch (SPDM)	Sept 2003
Six person permanent international human presence capability	Sept 2004
Seven person permanent international human presence capability	Oct 2004

5. Progress Report and Explanations of Variances

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 Dexterous Manipulator (SPDM) - a robotic "hand" that works in conjunction with the SSRMS.

The Space Station Remote Manipulator System (SSRMS) was successfully completed and delivered to the Kennedy Space Center (KSC) in May 1999. The work on the Mobile Base System has been minimized to support the delivery of the SSRMS, and a new MBS schedule is being developed. The Special Purpose Dexterous Manipulator (SPDM) Critical Design Review (CDR) was successfully completed in December 1998 and the Artificial Vision Unit was delivered to KSC in December 1998. Delays in the program since its inception are due to the complexity of accomplishing such an endeavour in the context of a multi-national program. This results in schedule slips on the overall program, impacting the Canadian contribution.

6. Industrial Benefits

Since 1984, the program has issued about 750 contracts (\$919 million), with expenditures benefiting all regions of the country, accruing socio-economic benefits of \$2.8 billion and creating 32,000 jobs.

Companies are already adapting Space Station technology to capture opportunities on the ground. The Strategic Technologies for Automation and Robotics (STEAR) program is actively transferring Space Station technology to firms in many different industries. STEAR, established in 1987, supports industry-led projects to develop dual-use automation and robotic technology, that can be applied on Earth and in space. Following are just a few examples of how companies are using their STEAR experience to create new products and processes.

Hazardous Environments - Each day, hundreds of drums containing toxic waste are produced throughout North America. In many cases, they must be stored prior to disposal. Storage warehouses can contain 12,000 or more drums, each of which must be constantly monitored to prevent leaks. Kinetic Sciences Inc. has used STEAR funding to develop the "Eagle Eye" 3-D machine vision system. Eagle Eye is mounted on a mobile robot that can roam a warehouse to identify small changes in storage drums that may signal impending failure. Spar Aerospace from Brampton, Ontario worked with the US Department of Environment applying light and medium duty utility arms for radioactive environments, robotic excavators, and robotic inspection and maintenance vehicles.

Food Inspection - Canpolar East Inc. of St. John's, Newfoundland developed a high speed, high resolution vision system whose primary application will be automated groundfish fillet inspection. The Parasensor system combines machine vision and expert system technologies to detect irregular fillets.

Automobile Refuelling - The Shell Smart Pump, considered as one of the world's first and most sophisticated consumer robots, is a triumph of Canadian technological innovation. International Submarine Engineering Ltd, from Port Coquitlam, BC, developed the first autonomous robotic automobile refuelling robot and it is now being installed at a new Shell service centre in Sacramento, California. Shell, with more than 6,000 eligible self-serve gas stations in the US alone, expects this to become the largest production consumer robot in the world.

Television Equipment - Miranda Recherches Inc., from Ville St-Laurent, Quebec, developed Espace, a product for visualizing up to four video images on a single high resolution monitor, and managing and modifying these images in real-time through a Windows™ type graphical interface.

Transport Planning - Dynacon Enterprises Ltd., from Downsview, Ontario, developed an automated expert system operation planning software. The software was used in cooperation with a major food supply company to plan the routes, schedules and loading sequence of delivery trucks that supply a network of supermarkets.

Medicine - CIFRA Medical Inc., from Ste-Foy, Quebec, has developed a digital imaging system for medical radiology. The High End Medical Imaging System can offer numerical medical X-ray images in real time. The Microgravity program provides funds for Aastra Aerospace to see if the process for encapsulating pancreatic islet cells could be improved in microgravity. Experiments at Laval University, are using microgravity crystallization to aid breast cancer research. Studies of the structure of a human protein that is critically important in the conservation of sex hormones are also underway. The protein is a significant target of researchers working on cures for breast and prostate drug therapy.

Agriculture - Farmers apply large amounts of herbicides to control weeds. Reducing herbicide use would reduce costs and improve the health of farmers - and the environment. APRO Applied Robotics of Saskatoon has developed an automated agricultural sprayer that uses machine vision to detect the presence of weeds. Now, farmers can limit spraying to where weeds are detected, and greatly reduce their herbicide use. APRO used Strategic Technologies for Automation and Robotics (STEAR) support to develop the core technology (used on the Space Station to identify objects outside the station).

RADARSAT-1

1. Overview

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, 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.

The RADARSAT venture also supports fishing, shipping, oil and gas exploration, offshore drilling, mapping and ocean research. The development and operation of this system are expected to provide more than \$1 billion in benefits to the Canadian private and public sectors. In addition, \$56.9 million is expected in revenues to support the development and operations of RADARSAT-1. This includes \$16.5 million in royalties on world-wide sales of data, \$10.0 million from RADARSAT International Inc. for equipment, and \$30.4 million from provincial governments for work related to satellite construction.

2. Lead and Participating Departments

Sponsoring Agency:	The Canadian Space Agency
Contracting Authority:	Public Works & Government Services
Participating Departments:	Environment Canada
	Natural Resources Canada

3. Prime and Major Sub-Contractors

Prime

EMS Technologies (formerly Spar Aerospace)	Ste-Anne de Bellevue, Québec
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Sub-Contractors

SED Systems	Saskatoon, Saskatchewan
Lockheed Martin	Longueuil, Québec
EMS Technologies (formerly CAL Corp.)	Ottawa, Ontario
MDA	Richmond, British Columbia
Com Dev	Cambridge, Ontario
RADARSAT International (RSI)	Richmond, British Columbia
Ball Aerospace	Boulder, Colorado, USA

4. Major Milestones

The following table outlines the international milestones of *RADARSAT-1*:

Major Milestones		
Phase	Description	Date
A	Preliminary studies	Completed
B	Feasibility and concept definition	Completed
C1	Systems requirement and preliminary design	Completed
C2	Development and testing up to Qualification Test Review	Completed
D1	Manufacture of the proto flight subsystems up to acceptance testing of the subsystems	Completed
D2	Assembly and integration of the subsystems up to Flight Readiness Review, plus post-launch and commissioning activities up to System Acceptance	Completed
E	Operations	April 1996 to March 2003
	First Antarctic mission	Completed

5. Progress Report and Explanation of Variances

Effective Program Approval was obtained for *RADARSAT-1* in March 1991. It was launched in November 1995 and began commercial operations in April 1996. The initial system included receiving stations for Synthetic Aperture Radar (SAR) data in Prince Albert (Saskatchewan), Gatineau (Québec) and Fairbanks (Alaska). CSA and *RADARSAT International Inc.* have since signed agreements with network stations in Australia, Norway, the United Kingdom, Singapore, China, South Korea, Saudi Arabia, Thailand and Japan for the direct reception of the *RADARSAT* data.

Routine operations of *RADARSAT-1* commenced in April 1996, following a commissioning period. *RADARSAT-1* has supplied timely and high quality data to Radarsat International Inc., 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). At the end of March 1999, *RADARSAT-1* had fulfilled a total of 51,567 user requests. An estimated 99,837 minutes of data from over 17,768 orbits had been acquired. Average system performance is 96%. The world-wide client base includes more than 500 commercial and government users from 50 countries.

Operational improvements made to the *RADARSAT* system include cutting payload command data (RCD) delivery timeframe from more than 50 hours to 29, and improving the response time and robustness of the spacecraft's attitude control system. There was a complete upgrade of the hardware and production software of the Mission Management Data Base Management (MMO/DBM) planning system, resulting in a faster and more powerful system which is now accessible 24 hours a day (up from 12 hours in 1998) for request transmittal and tracking to the eight international network stations and five order desks. A new Disaster Watch was also created in order to prepare a database for possible disasters in Canada and abroad.

The RADARSAT system is designed to provide four-hour turnaround in the electronic delivery of images to the Canadian Ice Service for producing ice charts for the Canadian Coast Guard. In operation, delivery time is averaging 1.2 hours from the time the image is acquired by the satellite, and is often within one hour. During 1998, the Canadian Ice Service used over 4,000 image frames of RADARSAT data and supplied more than 64,000 image products and 9,000 charts to its 300 clients. It has been estimated that RADARSAT is saving more than \$7 million per year in data acquisition costs to the Canadian Ice Service.

The RADARSAT Background Mission had archived substantial volumes of images for future use. This includes the first Synthetic Aperture Radar (SAR) coverage of the world's continents, their continental shelves and the polar ice caps, as well as some islands and their surrounding oceanographic features. *RADARSAT-1* is creating an archive of global multi-mode and multi-season SAR data. The Background Mission is also supplying a global stereo data set of the world's landmass. Most of North America and Western Europe has been covered, providing data suitable for mapping a wide range of terrain conditions. Fine beam coverage of the world's capital and major cities was also completed in 1999.

The first mapping of Antarctica by *RADARSAT-1*, the Antarctic 1 Mapping Mission, took place between September 9, 1997 and October 20, 1997. It has been a resounding success, far exceeding NASA's expectation both in completeness of coverage and in quality of the images. The Discovery Channel Canada also selected the Antarctic Mapping Mission as one of its top 10 science stories of 1999. *RADARSAT-1* acquired a total of 8,000 images, 2,000 more than originally planned. The data is used to study the effects of climatological, glaciological, geological and human activity processes on the Antarctic continent. It has revealed new ice stream systems in East Antarctic, and achieved the first radar-driven map of ice division and catchment areas and extensive mega-snow dune fields. The Antarctic Mapping Mission fulfils a CSA commitment to NASA and National Ocean and Atmospheric Administration (NOAA) in return for launching *RADARSAT-1* in 1995.

Radarsat International Inc. (RSI) is using the Internet to improve access and delivery of products. To open new markets, new products and services have been introduced: RADARMaps, large area mosaics, emergency response subscription service, per km² pricing, monitoring services and RADARSAT-derived Digital Elevation Models.

6. Industrial Benefits

SPAR and its Canadian subcontractors created over 2,000 person-years of high technology employment during the construction phase of *RADARSAT-1*. Ongoing mission operations employ 75 people at CSA Saint-Hubert, 7 in Saskatoon, 15 at the ground stations in Prince Albert and Gatineau, as well as more than 80 at RSI in Richmond BC. In a highly competitive marketplace for space-based information, RSI has won roughly 15% of the world's space borne remote sensing market in just three years. In 1998, RADARSAT commercial data orders grew to more than \$10.6 million based on 8,800 scenes. RSI and its team of 75 international distributors and certified network stations serve 500 clients in more than 50 countries. Total 1998-1999 revenues from commercial RADARSAT products and services exceeded \$15 million.

The RADARSAT User Development Program has supported 37 contracts worth more than \$11.4 million for the development of new applications using SAR data. To date this investment has helped bring 21 products and services to market resulting in over \$14 million in revenues (excluding data sales) and leveraging an estimated \$3 million in RADARSAT data sales. Since 1995 the User Education and Training Initiative has funded 39 projects to develop and market educational and training Earth observation materials. The Earth Observation Pilot Projects Program within the Earth Observation Support program, has supported 21 projects to transfer Earth observation technology to a broader base of industrial and operational users.

RADARSAT-2

1. Overview

RADARSAT-1, Canada's first Earth Observation satellite, launched in 1995, established Canada among the world leaders in satellite remote sensing technology. The RADARSAT system provides imagery to government and commercial users, primarily for resource management and environmental monitoring. *RADARSAT-1* has a life expectancy of 6 years.

In June 1994, the government directed the Canadian Space Agency 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, following a formal Request for Proposal, MacDonald Dettwiler and Associates (MDA) was selected to construct and manage *RADARSAT-2*.

The *RADARSAT-2* project pertains to the design, development, test, deployment and operation of a space-borne Synthetic Aperture Radar (SAR) to provide global coverage of terrestrial phenomena as a follow-on to *RADARSAT-1*. *RADARSAT-2* will continue to provide all-weather, day and night coverage of the entire globe, and to support fishing, shipping, oil and gas exploration, offshore drilling, mapping and ocean research. The long-term objective is to create a commercial industrial satellite remote sensing business in Canada. *RADARSAT-2* design and construction improves upon *RADARSAT-1* with new capabilities to ensure Canada's continued leadership in the satellite remote sensing global marketplace.

The total project cost including the launch is an estimated \$460 million, with the government contributing \$379.5 million and the balance of \$80.5 million provided by MDA.

2. Lead and Participating Departments

Sponsoring Agency:	The Canadian Space Agency
Contracting Authority:	The Canadian Space Agency
Participating Departments:	Natural Resources Canada Environment Canada Atlantic Canada Opportunities Agency Western Economic Diversification Canada Canada Economic Development for Quebec Regions Industry Canada Fisheries and Oceans National Defence Foreign Affairs and International Trade Justice

3. Prime and Major Sub-Contractors

Prime MDA	Richmond, British Columbia
Sub-Contractors EMS Technologies RSI Alenia Aerospazio	Ste-Anne de Bellevue, Québec Richmond, British Columbia Rome, Italy

4. Major Milestones

The following table outlines the international milestones driving RADARSAT-2:

Major Milestones		
Phase	Description	Date
A and B	Requirement Definition	June 1999
C and D1	Subsystem Design and Construction	September 2001
D2	Integration and Test	March 2002
E1	Pre-Launch Preparations	October 2002
E2	LEOP and Commissioning	January 2003
E3	Operations	January 2003 To April 2010

5. Progress Report and Explanation of Variances

In February 1998, MacDonald Dettwiler & Associates (MDA) was selected as the prime contractor to build and operate RADARSAT-2. The Canadian Space Agency and MacDonald Dettwiler & Associates signed a Master Agreement in December 1998 for the RADARSAT-2 mission, under a firm price contract in which the government contribution was \$225 million, in exchange for data. MDA was to invest \$80 million. The Master Agreement between the CSA and MDA was updated in January 2000 to reflect changes in the schedule and the latest cost estimates. 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. CSA will provide an additional "in-kind" contribution of certain assets, plus the services of its David Florida Laboratory and the National Research Council Canada's Institute of Aerospace Research laboratory for spacecraft integration and testing.

During 1998-99 MDA initiated a number of subcontracts with key subsystem suppliers. The requirement review for the mission and the satellite system, and the preliminary design review for the bus and the payload were completed during the past year. In December 1999 the CSA and MDA selected a European contractor for the construction of the RADARSAT-2 bus.

The two main challenges facing RADARSAT-2 are: to negotiate an alternate launch arrangement, since NASA has decided not to provide a launch; and to develop a suitable data distribution policy given the potential uses of high resolution radar data.

6. Industrial Benefits

A major objective of the project is the transition of the Earth observation business from public sector to the private sector. It builds on the SAR data and value-added markets established with RADARSAT-1 to strengthen the Canadian industry's position as suppliers of SAR-related technology, systems and value-added products and services. Specifically, manufacturing potential and competitiveness will be developed in Canadian industry in the areas of phased array antenna design/manufacture, high performance receiver/transmitter design and manufacture and enhanced structure design. Additionally, opportunities will be created for the export of ground station systems. The new capabilities also make possible new applications, creating new and expanded markets for data sales and value-added products.

The MDA proposal estimates the total industrial benefit resulting from RADARSAT-2 at \$2 billion, of which 30% is projected for small business and 60% expected to derive from export sales. This is five times greater than the CSA's investment and represents an enormous opportunity for this business sector. Of this figure, 84% results directly from activities associated with the construction, operation and data distribution of RADARSAT-2 with the balance coming from the use of the technology that is developed on other similar programs.

4.4 Summary of Transfer Payments

Financial Information				
(\$ millions)	Forecast Spending 1999-2000	Planned Spending 2000-2001	Planned Spending 2001-2002	Planned Spending 2002-2003
GRANTS				
Space Knowledge, Applications & Industry Development	2.0	0.8	0.8	0.8
CONTRIBUTIONS				
Space Knowledge, Applications & Industry Development	16.9	31.4	48.7	47.0
Total Grants and Contributions	18.9	32.2	49.5	47.8

4.5 Source of Responsible and Non-Responsible Revenue

Financial Information				
(\$ millions)	Forecast Spending 1999-2000	Planned Spending 2000-2001	Planned Revenue 2001-2002	Planned Revenue 2002-2003
Responsible Revenue				
Canadian Space Program				
Royalties from RADARSAT International	2.9	4.0	4.1	4.1
Total Responsible Revenue	2.9	4.0	4.1	4.1
Non-Responsible Revenue				
Canadian Space Program				
DFL testing service fees	0.4	0.5	0.5	0.0
Rental fees and miscellaneous	0.0	0.0	0.0	0.0
Total Non-Responsible Revenue	0.5	0.5	0.5	0.0
Total Responsible and Non-Responsible Revenue	3.4	4.5	4.6	4.1

Nota: Due to rounding, figures may not add to totals shown.

4.6 Net Cost of Program for the Estimates Year

Financial Information	
(\$ millions)	Canadian Space Program
<i>Planned Spending</i>	351.5
Plus:	
Services Received without Charge	
Accommodation provided by Public Works and Government Services Canada (PWGSC)	0.1
Contributions covering employers' share of insurance premiums and costs paid by TBS	2.1
Workman's compensation coverage provided by Human Resources Canada	0.0
Salary and associated costs of legal services provided by Justice Canada	0.0
Total - Services Received without Charge	2.2
Total Cost of the Program	353.6
Less:	
Respendable Revenue	4.0
Non-respendable Revenue	0.5
Total Revenue	4.5
2000-2001 Net Cost of the Program	353.2
Nota: Due to rounding, figures may not add to totals shown.	

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5.2 Legislation administered and associated regulations

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

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5.4 Abbreviations and acronyms

ACE	Atmospheric Chemistry Experiment
ACOA	Atlantic Canada Opportunities Agency
ADRO	Application Development and Research Opportunity
ASVS	Advanced Space Vision System
CCRS	Canada Centre for Remote Sensing
CDR	Critical Design Review
CEO	Net Canadian Earth Observation Net
CIS	Canadian Ice Services
CNES	Centre National d'Études Spatiales (France)
CPA	Cold Plasma Analyser
CRC	Communications Research Centre
CSA	Canadian Space Agency
CSP	Canadian Space Program
CSSP	Canadian Space Station Program
CSVS	Canadian Space Vision System
DFL	David Florida Laboratory
DND	Department of National Defence
DUP	Data User Program
EE	Earth and Environment
EHF	Extremely High Frequency
EMC	Electromagnetic Compatibility
ENVISAT	Contribution to the Environmental Satellite Development Program of ESA
EOPP	Earth Observation Preparatory Program (ESA)
EPA	Effective Program Approval
ERS	European Remote Sensing
ESA	European Space Agency
FIS	Financial Information System
FTE	Full Time Equivalent
FUSE	Far Ultraviolet Spectroscopic Explorer
GDP	Gross Domestic Product
GSTP	General Support Technology Program
HR	Human Resources
IFMS	Integrated Financial Management System
IGA	Intergovernmental Agreement
IML	International Microgravity Laboratory
IR	Infra Red
ISAS	Institute of Space and Astronautical Science of Japan
ISIS	International Satellite for Ionospheric Sounding
ISS	<i>International Space Station</i>
ITAR	International Traffic in Arms Regulations
KSC	Kennedy Space Center
LEOP	Launch and Early Orbit Phase
LMS	Life and Microgravity Spacelab
LTSP	Long-Term Space Plan
MANTRA	Middle Atmosphere Nitrogen Trend Assessment
MBS	Mobile Base System
MCP	Major Crown Project
MDA	MacDonald Dettwiler & Associates
MEIT	Multi-Element Integration Testing
MIM	Microgravity Isolation Mount
MMLC	Multimedia Learning Centre
MMO/DBM	Mission Management Data Base Management
MOC MSS	Operations Complex
MOPITT	Measurement of Pollution in the Troposphere
MOTS	Mobile Operations Training Simulator
MSAT	Mobile Satellite
MSP	Microgravity Sciences Program
MSS	Mobile Servicing System
MSTP	European Manned Space Program
MTPE	Mission To Planet Earth

NASA	National Aeronautics and Space Administration (United States)
NASDA	National Space Development Agency (Japan)
NOAA	National Oceanic & Atmospheric Administration (United States)
NRC	National Research Council of Canada
NSERC	Natural Sciences and Engineering Research Council of Canada
NSPO	National Space Program Office
NSTS	National Sector Team for Space
OSIRIS	Optical Spectrograph and Infrared Imaging
OSC	Orbital Sciences Corporation
OSM	Operational Space Medicine
PAS	Program Activity Structure
PIM	Passive Intermodulation Measurement
POEM/ENVISAT	Polar Orbit Earth Observation Mission
PPA	Preliminary Project Approval
PSDE	Payload and Spacecraft Development and Experimentation
PWGSC	Public Works and Government Services Canada
QUELD	Queen's University Experiment on Liquid Diffusion
R&D	Research and Development
RF	Radio Frequency
RSI	RADARSAT International Inc.
RUDP	RADARSAT User Development Program
S&T	Science and Technology
SAP R/3	(Systems, Products, and Programs in Data Processing - Realtime System version 3)
SAR	Synthetic Aperture Radar
SIFAC	Space Industry Forum in Atlantic Canada
SME	Small and Medium Sized Enterprise
SMS	Supra Thermal Ion Mass Spectrometer
SOSC	Space Operations Support Centre
SPDM	Special Purpose Dextrous Manipulator
SRMS	Shuttle Remote Manipulator System
SSRMS	Space Station Remote Manipulator System
STACI	Space Technology Atlantic Canada Initiative
STEAR	Strategic Technologies for Automation and Robotics
STS	Space Transportation System
SVS	Space Vision System
TAA	Technical Assistance Agreement
TMI	Telesat Mobile International
TPA	Thermal Plasma Analyser
TRE	Torso Rotation Experiment
UARS	Upper Atmospheric Research Satellite
VCF	Visual Coordination Facility
WINDII	Wind Imaging Interferometer
Y2K	Year Two Thousand