Canadian Space Agency

2015–16

Departmental Performance Report
Sub-Programs and Sub-Sub-Programs

Table of Contents

Program 1.1: Space Data, Information and Services

Sub-Program 1.1.1: Earth Orbit Satellite Missions and Technology

Description

This Sub-Program encompasses the development of complete Canadian satellite systems or of sub-systems, payloads, instruments or other components provided to domestic and foreign satellites. This Sub-Program also includes the development of advanced technologies that could shape or determine the nature of potential new Earth orbit satellite missions. This Sub-Program is necessary because Government of Canada (GoC) organizations use satellite-generated data, information and services to deliver their mandate; and so do academia to perform their research.

This Sub-Program is delivered in collaboration with GoC organizations, along with the participation of Canadian industry, academia and foreign space agencies. This collaborative effort is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
224,510,409	169,603,203	54,907,206

Refer to Sub-Sub-Programs for variance explanations.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
76.9	70.6	6.3

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. GoC organizations are using space-based data to deliver their mandate.	1. Number of GoC's programs using space data or derived information to deliver their mandate.	37	84
	2. Percentage of RADARSAT data used in program's delivery.	40% Research and Development 60% Operations	R&D: 35.7% Operations: 64.3%

Sub-Sub-Program 1.1.1.1: Earth Observation Missions

Description

This Sub-Sub-Program encompasses the definition, design, technology development, and implementation of Earth orbit satellites dedicated to producing data, information or imagery of Earth and its atmosphere, ranging from its sub-surface to its upper atmospheric layers, including space surveillance for asteroids, earth orbiting objects and space debris. This Sub-Sub-Program serves continuous operations and is necessary to produce pertinent Earth Observation data and imagery that assist with the mandate delivery of Government of Canada (GoC) organizations that deal especially with key national priorities, such as environment, climate change, weather, natural resources, sovereignty, defence, safety and security. It also provides academia with data required for its research.

This Sub-Sub-Program is delivered in collaboration with GoC organizations, along with the participation of Canadian industry, academia and foreign space agencies. This collaborative effort is formalized under contracts and partnership agreements with national, public/private and international organizations. This Sub-Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
214,221,097	164,506,979	49,714,118

The significant variance of $49.7 million is mainly attributable to the re-profiling of funds for the RADARSAT Constellation Mission (RCM) in order to meet revised project milestones.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
65.2	61,0	4.2

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Earth observation missions provide GoC organizations and academia with data and information.	1. Number of GoC programs provided with data and images from Earth Observation missions.	42	56
	2. Number of academia provided with data and images from Earth Observation missions.	19	19
	3. Number of users of Earth Observation data	250	250

Sub-Sub-Program 1.1.1.2: Communications Missions

Description

This Sub-Sub-Program encompasses the definition, design, technology development, and implementation of Earth orbit satellites dedicated to delivering continuous communications, including Navigation, Positioning and Timing (NPT) services. This Sub-Sub-Program serves continuous operations and is necessary to provide pertinent communications and NPT services that assist Government of Canada (GoC) organizations in the delivery of their mandate, particularly those locating and monitoring vehicle or ship signals, those dealing with remote communities or those managing other key national priorities, such as sovereignty, defence, safety and security.

This Sub-Sub-Program is delivered in collaboration with GoC organizations, along with the participation of Canadian industry, academia and foreign space agencies. This collaborative effort is formalized under contracts and partnership agreements with national, public/private and international organizations. This Sub-Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
4,380,384	3,201,327	1,179,057

The $1.2 million variance is mainly attributable to the delayed launch of the Maritime Monitoring and Messaging Microsatellite (M3MSat).

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
8.5	7.8	0.7

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Satellites provide communications services that respond to the expressed needs of GoC organizations	1. Number of Satellite Communication missions / instruments in operation.	1	0*
	2. Number of GoC organizations using data from Satellite Communication missions.	1	0*

* M3MSAT launch was deferred to 2016-17.

Sub-Sub-Program 1.1.1.3: Scientific Missions

Description

This Sub-Sub-Program encompasses the definition, design, technology development, and implementation of Earth orbit satellites dedicated to producing scientific data and information for research performed by Government of Canada (GoC) organizations or academia. Examples of this research are those pertaining to climate processes and space weather (solar winds and their interaction with the Earth's magnetic field). This Sub-Sub-Program is necessary to produce pertinent scientific data and information that allow GoC organizations to mitigate damage or avoid the disabling of critical ground and space infrastructure, such as pipelines, electricity networks and satellites that can sustain damage from the effects of solar winds. In addition, with their enhanced understanding of climate processes and the improved models made possible through this Sub-Sub-Program, GoC organizations are better able to provide weather and climate forecasting. Academia also uses the data and information produced through this Sub-Sub-Program to perform its own research.

This Sub-Sub-Program is delivered in collaboration with GoC organizations, along with the participation of Canadian industry, academia and foreign space agencies. This collaborative effort is formalized under contracts and partnership agreements with national, public/private and international organizations. This Sub-Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
5,908,928	1,894,897	4,014,031

The $4 million variance is mainly attributable to revised cash flow requirements and the re-profiling of funds for the Surface Water Ocean Topography satellite (SWOT) project.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
3.2	1.8	1.4

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Solar and Earth System scientific space missions reflect GoC organizations and academia priorities.	1. Number of Solar and Earth System missions/instruments in operation.	25	26
	2. Number of Canadian and international organizations participating in CSA's Solar and Earth System science missions.	130	66*

* Based on partial survey information available at the time of reporting.

Sub-Program 1.1.2: Ground Infrastructure

Description

This Sub-Program includes the development, installation and use of an integrated and coordinated national system of ground infrastructure to receive data from domestic or foreign satellites. In addition, the ground infrastructure houses and uses the equipment required for satellite operations. This Sub-Program is necessary to operate satellites as well as to process and make available space-based data received by the Canadian Space Agency to assist Government of Canada (GoC) organizations in delivering their mandate. Finally, this Sub-Program capitalizes on Canada's geographical advantage by capturing space data from the increasing number of satellites flying over the Arctic and by installing ground stations in this strategic location.

This Sub-Program is delivered with the participation of industry, GoC organizations and foreign space agencies. This collaborative effort is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
16,575,512	13,350,420	3,225,092

Refer to Sub-Sub-Programs for variance explanations.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
24.4	23.0	1.4

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Expressed Canadian and foreign data needs are fulfilled by ground infrastructure.	1. Percentage of acquisitions request fulfilled.	RADARSAT-2: 85% SCISAT: 85% NEOSSat: 70%	RADARSAT-2: 83% SCISAT: 99% NEOSSat: 71%
	2. Ratio of acquisitions request fulfilled to missions acquisition requirements.	RADARSAT-2: 50% SCISAT: 80% NEOSSat: 65%	RADARSAT-2: 83% SCISAT: 99% NEOSSat: 71%
2. National ground infrastructure is reliable.	1. Percentage of successful satellite contacts.	90%	96%

Sub-Sub-Program 1.1.2.1: Satellite Operations

Description

This Sub-Sub-Program encompasses the Telemetry, Tracking and Command (TT&C) of Canadian satellites or of foreign satellites when such services are required from Canadian stations. It also includes the development, installation and use of ground infrastructure that processes the data and operates satellites. This Sub-Sub-Program is necessary to render orbiting satellites functional.

The operations of Canadian Space Agency (CSA) satellites are mostly conducted with CSA equipment located in Canada. In some instances, formal arrangements can be concluded between CSA, Canadian industry, Government of Canada (GoC) organizations or international partners to operate one party's satellites using another party's equipment. Those arrangements can also provide for the location of one party's equipment in another party's facilities.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
11,275,576	8,280,682	2,994,894

The $3 million variance shown in the Budgetary Financial Resources table is mainly attributable to revised cash flow requirements resulting from delays in the contract issuance for the Multi-Mission Operations Center as well as the decision not to build the antenna for the Northern Ground Station (NGS).

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
19.9	20.2	(0.3)

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. CSA's satellites are functioning as per operational requirements.	1. Percentage of system availability.	SCISAT: 90% NEOSSat: 80%	SCISAT: 99% NEOSSat: 83%
	2. Number of Canadian satellites operated by CSA as per operational requirements.	2 SCISAT and NEOSSat	2 SCISAT and NEOSSat
2. Foreign satellite missions are supported.	1. Number of foreign satellites supported.	2	6

Sub-Sub-Program 1.1.2.2: Data Handling

Description

This Sub-Sub-Program includes a coordinated national approach to determine optimal station locations and space data handling. This Sub-Sub-Program is necessary for the planning and tasking of data acquisition, as well as the capture, calibration, cataloguing, archiving and availability of space data received from domestic or foreign satellites to assist Government of Canada (GoC) organizations in delivering their mandate.

Data handling operations are mostly conducted with Canadian Space Agency (CSA) equipment, located in its ground facilities. In some instances, formal arrangements can be concluded between CSA, GoC organizations or international partners to use another party's equipment located within its facilities. This Sub-Sub-Program is delivered with the participation of Canadian industry, foreign space agencies and GoC organizations. This collaborative effort is formalized under contracts and partnership agreements with national, public/private and international organizations. This Sub-Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
5,299,936	5,069,738	230,198

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
4.5	2.8	1.7

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Satellite data provided to GoC organizations and academia.	1. Number of RADARSAT-2 images delivered to GoC organizations and other customers.	25,000	27,997
	2. Number of validated and used instruments in Sun-Earth system sciences.	26	26

Sub-Program 1.1.3: Space Data, Imagery and Services Utilization Development

Description

This Sub-Program develops utilization of space-based data, imagery and information, and of communications services available on space assets for the benefit of the user community, primarily Government of Canada (GoC) organizations and academia. This Sub-Program is necessary to foster the development of a Canadian value-added industry that turns space data and information into readily useable products, as well as to increase the ability of GoC organizations to use space-based solutions (data, information and services) for the delivery of their mandate and to increase the ability of academia to perform their research.

This Sub-Program engages the participation of the Canadian space industry and academia and is formalized under contracts and partnership agreements with national, public/private and international organizations.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
18,523,080	26,233,438	(7,710,358)

Refer to Sub-Sub-Programs for variance explanations.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
6.8	9.0	(2.2)

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. GoC organizations are using space-based solutions to deliver their mandate.	1. Number of GoCs programs using developed applications or derived information.	14	38
	2. Average number of programs using each developed applications.	3	3.16
2. The Canadian scientific community uses space-based data to conduct their research.	1. Number of peer-reviewed papers related to data utilization produced in academia and R&D community in Canada.	[1]SOAR: 10 [2]SESS: 220	251

[1] SOAR: Science and Operational Applications Research

[2] SESS: Sun-Earth System Science

Sub-Sub-Program 1.1.3.1: Earth Observation Data and Imagery Utilization

Description

This Sub-Sub-Program develops the utilization of Earth observation imagery and atmospheric data acquired from Canadian and foreign space assets, ranging from its subsurface to its upper atmospheric layers. This also applies to weather and climate imagery. This Sub-Sub-Program is necessary to broaden the applicability of currently available Earth observation space products and services (optimization) or to create new ones (innovation) for the user community (Government of Canada (GoC) organizations and academia).

This Sub-Sub-Program engages the participation of the Canadian space industry and academia and is formalized under contracts and partnership agreements with national, public/private and international organizations. This Sub-Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
10,186,176	16,987,925	(6,801,749)

The $6.8 million variance is mainly attributable to revised cash flow requirements for the provision of value-added satellite reports/images for humanitarian needs.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
6.3	7.5	(1.2)

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Enhanced GoC organizations ability to turn Earth Observation data into products and services.	1. Number of Earth Observation data utilization activities supported.	GRIP:[3] 17	17
2. Canadian industry ability to turn Earth Observation data into products and services.	1. Number of Earth Observation data utilization activities supported.	EOADP:[4] 28	30
3. The scientific community produces new ideas to turn Space data into products and services.	1. Number of Earth Observation data utilization activities supported.	SOAR:[5] 168	188

[3] GRIP: Government Related Initiatives program

[4] EOADP: Earth Observation Application Development program

[5] SOAR: Science and Operational Applications Research

Sub-Sub-Program 1.1.3.2: Communications Services Utilization

Description

This Sub-Sub-Program develops the utilization of space communications, including Navigation, Positioning and Timing (NPT) services available through Canadian and foreign satellites. This Sub-Sub-Program is necessary to broaden the applicability of currently available communications services (optimization) or to create new ones (innovation) for Government of Canada (GoC) organizations.

This Sub-Sub-Program engages the participation of the Canadian space industry and is formalized under contracts and partnership agreements with national, public/private and international organizations. This Sub-Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
8,336,904	8,498,673	(161,769)

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
0.5	1.3	(0.8)

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Enhanced GoC organizations ability to use communications space assets.	1. Number of communications application development activities supported.	0	0

In 2015–16, the CSA continued to assess the current state-of-the-art usage of Space-based Automatic Identification System (S-AIS) data within the GoC user community to identify needs, gaps and level of interest in S-AIS technologies and data. Hence, the application development activities in the communications field did not resume.

Sub-Sub-Program 1.1.3.3: Scientific Data Utilization

Description

This Sub-Sub-Program develops the utilization and validates the quality of Canadian and foreign space-based scientific data and derived information that address science questions, such as those related to our understanding of the Earth's climate system and magnetic field (magnetosphere). This Sub-Sub-Program involves the collaboration of Canadian scientists from Government of Canada (GoC) organizations and academia. This Sub-Sub-Program is necessary to broaden the applicability of currently available space scientific data (optimization) or to create new ones (innovation) for GoC organizations and academia, especially in weather forecasts, climate change and space weather.

This Sub-Sub-Program engages the participation of the Canadian space industry, academia and GoC organizations scientists, and is formalized under contracts and partnership agreements with national, public/private and international organizations. This Sub-Sub- Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
0	746,840	(746,840)

The $0.7 million variance is mainly attributable to complementarity between the phases and the investment objectives for the scientific support. The planned spending was identified in sub-sub-programs 1.1.1.3 and 1.1.2.2, whereas it should have been identified in 1.1.3.3. This issue has since been rectified.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
0	0.2	(0.2)

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Enhanced scientific community ability to use scientific data.	1. Number of Solar and Earth System scientific data utilization activities supported.	8	16

Program 1.2: Space Exploration

Sub-Program 1.2.1: International Space Station (ISS)

Description

This Sub-Program uses the International Space Station (ISS) - a unique Earth orbiting laboratory - to learn to live and work in space while conducting scientific, medical and engineering studies. It includes the assembly and maintenance of the ISS through the use of the Canadian Mobile Servicing System (MSS) and the design, development and operations of payloads and technological demonstrations aboard the ISS. This Sub-Program is necessary to generate specific understanding and technological advances to prepare for the challenges of space exploration and for terrestrial benefits. This Sub-Program provides Canadian industry and academia privileged access to the ISS.

This Sub-Program is performed in collaboration with Government of Canada (GoC) organizations and foreign space agencies. This collaborative effort is captured under contracts, contributions, grants and/or international partnership agreements.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
83,310,375	66,117,824	17,192,551

Refer to Sub-Sub-Programs for variance explanations.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
100.1	88.5	11.6

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Development of operational and technological know-how related to long-duration space missions (with potential Earth application) acquired through participation in ISS operations and laboratory missions.	1. Number of Canadian missions / solutions / instruments flown on ISS.	10	17
	2. Percentage of Canadian missions / solutions / instruments flown on ISS that met their mission requirements.	100%	100%
2. Canada, a well-positioned partner, influences the ISS program direction.	1. Number of CSA's participation in ISS program boards and panels.	67	64

Sub-Sub-Program 1.2.1.1: International Space Station Assembly and Maintenance Operations

Description

This Sub-Sub-Program includes the provision and operation of the Canadian Mobile Servicing System (MSS), composed of three Canadian robots - Canadarm2, Dextre and the Mobile Base System. MSS operations and maintenance services are conducted by Canadian or foreign astronauts on board the International Space Station (ISS) and by ground controllers and engineers located in established facilities at the Canadian Space Agency (CSA) and the National Aeronautics and Space Administration (NASA) - Johnson Space Center. This Sub-Sub-Program also includes the provision of specialized MSS training, systems engineering and software services, flight procedures development as well as the facility infrastructure necessary to operate the MSS through its life cycle.

This Sub-Sub-Program is necessary to fulfill Canada's ongoing commitment to the international partnership to assemble and maintain the ISS, a legally binding obligation under the Canadian Civil International Space Station Agreement Implementation Act. This Sub-Sub-Program is funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
71,544,759	62,638,657	8,906,102

The $8.9 million variance is mainly attributable to the re-profiling of funds in order to meet the cash flow requirements for the Common Systems Operations Costs segment and for the Mobile Servicing System Replacement Cameras and Dextre Deployable Vision System projects related to the ISS.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
82.0	75.6	6.4

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. The Canadian contribution (Mobile Servicing System) meets the planned operational requirements identified in the ISS Increment Definition Requirements Document (IDRD) in accordance with the Intergovernmental Agreement (IGA) and the NASA/CSA MOU.	1. Percentage of operational requirements fulfilled.	100%	100%

Sub-Sub-Program 1.2.1.2: International Space Station Utilization

Description

This Sub-Sub-Program encompasses the implementation of scientific, operational, medical and technological studies in specific areas, such as life sciences, radiation, material or fluid sciences, to be conducted aboard the International Space Station (ISS) by Government of Canada (GoC) organizations, academia or the private sector. The ISS offers said organizations the advantages of an orbiting platform with human presence and prolonged microgravity exposure. This Sub-Sub-Program is necessary for testing novel technologies and conducting scientific studies in the unique environment of the ISS, leading to a better understanding of long-duration space missions and to potential terrestrial benefits.

This Sub-Sub-Program is performed in collaboration with GoC organizations and foreign space agencies. This collaborative effort is captured under contracts and/or international partnership agreements. This Sub-Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
11,765,616	3,479,167	8,286,449

The $8.3 million variance is mainly attributable to the re-profiling of funds in order to meet the cash flow requirements for the Life Science Research System project related to the ISS.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
18.1	12.9	5.2

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Optimal utilization of the International Space Station (ISS).	1. Percentage of programmatic objectives achieved through ISS utilization.	80%	80%
	2. Number of Canadian stakeholders involved in activities on the ISS.	9	9
	3. Proportion of ISS resources used.	95%	87%

Sub-Program 1.2.2: Exploration Missions and Technology

Description

This Sub-Program encompasses the development and use of astronomy and planetary missions as well as the development of advanced exploration technologies. This Sub-Program is necessary as it contributes valued Canadian signature technologies to international space exploration endeavours and generates a better understanding of the universe, the solar system and our home planet. It could also lead to technology transfers for terrestrial benefits. This Sub-Program provides Canadian industry and academia with unique opportunities through their participation in international space exploration initiatives.

This Sub-Program is performed in collaboration with foreign space agencies, Government of Canada (GoC) organizations and through CSA participation in international groups, such as the International Space Exploration Coordination Group. This collaborative effort takes shape under contracts, grants, contributions and/or international partnership agreements.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
24,666,216	25,609,063	(942,847)

Refer to Sub-Sub-Programs for variance explanations.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
54.8	51.5	3.3

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Technological know-how is acquired through Space Exploration endeavours (Astronomy and Planetary).	1. Proportion of the CSA's missions / solutions / instruments that met their mission performance requirements at acceptance review and/or at commissioning.	1/1	2/2*
2. Canada maintains a strategic positioning which supports its capacity to influence space exploration missions and decision-making processes in key international space exploration forums.	1. Number of CSA sponsored Highly Qualified Personnel (HQP) nominated on International Space Exploration decision bodies.	10	17
3. CSA's participation in space exploration missions provides access to scientific data about the Solar system and the Universe.	1. Number of CSA's sponsored space astronomy and planetary missions providing data to Canadian scientific community.	4	5

*OSIRIS-REx Laser Altimeter (OLA) and the Canadian ASTRO-H Metrology System (CAMS) at acceptance reviews

Sub-Sub-Program 1.2.2.1: Space Astronomy Missions

Description

This Sub-Sub-Program encompasses the definition, design, technology development, implementation and use of Canadian scientific instruments and signature technologies made available to Canadian and international space astronomy missions. This Sub-Sub-Program is necessary to perform space astronomy investigations and generate data and new knowledge about the universe.

This Sub-Sub-Program is performed in collaboration with foreign space agencies, Government of Canada (GoC) organizations and through consultations with the Canadian astronomical community. This collaborative effort takes shape under contracts and/or international partnership agreements. This Sub-Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
6,089,504	7,419,585	(1,330,081)

The $1.3 million variance is mainly attributable to additional funding received from the Capital Budget Carry-forward mechanism for the OSIRIS-REx Laser Altimeter (OLA) project.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
8.1	6.0	2.1

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Canadian know-how and expertise allow Canada to lead or participate in international space astronomy missions.	1. Number of technological and scientific solutions being developed by the CSA in the context of astronomy missions.	1	2*

* James Webb Space Telescope and the Canadian ASTRO-H Metrology System

Sub-Sub-Program 1.2.2.2: Planetary Missions

Description

This Sub-Sub-Program encompasses the definition, design, technology development, implementation and use of Canadian scientific instruments and signature technologies made available to international exploration missions. The Sub-Sub-Program is necessary to reach exploration destinations such as planets and asteroids or new exploration platforms to conduct planetary science investigations, to generate data and new knowledge and to conduct engineering and/or planetary resource management activities.

This Sub-Sub-Program is performed in collaboration with the international space exploration community, Government of Canada (GoC) organizations and foreign space agencies. This collaborative effort takes shape under contracts and/or international partnership agreements. This Sub-Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
6,046,952	7,587,905	(1,540,953)

The $1.5 million variance is mainly attributable to additional funding received from the Capital Budget Carry-forward mechanism for the James Webb Space Telescope project.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
10.0	9.6	0.4

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Canadian know-how and expertise allow Canada to participate in planetary exploration missions.	1. Number of technological and scientific solutions being developed by the CSA in the context of planetary missions.	1	1

Sub-Sub-Program 1.2.2.3: Advanced Exploration Technology Development

Description

This Sub-Sub-Program includes the development of advanced Canadian signature technologies to be used in potential astronomy and planetary missions that could be destined for the Moon, Mars, asteroids or other celestial bodies. This Sub-Sub-Program is necessary to shape or determine the nature of Canada's contribution to potential international exploration and astronomy missions and could lead to spin-offs. In addition, the Sub-Sub-Program includes terrestrial deployments in analogue sites that offer geological similarities with Martian or Lunar surfaces, where this technology and its operational aspects are being tested and where exploration-related science is conducted for proof of concepts.

This Sub-Sub-Program is performed in collaboration with foreign space agencies and Government of Canada (GoC) organizations and through the Canadian Space Agency participation in international groups, such as the International Space Exploration Coordination Group. This collaborative effort takes shape under contracts and/or international partnership agreements.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
12,529,760	10,601,573	1,928,187

The $1.9 million variance is mainly attributable to revised cash flow requirements resulting from delays in the contract issuance for the Space Medicine Decision Support System.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
36.7	35.9	(0.8)

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Maturing science, technology and operational solutions for planning and strategic positioning purposes.	1. Number of science, technology and operational solutions that are under development in conformity with the orientations and conclusions of the Canadian Space Exploration plan.	7	18

Sub-Program 1.2.3: Human Space Missions and Support

Description

This Sub-Program encompasses all activities required to recruit, develop, train and maintain a healthy and highly-qualified Canadian astronaut corps capable of participating in space exploration missions. It also includes all activities directed at mitigating health risks associated with those missions, such as the development of advanced technologies to be used in support of human space missions. This Sub-Program is necessary to generate specialized knowledge in fields that sustain human space flights, such as life sciences and space medicine. Furthermore, by exploring technological solutions to the various challenges of human space flight, this Sub-Program could contribute to alternate healthcare delivery mechanisms for terrestrial applications.

This Sub-Program is performed with Government of Canada (GoC) organizations and foreign space agencies. This collaborative effort is formalized under contracts, grants, contributions or international partnership agreements.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
4,431,288	4,682,911	(261,623)

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
13.7	14.8	(1.1)

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Human space flight generates “unique” health and life sciences knowledge, and technological know-how to sustain life and mitigate health risk during long-duration space flight.	1. Number of activities that lead to health risk mitigation strategies, technologies and/or countermeasures.	13	14

Sub-Sub-Program 1.2.3.1: Astronaut Training and Missions

Description

This Sub-Sub-Program encompasses activities associated with all phases of an astronaut career from recruitment to retirement, including space missions. This Sub-Sub-Program includes the management of National Astronaut Recruitment Campaigns; the implementation of individualized astronaut career management plan; the implementation of basic, advanced and mission-specific training; collateral duties assignment; space mission negotiations and assignment; as well as all the logistical, administrative and operational support activities in the pre–flight, in–flight and post–flight periods. This Sub-Sub-Program is necessary to live and work in a space environment and in order to further our understanding of human behaviour and health in space, and to conduct experiments and collect space-based scientific data useful to the science community.

This Sub-Sub-Program is performed with Government of Canada (GoC) organizations and foreign space agencies. This collaborative effort is formalized under contracts or international partnership agreements.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
2,179,328	2,174,516	4,812

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
8.1	7.0	1.1

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Canadian astronaut corps is ready to assume any responsibilities on an expedition to the International Space Station (ISS).	1. Number of astronaut activities undertaken in preparation for eventual ISS mission assignments.	4	4

Sub-Sub-Program 1.2.3.2: Operational Space Medicine

Description

This Sub-Sub-Program delivers operational and clinical healthcare activities during all phases of basic, advanced and mission-specific training as well as during the pre-flight, in-flight and post-flight periods. It also promotes and ensures the physical, mental, social well-being and safety of Canadian astronauts. This Sub-Sub-Program is necessary to ascertain the overall health of Canadian astronauts and to monitor long-term health status.

This Sub-Sub-Program is performed with Government of Canada (GoC) organizations and foreign space agencies. This collaborative effort is formalized under contracts or international partnership agreements. This Sub-Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
1,033,080	1,016,757	16,323

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
2.9	3.6	(0.7)

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Astronauts' health is optimized to meet mission requirements.	1. Number of active astronauts medically certified for ISS assignment and duties.	2	2
2. Astronauts' long-term health is monitored following their active careers.	1. Percentage of eligible astronauts participating in their long-term health monitoring.	25%	75%

Sub-Sub-Program 1.2.3.3: Health and Life Sciences

Description

This Sub-Sub-Program encompasses space medicine and life sciences activities that explore health care delivery and life sustainability solutions on future long-duration exploration missions. These benefits are targeted at the space exploration community, mainly academia and partnering agencies. This Sub-Sub-Program develops collaborative projects with academia and industry. It uses analogue sites that offer relevant similarities with the harsh environment of space, and where exploration-related medical and life science studies are conducted. This Sub-Sub-Program is necessary to identify, understand, mitigate or eliminate health risks associated with human space flights, and to understand and address the needs of humans during those missions. The solutions could also be offered as alternative healthcare delivery mechanisms for terrestrial benefits through the transfer of space technology.

This Sub-Sub-Program is performed with Government of Canada (GoC) organizations and foreign space agencies. This collaborative effort is formalized under contracts or international partnership agreements. This Sub-Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
1,218,880	1,501,638	(282,758)

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
2.7	4.2	(1.5)

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Performance of space life sciences studies with potential benefits for Canadians and to enable human exploration of space.	1. Number of studies aiming at the development of countermeasures and enhanced human performance and life support.	9	11
	2. Number of partnerships addressing potential terrestrial health care solutions.	2	2

Program 1.3: Future Canadian Space Capacity

Sub-Program 1.3.1: Space Expertise and Proficiency

Description

This Sub-Program includes the development and enhancement of Canada's space capacity. This Sub-Program supports research in private or public organizations and sustains the development of highly qualified personnel in science and engineering. We encourage scientists and engineers to perform relevant development activities in space science and technology, and to develop their know-how by offering them financial support to sustain their research project and access to infrastructure devoted to world-class research and training, among which fast execution and small-size missions offer frequent flight opportunity. This Sub-Program is necessary to create and sustain a pool of space expertise and proficiency that will form the next generation of space professionals and workers and to provide solutions for future Canadian space endeavours.

This Sub-Program is delivered with the participation of funding agencies, Government of Canada (GoC) organizations, foreign space agencies and not-for-profit organizations. This collaborative effort is formalized under national and international partnership or contracts. This Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
10,015,744	8,502,119	1,513,625

The $1.5 million variance is mainly attributable to lower costs than planned for STRATOS the stratospheric balloon campaign as well as to an internal fund reallocation to the Internal Services program following personnel reorganization.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
40.7	30.7	10.0

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. A pool of space experts and professionals is sustained and enhanced.	1. Number of scientists and engineers involved through opportunities provided by the program.	615	327*
2. Research is conducted in priority areas.	1. Number of research projects conducted through opportunities provided by the program.	32	23
3. Advancement of Science & Technology solutions for future space initiative.	1. Number of peer-reviewed papers, reports and conference proceedings acknowledging CSA support.	310	53*

* A new measurement methodology was applied; target will be adjusted accordingly in 2016-17.

Sub-Program 1.3.2: Space Innovation and Market Access

Description

This Sub-Program includes the development and enhancement of Canada's space capacity through innovation and market positioning. Through leading-edge technology and facilities, and international arrangements, the Sub-Program improves Canadian industrial competitiveness so that space users are continuously well served through constantly improving optimal and cost-effective space solutions. This Sub-Program is necessary to foster entrepreneurship that enhances Canadian industry's international positioning on commercial and government markets.

This Sub-Program is performed with industry and is formalized under contracts or contributions. Foreign space agencies are partners in this endeavour, so that Canadian industry can access foreign markets through innovation or international arrangements.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
50,543,049	49,019,307	1,523,742

Refer to Sub-Sub-Programs for variance explanations.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
25.4	22.9	2.5

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Through innovation and international arrangements, Canadian industry is well positioned on international commercial and government markets.	1. Number of Canadian companies exporting space-related goods and services.	50	73
	2. Value of Canadian space-related goods and services exported.	$1.6 billion	$1.6 billion
2. Enhanced Canadian industry competitiveness.	1. Number of Canadian companies successfully obtaining national / international work orders.	100	77*

* The measurement methodology is under review.

Sub-Sub-Program 1.3.2.1: International Market Access

Description

This Sub-Sub-Program consists in facilitating foreign market access by the Canadian space industry through negotiating, implementing and managing special international arrangements. For example, in return for Canadian Space Agency (CSA) monetary contributions to the European Space Agency (ESA) under the long-lasting ESA-Canada Agreement, Canadian industry obtains some of the contracts awarded by ESA; thus penetrating a market that would otherwise be limited to Europeans. This Sub-Sub-Program is necessary as it results in increased access to foreign government market share for Canadian industry.

This Sub-Sub-Program is delivered through concluding international agreements, trade measures, or other mutually beneficial arrangements that create a favorable political or trade environment that facilitates access to global markets. This Sub-Sub Program is funded through the European Space Agency Contributions program.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
26,720,216	28,474,260	(1,754,044)

The $1.8 million variance is mainly attributable to additional increased payments in relation to the Cooperation Agreement with the European Space Agency.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
2.5	4.2	(1.7)

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Canadian investments through the ESA Agreement allow Canadian industry to access the institutional European market.	1. Canadian industrial return coefficient (ratio between the actual value of contracts awarded by ESA to Canadian organizations and the ideal value of contracts awarded by ESA to Canadian organizations).	96% or higher	99%
2. The Canadian industry has access to flight opportunities for its space technologies and components.	1. Number of technologies or components developed by Canadian industry which have been space qualified and/or have acquired flight heritage through Canada's participation in ESA programs.	5 opportunities over the duration of the agreement (2012–19)	5

Sub-Sub-Program 1.3.2.2: Enabling Technology Development

Description

This Sub-Sub-Program consists of technology development and demonstration activities that contribute to maintaining or developing a technological edge in promising fields, such as switches, batteries, launchers, antennas, solar panels, etc. This Sub-Sub-Program is necessary as the enabling (generic) technology developed reduces costs and technological risks on multiple mission types, enhances the efficiency or performance of already established space solutions, and facilitates the commercialization of new products through innovation.

This Sub-Sub-Program is performed with industry and is formalized under contracts. This Sub-Sub-Program is also funded through the Class Grant and Contribution Program to Support Research, Awareness and Learning.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
23,822,833	20,545,047	3,277,786

The $3.3 million variance is mainly attributable to contributions being carried forward for the Space Technology Development Program.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
23.0	18.7	4.3

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Increased technological capability of Canadian industry.	1. Number of different technologies addressed.	60	85

Sub-Program 1.3.3: Qualifying and Testing Services

Description

This Sub-Program consists of specialized activities and services for the assembly, integration, and testing of space hardware and involves space qualifying technology, sub-units, units or entire spacecraft developed by Canadian academic institutions, Government of Canada (GoC) organizations, and industry, as well as international partners and clients. This Sub-Program is necessary to ensure that mission-assigned technology and entire systems can safely and reliably meet the rigors of space and to demonstrate the suitability and effectiveness of new Canadian space technology for providing valuable contributions to space missions. This provides an effective base for increasing Canada's capability to participate in future space programs.

This Sub-Program is delivered by the CSA's David Florida Laboratory on a fee-for-service basis.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2015–16 Actual Spending	2015–16 Difference (actual minus planned)
5,709,400	4,282,607	1,426,793

The $1.4 million variance is mainly attributable to internal reallocations for projects related to the International Space Station as well as to delays in the issuance of contracts.

Human Resources (FTEs)

2015–16 Planned	2015–16 Actual	2015–16 Difference (actual minus planned)
34.9	33.6	1.3

Performance Results

Expected Results	Performance Indicators	Targets	Actual Results
1. Test results of space hardware prove to be reliable in demonstrating suitability for launch and space environment.	1. Percentage of client satisfaction towards the quality of the services provided.	95% or more.	100%