Canadian Space Agency

1997-98 Estimates

Part III

Expenditure Plan

The Estimates Documents

The Estimates of the Government of Canada are structured in three 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 Part III documents provide additional detail on each department and its programs primarily in terms of the results expected for the money spent.

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Catalogue No. BT31-2/1998-III-93
ISBN 0-660-60129-X

Canadian Space Agency

1997-98 Estimates

Part III

Expenditure Plan

Approved

Minister of Space Agency

January 20, 1997

Canadian Space Agency

1997–1998 Estimates

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Approved

Minister of Industry

Preface

This Expenditure Plan is designed to be used as a reference document. It contains several levels of detail, beginning with Spending Authorities as extracted from Part II of the Estimates and Volume II of the Public Accounts. This format provides continuity with other Estimates documents and helps readers to assess the financial performance of the Canadian Space Agency (CSA) during the past year.

Following the Spending Authorities extracts, the main body of this Expenditure Plan is divided into four sections:

- "Section I — Executive Summary" summarizes key CSA plans, priorities and results achieved in serving Canadians.
- "Section II — Departmental Plan" presents CSA's objectives and plans, an overview of CSA, its seven business lines, the results expected of each business line, and information on the change-management issues affecting CSA.
- "Section III — Departmental Performance" describes CSA's performance, the results achieved by business lines, and the impact of this performance on plans for the future.
- "Section IV — Supplementary Information" provides further information on costs and resources, as well as special analyses to help the reader understand CSA's programs more fully.

The 1997–98 Expenditure Plan marks the beginning of CSA's transition to its new performance-management framework and associated performance-measurement approach. The framework will be refined during the year and fully applied in the 1998–99 Expenditure Plan.

This Expenditure Plan also reflects some adjustments to CSA's organization to improve its response to the challenges of the Canadian Space Program and the realities of international space business. These changes are explained in section II under "Organization and Program Composition."

Human resources are reported in employee full-time equivalents (FTEs). FTEs factor out the length of time that an employee works during each week by calculating the rate of assigned hours of work over scheduled hours of work.

Table of Contents

Section I
Executive Summary

The 1997–98 Part III of the Estimates — Expenditure Plan for the Canadian Space Agency (CSA) covers the CSA's plans and objectives into fiscal year 1999–2000 and details CSA accomplishments since 1995–96.

Worldwide, space activities are evolving at an accelerated pace. This is particularly true for satellite communications and remote sensing of the Earth, the two priority areas of the space program. Canada is prepared to take a forefront position in the "wired world" of the 21st-century global economy. Space science and technology are essential elements of the Agency's ability to improve the quality of life for Canadians and to create sustainable employment and economic growth. In the knowledge-based economy, the CSA also plays a key role in promoting and enhancing the Science and Technology culture in Canada and in using the unique appeal of space to attract young Canadians in choosing a career in science or engineering.

Objectives of the CSA are to develop and apply space science and technology to meet Canadian needs, and to foster an internationally competitive space industry. Since 1995–96, CSA has been working actively with the Canadian research community and the space industry to further define and implement the new thrusts that were given to the space program in 1994. In addition to launching and starting operation of RADARSAT I, Canada's first remote sensing satellite, the CSA successfully completed significant scientific work on phenomena related to the Earth's atmosphere; contributed to improving health care and diagnostics; and advanced the development and application of various innovative satellite technologies. Internally, the CSA has involved all staff in a major reorganization of its structure and has further developed its capability to track and report on achievements.

Between 1997–98 and 1999–2000, CSA will complete the integration and performance testing of the Mobile Servicing System for the International Space Station. It will also negotiate with the industry to build and operate RADARSAT II and its successors, and to develop a new generation of satellite-communications technologies with the private sector. The Agency will also prepare the next Long Term Space Plan, which will include proposals for new initiatives based on a 25-year outlook of domestic and international trends.

Section II
Departmental Plan

A. Summary of Departmental Plans and Priorities

The Canadian Space Agency (CSA) engages in five major activities in order to achieve its objectives. These activities are carried out by seven business lines

- Earth Observation
- Satellite Communications
- Canadian Space Station Program
- Canadian Astronaut Program
- Space Science
- Space Technology
- Executive and Horizontal Coordination

The objectives and priorities of each business line are summarized in Table II-1.

Objectives of the CSA

- Development and application of space S&T to meet Canadian needs
- Development of an internationally competitive space industry

Categories of Activities

- Effective management of Long Term Space Plan II
- Leadership in space research and development (R&D) for the benefit of Canadians and humanity
- Application of space knowledge to business development and technology transfer
- Related commercial and scientific activities
- Increased awareness of and education on the importance of space

The results relating to each business line are summarized in Table III-1.

Table II-1. Objectives and Priorities of the Business Lines

Abbreviations:

CO	**carbon monoxide**	**MOPITT**	**Measurement of Pollution in the Troposphere**
CSA	**Canadian Space Agency**	**MSS**	**Mobile Servicing System**
CSP	**Canadian Space Program**	**NASA**	**National Aeronautics and Space Administration**
DFL	**David Florida Laboratory**	**NSERC**	**Natural Sciences and Engineering Research Council of Canada**
ESA	**European Space Agency**	**SME**	**small- and m edium-scale enterprise**
LTSP II	**Long Term Space Plan II**	**S&T**	**science and technology**
MIM	**Microgravity Isolation Mount**		

Business lines						
Earth Observation	**Satellite Communications**	**Canadian Space Station Program**	**Canadian Astronaut Program**	**Space Science**	**Space Technology**	**Executive and Horizontal Coordination**
Objectives						
Ensure Canadian leadership in the international Earth-observation market; and meet Canadian environmental-monitoring and resource-manage ment needs	**Ensure that Cana-dians have access to new multi media, per-sonal, and mobile communica tions made possible by advanced satel lite com mu ni ca-tions; and maintain or expand Canadian industry's share of the international market for these new services**	**Enhance Canada's ability to operate in space and exploit the potential of space technologies, particularly auto-mation and robotics; and meet our commitments to the International Space Station Program**	**Train Canadian astronauts to participate in international human space flights; contribute to Canadian S&T experiments in space; and inspire Canadian youth to pursue careers in S&T**	**Ensure that Canada maintains a position of excellence in the worldwide scien tific exploration of space; and procure from Cana dian industry the instruments needed to obtain relevant scientific data**	**Ensure that Canada remains at the forefront of space-technology develop ment in preparation for Canada's future space programs; and enhance Canadian industry's internation al competitiveness through technology transfer and diffusion**	**Provide strategic direction, management and administrative support services to the CSA; and ensure the necessary cohesion of all CSP activities**

Table II-1. Objectives and Priorities of the Business Lines continued

Business lines						
Earth Observation	**Satellite Communucations**	**Canadian Space Station Program**	**Canadian Astronaut Program**	**Space Science**	**Space Technology**	**Executive and Horizontal Coordination**
Priorities						
● Negotiation and Implementation of an arrangement with a consortium of Canadian companies for the construction and operation of RADARSAT II that limits government commitment to $225M ● Development of a world-class, value-added remote-sensing industry ● Improved management of Canada's environment and natural resources through the use of Earth-observation satellite techno-logies ● Operation of RADARSAT I to generate royalty fees and develop applications ● Preparation for testing of RADARSAT II	● Negotiation and implementation of arrangements with Canadian satellite communications manufacturers and service providers for the development of the advanced technologies required to provide access to the upcoming satellite-based multimedia services for all Canadians ● Enhance the participation of Canadian companies in the international mega-projects	● Completion of the integration and performance testing of the MSS for the International Space Station in 1997–98 ● Delivery of the MSS to NASA in January 1998 ● Provision of environmental-test support for Canada's contribution to the International Space Station Program	● Testing of the Canadian MIM (an instrument designed to minimize the vibrations that affect fluids and material experiments in space) with Canadian astronaut Bjarni Tryggvason's flight aboard the shuttle in July 1997 ● Flight of Canadian astronaut Dave Williams with the Neurolab mission in March 1998	● Increased under-standing of space and atmospheric phenomena and resulting terrestrial effects through the development of MOPITT, to measure CO and methane in the atmosphere, and *Odin*, to measure atmospheric ozone, for launch in 1998–99 ● Improved health care and medical diagnostics and increased preven-tion of the health hazards of space flights, through space life experi-ments designed by Canadian scientists and carried out by our astronauts	● Enhanced techno-logical capabilities of the high-tech industry through strategic technology development and transfer ● Support for the competitiveness of Canadian space companies, consistent with the government's priority for jobs, growth, and international business development	● Enhanced S&T culture in Canada through the exploitation of space ● Effective management of LTSP II ● Review of LTSP II objectives and progress to accommodate new circumstances and opportunities ● Development of LTSP III ● Development of industrial alliances with European industry through Canada's participation in ESA programs ● Implementation of a commun-ications and awareness strategy ● Production and dissemination of a wide range of space information and resources across Canada ● Provision of financial assistance through NSERC ● Provision by DFL of environmental testing to a range of clients

B. Departmental Overview

1. Roles, Responsibilities and Mission

Canada's unique geographic and demographic character has inspired Canadians to adapt space S&T to meet our national needs. Canada has been involved in space activities to achieve the following concrete goals: to link Canadians from coast to coast, to enhance the management of our environment and natural resources, and to learn how phenomena in space affect life on Earth. The space industry is rapidly becoming a building block of the knowledge-based economy, providing the type of activities and high-quality jobs required in technologically advanced nations. This sector employs approximately 3000 persons in all regions of the country; it generates about $1 billion in sales of goods and services; and 45% of its manufacturing sales are exports.

Mandate

The legislated mandate of CSA, from the *Canadian Space Agency Act*, S.C. 1990, c. 13, is as follows:

> ... 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.

Mission

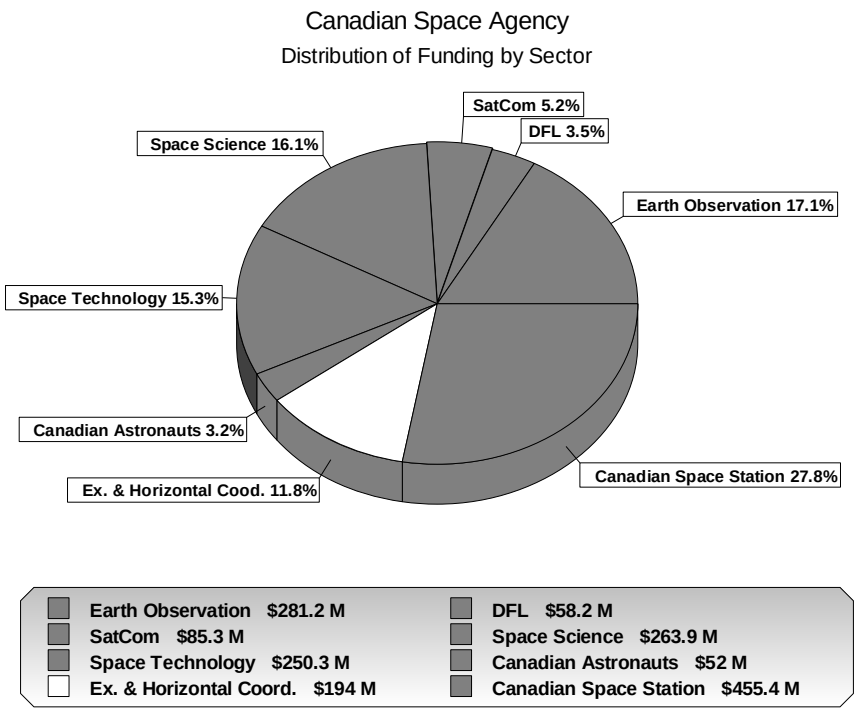
The Canadian Space Agency is committed to leading the development and applications of space knowledge for the benefit of Canadians and humanity.

To achieve this, CSA

- pursues excellence collectively;
- advocates a client-oriented attitude;
- supports employee-oriented practices and open communications;
- commits to both empowerment and accountability; and
- pledges to cooperate and work with partners to our mutual benefit.

Long Term Space Plan

The government has recognized the strategic importance of space as an important engine for social and economic progress in the 21st century. A new Canadian Space Program (CSP) was announced in June 1994 with the principal objectives of meeting Canadian needs and developing an internationally competitive space industry. The CSP also provided for a reduced role for Canada in the International Space Station Program. The CSP budget of $2.1 billion is over a ten-year period; to date, $1.6 billion has been allocated to the CSA and $457 million remains to be allocated.



Space Policy Framework

The government also approved a Space Policy Framework to guide the implementation of the LTSP II initiatives:

- Priority is to be given to the development and application of space technologies in the Earth Observation and Satellite Communications programs.
- Programming is to be designed to maximize the leverage of federal funding, through partnership with industry and the provinces, to ensure commercial success.
- Implementation of programs is to be open to more firms, particularly small- and medium-size enterprises (SMEs).
- Sustainable industrial regional development is to be pursued through the use of regional-distribution targets.
- Synergy between civil and defence space activities is to be encouraged to optimize the effectiveness of federal space funding.

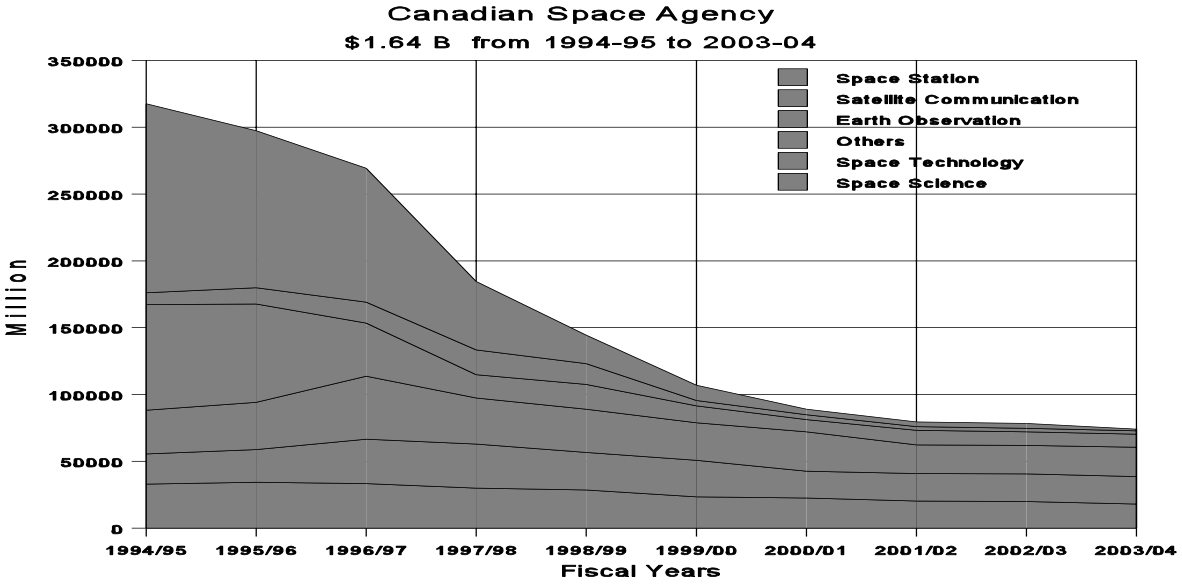
This policy framework provides an important role for industry in the management of the new Earth Observation and Satellite Communications programs. This increase in private sector participation is expected to make the technology developments more in tune with the real needs of Canadians. It will also encourage companies to further commercialize these technologies.

S&T Strategy and the Jobs and Growth Agenda

CSP is also influenced by government-wide initiatives such as Program Reviews, the new National Strategy for Science and Technology (National S&T Strategy), the Jobs and Growth Agenda, the Youth Initiative, and the Quality Service Initiative. CSA will help realize the goals of the National S&T Strategy, particularly with respect to job creation and economic growth, in the following ways:

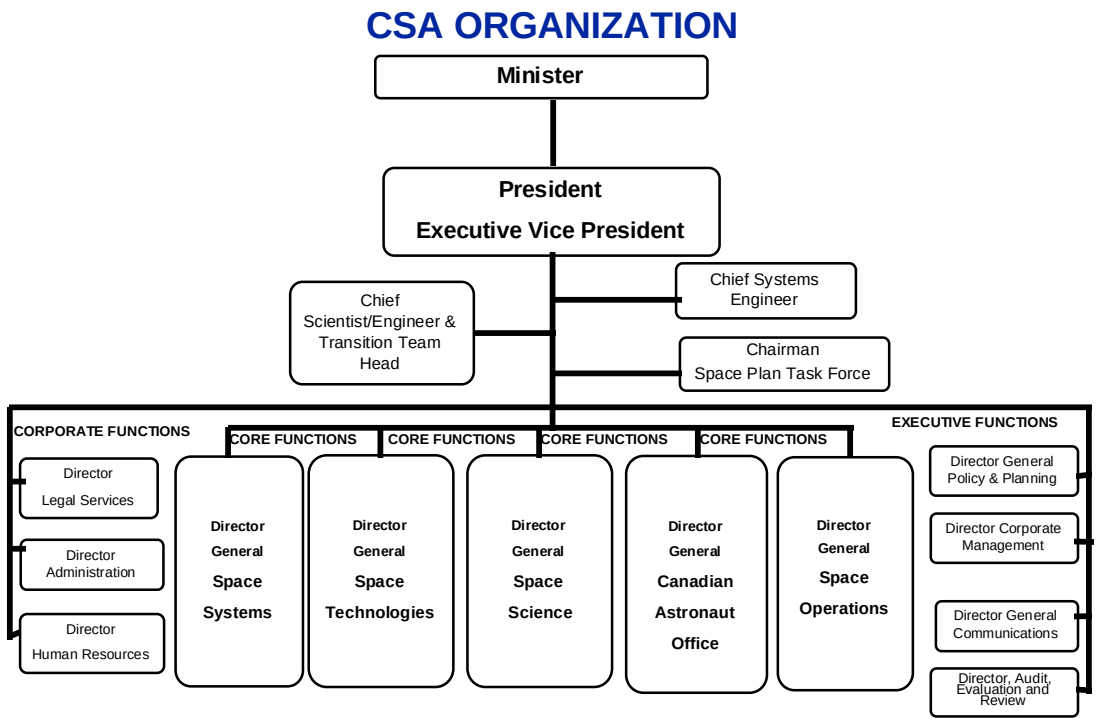
- by enhancing the technological capabilities of SMEs;
- by carrying out initiatives to support the international marketing efforts of Canadian space companies and to support sustainable regional industrial development;
- by implementing a country-wide communications and space-awareness campaign to take advantage of the unique appeal of space; and
- by partnering with the other organizations in the Industry Portfolio to implement the government S&T action plan.

As illustrated in the diagram below, CSA funding will continue to decline as the LTSP II initiatives move to completion by the turn of the century. Because it takes a long time to develop space proposals responding to government thrusts and Canadian needs, CSA has started looking for ideas for a new LTSP. These new program proposals will be inspired by a 25-year space outlook based on domestic and international trends.



Consistent with the new Government Expenditure Management System, the CSA may request adjustments to plans set out in this document to reflect changing circumstances. Among others, potential program adjustments could be requested following decisions such as whether to manufacture the Special Purpose Dexterous Manipulator for Space Station; continue to invest in microgravity research and renew Canada's partnership with the European Space Agency.

2. Organization and Program Composition



CSA has revised its organizational and decision-making structures to improve their ability to contribute to government objectives and strategies and to improve coordination with central agencies and other departments.

Reporting to the Minister of Industry, the Chief Executive Officer of CSA is the President, who is supported by an Executive Vice-President. The President and Executive Vice-President are also supported by the Chief Scientist/Engineer; the Chief Systems Engineer; and the Chair of the Space Plan Task Force. Under the President and Executive Vice-President, there are three areas of responsibility: core, executive and corporate functions.

The core functions are carried out by the following directorates and business lines: Space Systems, which provides project-management and engineering services; Space Technologies; Space Science; Canadian Astronaut Office; and Space Operations, which provides an environmental test facility (the David Florida Laboratory) and operates the space and ground segments of CSA's space-related assets. This includes the Radarsat I Ground Station and Satellite. The core functions are responsible for meeting the technical mandate of the Agency (e.g. delivery of major programs, developing technologies, scientific knowledge).

The reorganization of CSA strengthened its executive and horizontal functions and improved the decision-making process. The executive functions are carried out by the following directorates: Policy and Planning; Corporate Management; Communications; and Audit, Evaluation and Review. Horizontal functions are delivered by the following directorates: Legal Services; Administration; and Human Resources.

CSA's programs and activities are structured around its business lines, identified on page 2.

The relation between these business lines and the organization is shown in Appendix 1.

3. Corporate Objectives and Priorities

Objectives

The government has recognized the strategic importance of space in the creation of a knowledge-based economy in Canada. A CSP for 1994–95 to 2003–04 was announced in June 1994, with the following principal objectives:

- to develop and apply space S&T to meet Canadian needs; and
- to develop an internationally competitive space industry.

Priorities

The priorities that CSA expects to achieve during the 1997–98 to 1999–2000 planning period appear under the five major categories of activities, shown below:

1. Effective management of LTSP II

   - Review of LTSP II objectives and progress to recommend to Cabinet mid-course adjustments to accommodate new circumstances and opportunities
     (Executive and Horizontal Coordination)
   - Support for the competitiveness of Canadian space companies, consistent with the government's priority for jobs, growth and international business development
     (Space Technology)
   - Implementation of recommendations arising from the evaluation of the benefits and management of Canada–European Space Agency (ESA) cooperation
     (Executive and Horizontal Coordination)

2. Leadership in space R&D for the benefit of Canadians and humanity

   - Increased understanding of space and atmospheric phenomena and resulting terrestrial effects through the development of two instruments: MOPITT (Measurement of Pollution in the Troposphere) for measuring carbon monoxide and methane in the troposphere, and Sweden's *Odin* satellite, for measuring atmospheric ozone, for launch in 1998–99
     (Space Science)
   - Improvements in health care and medical diagnostics and increased prevention of health hazards of space flight through space life experiments developed by Canadian scientists and carried out by our astronauts
     (Space Science)
   - Enhanced technological capabilities of the high-tech industry through strategic technology development and transfer
     (Space Science; Space Technology)

- Completion of the integration and performance testing of the Mobile Servicing System (MSS) for the International Space Station in 1997–98 and delivery of the MSS to the National Aeronautics and Space Administration (NASA) in December 1997

  (Canadian Space Station Program)

3. Application of space knowledge to business development and technology transfer

- Negotiation and implementation of arrangements with a consortium of Canadian companies and other parties aimed at the successful exploitation of the world market in Earth observation (radar satellite imaging through the construction and operation of RADARSAT II)

  (Earth Observation)

- Development of a world-class, value-added remote-sensing industry to take advantage of opportunities in the international marketplace through the assistance provided to SMEs for the development of applications based on satellite data

  (Earth Observation)

- Improved management of Canada's environment and natural resources through the use of Earth-observation satellite technologies and data

  (Earth Observation)

- Negotiations and implementation of arrangements with Canadian satellite communications manufacturers and service providers for the development of the advanced technologies required to provide access to the new satellite-based multimedia services for all Canadians

  (Satellite Communications)

- Strategic development of industrial alliances with European industry through Canada's participation in ESA programs

  (All business lines)

4. Related commercial and scientific activities

- Continued operations of David Florida Laboratory (DFL) as a world-class facility for the assembly and testing of space-based hardware, from domestic and foreign space industries and agencies

  (All business lines)

- Testing of the Canadian Microgravity Isolation Mount (MIM) — an instrument designed to minimize the vibrations that affect fluids and material experiments in space — with Canadian astronaut Bjarni Tryggvason's flight aboard the space shuttle in July 1997

  (Canadian Astronaut Program)

- Flight of Canadian astronaut Dave Williams with the Neurolab mission, scheduled for March 1998

  (Canadian Astronaut Program)

- Operation of RADARSAT I to generate royalty fees and develop related applications

  (Earth Observation)

5. Increased awareness of and education on the importance of space

- Enhanced S&T culture in Canada through exploitation of the unique appeal of space
  (Executive and Horizontal Coordination)

- Production and dissemination of a wide range of space information and resources to teachers, students and the public through a network of Space Resources Centres in the five main geographic regions of Canada
  (Executive and Horizontal Coordination)

- Provision of financial assistance, in cooperation with the Natural Sciences and Engineering Research Council of Canada (NSERC), to graduate students in space science and engineering
  (Executive and Horizontal Coordination)

4. Resource Plans and Financial Tables

With about 350 employees, CSA is a relatively small organization. More than 85% of its funding is contracted out to Canadian industry and scientific organizations. CSA does not have a significant A-Base, and most of its programming and financing have been established through periodic LTSPs approved by Cabinet.

The overall CSA funding profile is shown under "Spending Authorities," below.

Spending Authorities

Authorities for 1997–98 — Part II of the Estimates

Figure 1
Financial Requirements by Authority

Vote	(thousands of dollars)	**1997–98 Main Estimates**	**1996–97 Main Estimates**
	Canadian Space Agency		
30	Operating expenditures	**47,614**	48,772
35	Capital expenditures	**96,909**	135,392
40	Grants and contributions	**36,327**	39,590
(S)	Contributions to employee benefit plans	**3,687**	3,169
	Total Agency	**184,537**	226,923

Figure 2
Votes — Wording and Amounts

Vote	(thousands of dollars)	1997–98 Main Estimates
	Canadian Space Agency	
30	Canadian Space Agency — Operating expenditures	**47,614**
35	Canadian Space Agency — Capital expenditures	**96,909**
40	Canadian Space Agency — Grants listed in the Estimates and contributions	**36,327**

Figure 3
Departmental Planned Resource Levels

(thousands of dollars)	Main Estimates [1] 1996–97	**Main Estimates 1997–98**	**Planned 1998–99**	**Planned 1999-2000**
Operating expenditures [2]	50,993	**50,237**	48,290	44,207
Gross capital expenditures [2]	144,940	**105,376**	82,170	65,060
Revenue credited to the Vote	(8,600)	**(7,403)**	(14,700)	(16,400)
Grants and contributions	39,590	**36,327**	28,609	14,103
Total Main Estimates	**226,923**	**184,537**	**144,369**	**106,970**

(1) Does not reflect Supplementary Estimates. Includes Main Estimates only.
(2) Includes Contributions to employee benefit plans.

Figure 4
Departmental Overview

(thousands of dollars)	Main Estimates [1] 1996–97	**Main Estimates 1997–98**	**Planned 1998–99**	**Planned 1999–2000**
Gross Estimates	235,523	**191,940**	159,069	123,370
Revenue credited to the Vote	(8,600)	**(7,403)**	(14,700)	(16,400)
Total Main Estimates	**226,923**	**184,537**	**144,369**	**106,970**
Revenue credited to the Consolidated Revenue Fund	(391)	**(428)**	(435)	(442)
Estimated cost of services by other departments	1,569	**1,554**	Not available	
Net Cost of the Department	**228,101**	**185,663**	**143,934**	**106,528**

(1) Does not reflect Supplementary Estimates. Includes Main Estimates only.

Figure 5
Net Cost of the Program by Business Line

(thousands of dollars)	1997–98 Main Estimates					
	Operating [1]	Capital [1]	Grants and Contributions	Gross Expenditures	Less: Revenues Credited to the Vote	Total Main Estimates
Business Lines						
Earth Observation	1,013	18,781	11,190	30,984	7,403	23,581
Satellite Communications	6,834	2,500	15,577	24,911	—	24,911
Canadian Space Station Program	96	51,121	0	51,217	—	51,217
Canadian Astronaut Program	6,775	0	0	6,775	—	6,775
Space Science	3,279	26,429	150	29,858	—	29,858
Space Technology	13,504	6,124	9,034	28,662	—	28,662
Executive and Horizontal Coordination	18,736	421	376	19,533	—	19,533
	50,237	**105,376**	**36,327**	**191,940**	**7,403**	**184,537**
Other Revenues and Expenditures						
Revenue credited to the Consolidated Revenue Fund						(428)
Estimated cost of services provided without charge by other government departments						1,554
Net Cost of the Program						**185,663**

(1) Includes contributions to employee benefit plans.

Figure 6
Appropriated Planned Spending by Business Line

(thousands of dollars)	Main Estimates[1] 1996–97	Main Estimates 1997–98	Planned 1998–99	Planned 1999–2000
Business Lines				
[1]Earth Observation	51,325	30,984	37,729	33,176
[2]Satellite Communications	14,889	24,911	21,732	8,746
[3]Canadian Space Station Program	85,858	51,217	21,308	11,480
Canadian Astronaut Program	8,783	6,775	6,705	4,690
[4]Space Science	33,464	29,858	28,382	23,296
Space Technology	23,566	28,662	24,906	24,357
[5]Executive and Horizontal Coordination	17,638	19,533	18,307	17,625
Subtotal	**235,523**	**191,940**	**159,069**	**123,370**
Less: Revenue credited to the Vote	**(8,600)**	**(7,403)**	**(14,700)**	**(16,400)**
Total	**226,923**	**184,537**	**144,369**	**106,970**

(1) Does not reflect Supplementary Estimates. Includes Main Estimates only.

1 The drop is explained by Radarsat I satellite operations being increasingly funded by our royalties on sales of data and a reduction in ESA Earth Observation Activities

2 Increase is due to an additional ESA Communications/related activities

3 Canadian Space Station decrease in levels reflect the Space Station Manufacturing Effort completion

4 $2.6M decrease due to a reduction in the Microgravity Science Program Activity and to accommodate the revised schedules of scientific instruments

5 Increase is due to the regrouping of the support and administrative functions previously in the Core Programs

C. Details by Business Line

1. Earth Observation

Objectives

- To ensure Canadian leadership in the emerging international Earth-observation market
- To meet Canadian environmental-monitoring and resource-management needs

Operating Context and Key Initiatives

Working with the private sector and other domestic and international partners, the Earth Observation business line focuses on the provision of Earth-observation data and the development and application of Canadian space and ground technology to meet Canadian and international needs, particularly in the areas of environmental monitoring and resource management.

The Earth Observation Program achieves its objectives through the following elements:

- RADARSAT I operations;
- RADARSAT II development;
- synthetic aperture radar (SAR) technology development;
- ground infrastructure; and
- applications development and technology transfer.

The overall strategy is to progressively transfer Canada's unique expertise in this area to the private sector and to ensure its commercial success by encouraging development of worldwide applications and sales of data and data products. Strategies related to specific elements include the following:

- ensuring that RADARSAT I continues to supply valuable, timely data to program partners, including federal user departments and agencies such as the Ice Services Branch of Environment Canada; provincial governments; and RADARSAT International Inc. (RSI), the private-sector company that sells RADARSAT data worldwide and pays royalties to the government;
- implementing the Earth Observation Program (ground infrastructure and applications development and technology transfer components), in cooperation with the Canada Centre for Remote Sensing (CCRS), to
  - develop applications for Earth-observation data, especially radar-satellite data, in areas with greatest market potential,
  - develop a strong Canadian Earth-observation value-added industry, and

- maximize returns on public investment in Earth-observation infrastructures through partnerships with other federal institutions and the provinces to increase leverage of funds and effective use of RADARSAT data;

- implementing, with industry and international partners, the RADARSAT II to ensure the commercial viability of the RADARSAT family of satellites; and

- identifying areas where CSA could cooperate with the Department of National Defence (DND) on communications technology and infrastructure development.

Change-Management Issues

Implementation of the Earth Observation strategies and activities could be hindered by several challenges, including the following:

- RADARSAT commercial data sales may not generate a royalty revenue stream in line with expectations from the operations of RADARSAT I; and

- concluding a partnership agreement with all parties on RADARSAT II that ensures Canada will continue to successfully exploit this new emerging international market may be difficult.

Results Expectations

- **Development of the Canadian remote-sensing industry (exploiting data from RADARSAT I) and partnerships with the private sector for Earth observations**

- Increased Canadian awareness of space S&T and applications for industry and society

- Research opportunities for students in space S&T

- Space hardware qualified by the DFL, a world-class facility for assembly and environmental testing.

The intended effects of the Earth Observation Program are new international market niches for Canadian companies, solutions for resource-management problems, knowledge of land and waters, commercial activity, and employment.

In 1997–98, the development component of the Earth Observation business line will

- see the beginning of the private-sector management of Canada's remote-sensing business and the procurement of RADARSAT II; and

- continue the Earth Observation Support Program (to upgrade ground infrastructure, develop applications, and promote the value-added industry).

The operations component of the Earth Observation business line operates the RADARSAT I satellite from the Mission Control Centre in Saint-Hubert. In 1997–98, the operations component will

- control the operational phase of the satellite;
- support commercial and government use of RADARSAT I data; and
- provide data for R&D applications.

Comparative Financial Plan

Figure 7
Appropriated Planned Spending — **EARTH OBSERVATION**

(thousands of dollars)	Main Estimates [1] 1996–97	**Main Estimates 1997–98**	**Planned 1998–99**	**Planned 1999–2000**
Service Lines / Sub-Activities				
RADARSAT I operations	12,054	**1,163**	13,606	14,469
RADARSAT II development	5,100	**0**	1,814	1,300
Synthetic Aperture Radar technology development (SAR)	300	**0**	0	0
Ground infrastructures	4,100	**4,482**	4,432	3,580
Applications development and technology transfer	11,023	**13,285**	8,790	8,113
European Space Agency Earth observation	18,475	**11,190**	8,480	5,298
David Florida Laboratory	273	**864**	607	416
Subtotal	**51,325**	**30,984**	**37,729**	**33,176**
Less: Revenue credited to the Vote	(8,600)	**(7,403)**	(14,700)	(16,400)
Total	**42,725**	**23,581**	**23,029**	**16,776**

(1) Does not reflect Supplementary Estimates. Includes Main Estimates only.

2. Satellite Communications

Objectives

- To maintain or expand Canadian industry's share of the growing international market for these new services
- To ensure that Canadians have access to new multimedia, personal, and mobile communications services made possible by advanced satellite communications technologies

Operating Context and Key Initiatives

In partnership with the private sector, the Satellite Communications business line develops satellite-communications technologies and services for Canadian needs while maintaining or expanding Canadian industry's share of this growing international market.

The business line includes the following major program elements:

- Advanced Satellite Communications Initiative; and
- International Mobile Initiative.

The overall strategy of the Satellite Communications business line is to negotiate arrangements with the Canadian telecommunications industry for the development of technologies and systems that will give all Canadians access to advanced communications services; and to help our industry maintain or develop niches in the international markets. Strategies related to program elements include the following:

- negotiating co-funded arrangements with the private sector to design user-driven and industry-led Advanced Satellite Communications and International Mobile initiatives;
- establishing program-implementation arrangements that optimize synergies CSA, Communications Research Centres (CRCs) and industry and are cost effective; and
- identifying areas where CSA could cooperate with DND on communications technology and infrastructure development.

Change-Management Issues

In achieving the Satellite Communications business-line results, CSA and the CRCs (Industry Canada) face the following challenges:

- difficulties in forming satisfactory partnerships with industry;
- limitations on the ways global or regional satellite services may be provided, until international telecommunications policies change, under the World Trade Organization;
- hindrances to the development of space-satellite service delivery arising from the regulations that govern broadcasting and telecommunications; and
- difficulties safeguarding Canadian manufacturing interest while implementing new satellite-communications-based services.

Results Expectations

- **Development of satellite-communications technologies and services to meet Canadian needs (e.g., equitable access to bandwidth-on-demand services in all parts of Canada**
- Increased Canadian awareness of space S&T and applications for industry and society
- Research opportunities for students in space S&T
- Space hardware qualified by the DFL, a world-class facility for assembly and environmental testing.

Satellite communications is the most mature space technology application and has the greatest potential for immediate economic return. This business line will ensure that Canadians continue to benefit from services provided by advanced space technologies and that Canadian industry maintains or expands its share of the expanding international market for these new services and products.

In 1997–98, the Satellite Communications business line will continue the following:

- the implementation phase of the Advanced Satellite Communications Initiative; and
- the second phase of an Advanced Satellite Communications project (onboard processing) with ESA.

Comparative Financial Plan

Figure 8
Appropriated Planned Spending — **SATELLITE COMMUNICATIONS**

(thousands of dollars)	Main Estimates [1] 1996–97	**Main Estimates 1997–98**	**Planned 1998–99**	**Planned 1999–2000**
Service Lines / Sub-Activities				
Advanced Satellite Communications Initiative	0	**0**	0	0
International Mobile Initiative	3,396	**2,997**	2,997	2,697
European Space Agency Satellite Communications	10,398	**15,577**	12,544	1,358
David Florida Laboratory	1,095	**6,337**	6,191	4,691
Total	**14,889**	**24,911**	**21,732**	**8,746**

(1) Does not reflect Supplementary Estimates. Includes Main Estimates only.

3. Canadian Space Station Program

Objectives

- To enhance Canada's ability to operate in space and exploit the potential of space technologies, particularly automation and robotics
- To meet our commitments to the International Space Station Program

Operating Context and Key Initiatives

The Canadian Space Station Program business line will ensure that Canadians benefit from their investment in space robotics and from Canada's access to the International Space Station and that CSA meets its commitments to its international partners.

The program elements of the Canadian Space Station Program business line are the following:

- MSS development;
- MSS operations and utilization;
- SPDM design; and
- Strategic Technologies for Automation and Robotics (STEAR).

The overall strategy is to maximize Canadian industry's participation in a large, international, cooperative S&T program and in the development and operation of advanced space robotics; to plan for the use of the Space Station by Canadian scientists; and to meet our commitments to our International Space Station partners.

Strategies related to specific elements include the following:

- managing the Canadian industrial team so that it completes the development of the MSS on time and within budget and managing the changing interfaces agreed to by NASA and CSA in June 1994;
- shifting the primary focus within CSA and in Canadian industry from space-system development to ground-segment and operation activities;
- ensuring that the division of responsibilities between CSA and NASA allows Canada to maximize the benefits from its participation in this international program;
- working with the private sector to assess options for the manufacturing of the Special Purpose Dextrous Manipulator (SPDM) in Canada; and
- negotiating in-kind arrangements with international partners to keep down the cost of using Canada's share of Space Station resources.

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- negotiating in-kind arrangements with international partners to keep down the cost of using Canada's share of Space Station resources.

Change-Management Issues

Design and schedule changes to the International Space Station will produce requests for modifications to the MSS. CSA must keep these modifications to a minimum and ensure that they do not increase the costs of MSS development and operations.

Integration and testing (especially human rating, system components, technical interfaces, and on-orbit performance) of the MSS may reveal problems that affect the schedule and cost. CSA is working to minimize these effects through simulation and analysis of as many on-orbit conditions as practical and by tailoring management agreements specifically to limit risk.

The Space Station agreement with the United States gives Canada until 31 March 1997 to decide whether to build the SPDM. The CSA has begun discussions with its industrial and governmental partners to assess Canada's options in this area.

The prime contract for MSS Phase D1 (manufacturing and testing) has been amended so that the scope of work for the Space Station Remote Manipulator System (SSRMS) and the Mobile Base System (MBS) covers on-orbit commissioning, to better reflect Canada's commitment in this area.

Results Expectations

- **Completion of MSS and other obligations to the International Space Station Program**
- **Economic benefits (e.g., employment, regionally distributed industrial activity) of investments in space technologies**
- Increased Canadian awareness of space S&T and applications for industry and society
- Research opportunities for students in space S&T
- Space hardware qualified by the DFL, a world-class centre for assembly and environmental testing.

CSA is committed to delivering the first part of the MSS (the SSRMS) to NASA in January 1998 to meet a launch deadline of January 1999. The remainder of the MSS (the MBS) is scheduled for launch in August 1999.

Successful on-orbit checkout of the MSS, under the control and support of the MSS Operations Complex in Saint-Hubert, is expected to boost the visibility of Canadian space-robotics technology and demonstrate Canada's ability to deliver and operate turnkey robotic solutions. The long-term benefits of this business-line item include substantial export sales, employment, and sustainable development in all regions of Canada.

Gaining experience in the operations of such a sophisticated space system, along with successful demonstration of the capability of the space and ground systems of the MSS, is the key to Canada realizing the longer-term economic benefits from this business line item. These goals can be succinctly stated as achieving a $5.5 billion return on a $1.2 billion investment, mostly achieved through spin-off and diffusion, as well as 60 000 person–years employment for Canadians in all economic regions of the country.

Consistent with, and building on, the performance items described above, in 1997–98 the business line will

- perform the acceptance review of the SSRMS and MBS;
- support a validation flight for the Canadian Space Vision Program;
- implement the MSS Operations Complex in Saint-Hubert, Quebec.

The CSA will be working with its partners to assess options that would allow Canada to manufacture the SPDM, a "next-generation" robotic system that would ensure that Canada retains its position as the leader in the space-robotics niche as one of the principle activities of the business line.

Comparative Financial Plan

Figure 9
Appropriated Planned Spending — **CANADIAN SPACE STATION PROGRAM**

(thousands of dollars)	Main Estimates [1] 1996–97	**Main Estimates 1997–98**	**Planned 1998–99**	**Planned 1999–2000**
Service Lines / Sub-Activities				
Mobile Servicing System Development	53,046	**35,665**	12,062	5,171
Mobile Servicing System Operations	21,156	**15,456**	9,160	6,239
Strategic Technologies for Automation and Robotics	5,266	—	—	—
David Florida Laboratory	6,390	**96**	86	70
Total	**85,858**	**51,217**	**21,308**	**11,480**

(1) Does not reflect Supplementary Estimates. Includes Main Estimates only.

4. Canadian Astronaut Program

Objectives

- To train Canadian astronauts to participate in international human space flights
- To contribute to Canadian S&T experiments in space
- To inspire Canadian youth to pursue careers in S&T

Operating Context and Key Initiatives

The Canadian Astronaut Program business line ensures that Canadians, particularly those in the scientific community, benefit from participating in human flight in space and that CSA maintains an astronaut corps that can respond to Canadian needs in human space-based operations.

The Canadian Astronaut Program has the following elements:

- crew training for space missions;
- integration of scientific and technical payloads for flight; and
- space awareness.

The overall strategy aims at ensuring that Canadian astronauts support shuttle operations and Space Station assembly and operations, while providing access to space to Canadian industry and researchers.

Strategies related to specific elements include the following:

- to ensure that Canada retains a prominent role in space-robotic-system operations and training through negotiations on the division of responsibilities between NASA and CSA;
- to inspire youth to pursue careers in S&T; and
- to inform the public of the benefits of space activities, by capitalizing on the intense public interest in human space flight.

Change-Management Issues

Because of the time and resources required to prepare for shuttle missions, the high number of astronaut flights offered by NASA in the coming years will make it difficult to take full advantage of the S&T opportunities provided by these flights. CSA will work with industry and the Canadian research community to maximize the benefits of astronaut missions.

Results Expectations

- **Participation of several Canadian astronauts in space flights, with increased opportunities for research in space**
- Increased Canadian awareness of space S&T and applications for industry and society
- Research opportunities for students in space S&T
- Space hardware qualified by the DFL, a world-class facility for assembly and environmental testing.

The intended effects of the program are contributions to high-technology-systems development for space and Earth applications, microgravity research in life and material sciences, a better-informed public, and the enhancement of the international prestige of the CSP.

The performance indicators are the international and national prestige of Canadian astronauts; assessments of the astronauts' research contributions; delivery of project products on budget and on time; and changes in public awareness and perception of space S&T.

In 1997–98 the Canadian Astronaut Program will

- test the Canadian MIM on Bjarni Tryggvason's flight aboard the shuttle in July 1997; and
- participate on a Neurolab mission (astronaut Dave Williams) in March 1998.

Comparative Financial Plan

Figure 10
Appropriated Planned Spending **CANADIAN ASTRONAUT PROGRAM**

(thousands of dollars)	Main Estimates [1] 1996–97	**Main Estimates 1997–98**	**Planned 1998–99**	**Planned 1999–2000**
Service Lines / Sub-Activities				
Canadian Astronaut Program	8,509	**6,679**	6,619	4,621
David Florida Laboratory	274	**96**	86	69
Total	**8,783**	**6,775**	**6,705**	**4,690**

(1) Does not reflect Supplementary Estimates. Includes Main Estimates only.

5. Space Science

Objectives

- To ensure that Canada maintains a position of excellence in the worldwide scientific exploration of space
- To procure from Canadian industry the instruments needed to obtain relevant scientific data

Operating Context and Key Initiatives

On behalf of the Canadian space science community, the Space Science business line procures scientific instruments from Canadian industry and arranges for their deployment, operation and use in obtaining scientific data relevant to Canadian needs.

Space Science supports the participation of Canadian scientists through the following initiatives:

- Solar Terrestrial Relations;
- Atmospheric Chemistry and Physics;
- Astronomy;
- Space Life Sciences;
- Microgravity Sciences; and
- the Scientific Satellite Program (SCISAT).

Advisory committees with both scientific and industrial members have been established to serve these program elements.

To achieve these benefits for the scientific community and our space industry, Space Science will implement the following strategies:

- continuing international science cooperation with Canada's traditional partners and other nations (NASA, Russian Federation, Japan, Sweden, Finland, France, Italy and Australia) to improve funding leverage and increase access to scientific data;
- issuing and responding to a Canadian and international system of announcements of opportunity to ensure the widest possible participation in scientific ventures of interest to Canada;
- using peer review to ensure that the best proposals are chosen to meet Canada's space science needs; and
- exploiting the advanced R&D capabilities of Canadian industry, especially SMEs, and facilitating technology transfer from the universities to help Canadian companies become commercially competitive.

Change-Management Issues

The Space Science business line has a portfolio of more than 50 projects, almost all of which are international. The management of these international interfaces is difficult and costly; in most cases, the host agency sets the priorities and schedules. Developing complex scientific instruments under such circumstances is extremely risky and requires a flexible approach to cash flow and funding.

Funding for the Microgravity Science and Space Life Sciences programs terminates in 1998–99; therefore, the effectiveness of these programs must be proven if they are to be funded again.

Results Expectations

- **Increased understanding of space phenomena; avoidance of resulting terrestrial effects; improvement in atmospheric circulation models; increased understanding of pollution**
- **Prevention of health hazards of space flight; development of medical and material-processing improvements (e.g., diagnostics, health care)**
- **Improved capabilities of SMEs to develop and use space technologies**
- Increased Canadian awareness of space S&T and applications for industry and society
- Space hardware qualified by the DFL, a world-class facility for assembly and environmental testing.

The following are the intended effects of the business line:

- the advancement of knowledge;
- the development of highly qualified personnel;
- the application of research results; and
- the development of technologies, products and spin-offs.

The performance indicators for the Space Science business line are the following:

- the number, size and diversity of the experiments flown;
- the effectiveness of management in relation to the number of launches and the achievement of major milestones within available funding;
- the program's scientific output in terms of the number of scientific papers published in prestigious national and international scientific journals;
- the program's prestige and recognition in terms of acceptance of Canadian proposals in international missions; and
- the extent of technological and other benefits obtained, which include improvements in the regional distribution of government contracts.

In 1997–98, the Space Science business line will

- continue with operations of the Ultraviolet Auroral Imager on the Russian *Interball* satellite, the WINDII [Wind Imaging Interferometer] instrument on the NASA Upper-Atmospheric Research Satellite, and the Suprathermal Ion Mass Spectrometer (SMS) and the data reception of the Japanese *Akebono* satellite;
- further define the Canadian-led cooperative scientific-satellite missions with NASA;
- participate in the Japanese Very Long Baseline Interferometer Space Observation Project (VSOP);
- deliver the Optical Spectrograph and Infrared Imaging System (OSIRIS) to Sweden for integration with the *Odin* satellite, which is scheduled to be launched in early 1998;
- launch the Canadian Protein Crystallization Experiment to *Mir*, while continuing the operations of the MIM and Queen's University Experiment on Liquid Diffusion (QUELD) facilities;
- deliver the Thermal Plasma Analyser (TPA) to Japan for integration with the *Planet-B* spacecraft for the mission to Mars in 1998;
- deliver the MOPITT instrument to NASA for integration with the AM-1 spacecraft for the launch in June 1998; and

- deliver the Fine Error Sensor of the Far Ultraviolet Spectroscopic Explorer (FUSE) instrument for the *FUSE* satellite, to be launched in late 1998.

Comparative Financial Plan

Figure 11
Appropriated Planned Spending — **SPACE SCIENCE**

(thousands of dollars)	Main Estimates [1] 1996–97	**Main Estimates 1997–98**	**Planned 1998–99**	**Planned 1999–2000**
Service Lines / Sub-Activities				
Solar Terrestrial Relations	7,840	**7,098**	5,584	6,248
Atmospheric Chemistry and Physics	6,643	**6,248**	6,732	3,855
Astronomy	7,352	**7,394**	3,274	2,406
Space Life Sciences	2,795	**2,594**	2,444	0
Microgravity Science	6,207	**4,988**	3,248	0
Scientific Satellite Programs	1,988	**1,344**	7,014	10,649
David Florida Laboratory	639	**192**	86	138
Total	**33,464**	**29,858**	**28,382**	**23,296**

(1) Does not reflect Supplementary Estimates. Includes Main Estimates only.

6. Space Technology

Objectives

- To ensure that Canada remains at the forefront of space-technology development in preparation for Canada's future space programs
- To enhance Canadian industry's international competitiveness through technology transfer and diffusion

Operating Context and Key Initiatives

The Space Technology business line provides the resources and the technical expertise needed to introduce new technologies to Canadian industrial products and services.

The Space Technology business line consists of the following initiatives:

- Generic Technology Development;
- Strategic Technology Development;
- Participation in the Earth-observation, Communications, and other programs of ESA; and

- Diffusion and commercial exploitation of space technologies.

The following strategies are designed to ensure the continued success in the Space Technology business line:

- continue focusing technology-development projects on long-term needs and selected niche-market areas;
- develop partnership arrangements to lever funding;
- develop a systematic approach for transferring space technologies to non-space applications;
- increase participation of SMEs in the Space Technology program;
- closely coordinate R&D activities sponsored through ESA participation with those performed in house and contracted out; and
- manage participation in ESA and other contracting-out programs so as to maximize long-term Canadian exports of products and services.

Change-Management Issues

The Space Technology business line will face a number of challenges in implementing its strategic initiatives over the planning period:

- maintaining Canada's competitive advantage in the face of increased world competition resulting from consolidation and entry of defence-industry companies in the civilian market;
- maintaining international-partnership benefits as Canada's partner countries focus more on internal programs; and
- supporting Canada's penetration of the emerging Asian market.

Results Expectations

- **Economic benefits (e.g., employment, regionally distributed industrial activity) of investments in space technologies**
- **Enhanced Canadian R&D and industrial capability through development of application-oriented technologies**
- **Improved technical capabilities and revenues throughout the Canadian high-tech industry**
- **Improved adoption, adaptation, development, diffusion and direction of technology in Canadian industry**
- Increased Canadian awareness of space S&T and applications for industry and society
- Research opportunities for students in space S&T
- Improved skill sets for industry
- Operation of DFL as a world-class facility for assembly and testing of space-based hardware

The intended effects of the Space Technology program are applied research results; a competitive space industry; non-space spin-offs; and highly qualified personnel in the space industry.

To measure its effectiveness, the program uses six general indicators:

- scientific productivity measured by the number of inventions, technical communiques through technical papers, and workshops;
- performance of the space industry measured by exports;
- satisfaction of the Space Technology program's clientele;
- degree of co-funding and partnership with other industrial and departmental stakeholders;
- number and funding level of projects for SMEs; and
- industrial return from the ESA program.

The main benefits that flow from investments in space-technology development fall into the following categories:

- direct support to application-oriented missions, with resulting benefits to the scientific, technical or industrial users;
- industrial benefits to the participating Canadian space companies that are given the opportunity to supply components, systems and services to meet Canadian space needs and capture export sales;

- improved technical capabilities and revenues throughout the Canadian high-technology industry;

- industrial benefits through diffusion of space S&T to non-space applications;

- international alliances established as a result of Canada's participation in ESA programs and the International Cooperation Program, resulting in greater export opportunities; and

- research opportunities for students interested in space S&T.

In 1997–98 the Space Technology business line will

- implement the first wave of contracts for the General Support Technology Program (GSTP-2), including in-orbit demonstration of Canadian technologies such as radiation monitor and tethers;

- start negotiations with ESA with regard to a possible renewal of the current 10-year cooperation agreement, which expires at the end of 1998;

- demonstrate sea and land applications of the ESA MERIS payload;

- demonstrate the feasibility of space-based Lidars for atmospheric measurements;

- develop and demonstrate key technologies for small satellites, such as attitude sensors and simulation, command and data-handling systems;

- continue to develop smart structures, advanced materials, spacecraft structural qualification and test technologies, robotic force-reflecting hand controllers, tether technologies, robot dynamic characterization, and teleoperation;

- develop multimedia-telecommunications technologies nationally as well as internationally through international cooperation;

- continue development and diffusion of strategic technologies in automation and robotics;

- develop advanced technologies for optical intersatellite-communication links and mobile telecommunications;

- develop low-cost advanced SAR concepts for future RADARSAT missions, smallsat SAR concepts, integrated-circuit technology for satellite applications, and high-temperature superconductive payloads; and

- continue to develop cost reduction and miniaturization of digital technology for spacecraft applications.

Comparative Financial Plans

Figure 12
Appropriated Planned Spending **SPACE TECHNOLOGY**

(thousands of dollars)	Main Estimates [1] 1996–97	**Main Estimates 1997–98**	**Planned 1998–99**	**Planned 1999–00**
Service Lines / Sub–Activities				
Generic Technology Development	12,526	**12,253**	11,767	11,395
Strategic Space Technology Development	1,800	**1,500**	1,580	1,680
Strategic Technologies for Automation and Robotics	—	**5,665**	4,547	4,407
European Space Agency General Budget	8,407	**7,865**	6,136	6,186
European Space Agency Other Programs	650	**419**	189	0
David Florida Laboratory	183	**960**	687	689
Total	**23,566**	**28,662**	**24,906**	**24,357**

(1) Does not reflect Supplementary Estimates. Includes Main Estimates only.

7. Executive and Horizontal Coordination

Objectives

- To provide strategic direction, management and administrative support services to CSA
- To ensure the necessary cohesion of all CSP activities

Operating Context

The Executive and Horizontal Coordination business line supports the CSP decision-making process and develops, implements, coordinates and monitors strategies and plans to ensure the efficient implementation of the overall CSP (and the Space Policy Framework), in consultation with space stakeholders both inside and outside the federal government. It provides the CSP with strategic framework, assistance and support in the areas of international cooperation, federal–provincial relations, industrial policy, regional development, communications activities, and space awareness.

Executive and Horizontal Coordination achieves its objectives through the following functions:

- Executive functions;
  - Policy and Planning;
    - Government Liaison;
    - Business Line Management;
    - International Relations;
    - Industrial Relations and Policy;
  - Corporate Management;
  - Communications;
- Corporate functions; and
- The Space Plan Task Force.

Strategies related to specific elements include the following:

- developing a LSTP III;
- creating a Business Line Management unit to strengthen the strategic direction of CSA programs in relation to business lines and to assess performance of business lines;
- maintaining CSA's relationships with international organizations to enhance its position, as well as that of its stakeholders, and support marketing by the Canadian space industry;
- maintaining existing public- and private-sector partnerships and building new ones.
- developing recommendations on priorities, strategies and plans governing all aspects of international relations, including partnerships;
- gathering intelligence and undertaking environmental assessments;

Space Plan Task Force

Objectives

- To submit a proposal to realign CSP funding related to the International Space Station and the Satellite Communications and Earth Observation initiatives
- To prepare program proposals for the next Space Plan in cooperation with Canadian stakeholders, with a view to seeking Cabinet approval in 1998–99
- To evaluate the results at the Canada–ESA cooperation before April 30, 1997, and to make recommendations on the renewal of the cooperative agreement

Operating Context

Several major Canadians space initiatives will be completed soon. New projects need to be planned and initiated to maintain a significant Canadian space program within the context of a 2-5 year outlook on domestic and international trends.

Change-Management Issues

Developing acceptable initiatives in current government fiscal conditions is difficult. Industry and other partners will be asked to share increasingly in program costs and management.

Results Expectations

The efforts of the Space Plan Task Force would enable CSA to undertake new initiatives, and to continue important programs.

- forming partnerships with provincial governments for exchange of industrial information, support of space-related research activities, promotion of Canadian space-industry products and services, implementation of jointly funded programs, and regional distribution;

- developing industry-related strategies and policies for R&D, including interdepartmental coordination, industrial partnerships, technology transfer and commercialization, sector roadmapping, and prioritization; and

- developing and implementing a strategic communications framework for the CSA.

Change-Management Issues

The recent CSA reorganization made significant changes to the units and functions pertaining to this business line. A Policy and Planning Directorate and a Corporate Management Directorate were created to strengthen strategic planning, install a corporate approach to delivering our mandate and programs, and improve and streamline the delivery of essential horizontal support functions. Also, the new performance-assessment framework, with performance indicators designed to permit CSA to better report to Parliament, will be implemented in the coming year.

Results Expectations

- **Effective management of the Long Term Space Plan**

- **Increased awareness of and education on the importance of space**

The intended effects of Executive and Horizontal Coordination are the development and application of space S&T to meet Canadian needs, the development of an internationally competitive space industry, increased awareness of space S&T and applications for industry and society, research opportunities for students in space S&T, and optimal delivery of the CSP.

In 1997–98, this business line will

- implement the approved CSA performance-assessment framework;

- improve the CSA business line assessment process so it can be used to develop new long-term strategies and support financial decision-making;

- develop and implement a marketing support strategy, structures and tools;

- develop a communications and awareness strategy to enhance the impact of Canadian space activities on public opinion;

- expand the CSA database to accommodate the collection and dissemination of strategic industry-related information; and

- obtain Cabinet funding approval for implementation of new programs, sustainment of continuing programs, and completion of programs that are winding down.

Comparative Financial Plans

Figure 13
Appropriated Planned Spending — EXECUTIVE AND HORIZONTAL COORDINATION

(thousands of dollars)	Main Estimates [1] 1996–97	**Main Estimates 1997–98**	**Planned 1998–99**	**Planned 1999–2000**
Service Lines / Sub-Activities				
Executive	1,030	**1,043**	1,022	1,022
Executive Functions	8,772	**8,672**	7,559	7,217
Corporate Functions	7,836	**9,818**	9,726	9,386
Total	**17,638**	**19,533**	**18,307**	**17,625**

(1) Does not reflect Supplementary Estimates. Includes Main Estimates only.

Section III
Departmental Performance

A. Summary of Departmental Performance

Canada ranks eighth among the world's space-faring nations. Canada very early recognized that space would bring enormous benefits to its small population, spread over the second largest country on Earth. Canada was the third nation to launch a satellite, in 1962; this allowed for the very successful series of the *Anik* communications satellites and paved the way for the development of the Canadian space industry. The space program evolved into the remote sensing for management, surveillance and protection of the Canadian territory, oceans and environment. A unique expertise was also developed in robotics, thanks to the Canadian robotic arm (Canadarm), which equips the US space shuttles and has been effectively used on missions, such as to repair the Hubble space telescope. This strategic and world-renowned expertise has led to Canadian's being invited to participate as a full partner in the largest cooperative R&D program in history, the International Space Station. Canada's contribution to that program will be the MSS, which is to be used for the assembly, maintenance and operation of the station.

Circumstances have now changed dramatically: the end of the Cold War, the reduction in defence budgets, the budgetary constraints, and the restructuring of the aerospace industries around the world have contributed to modifying the approach national governments take to planning and financing space activities.

Fiscal year 1997–98 will mark the fourth year in the implementation of the LTSP II, announced by the Government of Canada in 1994. LTSP II launched a new direction for CSP and reflected the changing realities in the global environment affecting our space program. LTSP II provided funds for new initiatives during 1994–95 to 2003–04, as well as setting a new course for Canada's participation in the International Space Station. Through the Space Policy Framework, LTSP II also reconfirmed the importance of CSP to economic renewal and the role of the CSA in coordinating the federal government's civil space program. LTSP II helped to identify overriding objectives and major thrusts to be achieved to better enhance the strategic contribution of space to the agenda of this government — jobs and growth.

B. Departmental Overview

1. Key Responsibilities and Objectives

In conformity with the government's decision on the CSP in June 1994, CSA has developed a Program Evaluation Framework for its activities. One of its main elements is a Performance Framework, which articulates the full range of expected results and presents performance measures that will enable management to have the information it needs to monitor the achievements of missions, objectives and targets for CSA. The reporting systems are now in place to track progress on operational and corporate objectives.

A program of independent internal audits, program evaluations and other reviews has been established for CSA to measure and evaluate its effectiveness and efficiency. As well, a series of

performance frameworks for each of the business lines have been developed based on the overall CSA framework to ensure progress toward the objectives of the Government of Canada's investment in space.

The CSA evaluation framework, with the support of all concerned federal departments, will be expanded to include all programs and activities of CSP. This overall framework will provide a means of measuring progress toward the goals of the Government of Canada in its investment in space

2. Development of Performance Measures

In delivering its program and in achieving its objectives, CSA performs in five major categories of activities. The medium-term results expected from these activities are shown in Table III-1 (Performance Framework).

Table III-1. Performance Framework

CSA Categories of Activities				
Effective management of Long Term Space Plan II	Leadership in space R&D for the benefit of Canadians and humanity	Application of space knowledge to business development and technology transfer	Related commercial and scientific activities	Increased awareness of and education on the importance of space
CSA Results Expectations				
Development and application of space S&T to meet Canadian needs **(All business lines)**	Increased understanding of space phenomena; avoidance of resulting terrestrial effects; improvement in atmospheric circulation models; increased understanding of pollution **(SS)**	Improved technical capabilities and revenues throughout the Canadian high-tech industry **(ST)**	Operation of DFL as a world-class facility for assembly and testing of space-based hardware **(All business lines)**	Increased Canadian awareness of space S&T and applications for industry and society **(EHC)**
Development of an internationally competitive space industry **(All business lines)**	Prevention of health hazards of space flight; development of medical improvements (e.g., diagnostics, health care) **(SS)**	Development of Canadian remote-sensing industry (exploiting data from RADARSAT I) and partnerships with the private sector for Earth observations **(EO)**	Participation of several Canadian astronauts in space flights, with increased opportunities for research in space **(CAP)**	Research opportunities for students in space S&T **(All business lines)**
	Improved capabilities of SMEs to use space technologies **(SS and ST)**	Improved adoption, adaptation, development, diffusion and direction of technology in Canadian industry **(ST)**		
	Completion of MSS and other obligations to the International Space Station Program **(CSSP)**	Development of satellite-communications technologies and services to meet Canadian needs (e.g., equitable access to bandwidth-on-demand services in all parts of Canada **(SC)**		
	Economic benefits (e.g., employment, regionally distributed industrial activity) of investments in space technologies **(CSSP and ST)**			
	Enhanced Canadian R&D capability through development of application-oriented technologies **(ST)**			

Business line abbreviations:

CAP	Canadian Astronaut Program
CSSP	Canadian Space Station Program
EHC	Executive and Horizontal Coordination
EO	Earth Observation
SC	Satellite Communications
SS	Space Science
ST	Space Technology

Other abbreviations:

CSA	Canadian Space Agency
DFL	David Florida Laboratory
MSS	Mobile Servicing System
R&D	research and development
SME	small- and medium-scale enterprise
S&T	science and technology

3. Financial Tables

Figure 14
Departmental Appropriated Planned and Actual Spending

FINANCIAL PERFORMANCE

(thousands of dollars)	Actuals 1993–94	Actuals 1994–95	Main Estimates 1995–96	Actuals 1995–96
Business Lines / Activities				
Earth Observation	103,583	82,580	67,317	76,727
Satellite Communications	9,877	12,434	18,022	15,105
Canadian Space Station Program	173,100	141,521	136,300	118,386
Canadian Astronaut Program	5,997	7,252	8,768	7,435
Space Science	23,733	32,706	35,058	34,536
Space Technology	19,564	22,497	23,134	23,662
Executive and Horizontal Coordination	48,076	19,713	22,559	21,768
Subtotal	**383,930**	**318,703**	**311,158**	**297,619**
Less: Revenue credited to the Vote	(6,000)	(1,116)	(9,300)	0
Total	**377,930**	**317,587**	**301,858**	**297,619**

Figure 15
1995–96 Comparison of Main Estimates to Actuals

(thousands of dollars) (shaded lines show Actuals)	Operating [1]	Capital [1]	Grants and Contributions	Gross Expenditures	Less: Revenues credited to the Vote	Total
Business Lines						
Earth Observation	652	49,643	17,022	67,317	9,300	58,017
	1,566	58,963	16,198	76,727	0	76,727
Satellite Communications	7,010	227	10,785	18,022	0	18,022
	8,997	558	5,550	15,105	0	15,105
Canadian Space Station Program	4,271	132,029	0	136,300	0	136,300
	718	117,668	0	118,386	0	118,386
Canadian Astronaut Program	8,711	57	0	8,768	0	8,768
	7,406	29	0	7,435	0	7,435
Space Science	3,128	31,780	150	35,058	0	35,058
	3,984	30,402	150	34,536	0	34,536
Space Technology	13,217	617	9,300	23,134	0	23,134
	12,890	673	10,099	23,662	0	23,662
Executive and Horizontal Coordination	18,258	3,606	695	22,559	0	22,559
	17,577	3,545	646	21,768	0	21,768
Total Agency Estimates	**55,247**	**217,959**	**37,952**	**311,158**	**9,300**	**301,858** [3]
Total Agency Actuals	**53,138**	**211,838**	**32,643**	**297,619**	**0**	**297,619**
Other Revenues and Expenditures						
Revenue credited to the Consolidated Revenue Fund						(1,039)
						(2,849)
Estimated cost of services provided by other government departments [2]						1,799
Net Cost of the Program						302,618
						296,569

(1) Includes contributions to employee benefit plans.

(2) Accommodation received without charge from PWGSC ($456); Cheque Issue Services received without charge from PWGSC ($28); employee benefits covering the employer's share of insurance premiums and costs paid by TB ($1315).

(3) Actual net expenditures in 1995–96 were $4.2 million less than originally planned in Main Estimates. Significant factors contributing to this difference were:

- decrease of expenditures in the Canadian Astronaut Program due to the delay of the CANEX-03 mission;
- increase in expenditures in the Earth Observation business line, as a result of the following:
  - launch-date delay of RADARSAT satellite,
  - insurance-premium payment of RADARSAT satellite, and
  - reprofiled RADARSAT expected royalty revenues;
- decrease in expenditures in the Earth Observation business line resulting from the delayed implementation of the Earth Observation program, directly related to the launch delay of the RADARSAT satellite;
- decrease in contributions expenditures in the Satellite Communications business line due to the technical delay in the commencement of the European Space Agency Advanced Research in Telecommunications Program; and,
- decrease in the Canadian Space Station Program mainly related to a deferral of contingency funding to meet future year requirements for coverage of potential risks on the manufacture of the Mobile Servicing System for the Space Station.

C. Details by Business Line

1. Earth Observation

Results Expectations

- **Development of the Canadian remote-sensing industry (exploiting data from RADARSAT I) and partnerships with the private sector for Earth observations**

The main program and operational outputs of the Earth Observation business line are contracts to industry; satellite-based Earth-observation SAR data; and enhancements planned for the RADARSAT system. The components of the business line are operation of the RADARSAT I satellite, launched in November 1995; development of RADARSAT II and other follow-on satellites; development of more-advanced SAR technologies for future RADARSAT satellites; and the Earth Observation Support Program.

Performance

The Earth Observation business line is developing a successful Canadian remote-sensing industry, exploiting data from RADARSAT I, in partnership with the private sector in Earth observation.

RADARSAT I was launched in November 1995 from the Vandenberg Air Force Base in California. Commercial operations commenced in April 1996, following a commissioning period. RADARSAT I has been implemented through a contract with Spar Aerospace, with major subcontracts to all the major Canadian suppliers in the space industry. Numerous smaller support contracts were also issued. The estimated cost of the project from 1980 to 2000 is $642.3 million, excluding the launch, which was provided by the United States under the terms of an international memorandum of understanding.

Effective management controls were put in place on the technical side to ensure quality and performance through quality-assurance programs and program review. An important example (1995–96) was the Blue Ribbon review by a panel of industry experts, which was convened to review the state of readiness of the overall system prior to launch. On the programmatic side, systems were put in place to track expenditures, schedules and revenues effectively. The RADARSAT I major Crown project was assigned certain regional distribution objectives. The majority of these have been met or exceeded.

The RADARSAT I project's revenue is derived from two sources: the contributing provinces (British Columbia, Saskatchewan, Ontario and Quebec) and RSI. The provinces paid $57.4 million, equal to one third of project expenditures related to work performed in their respective territories. RSI is a private-sector organization that will commercialize RADARSAT data. The company expects to generate revenues of $265 million over the five-year operating life of the spacecraft, from 1995 to 2000, and to return to the federal government projected royalties of $53.0 million. RSI will also fund the purchase of the SAR data processor to a limit of $10 million.

LTSP II announced provisions for a second RADARSAT satellite, which is to provide data for the five years following the 1995–2000 projected lifespan of RADARSAT I. Through this initiative, it is envisaged that the development and operations of RADARSAT II and follow-on satellites will be turned over to the private sector.

SAR Technology Development is an advanced program focusing beyond RADARSAT I and II. It is aimed at the development of enabling technologies required for future systems based on market-driven requirements. Some studies have been conducted for a next-generation satellite (RADARSAT III), in partnership with the French Space Agency. A total of $237.5 million has currently been allocated for RADARSAT II and the follow-on program.

The Earth Observation Support Program is intended to assist in the commercialization of Earth-observation data by the private sector and will ensure that Canadian industry is in a position to respond to the demand that this created. It includes the Ground Infrastructure and Applications and the Technology Transfer programs, which will ensure that Canada can receive data from new Earth-observation satellites and support the emerging Canadian value-added industry in developing applications to meet Canadian and international market needs. The Earth Observation Support Program is managed by CSA, in cooperation with CCRS, under the terms of a memorandum of understanding between the two organizations. The total amount set aside for this initiative, through the LTSP II is $91.1 million.

The Earth Observation business line has passed several important milestones in 1995–96:

- CSA received a preliminary private-sector business plan for privatizing the RADARSAT II Program and ensuring that Canadian industry secures a significant part in this new international imagery market;

- upgrade of ground infrastructure and development of applications users were encouraged under the Earth Observation Support Program; and

- Ground Infrastructure and Satellite Data Applications Development programs were delivered to ensure that Canada can receive data from new Earth-observation satellites and to support the emerging Canadian value-added industry in developing applications to meet Canadian and international market needs.

The Earth Observation program operations aspects consist of the operation of the RADARSAT I satellite system from the Mission Control Centre in Saint-Hubert, Quebec. The system includes SAR data-receiving stations at Prince Albert, Saskatchewan; Gatineau, Quebec; and Fairbanks, Alaska. CSA and RSI signed agreements with network stations in Norway, United Kingdom, Singapore, China and Japan for the direct reception of the RADARSAT data.

In 1995–96, the Earth Observation program operations component’s RADARSAT I system started the following activities:

- undertaking the operational phase of the satellite;

- supporting the commercial and government use of RADARSAT I data; and

- providing data for applications R&D.

Figure 16
1995–96 Comparison of Main Estimates to Actuals

(thousands of dollars) (shaded lines show Actuals)	Operating [1]	Capital [1]	Grants and Contributions	Gross Expenditures	Less: Revenues Credited to the Vote	Total
Service Lines /Sub- Activities						
RADARSAT I	0	34,363	0	34,363	9,300	25,063
	0	48,726	0	48,726	0	48,726
RADARSAT II	0	4,600	0	4,600	0	4,600
	0	5,137	0	5,137	0	5,137
SAR Technology Development	0	600	0	600	0	600
	0	849	0	849	0	849
Ground Infrastructures	0	4,100	0	4,100	0	4,100
	82	1,400	0	1,482	0	1,482
Applications Development and Technology Transfer	468	5,923	0	6,391	0	6,391
	411	2,086	0	2,497	0	2,497
ESA Earth Observation	0	0	17,022	17,022	0	17,022
	0	0	16,198	16,198	0	16,198
David Florida Laboratory	184	57	0	241	0	241
	1,073	765	0	1,838	0	1,838
Total Estimates	**652**	**49,643**	**17,022**	**67,317**	**9,300**	**58,017**[2]
Total Actuals	**1,566**	**58,963**	**16,198**	**76,727**	**0**	**76,727**

(1) Includes contributions to employee benefit plans.

(2) Actual net expenditures in 1995–96 were $18.7 million higher than originally planned in Main Estimates. The most significant factors in this difference are

- increase in expenditures, a result of
  - launch-date delay of RADARSAT satellite,
  - insurance-premium payment of RADARSAT satellite, and
  - reprofiled RADARSAT expected royalty revenues; and
- decrease in expenditures resulting from the delayed implementation of the Earth Observation program, which was directly related to the launch delay of the RADARSAT satellite.

2. Satellite Communications

Results Expectations

- **Development of satellite-communications technologies and services to meet Canadian needs (e.g., equitable access to bandwidth-on-demand services in all parts of Canada**

The main program and operational outputs of the Advanced Satellite Communications Initiative will be next-generation commercial-satellite components and services. These outputs will enhance the position of the Canadian satellite-communications industry as a world-class supplier of space subsystems and provide Canadians with new multimedia and personal-communications services.

The main performance indicators will be sales of products developed by industry; and availability of new multimedia and personal-communications services in regions of Canada.

Performance

The Advanced Satellite Communications Initiative has focused on the development of the new technologies needed to enable the development of new satellite systems that will provide bandwidth-on-demand Information Highway type services to all Canadians. These new multimedia-service offerings may deliver a combination of entertainment, video, telephony, image transfer, and broadband communications to individuals.

The International Mobile Initiative is aimed at helping position Canadian industry in the fast-growing market for mobile and personal satellite-communications services, both as suppliers of subsystems to international consortia operating constellations of satellites and as providers of services to Canadians. At least six major international systems were currently being proposed, with a projected investment in facilities, over the next 10 years, of $10–$20 billion. A total budget of $24.5 million is allocated to this program.

In 1995–96, the Satellite Communications business line has accomplished the following:

- initiated the second phase of Advanced Satellite Communications Initiative (onboard processing) with ESA;
- completed the definition of the implementation phase of the Advanced Satellite Communications Initiative;
- concluded co-funded arrangements with the private sector; and
- awarded 10 contracts, valued at $7.1 million, to Canadian companies to develop technologies for personal mobile communications under the International Mobile Initiative.

Figure 17
1995–96 Comparison of Main Estimates to Actuals

FINANCIAL PERFORMANCE
SATELLITE COMMUNICATIONS

(thousands of dollars) (shaded lines show Actuals)	Operating [1]	Capital [1]	Grants and Contributions	Gross Expenditures	Less: Revenues Credited to the Vote	Total
Service Lines / Sub-Activities						
Advanced Satellite Communications	3,483	0	0	3,483	0	3,483
	3,775	0	0	3,775	0	3,775
International Mobile	2,795	0	0	2,795	0	2,795
	2,744	0	0	2,744	0	2,744
ESA Satellite Communications	0	0	10,785	10,785	0	10,785
	0	0	5,550	5,550	0	5,550
David Florida Laboratory	732	227	0	959	0	959
	2,478	558	0	3,036	0	3,036
Total Estimates	**7,010**	**227**	**10,785**	**18,022**	**0**	**18,022**[2]
Total Actuals	**8,997**	**558**	**5,550**	**15,105**	**0**	**15,105**

(1) Includes contributions to employee benefit plans.

(2) Actual net expenditures in 1995–96 were $2.9 million less than originally planned in Main Estimates. The most significant factor in this difference is the decrease in contributions expenditures due to the technical delay in the commencement of the European Space Agency Advanced Research in Telecommunications System Program.

3. Canadian Space Station Program

Results Expectations

- **Completion of MSS and other obligations to the International Space Station Program**
- **Economic benefits (e.g., employment, regionally distributed industrial activity) of investments in space technologies**

The main program and operational outputs of the Canadian Space Station Program business line are the following:

- the development and delivery of the MSS to the International Space Station on time, within budget, and as specified;
- development of the ground infrastructure to support the on-orbit testing and commissioning of the MSS;

- successful on-orbit commissioning of the MSS from the MSS operations facility in Saint-Hubert
- completion of the SPDM design;
- planning the use of the International Space Station by Canadian scientists; and
- the development of related and supporting technology and its dissemination to Canadian industry.

To meet the schedule of the international partners to the Space Station, CSA is committed to deliver the MSS elements to NASA to meet its launch deadlines and to support the assembly sequence. The following table shows the international milestones of concern to the business line:

Canadian Space Station Program	Date
Initiation of CSA's development and design phase	Jul 1987
First MSS elements delivery	Jan 1998
First Space Station elements launch	Nov 1998
First MSS elements launch (SSRMS)	Jan 1999
Second MSS elements launch (MBS)	Aug 1999
Permanently manned capability	Jun 2002

Performance

CSA remains on schedule to meet Canada's obligation to deliver the first of the MSS components (the SSRMS) to NASA in early 1998. By the end of March 1997, manufacture and assembly of SSRMS will be complete, with manufacture and assembly of MBS close behind. Acceptance reviews for both SSRMS and MBS are activities planned for 1997. Integration and test activities have been under way since the fall of 1996, with all flight units integrated at that time. The preliminary design of the Canadian Space Vision System was completed in 1996, and a preliminary version of the system was successfully flown in November of that year, on flight STS-80.

The Mobile Operations Training System (MOTS) component of the Mission Operations Complex at Saint-Hubert, Quebec, will be completed by the end March 1997, and the Multimedia Learning Centre, courseware development and the Virtual Operations Training Environment are well under way.

Since 1984, the program as a whole has issued some 749 contracts, worth approximately $919 million, benefiting all regions of the country. Social economic spin-offs accrued to date are $2.6 billion and the creation of 31,000 jobs. Since 1984, some 120 contracts are in progress or have been completed under the auspices of the Strategic Technologies for Automation and Robotics component, involving 71 companies as primary contractors and 31 other companies and 29 universities and institutes as subcontractors. The contracts include jointly funded and managed regional ventures.

Figure 18
1995–96 Comparison of Main Estimates to Actuals

FINANCIAL PERFORMANCE
CANADIAN SPACE STATION PROGRAM

(thousands of dollars) (shaded lines show Actuals)	Operating [1]	Capital [1]	Grants and Contributions	Gross Expenditures	Less: Revenues Credited to the Vote	Total
Service Lines/Sub-Activities						
MSS Development	0	104,544	0	104,544	0	104,544
	0	102,133	0	102,133	0	102,133
MSS Operations	0	21,690	0	21,690	0	21,690
	0	9,699	0	9,699	0	9,699
STEAR	0	4,471	0	4,471	0	4,471
	0	5,675	0	5,675	0	5,675
David Florida Laboratory	4,271	1,324	0	5,595	0	5,595
	718	161	0	879	0	879
Total Estimates	**4,271**	**132,029**	**0**	**136,300**	**0**	**136,300**[2]
Total Actuals	**718**	**117,668**	**0**	**118,386**	**0**	**118 386**

(1) Includes contributions to employee benefit plans.

(2) Actual net expenditures in 1995–96 were $17.9 million less than originally planned in Main Estimates. The most significant factor in this difference is the decrease related to the deferral of contingency funding to meet future year requirements for coverage of potential risks on the manufacture of the Mobile Servicing System for the Space Station.

4. Canadian Astronaut Program

Results Expectations

- **Participation of several Canadian astronauts in space flights, with increased opportunities for research in space**

The main program and operational outputs of the Canadian Astronaut Program business line are highly qualified and fully trained payload and mission specialists; and participation in space missions, communication activities, research, and technological development.

Performance

The Canadian Astronaut Program is securing several flights of Canadian astronauts, with increased opportunities for research in space.

The Flights

In 1996, two NASA space missions included Canadian astronauts. Marc Garneau flew as a mission specialist on STS-77 in May 1996, and Robert Thirsk flew as a payload specialist on STS-78 in

June 1996. Bjarni Tryggvason was assigned as a payload specialist on STS-85, scheduled for launch in July 1997, and Daffyd Williams was assigned as a mission specialist on STS-90, scheduled for March 1998.

Marc Garneau's mission, STS-77, had aboard the Canadian-led Commercial Float Zone Furnace (CFZF) experiment sponsored by the Space Science Program, in which 12 sample materials contributed by scientists from Canada, the United States and Germany were melted down to produce high-quality crystalline materials, using a specialized process called float zoning. Also aboard was the Canadian-designed and -built Aquatic Research Facility (ARF), which allowed Canadian and US researchers to conduct studies on the life cycles and feeding patterns of small aquatic animals. Canadarm once again played a critical role in this important space mission, assisting in the assembly of the International Space Station, which will function as a permanently staffed orbiting laboratory. Two Canadian Get Away Specials (GAS), NANO-GAS and ACTORS, were aboard space shuttle *Endeavor*. The results of these experiments, sponsored by the Space Science Program, are expected to lead to high-performance laser and electronic equipment and devices.

Robert Thirsk's mission, STS-78, with the International Life and Microgravity Spacelab (LMS), helped set the stage for the International Space Station by studying the effects of long-duration space flight on human physiology, and he helped conduct the types of experiments that would be done on the orbital platform. Among these was the Torso Rotation Experiment, a Canadian experiment designed by a McGill University team and sponsored by CSA's Space Science program to investigate the neurological and visual changes that the astronauts might experience in adapting to their space environment. The results of these experiments will have applications on Earth, in the medical field.

Flight Opportunities

Bjarni Tryggvason's mission, STS-85, will have MIM as the Canadian payload. Designed in Canada, MIM improves the microgravity environment for experimenters who use spacecraft such as the Russian space station *Mir* or the space shuttle by applying the principle of magnetic levitation to isolate experiments from the vibrations of the spacecraft. On 23 April 1996, a MIM unit was launched into space aboard the Russian *Priroda* module, which subsequently docked with *Mir*. The MIM was activated for the first time by US Astronaut Shannon Lucid during her six-month stay aboard *Mir*.

STS-90 will be a 16-day Neurolab mission to study the effects of microgravity on neurophysiology and human performance. The Spacelab, is a fully equipped international space laboratory carried in the shuttle's cargo bay, will offer a unique environment for international investigators to conduct a series of 26 experiments. The Canadian experiment, called the Visuo-Motor Coordination During Space Flight experiment, is designed to help researchers understand the change of motor function, such as pointing and grasping objects, under conditions of weightlessness. This project is significant to understanding the limits of muscular performance on Earth, with implications for rehabilitation after injuries. Canadians are also participating in a second experiment, the Role of Visual Cues in Spatial Orientation, which will reveal how people use visual systems to determine up and down in a zero-gravity environment. Orientation and depth perception are critically important to pilots of aircraft and space vehicles.

Awareness

Canadian astronauts have been making public-relations appearances at media events and at professional associations and educational institutions, where they speak about the research the astronauts are carrying out in space for Canadian scientists and its benefits for the Canadian public and the Canadian economy. From April to December 1996, a total of 1,119 requests for astronaut appearances were received

by the Canadian Astronaut Program. The Young Space Scientists Program was launched in 1996, and educational kits have been mailed out to schools all over Canada to involve students in the experiments being carried out by Canadian astronauts on space flights. The enthusiastic response from the students and from teachers, coupled with the fascination of the public and the media with the astronauts, gives high visibility to the whole space program.

Figure 19
1995–96 Comparison of Main Estimates to Actuals

FINANCIAL PERFORMANCE
CANADIAN ASTRONAUT PROGRAM

(thousands of dollars) (shaded lines show Actuals)	Operating [1]	Capital [1]	Grants and Contributions	Gross Expenditures	Less: Revenues Credited to the Vote	Total
Service Lines /Sub-Activities						
Canadian Astronaut Program	8,530	0	0	8,530	0	8,530
	7,275	0	0	7,275	0	7,275
David Florida Laboratory	181	57	0	238	0	238
	131	29	0	160	0	160
Total Estimates	**8,711**	**57**	**0**	**8,768**	**0**	**8,768**
Total Actuals	**7,406**	**29**	**0**	**7,435**	**0**	**7,435**

(1) Includes contributions to employee benefit plans.

(2) Actual net expenditures in 1995–96 were $1.3 million less than originally planned in Main Estimates. The most significant factor in this difference is the decrease of expenditures due to the delay of the CANEX-03 mission.

5. Space Science

Results Expectations

- **Increased understanding of space phenomena; avoidance of resulting terrestrial effects; improvement in atmospheric circulation models; increased understanding of pollution**
- **Prevention of health hazards of space flight; development of medical and material-processing improvements (e.g., diagnostics, health care)**
- **Improved capabilities of SMEs to develop and use space technologies**

The Space Science business line has the following main program and operational outputs:

- maintenance of a world-class capacity in astronomy and solar–terrestrial relations;
- expanded research activity in atmospheric sciences;

- expanded research capacity in the Space Life Sciences and Microgravity Science programs; and

- financial support for research using data collected by space missions and making maximum use of international missions of opportunity for flights on the NASA shuttle, the Russian space station *Mir*, and international satellites.

Performance

The work of the Space Science business line is helping us to understand space phenomena, avoid unwanted terrestrial effects, improve atmospheric-circulation models, and understand pollution. The Space Science business line is involved in the prevention of the health hazards of space flight, medical improvements such as diagnostics and health care, and improved capabilities of SMEs in using new technologies such as optical document readers.

In 1995–96 we have seen the successful launches of CSAR-2 and Oedipus-C, sounding rockets used for the study of microgravity effects on materials and for the study of the ionosphere, using a tether rocket. We witnessed the successful missions of MIM and QUELD on the Russian *Mir* Space Station, ARF-1, TRE and CFZF on the NASA shuttle, and the successful launch of the Russian *Interball* satellite with the Canadian UVAI aboard. Fifteen missions will have been supported; more than 12 major projects and more than 35 smaller projects are under development; and more than 10 new projects have been started.

In 1995–96 more than 100 papers have been published based on the results obtained on such projects as the Canadian WINDII, the Cold Plasma Analyser, the Viking and Freja Auroral Imagers, the Canopus network of ground-based observations, and SMS. In the life sciences, more than 20 papers were published using data from the International Microgravity Laboratories (IML-1 and 2), and more than 55 papers were published in the Microgravity Sciences. Postgraduate degrees, at the doctoral- and master's-degree levels, were granted for work based on the data from the above projects.

The business line's prestige and recognition are demonstrated by Canadian proposals having been accepted for several international missions: NASA's Neurolab and FUSE programs, Sweden's *Odin* satellite, Japan's *Planet B* satellite mission for the TPA project and the VSOP satellite, the Very Long Baseline Array astronomy program, the Space Drums furnace in the International Space Station furnace facility, and MIM and QUELD on the Russian *Priroda* module.

During this period, the program played a key role in supporting new and continuing initiatives in Atlantic Canada. For example, the Com Dev Atlantic facility continued to participate in the TPA project; the University of New Brunswick established a Space Science Industry chair and has also recently appointed a junior chairperson; and cooperative agreements with Atlantic Canada Opportunities Agency and the Maritime Provinces for cooperative activities in microgravity continue to accomplish established goals. As a result of the MOPITT project, a Space Science Industry chair has also been established at the University of Toronto, with support from Com Dev, Bomem, the University of Toronto, NSERC, AES, and CSA.

Technologies developed in recent Space Science project contracts have enabled SMEs to develop products and potential products. For example, CAL Corp has developed a wide-field star sensor; Bubble Technology Industries Inc. and Thomson & Nielsen Electronics Ltd. have developed dosimeters and radiation detectors; Ceramics Kingston now produces cutting and nonabrasive materials for the manufacturing industries; AMISTAR now exports semiconductor materials; Legacy System produces mass storage systems; AASTRA Aerospace Inc. exports communications equipment for both the United States and Canada (more than $6 million worth); and Bristol Aerospace Ltd. exports telemetry systems and

attitude- and guidance-control systems to the United States. All these products are intended for the international market. In addition, Bomem, Com Dev, and Bristol Aerospace have won contracts from the United States as a result of their Space Science work.

In 1995–96, the Space Science program has accomplished the following:

- launched the Ultraviolet Auroral Imager on the Russian *Interball* satellite;
- completed the optical spectrograph for Sweden's *Odin* satellite;
- signed a memorandum of understanding with NASA and initiated the program for the first Canadian-led science satellite since the *Alouette*–ISIS program in the late 1960s;
- launched the ARF and CFZF on the NASA shuttle;
- launched the Oedipus tethered rocket experiment;
- participated in the Japanese VSOP mission, providing recording, playback and correlation equipment; and
- launched MIM on the Russian *Priroda* module, along with the QUELD crystallization furnace.

Figure 20
1995–96 Comparison of Main Estimates to Actuals

FINANCIAL PERFORMANCE
SPACE SCIENCE

(thousands of dollars) (shaded lines show Actuals)	Operating [1]	Capital [1]	Grants and Contributions	Gross Expenditures	Less: Revenues Credited to the Vote	Total
Service Lines /Sub-Activities						
Solar Terrestrial Relations	604	10,420	0	11,024	0	11,024
	563	7,180	0	7,743	0	7,743
Atmospheric Chemistry and Physics	477	7,164	0	7,641	0	7,641
	318	8,902	0	9,220	0	9,220
Astronomy	249	4,650	0	4,899	0	4,899
	374	5,654	0	6,028	0	6,028
Space Life Sciences	390	2,300	150	2,840	0	2,840
	381	2,242	150	2,773	0	2,773
Microgravity Science	899	5,700	0	6,599	0	6,599
	405	6,395	0	6,800	0	6,800
Scientific Satellite Program	81	1,414	0	1,495	0	1,495
	1,812	0	0	1,812	0	1,812
David Florida Laboratory	428	132	0	560	0	560
	131	29	0	160	0	160
Total Estimates	**3,128**	**31,780**	**150**	**35,058**	**0**	**35,058**
Total Actuals	**3,984**	**30,402**	**150**	**34,536**	**0**	**34,536**

(1) Includes contributions to employee benefit plans.

6. Space Technology

Results Expectations

- **Economic benefits (e.g., employment, regionally distributed industrial activity) of investments in space technologies**
- **Enhanced Canadian R&D capability through development of application-oriented technologies**
- **Improved technical capabilities and revenues throughout the Canadian high-tech industry**
- **Improved adoption, adaptation, development, diffusion and direction of technology in Canadian industry**

The main program and operational outputs of the Space Technology program are the technologies required for Canada's space program. The technology thrusts for the new millennium include the following:

- improved high-resolution technologies for meteorology, spectroscopy and passive remote sensing;
- advanced SAR technologies;
- miniaturized and low-cost electronic and digital payload equipment;
- integrated-circuit and superconductive technologies;
- robotics and automation;
- advanced materials, thermal design, and analysis;
- dynamics and control of space structures; and
- test technologies.

Contracts to industry in these technology areas, continuation of cooperative efforts with ESA, and increased commercialization support are strong contributors to the competitiveness and export performance of the Canadian space industry.

Performance

In 1995–96, the Space Technology business line awarded contracts covering all priority sectors of CSP, with a value of $7.5 million. Industry and other stakeholders have contributed an additional 25%. SMEs were particularly successful, obtaining more than 50% of the total contract value. Nine projects were awarded to Canadian universities under the CSA–NSERC Research Partnerships Program, with 33%

of industrial cash contribution and 50% of the spending on student stipends. Five technology-transfer agreements from CSA to industry were successfully negotiated. These facts strongly indicate that the program meets the Canadian high-technology-industry needs for new technologies. They also show that industry has confidence that these projects will bring benefits by improving the industry's technical capabilities and revenue generation and by providing new opportunities to supply components, systems and services.

The Technology Diffusion Program awarded 11 contracts to promote the use and assist industry in demonstrating the feasibility and economic viability of transferring space technologies to non-space applications. The new International Cooperation Program was launched to allow Canadian participation in cooperative ventures with foreign partners, with the aim of demonstrating Canadian technology and benefitting from technology transfer from abroad. These programs complement technology-development activities, to better position Canadian industry and maximize the socioeconomic benefits to Canadians of the Space Technology program.

In 1995–96, ESA awarded $20 million worth of contracts to 18 companies across Canada. Those contracts were directly related to the priority areas of LTSP II, which are satellite communications and earth observation. For example, Canadian industry participates in the development of onboard processing techniques and hardware and processors for Advanced Synthetic Aperture and in Ka-Band Terminal.

Canada's participation in the programs of ESA since 1979 has given Canadian companies an opportunity to contribute to the advancement of space technologies; to supply components, systems and services; to develop strategic industrial alliances with European industry; to establish themselves on the European market; and to win other international contracts. In addition, the expertise gained by industry in ESA programs applies directly to ongoing and future national programs, such as Advanced Satcom and RADARSAT.

In 1995–96, the Space Technology program has overseen a variety of programmatic and technical achievements from its in-house and contracting-out activities:

- awarding ESA major contracts to Canadian companies for onboard processing technologies and the Envisat Program;
- moving the development of a bolometric array detector to a prototype stage as a prelude to full commercialization;
- completing a prototype laser scanner vision system for future use on the space shuttle;
- initiating development of advanced technologies and concepts for future SAR missions, such as RADARSAT III, jointly with the private sector;
- demonstrating a low-cost portable "suitcase" terminal for communications in areas with inadequate terrestrial infrastructure;
- developing a complete facility for testing the ACS systems for spacecraft; and
- implementing the new Strategic Space Technology Development programs, composed of the Industry Partnership Program, Technology Diffusion Program, and International Cooperation Program.

Figure 21
1995–96 Comparison of Main Estimates to Actuals

(thousands of dollars) (shaded lines show Actuals)	Operating [1]	Capital [1]	Grants and Contributions	Gross Expenditures	Less: Revenues Credited to the Vote	Total
Service Lines /Sub- Activities						
Generic Technology Development	11,845	579	200	12,624	0	12,624
	12,435	570	98	13,103	0	13,103
Strategic Technology Development	1,250	0	350	1,600	0	1,600
	0	0	219	219	0	219
STEAR	0	0	0	0	0	0
	0	0	0	0	0	0
ESA General Budget	0	0	8,001	8,001	0	8,001
	0	0	8,047	8,047	0	8,047
ESA Other Programs	0	0	749	749	0	749
	0	0	1,735	1,735	0	1,735
David Florida Laboratory	122	38	0	160	0	160
	455	103	0	558	0	558
Total Estimates	**13,217**	**617**	**9,300**	**23,134**	**0**	**23,134**
Total Actuals	**12,890**	**673**	**10,099**	**23,662**	**0**	**23,662**

(1) Includes contributions to employee benefit plans.

7. Executive and Horizontal Coordination

Results Expectations

- **Effective management of the Long Term Space Plan II**
- **Increased awareness of and education on the importance of space**

The main operational outputs of the Executive and Horizontal Coordination business line include the following:

- objectives and orientations for management of CSA's business;
- liaison with portfolio departments and central agencies;
- reports on federal government departments, Ottawa environment and portfolio activities;

- objectives, policies, programmatic priorities and strategies for participation in and contributions to federal activities;
- strategic program-level interface with stakeholders;
- reports on factors affecting space and business line and program areas;
- analysis of national and international policies and activities and their interrelationship with space, CSP and CSA;
- building and management of foreign partnerships to support the implementation of CSP;
- support to the export development activities of the Canadian space industry;
- management of the CSA's political relationships with foreign agencies and partners;
- implementation of policies and strategies to build partnerships with industry and provinces in support of space R&D and technology development, applications, commercialization and transfer; and
- communications and awareness strategies to maximize the impact on the public's perception of space.

Performance

In 1995–96, the major accomplishments of this component have been the following:

- consolidating industrial-cooperation activities with federal regional departments in the context of the two memoranda of understanding signed with ACOA and the Federal Office of Regional Development–Québec;
- editing a revised and enhanced version of the Canadian Space Directory database, listing the industries, universities, and research centres' capacities and competencies, as well as the different government levels involved in the implementation of CSP;
- organizing the annual conference, SIFAC '95, in Charlottetown in May 1995, and industrial missions to facilitate industrial partnerships and contracting opportunities for SMEs, particularly with large Canadian firms;
- signing memoranda of understanding with China and Ukraine in support of Canadian space-sector export initiatives;
- organizing an industrial mission to Beijing and governmental missions to Japan and Argentina and hosting a French industrial mission and a German governmental mission to Canada;
- writing, in consultation with the Working Group on International Trade in Space and Space-Related Products, the *1996–97 Canadian International Business Strategy for Space*;
- developing an international marketing strategy;

- formulating the terms of reference for the review of federal and private-sector space-related facilities;

- signing a memorandum of understanding with DND to define the objectives pursued by CSA–DND cooperation and putting in place cooperative-mechanisms-level activities; and

- developing a Corporate Communications Strategy and concluding a major awareness program across Canada.

- various space hardware qualifications by DFL, for CSA business line needs and other external clients.

Figure 22
1995–96 Comparison of Main Estimates to Actuals

FINANCIAL PERFORMANCE
EXECUTIVE AND HORIZONTAL COORDINATION

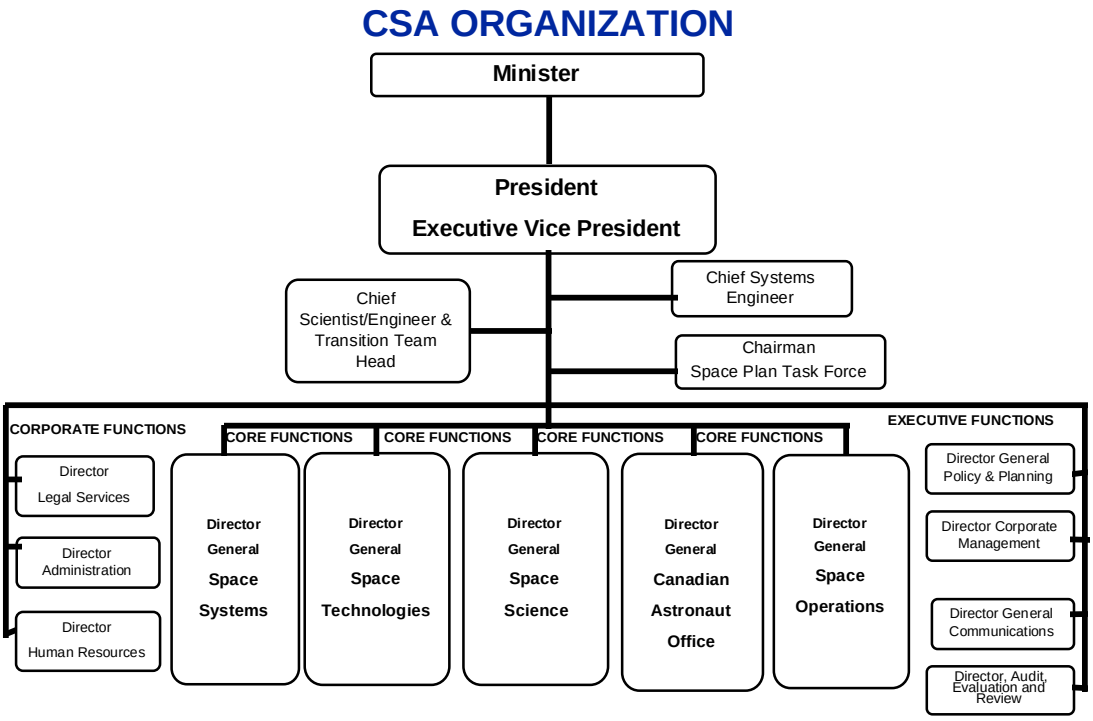
(thousands of dollars) (shaded lines show Actuals)	Operating [1]	Capital [1]	Grants and Contributions	Gross Expenditures	Less: Revenues Credited to the Vote	Total
Service Lines /Sub- Activities						
Executive	1,022	0	0	1,022	0	1,022
	1,031	0	0	1,031	0	1,031
Executive Functions	8,790	242	695	9,727	0	9,727
	8,606	364	646	9,616	0	9,616
Corporate Functions	8,446	3,364	0	11,810	0	11,810
	7,940	3,181	0	11,121	0	11,121
Total Estimates	**18,258**	**3,606**	**695**	**22,559**	**0**	**22,559**
Total Actuals	**17,577**	**3,545**	**646**	**21,768**	**0**	**21,768**

(1) Includes contributions to employee benefit plans.

Section IV
Supplementary Information

Appendix 1 — Organization

1.1 Organization Chart



Appendix 1 — Organization

1.2 Resource Requirements by Organization / Program Structure and Business Line ($000)

	1997–98 Main Estimates							
	Business Lines / Activities							
	EO	SC	CSSP	CAP	SS	ST	EHC	**Total**
Organization/Program Structure								
Executive							1,043	1,043
Executive Functions	12,440						7,351	19,791
Corporate Functions							9,818	9,818
Space Systems			51,121					51,121
Space Technologies	16,517	18,574				27,702		62,793
Space Science					29,666		265	29,931
Canadian Astronaut Office				6,679				6,679
Space Operations	2,027	6,337	96	96	192	960	1,056	10,764
Subtotal	30,984	24,911	51,217	6,775	29,858	28,662	19,533	191,940
Revenues credited to the Vote	(7,403)							(7,403)
Total	**23,581**	**24,911**	**51,217**	**6,775**	**29,858**	**28,662**	**19,533**	**184,537**

Abbreviations:

EO	Earth Observation
SC	Satellite Communications
CSSP	Canadian Space Station Program
CAP	Canadian Astronaut Program
SS	Space Science
ST	Space Technology
EHC	Executive and Horizontal Coordination.

Appendix 2 — Personnel Requirements

2.1 Details of Personnel Requirements by Business Line (FTEs)

	Actuals 1994–95	Actuals 1995–96	1996–97 Estimates	1997–98 Estimates	1998–99 Planned	1999–2000 Planned
Business Lines						
Earth Observation	44	43	33	26	27	27
Satellite Communications	18	15	4	20	23	22
Canadian Space Station Program	65	65	89	67	67	67
Canadian Astronaut Program	30	39	22	14	14	14
Space Science	28	29	36	20	20	20
Space Technology	56	62	62	64	64	64
Executive and Horizontal Coordination	114	117	103	*179	137	138
Total	**355**	**370**	**349**	****390**	**352**	**352**

* The apparent FTE increase in the Executive and Horizontal Coordination is a result of CSA reorganization, which regrouped Administrative and Support functions that were previously distributed among the various business lines.

** The total FTE increase will permit CSA to make the necessary resource adjustments required to reduce its contractuals significantly during the reorganizational transition period in 1997–98.

Appendix 2 — Personnel Requirements

2.2 Summary by Professional Category (FTEs)

	Actuals 1994–95	Actuals 1995–96	1996–97 Estimates	1997–98 Estimates	1998–99 Planned	1999–2000 Planned
Order-in-Council Appointments	2	2	2	2	2	2
Executive Group	21	26	27	27	21	21
Astronaut	8	8	8	7	7	7
Scientific and Professional	163	176	174	166	163	163
Administrative and Foreign Service	66	67	62	94	76	76
Technical	23	26	25	25	25	25
Administrative Support	70	64	51	68	57	57
Operational	2	1	0	1	1	1
Total	**355**	**370**	**349**	****390**	**352**	**352**

** The total FTE increase will permit CSA to make the necessary resource adjustments required to reduce its contractuals significantly during the reorganizational transition period in 1997–98.

Appendix 3 — Capital Projects

3.1 Capital Expenditures by Business Line ($000)

	Actuals 1994–95	Actuals 1995–96	1996–97 Estimates	1997–98 [1] Estimates	1998–99 [1] Planned	1999–2000 [1] Planned
Business Lines						
A. Earth Observation	65,503	58,963	32,183	18,781	28,342	27,043
B. Satellite Communications	593	558	365	2,500	2,000	800
C. Canadian Space Station Program	141,469	117,668	76,335	51,121	21,222	11,410
D. Canadian Astronaut Program	903	29	92	0	0	0
E. Space Science	28,983	30,402	29,862	26,429	25,209	20,759
F. Space Technology	707	673	5,931	6,124	5,027	4,925
G. Executive and Horizontal Coordination	5,015	3,545	172	421	370	123
Total	**243,173**	**211,838**	**144,940**	**105,376**	**82,170**	**65,060**

(1) Includes contributions to employee benefit plans for the Space Station and RADARSAT major Crown projects.

Appendix 3 — Capital Projects

3.2 List of Capital Projects by Business Line ($000)

	Previously Estimated Total Cost	Currently Estimated Total Cost	Forecast Expenditures to March 31, 1997	**Estimates 1997–98**	Future Years Requirements
Business Lines					
A. Earth Observation					
1. RADARSAT I	615,163	615,293	574,004	1,163	40,126
2. RADARSAT follow-on, planning	16,163	16,070	12,956	0	3,114
3. EO Support Program	87,064	83,304	17,482	17,265	48,557
4. Misc. capital projects				353	
				18,781	
B. Satellite Communications					
1. Building refit / DFL	7,111	7,111	3,111	2,500	1,500
C. Canadian Space Station Program	1,187,234	1,167,227	1,070,974	51,121	45,132
D. Space Science					
1. Space Science projects				26,429	
E. Space Technology					
1. Misc. capital projects				938	
2. STEAR Program				5,186	
				6,124	
F. Executive and Horizontal Coordination					
1. Misc. capital projects				421	
Total Capital Expenditures				**105,376**	

Appendix 3 — Capital Projects

3.2.1 Explanation of Major Changes Between Previously and Currently Estimated Total Costs ($000)

	Previously Estimated Total Cost	Currently Estimated Total Cost	**Increase (Decrease)**	Explanation
Business Lines				
A. Earth Observation				
3. Earth Observation Support Program	87,064	83,304	(3,760)	The Earth Observation Support Program has been de-scoped
C. Canadian Space Station Program	1,187,234	1,167,227	(20,007)	The STEAR program was transferred out of the major Crown project and is now in a different business line (Space Technology)

Appendix 3 — Capital Projects

3.3 Description of Major Crown Projects

A project is deemed to be a major Crown project (MCP) when its estimated cost will exceed $100 million and Treasury Board would assess the project as being one with a high risk. Treasury Board may dictate that projects with total projected cost of less than $100 million but with a current risk assessment of high be managed as MCPs. Further, Treasury Board reserves the right to require any project exceeding the Minister's delegated project-approval authority to be managed as an MCP.

Two of the projects in the CSA's capital program are MCPs. Reports on each are provided below.

3.3.1 Canadian Space Station Program

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 (ESA), and Japan to participate in the International Space Station Program. Canada's participation includes the design, construction, and operation of the Mobile Servicing System (MSS), plus responsibilities for the operations and use of the Space Station.

The Canadian Space Station Program received Effective Project Approval (EPA) from Treasury Board in February 1990. The program defines all activities required to discharge Canada's obligations up to and including completion of the on-orbit testing and commissioning of MSS.

Performance Objectives

- To develop and provide the space and ground elements that constitute MSS
- To develop the capability to assume operational responsibility for the Canadian-supplied elements
- To facilitate the use of the Space Station by Canadian industry, government and university sectors
- To develop and apply strategic technologies of significance to MSS, particularly in the field of automation and robotics
- To participate in the international management process established for the Space Station

Socioeconomic Objectives

- To improve regional distribution of space-related government expenditures
- To foster an environment conducive to the commercialization of technologies resulting from the program

Cost Objective

The total cost of the Canadian Space Station Program from 1990–91 to 1999–2000 is as follows:

(millions of dollars)	Currently Estimated Total Cost	Forecast Expenditures to March 31, 1997	**Estimates 1997–98**	Future Years' Requirements
	1,167,227	1,070,974	**51,121**	45,132

Schedule Objective

The schedule of the Canadian Space Station Program is designed to meet the requirements agreed to for implementation of the International Space Station Program. A summary of the Canadian phases follows:

	Schedule	
	Start	**End**
Phase A — Preliminary studies	Oct 1984	Aug 1985
Phase B — Project definition	Jul 1985	Jul 1987
Phase C — Design and development	Jul 1987	Apr 1993
Phase D1 — Manufacturing and testing	Dec 1992	Apr 1999
Phase D2 — Interim operations	Jan 1999	Apr 2000
Project evaluation	Feb 2000	Apr 2000

Equipment Element	**Delivery**	**Launch**
Space Station Remote Manipulator System	Apr 1997	Jan 1999
Mobile Base System	Oct 1998	Aug 1999

Lead and Participating Departments

Lead Authority: Canadian Space Agency
Service Department: Public Works and Government Services Canada

Major Milestones

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

Canadian Space Station	Date
Initiation of CSA's development and design phase	Jul 1987
First MSS elements delivery	Jan 1998
First Space Station elements launch	Nov 1998
First MSS elements launch (SSRMS)	Jan 1999
Second MSS elements launch (MBS)	Aug 1999
Permanently manned capability	Jun 2002

Achievements

By the end of March 1997, the manufacture and assembly of the Space Station Remote Manipulator System (SSRMS) (flight model) will be complete, and the manufacture and assembly of the Mobile Base System (MBS) will follow soon after. Acceptance reviews for both SSRMS and MBS are planned activities for 1997. Integration and test activities are under way (fall of 1996), with all flight units integrated and undergoing testing. Negotiations with primary contractors have been finalized for activities to be carried out after the acceptance review on SSRMS and MBS, as well as on launch support and sustaining engineering.

In 1996, the preliminary design for the Canadian Space Vision Program (CSVS) was completed, and in November 1996 the system was flown on mission STS-80. By the end of March 1997, the Mobile Operations Training Centre (MOTS) will be complete, and the Multimedia Learning Centre (MMLC) and the Virtual Operations Training Environment (VOTE) are well under way.

Since 1984 the program has issued about 750 contracts ($919 million), with expenditures benefitting all regions of the country, accruing social economic benefits of $2.6 billion and creating 31,000 jobs.

About 120 contracts have been awarded to 71 companies as contractors, along with 31 other companies and 29 universities and institutes as subcontractors, including regional ventures in Saskatchewan, Quebec and the Atlantic Provinces. These contracts are for the automation of operations; autonomous robotics; machine vision, path planning and collision avoidance; materials; tactile and proximity sensors; and ground control. The administration of Strategic Technologies for Automation and Robotics (STEAR) will be suspended by 1996–97 as it moves under more compatible administration in other areas of CSA's revised organization.

3.3.2 RADARSAT I

Overview

RADARSAT I is a Canadian-led project involving the United States, several of the provinces, and the private sector. This sophisticated remote-sensing satellite, carrying Synthetic Aperture Radar (SAR), was launched in November 1995 and will operate for about five years. It will be able to cover most of Canada every 72 hours; the Arctic, every 24 hours. It will monitor and map renewable resources for the

agricultural and forestry sectors. RADARSAT I will gather the data needed for more efficient resource management; ice, ocean and environmental monitoring; and Arctic and offshore surveillance. RADARSAT I will also support fishing, shipping, oil exploration, offshore drilling, and ocean research. The development and operation of this system are expected to generate 10,000 person–years of employment within Canada and provide more than $1 billion in benefits to the Canadian private and public sectors. In addition (and excluding a direct contribution of $32.0 million by the Province of Quebec to the primary contractor), a total of $93.4 million is expected in revenues to support the development and operations of RADARSAT I. This includes $53.0 million in royalties on worldwide sales of RADARSAT I data, $10.0 million from RADARSAT International Inc. (RSI) for equipment, and $30.4 million from provincial governments for work related to satellite construction.

Lead and Participating Departments

Lead Authority: Canadian Space Agency
Service Department: Public Works and Government Services Canada
Third Party: Natural Resources Canada

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 protoflight 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 2001

Summary of Costs

(thousands of dollars)	Currently Estimated Total Cost	Forecast Expenditures to March 31 1997	**Estimates 1997–98**	Future Years' Requirements
RADARSAT I	615,293	574,004	**1,163**	40,126

Achievements

EPA was obtained for RADARSAT I in March 1991. The Preliminary Design Review was held in July 1991, marking the end of the C1 phase. A contract for phase C2–D1 was awarded to the primary contractor in July 1991, with an amendment to cover all activities of the contractor until completion of phase D2. In 1994–95, the manufacturing, assembly, integration and testing were done on all the major subsystems, and contracts were awarded for all the significant ground-segment subsystems. During

1995–96, the spacecraft was assembled and tested and the full Space Ground System was qualified. RADARSAT I was launched in November 1995 and began system operations in April 1996. The system includes SAR data-receiving stations at Prince Albert, Saskatchewan; Gatineau, Quebec; and Fairbanks, Alaska. CSA and RSI signed agreements with network stations in Norway, United Kingdom, Singapore, China and Japan for the direct reception of the RADARSAT data.

3.3.3 Addendum on the David Florida Laboratory

Objective

- To cost-effectively provide an environmental test facility capable of meeting the current and emerging needs of Canada's space community and space-related objectives

Operating Context

The David Florida Laboratory (DFL) is Canada's national facility for testing, assembly and integration of satellites and other space hardware. Within the context of the current reorganization, DFL has been integrated into the Space Operations Branch of CSA. DFL is considered a critical component of CSA infrastructure, supporting CSA's priorities in the business lines and serving the private sector in the development and qualification of its space products. The costs of DFL are charged separately to the various main activities on business lines as shown in Figure 23.

Figure 23
Distribution of DFL Costs

	1997–98
Business Lines	
Earth Observation	864
Satellite Communications	6,337
Canadian Space Station Program [1]	96
Canadian Astronaut Program	96
Space Science	192
Space Technology	960
Executive and Horizontal Coordination	1,056
Total DFL costs	**9,601**

(1) Canadian Space Station Program, or ˝Space Robotics Development and Operations.˝

Change-Management Issues

A review has been undertaken of major Canadian space facilities, both public and private, with a view to ascertaining the scope of efficiency and effectiveness in the use of these facilities and providing an adequate framework within which to update a business plan for DFL.

DFL is a world-class facility for the integration and environmental testing of space systems and subsystems. DFL is needed for the completion of MSS and for conducting subsystem and component

testing for many customers, both in industry (commercial export sales) and in government (e.g., space science instruments). However, the programs of LTSP II have no defined workload for large-satellite integration and testing after 2001 (the RADARSAT II), and, as a result, program review removed most of the operational funding for DFL for after that year.

During this planning period, CSA will continue to maintain and operate DFL facilities for industry while working to define and assess its longer term large-satellite workload through dialogue with other government departments, such as Department of National Defence, on facility needs for their space projects and with international partners. As part of the reorganization of CSA, DFL has been integrated into the Space Operations Branch, in which its role as a critical component of CSA's infrastructure will be further defined and established. In parallel, CSA will enter into discussions with the private sector regarding alternatives for keeping the facility open (e.g., revised fee structures, private-sector partnerships). These discussions will be carried out in the context of the overall review of space facilities.

The rationalization study of major facilities will be completed in mid-1997, when a new business framework for the DFL will have been developed to deal with alternative approaches to DFL operations after 2001, including reduced levels of operation, private-sector partnerships or continued operation by the CSA, as an essential element of industrial strategy and to meet identified Canadian needs.

Results Expectations

The intended effects of the maintenance and operation of DFL include contributions to industrial growth, development and competitiveness; high-technology employment; technological autonomy in space (communications and remote sensing); contributions to the Consolidated Revenue Fund; and national and international recognition of Canadian capabilities in space.

In 1997–98, DFL will

- provide environmental testing in support of Canada's contribution to the International Space Station Program, through the qualification of system motor modules, end effectors and joints;
- provide environmental testing at both the system and subsystem levels to a range of domestic and foreign clients on a number of space- and terrestrial-based programs;
- prepare facilities to properly accommodate RADARSAT II spacecraft;
- continue the mid-life refit of the building to preserve, restore and maintain the facilities at an acceptable level and continue with detailed planning for refitting major elements of DFL test equipment; and
- continue marketing efforts for spacecraft-level assembly, integration and test (AI&T) work, both unilaterally and in conjunction with Canadian industry.

Actual Performance

The main program and operational outputs of DFL are the maintenance and operation of a national facility for spacecraft assembly, integration and testing in support of CSP; timely and accurate testing of satellites and other space-based and ground-segment hardware; the ongoing provision of world-class test facilities; and the acquisition and development of test technologies.

Since 1995–96, DFL environmental test facilities contributed to several programs and projects. The following are some operational highlights:

- a full environmental-test campaign, consisting of thermal vacuum, vibration and radio-frequency testing, as well as integration- and ambient-deployment testing on the mobile-communications satellites MSAT M1 and M2 — *supporting Satellite Communications;*

- a full environmental-test campaign (thermal vacuum, vibration and radio-frequency testing), plus integration and ambient deployments on RADARSAT I — *supporting Earth Observation;*

- vibration, thermal-vacuum, thermal passive intermodulation measurement (PIM), electromagnetic compatibility, radio frequency (RF) and deployment testing on a series of Skynet ultrahigh-frequency deployable helical antennas (qualification, engineering and flight models) — *supporting the development of the Canadian space industry;*

- significant progress in the environmental-test program for MSS, Canada's contribution to the International Space Station Program, including completion of testing of the qualification model of MBS and several system joints, motor modules and latching end effectors — *supporting the Canadian Space Station Program;*

- initiated environmental testing on the *Indostar* communications satellite for Spar Aerospace and CTA Space Systems of McLean, Virginia — *supporting the development of the Canadian space industry;*

- radio-frequency and thermal PIM testing on a number of INMARSAT aeronautical antennas for a variety of antenna manufacturers, both domestic and foreign — *supporting development of the Canadian space industry;*

- RF testing of DSAR [developmental SAR antenna] for RADARSAT II — *supporting Earth Observation and Space Technology;*

- environmental testing of Space Science's experimental facilities, including the Aquatic Research Facility (ARF), the Commercial Float Zone Furnace (CFZF), the Queen's University Experiment on Liquid Diffusion (QUELD II), Measurement of Pollution in the Troposphere (MOPITT), the thermal plasma analyser (TPA) and Neurolab Visual Coordination Facility (VCF) – *(supporting Space Science)*;

- environmental testing of the Canadian Astronaut Program's experiments and payloads, such as the space debris shield, the Microgravity Isolation Mount (MIM), and the Advanced Space Vision System (ASVS) — *supporting the Canadian Astronaut Program;*

- initiated practical-test phase of ESA's electrostatic discharge (ESD) characterization R&D program (ESD aspects of satellite design) with Matra Marconi Space, France — *supporting Space Technology;*

- participated in the systems engineering and technical assistance portion of Telesat Canada's consulting contract with NSPO, Taiwan, for the integration and test of the Taiwanese *Rocsat 1* satellite — *supporting development of the Canadian space industry;* and

- hosted about 400 registered visitors representing national and international delegations, serving to augment the international recognition of Canadian capabilities in space-based technology — *supporting increased awareness of and education on the importance of space.*

Appendix 4 — Additional Financial Information

4.1 Net Program Expenditures by Business Line

Financial Requirements 1997–98

(thousands of dollars)

				Spending Authorities	
	Gross Expenditures Total	**Revenues Credited to the Vote**	**Total Ministry Main Estimates**	**Statutory Expenditures**	**Voted Appropriations Non-Statutory Expenditures**
Canadian Space Agency					
Business Lines					
Earth Observation	30,984	(7,403)	23,581	(398)	23,183
Satellite Communications	24,911	0	24,911	(197)	24,714
Canadian Space Station Program	51,217	0	51,217	(716)	50,501
Canadian Astronaut Program	6,775	0	6,775	(234)	6,541
Space Science	29,858	0	29,858	(418)	29,440
Space Technology	28,662	0	28,662	(701)	27,961
Executive and Horizontal Coordination	19,533	0	19,533	(1,023)	18,510
Total Program	**191,940**	(7,403)	**184,537**	(3,687)	**180,850**
Revenue Credited to the Vote	(7,403)				
Other Revenues and Expenditures					
Revenue credited to the Consolidated Revenue Fund	(428)		(428)		
Estimated cost of services provided without charge by other Government departments	1,554		1,554		
Net Program Expenditures	**185,663**		**185,663**		

Appendix 4 — Additional Financial Information

4.2 Revenues and Expenditures

4.2.1 Gross and Net Departmental Expenditures by Business Line ($000)

	Estimates 1996–97	Estimates 1997–98	Planned 1998–99	Planned 1999–2000
Gross Expenditures by Business Lines				
Earth Observation	51,325	30,984	37,729	33,176
Satellite Communications	14,889	24,911	21,732	8,746
Canadian Space Station Program	85,858	51,217	21,308	11,480
Canadian Astronaut Program	8,783	6,775	6,705	4,690
Space Science	33,464	29,858	28,382	23,296
Space Technology	23,566	28,662	24,906	24,357
Executive and Horizontal Coordination	17,638	19,533	18,307	17,625
Total Gross Expenditures	**235,523**	**191,940**	**159,069**	**123,370**
Less:				
Revenues Credited to the Vote				
Revenues Credited to the Consolidated Revenue Fund by Business Lines				
Earth Observation	(8,600)	(7,403)	(14,700)	(16,400)
Satellite Communications	(87)	(37)	(30)	(26)
Canadian Space Station Program	(133)	(275)	(305)	(292)
Canadian Astronaut Program	(42)	(4)	(4)	(4)
Space Science	0	(4)	(4)	(4)
Space Technology	0	(8)	(4)	(9)
Executive and Horizontal Coordination	0	(42)	(34)	(43)
	(129)	(58)	(54)	(64)
Total Revenues Credited to the Vote and to the Consolidated Revenue Fund	**(8,991)**	**(7,831)**	**(15,135)**	**(16,842)**
Net Expenditures by Business Lines				
Earth Observation	42,638	23,544	22,999	16,750
Satellite Communications	14,756	24,636	21,427	8,454
Canadian Space Station Program	85,858	51,213	21,304	11,476
Canadian Astronaut Program	8,783	6,775	6,705	4,690
Space Science	33,464	29,858	28,382	23,296
Space Technology	23,566	28,662	24,906	24,357
Executive and Horizontal Coordination	17,509	19,475	18,253	17,561
Total Net Expenditures	**226,532**	**184,163**	**143,976**	**106,584**

Appendix 4 — Additional Financial Information

4.2 Revenues and Expenditures

4.2.1.1 Details of Revenues by Business Line ($000)

	Actuals 1994–95	Actuals 1995–96	1996–97 Estimates	1997–98 Estimates	1998–99 Planned	1999–2000 Planned
Revenue Credited to the Vote by Business Lines						
Earth Observation						
Contributions from the provinces for RADARSAT I development	1,116					
Recovery from RADARSAT International for data processor*			2,500	2,500		
Royalties			6,100	4,903	14,700	16,400
Total Credited to the Vote	**1,116**	**0**	**8,600**	**7,403**	**14,700**	**16,400**
Revenue Credited to the Consolidated Revenue Fund by Business Lines						
Earth Observation						
DFL testing service fees	393	452	87	37	30	26
Satellite Communications						
DFL testing service fees	595	1,630	133	275	305	292
Canadian Space Station Program						
DFL testing service fees	11	215	42	4	4	4
Canadian Astronaut Program						
DFL testing service fees		32		4	4	4
Space Science						
DFL testing service fees		32		8	4	9
Space Technology						
DFL testing service fees	21	130		42	34	43
Executive and Horizontal Coordination						
DFL testing service fees	43	338	117	46	42	52
Rental fees	6	18	12	12	12	12
Miscellaneous	1	2				
Total credited to CRF	**1,070**	**2,849**	**391**	**428**	**435**	**442**
Total Program Revenues	**2,186**	**2,849**	**8,991**	**7,831**	**15,135**	**16,842**

* The 1996–97 actual recovery from RSI for the data processor are $7.5 M.

Appendix 4 — Additional Financial Information

4.2 Revenues and Expenditures

4.2.2 Transfer Payments by Business Line ($000)

	Actuals 1994–95	Actuals 1995–96	1996–97 Estimates	1997–98 Estimates	1998–99 Planned	1999–2000 Planned
Grants by Business Lines						
Space Science	300	150	150	150	0	0
Space Technology	178	317	875	750	890	890
Executive and Horizontal Coordination	152	271	365	231	225	225
Total Grants	**630**	**738**	**1,390**	**1,131**	**1,115**	**1,115**
Contributions Business Lines						
Earth Observation	15,442	16,199	18,475	11,190	8,480	5,298
Satellite Communications	8,213	5,549	10,398	15,577	12,544	1,358
Space Technology	8,873	9,782	9,057	8,284	6,325	6,186
Executive and Horizontal Coordination	344	375	270	145	145	146
Total Contributions	**32,872**	**31,905**	**38,200**	**35,196**	**27,494**	**12,988**
Total Grants and Contributions	**33,502**	**32,643**	**39,590**	**36,327**	**28,609**	**14,103**

Appendix 4 — Additional Financial Information

4.2 Revenues and Expenditures

4.2.2.1 Details of Transfer Payments by Business Line ($000)

	Actuals 1994–95	Actuals 1995–96	1996–97 Estimates	1997–98 Estimates
Grants by Business Lines				
Space Science				
Grants to Ryerson Polytechnical University	300	150	150	150
Space Technology				
Grants for space-research partnerships	134	219	600	500
Grants for scholarships for space-related research	44	98	125	150
Grants for postdoctoral fellowships	0	0	150	100
Executive and Horizontal Coordination				
Internal Space University	100	190	175	175
Grants for promotion of the CSP and commercial exploitation of space technology	52	77	55	0
Grants for the Youth Awareness Program	0	4	35	56
Awards and Recognition Program	0	0	100	0
Total Grants	**630**	**738**	**1,390**	**1,131**
Contributions by Business Lines				
Earth Observation				
Contribution to ESA's Earth Observation Preparatory Program	1,082	1,379	1,181	1,279
Contribution to ESA's European Remote Sensing Satellite Program I	3,958	3,208	2,480	0
Contribution to ESA's European Remote Sensing Satellite Program II	4,045	3,353	4,193	0
Contribution to ESA's Preparatory Program of the first Polar Orbit Earth Observation Mission Program	6,357	8,259	10,621	9,911
Satellite Communications				
Contribution to ESA's Payload and Spacecraft Development and Experimentation Program	2,758	49	0	0
Contribution to ESA's Data Relay and Technology Mission Program	1,689	1,384	2,255	1,041
Contribution to ESA's Advanced Systems and Technology Program	705	835	869	0
Contribution to ESA's Advanced Research in Telecommunications Systems Program	3,061	3,281	7,274	14,536
Space Technology				
Contribution to ESA's General Support Technology Program	0	958	440	419
Contribution to ESA's Data Users Program	0	0	210	0
Contribution to ESA's European Manned Space Program	1,003	777	0	0
Contribution to ESA's general budget	7,870	8,047	8,407	7,865
Executive and Horizontal Coordination				
Contributions for promotion of the CSP and commercial exploitation of space technology	344	375	245	0
Contributions for the Youth Awareness Program	0	0	25	145
Total Contributions	**32,872**	**31,905**	**38,200**	**35,196**
Total Grants and Contributions	**33,502**	**32,643**	**39,590**	**36,327**

Appendix 4 — Additional Financial Information

4.2 Revenues and Expenditures

4.2.3 Revolving Funds

Canadian Space Agency does not have revolving funds.

Appendix 4 — Additional Financial Information

4.2.4 List of Related Tax Incentives

Canadian Space Agency does not have Related Tax Incentives.

Appendix 4 — Additional Financial Information

4.2 Revenues and Expenditures

4.2.5 Presentation by Standard Object ($000)

	Actuals 1994–95	Actuals 1995–96	1996–97 Estimates	1997–98 Estimates	1998–99 Planned	1999–2000 Planned
Personnel						
Salaries and wages	20,738	22,124	21,855	**21,689**	21,168	20,865
Contributions to employee benefit plans	2,970	3,123	3,169	**3,687**	3,599	3,547
	23,708	**25,247**	**25,024**	**25,376**	**24,767**	**24,412**
Goods and Services						
Transportation and communications	4,831	5,517	4,526	3,529	3,020	2,285
Information	819	1,296	1,016	761	732	395
Professional and special services	76,194	88,351	35,771	30,511	29,086	27,241
Rentals	846	570	382	536	501	457
Purchased repair and upkeep	1,377	3,119	2,372	1,849	1,749	1,690
Utilities, materials and supplies	3,770	3,750	4,276	3,269	2,964	2,253
Other subsidies and payments	304	13,111	30	2,267	2,264	2,231
	88,141	**115,714**	**48,373**	**42,722**	**40,316**	**36,552**
Capital	**173,352**	**124,015**	**122,536**	**87,515**	**65,377**	**48,303**
Transfer Payments						
Grants	630	738	1,390	1,131	1,115	1,115
Contributions	32,872	31,905	38,200	35,196	27,494	12,988
	33,502	**32,643**	**39,590**	**36,327**	**28,609**	**14,103**
Gross Expenditures	**318,703**	**297,619**	**235,523**	**191,940**	**159,069**	**123,370**
Less: Revenues Credited to the Vote	(1,116)	0.00	(8,600)	(7,403)	(14,700)	(16,400)
Net Budgetary Expenditures	**317,587**	**297,619**	**226,923**	**184,537**	**144,369**	**106,970**

Appendix 4 — Additional Financial Information

4.3 Assets

4.3.1 Summary of Loans and Investments

Canadian Space Agency does not have loans and investments.

Appendix 4 — Additional Financial Information

4.4 Liabilities

4.4.1 List of Contingent Liabilities

As of March 31, 1996, Canadian Space Agency does not have Contingent liabilities.

Appendix 5 — Statutes Administered by the Canadian Space Agency

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

Appendix 6 — References

Abbreviations and Acronyms

A

ACOA	Atlantic Canada Opportunities Agency
AI&T	Assenbly, integration and test
ARF	Aquatic Research Facility
ARTES	Advance Research in the Telecommunications Systems Program
ASTP	Advance Systems and Technology Program
ASVS	Advanced Space Vision System

C

CCRS	Canada Centre for Remote Sensing
CFZF	Commercial Float Zone Furnace
CNES	Centre national d'études spatiales français (French Space Agency)
CPA	cold plasma analyser
CRC	Communications Research Centre
CSA	Canadian Space Agency
CSP	Canadian Space Program
CSVS	Canadian Space Vision Program

D

DA	Departmental Approval
DFL	David Florida Laboratory
DND	Department of National Defence
DUP	Data User Program

E

EMC	elecromagnetic compatibility
EOPP	Earth Observation Preparatory Program
EPA	Effective Program Approval
ERS-01/02	European Remote Sensing
ESA	European Space Agency
ESD	electrostatic discharge

F

FORD-Q	Federal Office of Regional Development–Quebec
FBI	Federal Building Initiative
FTE	full-time equivalent
FUME	Far Ultraviolet Spectropscopic Explorer

G

GSTP	General Support Technology Program

I

IGA	Intergovernmental Agreement
IML-1 & 2	International Microgravity Laboratories

J

JPL	Jet Propulsion Laboratory

L

LTSP II	Long Term Space Plan II

M

MBS	Mobile Base System
MCP	major Crown project
MIM	Microgravity Isolation Mount
MMLC	Multimedia Learning Centre
MOPITT	Measurement of Pollution In the Troposphere
MOTS	Mobile Operations Training Simulator
MOU	memorandum of understanding
MRC	Medical Research Council of Canada
MSAT	Mobile Satellite
MSS	Mobile Servicing System
MSTP	European Manned Space Program

N

NASA	National Aeronautics and Space Administration
NRC	National Research Council of Canada
NSERC	Natural Sciences and Engineering Research Council of Canada

O

OPF	Operation Plan Framework
OSIRIS	Optical Spectrograph and Infrared Imaging System

P

PAS	Program Activity Structure
PIM	passive intermodulation measurement
POEM/ENVISAT	Polar Orbit Earth Observation Mission
PPA	Preliminary Project Approval
PRAB	Program Review Approval Board
PSDE	Payload and Spacecraft Development and Experimentation
PWGSC	Public Works and Government Services Canada

Q

QUELD	Queen’s University Experiment on Liquid Diffusion

R

RF	radio frequency
RSI	RADARSAT International Inc.

S

SAR	Synthetic Aperture Radar
SIFAC-95	Space Industry Forum in Atlantic Canada
SME	small- and medium-scale enterprise

SMS	suprathermal ion mass spectrometer
SOSC	Space Operations Support Centre
SPDM	Special Purpose Dextrous Manipulator
SRMS	Space Remote Manipulator Simulator
SSRMS	Space Station Remote Manipulator System
STACI	Space Technology Atlantic Canada Initiative
STEAR	Strategic Technologies for Automation and Robotics
STS-77 & 78	Space Transportation System
SVS	Space Vision System

T

TMI	Telesat Mobile International
TPA	thermal plasma analyser

U

UARS	Upper-Atmospheric Research Satellite

V

VCF	Visual coordination facility
VOTE	Virtual Operations Training Environment
VSOP	Very Long Baseline Interferometry Space Observatory Project

W

WED	Western Economic Diversification
WINDII	Wind Imaging Interferometer