THE CANADIAN SPACE AGENCY

2009-2010 Estimates

Report on Plans and Priorities

SECTION 2:

Analysis of Program Activities by Strategic Outcome

- Detailed Information -

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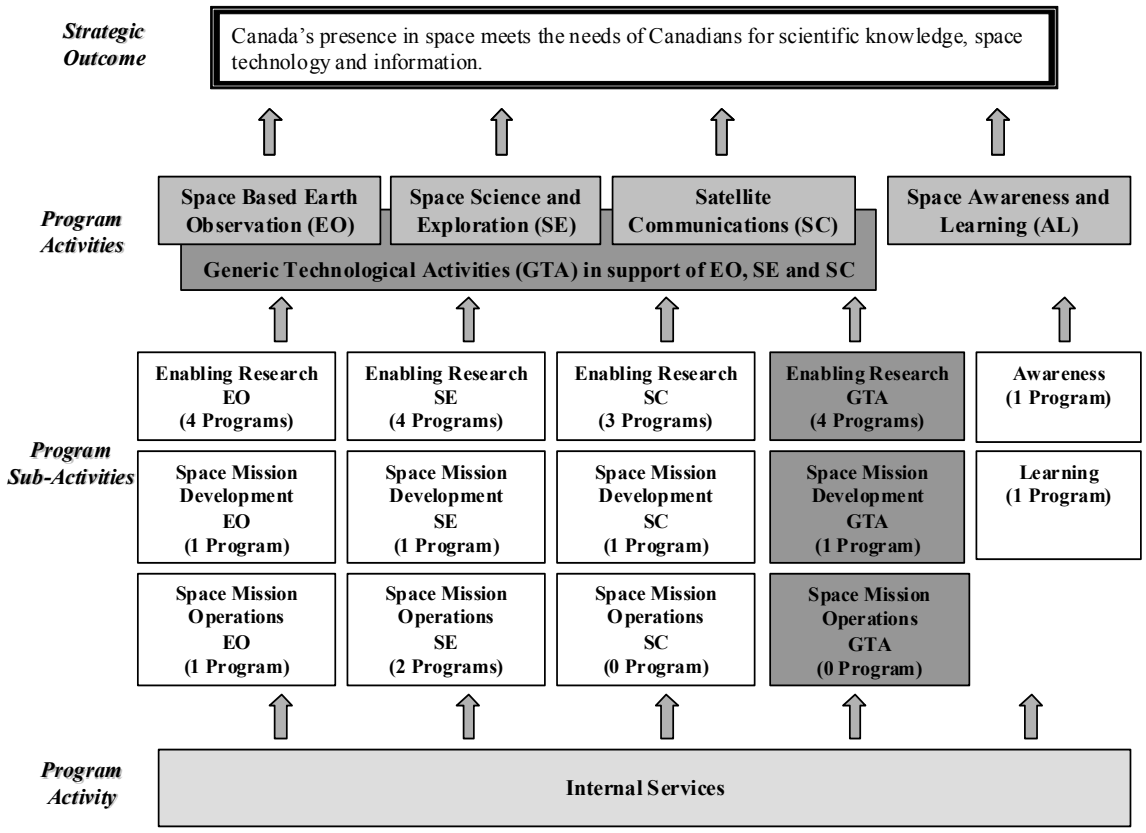
SECTION 2: ANALYSIS OF PROGRAM ACTIVITIES BY STRATEGIC OUTCOME



Description of Program Activities

The Canadian Space Agency manages its programs according to the Canadian Space Strategy which sets priorities for all space related program activities.

Space Based Earth Observation (EO): To develop and operationalize the use of Space Based Earth Observation for the benefit of Canadians, especially in the fields of environment, resource and land use management, as well as security and foreign policy.

Space Science and Exploration (SE): To better understand the Solar System and the Universe; expand our knowledge on the constituent elements and origins of life; and strengthen a human presence in space.

Satellite Communications (SC): To provide all Canadians with the means to participate and fully benefit from the global information age.

Generic Technological Activities (GTA): To provide leadership, coordination or support to Earth Observation, Space Science and Exploration, and Satellite Communications through activities that are generic in their nature since they contribute to all three program activities.

Awareness and Learning (AL): To further public understanding and engagement with regards to space related issues, ultimately leading to improving the scientific literacy of Canadians by carrying out a national awareness and learning initiative in support of the CSA programs.

Internal Services: To implement the government's commitment to modern public service management in accordance with the Management Accountability Framework's (MAF) expectations.

Description of Program Sub-Activities

Science and technology related program activities are broken down into three sub-activities, which supports the CSA in meeting the Government of Canada's Science and Technology Strategy, which outlines the conditions for success: a strong private-sector commitment to S&T, a strengthened knowledge base and, using leading-edge S&T initiatives as a magnet for talent.

Enabling Research: To provide leadership, coordination and support for basic and applied research and experimental development in line with the CSA priorities and stakeholders' expectations in order to increase the knowledge base, devise new applications through space missions, and allow the transfer of intellectual property and proven technologies to Canadian industry, academia, and government organizations.

Space Mission Development: To provide coordination and support for the development of space missions in line with CSA priorities and stakeholders' expectations through the definition, critical design, manufacturing, integration, testing and delivery phases leading to launch and early operations of space systems.

Space Mission Operations: To provide coordination or support to the operations of space missions in line with the CSA priorities and stakeholders' expectations through the development and conduct of on-orbit operations, system maintenance and logistic support, as well as data handling and delivery.

Space Awareness and Learning: This program activity has two sub-activities, which focus the CSA's initiatives on promoting an innovation culture, fostering education and the careers of young Canadians in the sciences and engineering, and attracting, developing and retaining highly qualified personnel in science and technology space related fields.

Awareness: To increase public awareness and understanding of how space programs affect and improve the quality of life.

Learning: To direct a sustained, multi-dimensional, interactive learning program to build knowledge and enhance interest in space science and technology.

Description of Program Sub-Sub-Activities

Financial, performance and management accountability information is linked at the program sub-sub-activity level. They contribute ultimately to the strategic outcome through a chain of results imbedded in corporate planning and reporting systems.

Program Activity: Space Based Earth Observation

Program Activity Priority: The program activity objective is to develop and operationalize the use of space Earth Observation (EO) for the benefit of Canadians, especially in the fields of environment, resource and land use management, as well as security and foreign policy.

SPACE BASED EARTH OBSERVATION (EO) PROGRAM ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicators**
The benefits of activities involved in Earth Observation from space serve Canadian users in the fields of environment, resource and land-use management, and security and sovereignty.	1. Proportion of active missions relative to the total number of missions supported by Canada in the EO priority areas. 2. Number of technological/scientific applications developed as a result of CSA's participation in space missions and/or support to projects/activities in EO. 3. Number of technological/scientific uses as a result of CSA's participation in space missions and/or support to projects/activities in EO.
Planning and Reporting Continuity: RPP 2008-2009 and DPR 2007-2008: http://www.asc-csa.gc.ca/asc/eng/resources/publications/default.asp#parliament	

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	85.8	85.4	105.3
HUMAN (FTEs)	78.0	64.5	59.8

To learn more about Earth Observation, go to:
http://www.asc-csa.gc.ca/asc/eng/satellites/default.asp?page=observation

The programs under this Program Activity are divided into three Sub-Activities: Enabling Research, Space Mission Development and Space Mission Operations.

Note that the program sub-activity performance measurement is identical in EO, SE and SC program activities. However, the detailed document addresses the reporting of the performance measurement at the sub-activity level individually for each program activity.

Program Sub-Activity: Enabling Research – Earth Observation

Objective: Provide leadership, coordination or support to Earth Observation (EO) applied research and experimental development in line with the CSA priorities and stakeholders expectations in order to increase the knowledge base and devise new applications through space missions, and to allow the transfer of intellectual property and proven technologies to Canadian industry, academia, and government organizations.

ENABLING RESEARCH – EARTH OBSERVATION PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicators**
New project/mission concepts that progress to subsequent development phases related to Agency's priorities.	1. Ratio of the number of new concepts presented to the number of new concepts retained for subsequent phase. 2. Quality of the concepts retained based on the average evaluation rating obtained according to the Priority Ranking Framework.
Expected Result #2	**Performance Indicator**
The CSA's in-house personnel are highly qualified, with recognized expertise, and are supported by a high-technology infrastructure that is suited to all Enabling Research projects/missions.	1. Number of consulting requests received by CSA personnel from external sources such as the private sector, academia and other space agencies.

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	23.3	27.4	27.2
HUMAN (FTEs)	14.6	14.6	14.6

1- EO Mission Concepts – Objective: Assume the leadership and support in the enabling research and development of new mission concepts leading to the realization of CSA or international Earth Observation (EO) space missions more specifically in the fields of advanced imaging technologies, atmospheric environment and climate change phenomena studies.

Expected Result #1	Performance Indicator
Industry, government and/or academia conduct mission and payload concept and feasibility studies to establish the technical and/or scientific feasibility and relevance of missions or payloads in order to enable CSA decisions on future EO space missions.	1. Number of concept / feasibility (mission and payload) and phase 0/A studies initiated, pursued or completed. (Target: 9)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	0.4	0.6	0.4
HUMAN (FTEs)	0.9	0.8	0.8

2- European Space Agency (ESA) Programs in EO – Objective: Through key international partnerships, enhance the Canadian industry's technological base and provide access to European market for value added products and services in the field of Earth Observation (EO). This is achieved through a financial contribution by the Agency to optional ESA programs in EO.

Expected Result #1	Performance Indicator
Successful development and demonstration of advanced technologies, systems, components, or studies provided for in the contracts awarded by ESA to Canadian firms under EO optional programs. (ENVISAT, EOEP, EarthWatch GMES Service Element, GMES Space Component).	1. Canadian industrial return in ESA optional programs in EO. (Target: 84% or higher)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	9.2	9.9	9.6
HUMAN (FTEs)	0.0	0.0	0.0

3- Science Programs in EO – Objective: Coordinate the Canadian Earth Observation (EO) scientific community in order to pursue world-class research space missions to advance our knowledge in the fields of atmospheric environment and climate change phenomena studies.

Expected Result #1	Performance Indicators
Identified opportunities for Canadian scientists to advance understanding and scientific knowledge of atmospheric environment through the use of space-based observations.	1. Number of scientific publications, reports and conference proceedings acknowledging CSA funding. (Target: 80) 2. Number of Highly Qualified Personnel (HQP) involved in the program. (Target: 70) 3. Number of research partnerships (nationally and internationally). (Target: 15) 4. Number of awards granted yearly under the CSA Grants & Contributions Program. (Target: 4)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	1.1	1.5	1.2
HUMAN (FTEs)	1.9	2.0	2.0

4- EO Application Development Programs – Objective: Enhance Canada's ground receiving and data processing systems, develop and demonstrate Earth Observation (EO) data value-added applications for commercial use and for Canadian government operations. This program aims in part at the private sector with some initiatives and at different federal departments with other initiatives.

Expected Result #1	Performance Indicators
Development of EO applications responding to user needs in government, industry, academia and not-for-profit organizations in the fields of environment, resource and land use management, and, security and foreign policy.	1. Number of new applications using EO data. (Targets: 22 that is 4 for EOADP and 18 for GRIP) 2. Number of new users of EO applications. (Targets: 52 that is 8 for EOADP and 44 for GRIP)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	12.7	15.5	15.9
HUMAN (FTEs)	11.8	11.8	11.8

Highlights of Expected Accomplishments – Enabling Research (EO)

- Following the successful launch of RADARSAT-2 in December 2007, the Canadian government data allocation plan will be implemented to manage the $445 million worth of prepaid data from the satellite. The objective of the program is to ensure that the allocation is effectively used by the Canadian Government. During the first year, CSA will negotiate agreements with Government departments to develop data acquisition plans. The results from the first Announcement of Opportunities (AO) will be presented at a workshop and more AO targeting Canadian remote communities will be announced.

- The Canadian Space Agency, in cooperation with the Center for South-eastern Tropical Advanced Remote Sensing (CSTARS), the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA), has launched in 2008 an International Announcement of Opportunity (AO) for researching new developments in applications of RADARSAT-1 data and innovative research and mapping applications related to ocean surface space borne SAR imagery of hurricanes. This new research will help investigators become better prepared for using the more advanced data from missions like RADARSAT-2 and other international missions in the future. An Announcement of Opportunity was circulated among the global research community and 14 proposals from Canada and other countries were received. The results from the research groups will be submitted by the end of 2009.

- Through the Earth Observation Application Development (EOADP) and the Government Related Initiatives (GRIP) Programs, the CSA will continue satellite data application development and utilization, to support the growth of Earth Observation capabilities within the Canadian Government Departments and Agencies and the service industry.

- The CSA will initiate concept studies to evaluate how Canadian and international user needs can be met using space based EO.

- The CSA will support Canadian scientists to access ESA Earth Explorer mission data and Canadian companies to participate in the development of advanced space-borne instruments and user-oriented applications through the participation in ESA Programs. For example:

    - The calibration and validation activities of the Earth Explorer Soil Moisture and Ocean Salinity (SMOS) and CryoSAT-2 missions;
    - The development of applications in the field of aquaculture, forestry and subsidence, global wetland and Polar monitoring; and
    - The development of the Electric Field Instrument, designed to monitor ionosphere for the SWARM mission.

- The CSA and ESA will contribute to the implementation of the MORSE initiative. This interagency activity aims at developing and demonstrating the usefulness of EO data for monitoring coastlines and coastal processes in the Arctic. Both agencies will issue Call for Proposals and will support research activities focusing on the information needs of Arctic coastal users in government, non-governmental, and, industrial and scientific organizations.
- The CSA will initiate a study contract to complete the assessment of the requirements of the Canadian government users for a polar satellite system as part of a joint study with Department of National Defence (DND) and Environment Canada. The concept of the Polar Communications and Weather Mission is to put a constellation of satellites in highly elliptical orbit over the North Pole to provide communication and monitoring weather services in the Arctic.

Program Sub-Activity: Space Mission Development – Earth Observation

Objective: Provide coordination or support to the development of Earth Observation space missions in line with CSA priorities and stakeholders expectations through the definition, critical design, manufacturing, integration, testing and delivery phases leading to launch and early operations of space systems.

SPACE MISSION DEVELOPMENT – EARTH OBSERVATION PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicator**
Space mission proposals that efficiently, effectively and economically progress to subsequent operations phases in accordance with objectives, requirements, initial or revised specifications.	1. Percentage of projects requiring more than one EPA (Effective Project Approval) or an amendment to initial EPA over the total number of projects.
Expected Result #2	**Performance Indicator**
The CSA's in-house personnel are highly qualified, with recognized expertise, and are supported by a high-technology infrastructure that is suited to all Space Mission Development projects.	1. Rate of expertise matrix support to all of CSA's program activities.

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	48.2	43.8	64.3
HUMAN (FTEs)	36.9	22.6	17.7

1- EO Projects – Objective: Ensure the development, delivery and commission of space-qualified systems for Earth Observation (EO) missions in the fields of advanced imaging technologies, atmospheric environment and climate change phenomena studies through effective project, quality and engineering management.

Expected Result #1	Performance Indicator
EO projects' deliverables meet mission objectives at critical steps.	1. Number of missions/projects associated with science support. (Target: 3)
Expected Result #2	**Performance Indicators**
EO projects' deliverables are met.	1. Project milestones are met as defined in the detailed work plan. (Target: 75% of milestones achieved versus planned) 2. Project cost is maintained within authorized levels. (Target: 100%) 3. Risks are identified and mitigation plans prepared for each project. (Target: 100%)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	48.2	43.8	64.3
HUMAN (FTEs)	36.9	22.6	17.7

Highlights of Expected Accomplishments – Space Mission Development (EO)

- With RADARSAT-2 being fully operational and data being regularly used by the government departments, the CSA is preparing the closure of the RADARSAT-2 Major Crown Project with the objective to submit the closure report to Treasury Board in June 2009.
- A Preliminary Design for RADARSAT Constellation, initiated in November 2008, is expected to be completed by March 2010. In parallel, the satellites' procurement will be developed with the objective of awarding a contract by the end of March 2010. This program will enhance the Canada's ability to use radar imagery for operational maritime surveillance, disaster management and ecosystem monitoring and will support the strategic objectives of Canada on security and sovereignty, particularly in the Arctic. The launch of the first satellite is planned for late 2014 followed by the other two satellites in 2015 and 2016 respectively.
- Many Canadian companies are expected to be supplying Space and Ground Segment subsystems for the missions Sentinel-1, 2 and 3 of the ESA Global Monitoring for Environment and Security (GMES) space component program. Sentinel missions are designed to provide necessary input data to be used by the GMES users, which is also expected to be very useful to Canadian Government users.

- Many Canadian companies are anticipating their participation in EarthCARE mission through ESA and JAXA (Japanese Space Agency). Canada is expected to provide components for the Multi-Spectral Imager cloud radar and microbolometer detector.

- The CSA will pursue the Chinook mission and the Stratosphere Wind Interferometer For Transport studies (SWIFT) through validation of key technology components and the assessment of partnership options. This mission is designed to study stratospheric winds and ozone flux so that medium-range weather forecasts, climate change prediction and the ozone layer recovery assessment are improved. The three-year mission is currently planned for 2016-2018.

- The CSA is developing a tandem Nanosat mission JC2Sat with JAXA. Both satellites will carry an infrared sensor but in two different frequency bands. These sensors will use innovative bolometer technology developed in Canada. The launch is planned for 2011 on a Japanese launcher.

- The CSA is also exploring partnership with NASA on JPL's (Jet Propulsion Laboratory) Earth observation missions which are complementary to the CSA program, in order to provide data to Canadian Government users on soil moisture. In 2009, the CSA will explore contribution to JPL's Soil Moisture Active Passive (SMAP) mission in order to provide direct access to the Meteorological Service of Canada about soil moisture information for the land mass of Canada over the next decade. Soil moisture information is important for weather prediction on precipitation and to predict flash floods by giving the level of soil humidity saturation.

Program Sub-Activity: Space Mission Operations – Earth Observation

Objective: Provide coordination or support to the operations of Earth Observation space missions in line with the CSA priorities and stakeholders' expectations through the development and conduct of on-orbit operations, system maintenance and logistic support, as well as data handling and delivery.

SPACE MISSION OPERATIONS – EARTH OBSERVATION PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicators**
The CSA's in-house personnel are highly qualified, with recognized expertise, and are supported by a high-technology infrastructure that is suited to all Space Mission Operations activities.	1. Annual rate of investment in maintenance and improvement of the infrastructure required for missions in operation phases. 2. Quality of the internal expertise specializing in advice and technology-watch to ensure the successful flow of missions reaching operation phases.

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	14.2	14.3	13.8
HUMAN (FTEs)	26.5	27.3	27.5

1- EO Mission Operations – Objective: Operate the space and ground segments for Earth Observation (EO) mission operations in the fields of advanced imaging technologies, atmospheric environment and climate change phenomena studies.

Expected Result #1	Performance Indicator
CSA operational satellite missions are supported in accordance with mission requirements.	1. Provision of services and infrastructures for operational EO satellite missions as per requirements. (Target: services for RADARSAT-1, RADARSAT-2 and SCISAT-1)
Expected Result #2	**Performance Indicators**
Data and images received from EO satellites are delivered in accordance with client requests.	1. Volume of data acquired or delivered as per mission requirements and resources. (Targets: 300 Gbytes from SCISAT-1; 5 000 SAR minutes from RADARSAT-1; 5 000 images from RADARSAT-2) 2. Provision of data and services in response to international agreements. (Target: 3 agreements implemented)
Expected Result #3	**Performance Indicator**
EO Space Mission Operations meet user/client needs as per mission requirements.	1. Number of missions in operational phase associated with science support. (Target: 4)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	14.2	14.3	13.8
HUMAN (FTEs)	26.5	27.3	27.5

Highlights of Expected Accomplishments – Space Mission Operations (EO)

- RADARSAT-1 operations will continue with the usual level of high performance for satellite reliability and image production, and the supply of data to Canadian Government clients from RADARSAT-2 as per client needs. With two satellites in operations data continuity to users is more assured. Moreover, a contingency plan is in place to secure the use of ENVISAT from ESA as backup in order to continue to meet the needs of operational users if Canadian satellites were unable to meet this

requirement. This contingency plan provides an equivalent back-up capability to ESA using RADARSAT 1 and 2 data.

- The CSA will ensure Canada's commitment, as an official member of the International Charter *Space and Major Disasters*, to use EO satellites in response to disasters. The CSA regularly contributes RADARSAT's data and strategic EO-derived information products upon charter activation.

- The CSA will continue to support and operate SCISAT, a Canadian mission launched in August 2003. The mission is providing a large amount of very high quality data on more than 30 chemical species in the atmosphere for climate, weather and pollution studies. Through an agreement with ESA, the data that are not accessible from Canada are received by one European and one American station therefore greatly expanding the range of coverage.

- The CSA will continue to support MOPITT and OSIRIS, two major Canadian science instruments that are currently orbiting Earth and collecting new environmental data. MOPITT, on the NASA Terra satellite, measures pollutants in the troposphere, providing a wealth of data on global pollutant monitoring and transport while OSIRIS, on the Swedish Odin satellite, measures ozone in the stratosphere and mesosphere and provides important data to assess and predict the health of the ozone layer.

- The CSA will continue to support the validation of CloudSat data. CloudSat is a NASA satellite launched in 2006 to which Canada contributed important radar components. It is designed to study the water, snow and ice content of clouds, providing data to improve climate models and weather forecasting. As part of an agreement with NASA, the CSA will continue collaborating with the Meteorological Service of Canada (MSC) to run comprehensive validation campaigns.

Program Activity: Space Science and Exploration

Program Activity Priority: The program activity objective is to better understand the Solar System and the Universe; expand our knowledge on the constituent elements and origins of life; and strengthen a human presence in space.

SPACE SCIENCE AND EXPLORATION (SE) PROGRAM ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicators**
Participation in Canadian and international missions expands the scientific knowledge base made available to Canadian academia and R&D communities in the areas of astronomy, space exploration and solar-terrestrial relations, as well as in physics and life sciences.	1. Proportion of active missions relative to the total number of missions supported by Canada in the SE priority areas. 2. Number of scientific/technological applications developed as a result of CSA's participation in space missions and/or support to projects/activities in SE. 3. Number of peer-reviewed papers produced in academia and the R&D community in Canada recognizing CSA's support through its participation in space missions and/or support to projects/activities in SE.
Planning and Reporting Continuity: RPP 2008-2009 and DPR 2007-2008: http://www.asc-csa.gc.ca/asc/eng/resources/publications/default.asp#parliament	

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	143.3	117.6	103.8
HUMAN (FTEs)	191.9	183.1	178.2

To learn more about Space Science and Exploration, go to:
http://www.asc-csa.gc.ca/asc/eng/sciences/default.asp and,
http://www.asc-csa.gc.ca/asc/eng/exploration/default.asp

The programs under this Program Activity are divided into three Sub-Activities: Enabling Research, Space Mission Development and Space Mission Operations.

Note that the program sub-activity performance measurement is identical in EO, SE and SC program activities. However, the detailed document addresses the reporting of the performance measurement at the sub-activity level individually for each program activity.

Program Sub-Activity: Enabling Research – Space Science and Exploration

Objective: Provide leadership, coordination or support to Space Science and Exploration (SE) applied research and experimental development in line with the CSA priorities and stakeholders expectations in order to increase the knowledge base and devise new applications through space missions, and to allow the transfer of intellectual property and proven technologies to Canadian industry, academia, and government organizations.

ENABLING RESEARCH – SPACE SCIENCE AND EXPLORATION PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicators**
New project/mission concepts that progress to subsequent development phases related to Agency's priorities.	1. Ratio of the number of new concepts presented to the number of new concepts retained for subsequent phase. 2. Quality of the concepts retained based on the average evaluation rating obtained according to the Priority Ranking Framework.
Expected Result #2	**Performance Indicator**
The CSA's in-house personnel are highly qualified, with recognized expertise, and are supported by a high-technology infrastructure that is suited to all Enabling Research projects/missions.	1. Number of consulting requests received by CSA personnel from external sources such as the private sector, academia and other space agencies.

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	44.5	42.5	42.4
HUMAN (FTEs)	47.6	43.7	39.3

1- SE Mission Concepts – Objective: Assume the leadership and support in the enabling research and development of new mission concepts leading to the realization of CSA or international Space Science and Exploration (SE) missions.

Expected Result #1	Performance Indicators
Industry, government and/or academia conduct mission and payload concept and feasibility studies to establish the technical and/or scientific feasibility and relevance of missions or payloads in order to enable CSA decisions on future SE space missions.	1. Number of concept/feasibility (mission and payload) and phase 0/A studies initiated, pursued or completed. (Target: 24) 2. Number of analogue mission deployments realised. (Target: 2)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	21.4	20.1	22.2
HUMAN (FTEs)	13.6	11.5	7.8

2- ESA Programs in SE – Objective: Through key international partnerships, foster the participation of Canadian academia and the demonstration of Canadian space technologies in European Space Science and Exploration (SE) missions. This is achieved through a financial contribution by the Agency to optional ESA programs in SE.

Expected Result #1	Performance Indicator
Successful development and demonstration of advanced technologies, systems, components, or studies provided for in the contracts awarded by ESA to Canadian firms under Human and robotics exploration programs, including ISS sciences. (Space Exploration, ELIPS program).	1. Canadian industrial return in ESA optional programs in SE. (Target: 84% or higher)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	10.1	9.4	6.7
HUMAN (FTEs)	0.0	0.0	0.0

3- SE Programs – Objective: Coordinate the Canadian Space Science and Exploration (SE) community in order to pursue world-class research space missions to advance our knowledge of basic physical and chemical processes, the near-Earth space environment and Earth's electromagnetic field, our solar system, the universe and its evolution, as well as the adaptation of humans and other life forms in the weightless environment. This program includes activities within the following scientific fields: astronomy, life sciences, physical sciences, space exploration et solar-terrestrial relations.

Expected Result #1	Performance Indicators
Identified opportunities for Canadian scientists to advance exploration readiness and scientific knowledge through CSA, national and international research missions.	1. Number of scientific publications, reports and conference proceedings acknowledging CSA funding. (Target: 350) 2. Number of Highly Qualified Personnel (HQP) involved in the program. (Target: 400) 3. Number of research partnerships (nationally and internationally). (Target: 80) 4. Number of awards granted yearly under the CSA Grants & Contributions Program. (Target: 25)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	8.0	7.8	8.4
HUMAN (FTEs)	21.5	20.2	19.5

4- Human Space Flight Expertise – Objective: Maintain a trained, experienced and versatile Astronaut Corps to meet the needs of the Canadian Space Science and Human Exploration community and while doing so, increase the opportunities of access to space for Canadian scientists.

Expected Result #1	Performance Indicators
Maintain a healthy, trained, and versatile Astronaut Corps and professional support team to meet the needs of the Canadian space science and human exploration programs.	1. Delivery of ongoing training plan for the Astronaut Corps and its professional support team as per international agreements. (Target: new astronauts started basic training; training requirements met for astronauts and professional support teams) 2. Provision of expertise to CSA operational projects and external agencies initiatives. (Targets: 3 projects supported to meet medical needs; 2 external initiatives supported by astronauts) 3. Provision of operational support to missions. (Target: 2 missions supported by CSA professional support teams)

RESOURCES	2008-2009	2009-2010	2011-2012
FINANCIAL ($ in millions)	4.9	5.2	5.1
HUMAN (FTEs)	12.5	12.0	12.0

Highlights of Expected Accomplishments – Enabling Research (SE)

- The CSA will continue to participate actively to the International Space Exploration Coordination Group that was created in 2007 to promote coordination for Moon and Mars exploration between various space agencies around the world.
- Within the Mission Concepts Program, the CSA established exploration core activities supporting the development of ground prototypes of systems that could become potential contributions to future Moon or Mars missions. The exploration core is being implemented in partnership with industry, university, research institutions and other government departments. In 2009-2010, a first analogue mission and a first prototype Request for Proposals (RFP) will take place.
- Through partnership with the European Space Agency (ESA), the CSA will position the Canadian industry and scientists in future scientific and technological developments relating to the European planetary exploration program called Aurora and the physical and life sciences programs called ELIPS-2 and ELIPS-3.
- The CSA will consult on a regular basis with the Canadian science community on program development and work with other government departments to maximize the synergy with the government of Canada.
- The CSA will maintain its human space flight expertise to meet the requirements of the CSA's space sciences and human exploration programs. Two Canadian astronauts are now training in preparation for long-duration space flight on the ISS in May 2009. Another Canadian astronaut has been assigned to a Space Shuttle flight in the spring/summer of 2009 and a second long-duration expedition on ISS is expected in the 2012-2014. To ensure that Canada has enough astronauts to fully take advantage of the flight opportunities available through its investment in the International Space Station Program, the CSA will pursue and conclude its Astronaut Recruitment Campaign with the addition of two new astronauts.
- The CSA will maintain a robust parabolic flight program in collaboration with the National Research Council that offers science opportunities for up to 20 seconds of freefall.
- The CSA will complete the early phase of ORBITALS (Outer Radiation Belt Injection, Transport, Acceleration and Loss Satellite) development. The work will focus on technical risk reduction. ORBITALS aims at improving space weather models and forecasts to protect critical space and ground infrastructures from damaging solar events. The projected launch date for ORBITALS is 2012.

Program Sub-Activity: Space Mission Development - Space Science and Exploration

Objective: Provide coordination or support to the development of Space Science and Exploration (SE) space missions in line with CSA priorities and stakeholders expectations through the definition, critical design, manufacturing, integration, testing and delivery phases leading to launch and early operations of space systems.

SPACE MISSION DEVELOPMENT – SPACE SCIENCE AND EXPLORATION PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicator**
Space mission proposals that efficiently, effectively and economically progress to subsequent operations phases in accordance with objectives, requirements, initial or revised specifications.	1. Percentage of projects requiring more than one EPA (Effective Project Approval) or an amendment to initial EPA over total number of projects.
Expected Result #2	**Performance Indicator**
The CSA's in-house personnel are highly qualified, with recognized expertise, and are supported by a high-technology infrastructure that is suited to all Space Mission Development projects.	1. Rate of expertise matrix support to all of CSA's program activities.

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	43.4	19.8	8.5
HUMAN (FTEs)	16.9	14.4	14.4

1- SE Projects – Objective: Ensure the development, delivery and commission of space-qualified systems for Space Science and Exploration (SE) missions within the following scientific fields: astronomy, life sciences, physical sciences, space exploration and solar-terrestrial relations through effective project, quality and engineering management.

Expected Result #1	Performance Indicator
SE projects' deliverables meet mission objectives at critical steps.	1. Number of missions/projects associated with science support. (Target: 17)

Expected Result #2	Performance Indicators
SE projects' deliverables are met.	1. Project milestones are met as defined in the detailed work plan. (Target: 75% of milestones achieved versus planned) 2. Project cost is maintained within authorized levels. (Target: 100%) 3. Risks are identified and mitigation plans prepared for each project. (Target: 100%)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	43.4	19.8	8.5
HUMAN (FTEs)	16.9	14.4	14.4

Highlights of Expected Accomplishments – Space Mission Development (SE)

- Canada is participating in the James Webb Space Telescope (JWST), a major facility-class space observatory that will be launched in 2013. The JWST is a successor to the highly successful Hubble Space Telescope (HST). Canada is responsible for the design and construction of the Fine Guidance Sensor (FGS), a critical element of the mission, which ensures the very precise pointing of the telescope and the provision to the international astronomical community of simultaneous images. The manufacturing of the FGS will continue in 2009 in order to be delivered to NASA in 2010. By virtue of the CSA's contribution, Canadian astronomers will have guaranteed access to 5% of the observing time of the James Webb Space telescope.

- The Enhanced Polar Outflow Probe (ePOP) mission, integrated with the CASSIOPE Mission, is scheduled for launch in 2009. It will probe the upper atmosphere and ionosphere region where solar variability exerts influence on global change in various time scales. The scientific data collected by ePOP will help scientists understand particle exchange and energy coupling processes between the Earth’s atmosphere and space environment. The suite of ePOP instruments integrated in the CASSIOPE satellite will undergo environmental testing at the David Florida Laboratory.

- The CSA will continue the manufacturing and testing of the Flight Detector Subsystem for the UltraViolet Imaging Telescope (UVIT) onboard the ASTROSAT satellite of the Indian Space Research Organization (ISRO). The subsystem will be delivered to ISRO in 2009. It is scheduled for launch by 2010. The CSA's participation will guarantee 5% of the observing time for Canadian scientists and obtain ASTROSAT's astronomic data.

- The NEOSSat mission, a joint Canadian Space Agency and Department of National Defence mission, is a combination of the Near Earth Space Surveillance (NESS) and the High Earth Orbit Surveillance (HEOS) projects. It is expected that 50% of NEOSSat time will be used to observe the inner portion of the solar system to discover, track and study asteroids and comets. The other 50% of the operating time will be used to track satellites in high-Earth orbit to update the orbit parameters of known satellites flying over the Canadian territory. A prime contractor has been selected and detailed design will continue during 2009. The NEOSSat spacecraft will undergo manufacture, assembly integration and testing activities during 2009-2010 in order to be ready for launch in 2010.
- The CSA will support the Assembly and Test Launch Operations (ATLO) of the Alpha Particle X-ray Spectrometer (APXS) for the Mars Science Laboratory. The Canadian contribution will help scientists to determine the chemical composition of various soil, dust and rock samples on the planet. The launch by NASA is scheduled for 2011.
- The NEPTEC TriDAR vision system will be used by the end of 2009 for docking the space shuttle to the International Space Station. This project is a joint venture with NASA. The technology is relevant to applications that could include rendezvous and docking, rover navigation and terrain mapping.
- The CSA will continue to work with the European Space Agency (ESA) to support the activities of Canadian scientists in science teams that have as objective to utilize the CSA-developed Microgravity Vibration Isolation System (MVIS), which is part of the European Space Agency's Fluid Science Laboratory on the International Space Station.
- The CSA will continue to develop missions aiming at maximising the use of the Canadian allocation of the International Space Station for scientific experimentation, technological demonstrations, or educational activities.
- The CSA will continue to work with the European Space Agency, the Japan Aerospace and Exploration Agency, and NASA towards the solicitation and development of multinational, world-class proposals for scientific research on the International Space Station. In 2009, this will occur through the International Life Sciences Research Announcement and the European Space Agency's Physical Sciences Announcement of Opportunity.

Program Sub-Activity: Space Mission Operations – Space Science and Exploration

Objective: Provide coordination or support to the operations of Space Science and Exploration (SE) space missions in line with the CSA priorities and stakeholders' expectations through the development and conduct of on-orbit operations, system maintenance and logistic support, as well as data handling and delivery.

SPACE MISSION OPERATIONS – SPACE SCIENCE AND EXPLORATION PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicators**
The CSA's in-house personnel are highly qualified, with recognized expertise, and are supported by a high-technology infrastructure that is suited to all Space Mission Operations activities.	1. Annual rate of investment in maintenance and improvement of the infrastructure required for missions in operation phases. 2. Quality of the internal expertise specializing in advice and technology-watch to ensure the successful flow of missions reaching operation phases.

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	55.4	55.3	52.8
HUMAN (FTEs)	127.5	125.0	124.5

1- International Space Station (ISS) – Objective: Provide required CSA operations, training and engineering services support to the International Space Station (ISS) Program.

Expected Result #1	Performance Indicators
The Canadian Space Station Program (CSSP) meets the requirements of the International Space Station Program (ISSP) in accordance with the Intergovernmental Agreement (IGA) and the NASA/CSA Memorandum of Understanding (MOU).	1. Continuity of on-orbit operations of MSS to meet the ISSP requirements and to fulfil the CSSP mandate. (Target: scheduled MSS operations conducted in accordance with ISSP requirements) 2. Delivery of MSS generic training to international astronauts and ground personnel. (Target: ISSP training requirements met) 3. Delivery of MSS engineering and technical support (personnel and facilities) for the MSS. (Target: scheduled MSS operations supported in accordance with ISSP requirements)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	47.7	47.5	47.3
HUMAN (FTEs)	111.9	109.7	109.2

2- SE and Human Space Flight Mission Operations – Objective: Operate the space and ground segment for SE missions and human space flight missions of Canadian Astronauts to optimize returns of scientific data and knowledge within the following scientific fields: astronomy, life sciences, physical sciences, space exploration and solar-terrestrial relations.

Expected Result #1	Performance Indicator
SE Space Mission Operations meet mission objectives and user/client expectations.	1. Number of missions in operational phase associated with science support. (Target: 12)
Expected Result #2	**Performance Indicators**
SE Space Mission Operations meet mission requirements and client needs.	1. Provision of expertise to support the needs of internal sponsoring organizations for payload projects throughout their development and operation. (Targets: 1 new ISS payload project supported ; 1 ongoing ISS payload project supported ; 1 ongoing non-ISS payload project supported) 2. Provision of Operations Engineering expertise to the development of new CSA missions and external agencies initiatives. (Targets: 2 initiatives supported)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	7.7	7.7	5.6
HUMAN (FTEs)	15.5	15.3	15.3

Highlights of Expected Accomplishments – Space Mission Operations (SE)

- The Phoenix mission successfully landed on the northern polar region of Mars on May 25, 2008. After exposing the upper few feet of surface with a robotic arm, the Phoenix Lander analyzed weather conditions of the region. Canada's contribution, an onboard Meteorological Station (MET), recorded the daily weather of the Martian northern plains using temperature and pressure sensors, as well as a light detection and ranging (LIDAR) instrument. The data, from this highly productive mission, will be analyzed in 2009-2010.

- The CSA will continue to support the Canadian GeoSpace Monitoring (CGSM) Program, a network of ground facilities instruments across Northern Canada. It supports national and international scientific activities related to understanding near-Earth environment, namely, space weather. The CGSM serves also to collect and distribute high quality science data used by other government departments and in support of satellite missions including ePOP, PCW, and ORBITALS.

- The Local Oscillator Source Unit (LSU) that was successfully integrated in the Heterodyne Instrument for the Far Infrared (HIFI) put on ESA's Herschel satellite will be launched in 2009. It will carry an infrared telescope and three scientific instruments that will allow scientists to address key science questions such as how galaxies were formed in the early universe and how stars have been forming throughout the history of the universe.

- The CSA will upgrade its ground control operations for Canadarm2 to enable the handling of heavy payloads as scheduled. The development of expanded ground control capabilities for future Dextre operations will enable a more efficient on-orbit commissioning of this new element significantly reducing astronaut time requirements. The CSA will also develop concept studies for Dextre compatible tools to broaden Dextre's use on-orbit.

- The CSA will continue to maintain operational preparedness for the MSS to support ISS assembly and maintenance operations. This will entail the preparation and certification of flight products and procedures to support operations that are not yet all fully defined. The operation of Dextre will evolve MSS operations from highly planned and concisely tested assembly operations to more generic and holistic maintenance concepts. This represents a major philosophical shift to Space Mission Design standards and better position Canada to support future exploration program endeavours.

- The CSA will release the MSS-6.1 software, which will provide major enhancements to the Canadarm2's capability and enable it to capture free flying vehicles and enhance the Ground Control capabilities of Dextre. Canadarm2 will be required to capture the first vehicle, the Japanese free flying H-II Transfer Vehicle (HTV), in September 2009.

- CSA will build and pre-position on-orbit the camera lens covers that will be required to protect MSS cameras from contamination resulting from H-II Transfer Vehicle (HTV) free flier proximity operations. The CSA will also build and deliver software to support the capture of commercial vehicles (Dragon) to the ISS in 2009 as well as the supporting software for follow-on HTV missions.

- The CSA will continue to fulfill its obligations for MSS operations. This involves maintaining and providing technical support for hardware and software; performing repair and overhaul work on hardware; providing MSS related training and qualification for all astronauts, cosmonauts and ground support personnel; planning and supporting MSS operations ; and conducting operations in conjunction with the NASA Houston flight control room from the Remote Multi-Purpose Support Room in St-Hubert, Quebec. The CSA will also prepare one spare Canadarm2 Latching End Effector (LEE) to be delivered and pre-positioned on-orbit in late 2009 in case of on orbit failure of Canadarm2 during its life.

- The CSA will be available to support ESA for the on-orbit commissioning of the Microgravity Vibration Isolation System (MVIS) launched in early 2008. The CSA will provide operational and technical support to the MVIS throughout the life of the MVIS. By providing this important component to ESA, Canadian scientists will gain access to this unique European ISS laboratory in space.

- The CSA will support the launch and operational activities related to the Advanced Plant Experiments (APEX). This experiment seeks evidence that gravity has a direct effect on the cells that contribute to the formation of reaction wood formation in willow (Cambium wood experiment).

- The CSA will continue to explore how the Advanced Astronaut Medical Support (ADAMS) project can contribute to human exploration. Specifically, the CSA will continue to explore solutions to the delivery of health care on future long duration exploration-class missions and how these solutions can help improve healthcare delivery on Earth through the transfer of space technology. CSA will develop collaborative projects with academia and industry and will continue to use analog environments for requirements definition and proofs of concept.

- The CSA will also support two physiological experiments, BISE and VASCULAR. These studies will attempt to better understand the effects of long-duration microgravity on human adaptability and health.

- The CSA will continue to collect radiation exposure data through a collaborative project with International Partners on the ISS using Canadian made radiation dosimeters.

- The CSA will support operations of experiments and educational activities on the ISS. These experiments include the return of Cerebral control (CCISS) in 2008, Cambium wood experiment, Bodies in the Space Environment (BISE), IRIS, Tomatosphere III, Radi-N, and Binary Colloid Alloy Test-5 (BCAT-5) in 2009.

Program Activity: Satellite Communications

Program Activity Priority: The program activity objective is to provide all Canadians with the means to participate and fully benefit from the global information age.

SATELLITE COMMUNICATIONS (SC) PROGRAM ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicators**
State-of-the-art systems and applications are developed to satisfy the needs of the Canadian government and population in order to ensure that Canada remains a world leader in satellite communications.	1. Proportion of active missions relative to the total number of missions supported by Canada in the SC priority areas. 2. Number of technological applications developed as a result of CSA's participation in space missions and/or support to projects/activities in SC.
Planning and Reporting Continuity: RPP 2008-2009 and DPR 2007-2008: http://www.asc-csa.gc.ca/asc/eng/resources/publications/default.asp#parliament	

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	20.3	14.9	9.9
HUMAN (FTEs)	14.2	13.1	13.1

To learn more about Satellite Communications, go to:
http://www.asc-csa.gc.ca/asc/eng/satellites/default.asp?page=observation

The programs under this Program Activity are divided into three Sub-Activities: Enabling Research, Space Mission Development and Space Mission Operations. However, Space Mission Operations has no activities planned for 2009-2010 and will not be mentioned in this report.

Note that the program sub-activity performance measurement is identical in EO, SE and SC program activities. However, the detailed document addresses the reporting of the performance measurement at the sub-activity level individually for each program activity.

Program Sub-Activity: Enabling Research – Satellite Communications

Objective: Provide leadership, coordination or support to Satellite Communications (SC) applied research and experimental development in line with the CSA priorities and stakeholders expectations in order to increase the knowledge base and devise new applications through space missions, and to allow the transfer of intellectual property and proven technologies to Canadian industry, academia, and government organizations.

ENABLING RESEARCH – SATELLITE COMMUNICATIONS PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicators**
New project/mission concepts that progress to subsequent development phases related to Agency's priorities.	1. Ratio of the number of new concepts presented to the number of new concepts retained for subsequent phase. 2. Quality of the concepts retained based on the average evaluation rating obtained according to the Priority Ranking Framework.
Expected Result #2	**Performance Indicator**
The CSA's in-house personnel are highly qualified, with recognized expertise, and are supported by a high-technology infrastructure that is suited to all Enabling Research projects/missions.	1. Number of consulting requests received by CSA personnel from external sources such as the private sector, academia and other space agencies.

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	14.7	10.9	8.9
HUMAN (FTEs)	0.0	0.0	0.0

1- SC Mission Concepts: Assume the leadership and support in the enabling research and development of new mission concepts leading to the realization of CSA or international Satellite Communications (SC) missions including search and rescue, and satellite navigation.

Expected Result #1	Performance Indicator
Industry, government and/or academia conduct mission and payload concept and feasibility studies to establish the user requirements for new missions and to evaluate the technical and scientific feasibility and the relevance of these proposed missions to the government priorities in order to enable a decision on future SC space missions.	1. Number of concept/phase 0 and phase A studies completed. (Target: 2)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	4.1	0.5	0.5
HUMAN (FTEs)	0.0	0.0	0.0

2- ESA Programs in SC – Objective: Through key international partnerships, enhance the Canadian industry's technological base and provide access to European market for value added products and services in the field of Satellite Communications (SC). This is achieved through a financial contribution by the Agency to optional ESA programs in SC.

Expected Result #1	Performance Indicator
Successful development and demonstration of advanced technologies, systems, components, or studies provided for in the contracts awarded by ESA to Canadian firms under the SC programs. (ARTES, Galileosat and GNSS (Global Navigation Satellite System) Evolution programs)	1. Canadian industrial return in ESA optional programs in SC. (Target: 84% or higher)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	9.6	9.4	7.4
HUMAN (FTEs)	0.0	0.0	0.0

3- SC Application Development Programs – Objective: Enhance Canada's ground segment telecommunications technologies, develop and demonstrate Satellite Communications (SC) applications for commercial use and Canadian government operations.

Expected Result #1	Performance Indicator
Northern Communities access and utilize the Anik F2 Government of Canada Capacity Credit (GoCCC).	1. Number of communities using the Government of Canada Capacity Credit for Government Applications and Services. (Target: between 1 and 3 communities)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	1.0	1.0	1.0
HUMAN (FTEs)	0.0	0.0	0.0

Highlights of Expected Accomplishments – Enabling Research (SC)

- The CSA will continue to work towards the utilization of the Government of Canada capacity credit (GoC CC) for broadband telecommunications services in the North. Additional demonstration of Ka-band technology will improve the use of the AnikF2 by northern communities for trials of innovative government services and in specific areas of interest to other government departments. The first phase of the GoC CC implementation is technical in nature with Ground Segment upgrades at the Vancouver and Winnipeg Teleports, with suitable level of redundancy built-in, and the manufacturing and testing of 100 Next Generation Ka-band terminals. The contract for Ground Segment Upgrades and the procurement for the terminals are expected to be completed by the end of 2009. The Planning for the years 7 and 8 for the Utilization Phase is ongoing. A Call for Interest to potential end-users in the northern communities will be issued in summer 2009.

- The CSA has approved Phase A for the Polar Communications and Weather mission in 2008 and will develop the Mission Requirement and the preliminary system requirements in 2009-2010. The Concept of the Polar Communications and Weather Mission is to put a constellation of satellites in highly elliptical orbit over the North Pole to provide communication and monitoring weather services in the Arctic. The weather component of the mission falls within the Earth Observation Program Activity, while the polar communication falls within the Satellite Communication Program Activity.

- The CSA will prepare an enhanced Satellite Communications Applications Program aimed at developing applications and space based services in close relationship with the user communities. Advanced technologies and ground systems will be developed and demonstrated for satellite based communications, global navigation, and search and rescue.

- The CSA will establish an Advanced Satellite Communications Program aimed at developing technologies to maintain leadership in satellite based communications, navigation and search and rescue systems.

- The CSA will work with other government departments such as National Resources Canada (NRCan) and the Department of Foreign Affairs and International Trade (DFAIT) to improve the governance structure of global navigation satellite system (GNSS) activities within the federal government.

- The CSA will continue to assess the telecommunications requirements of federal government users and evaluate how future telecommunication satellite systems can respond to identified needs.

- The CSA will initiate a preliminary study for a constellation of micro-satellites to provide an automatic identification system for ships with the objective of improving maritime monitoring on Canada's coasts.

- The CSA will initiate a preliminary study to evaluate the user requirements for the EMMA mission. This is an experimental microsatellite in Low Earth Orbit (LEO) to monitor frequency spectrum usage from space. The developed concept and its related technologies would support the Government's Sovereignty mandate as well as contributing towards the identification and reduction of Electromagnetic (EM) interference.

- With the successful completion of an initial concept study for a V-Band Next Generation Satellite Communications Payload, CSA will initiate risk mitigation activities on key technologies required for this mission which is aimed at developing and demonstrating advanced, world-leading broadband services.

- Canada's participation in the European Space Agency (ESA) programs allows our industry to access forward-looking studies on new telecommunications services; to develop new technologies, equipment and applications in multi-media, inter-satellite and mobile communications; and to demonstrate satellite-based communications services such as interactive communications services for remote communities and for disaster management. For example, in satellite navigation, CSA will continue its collaboration with ESA the development of the Galileo ground infrastructure to support the monitoring of the quality of the localisation signal generated by the four experimental In-Orbit-Validation satellites planned to be launched in 2010.

Program Sub-Activity: Space Mission Development – Satellite Communications

Objective: Provide coordination or support to the development of Satellite Communications (SC) space missions in line with CSA priorities and stakeholders expectations through the definition, critical design, manufacturing, integration, testing and delivery phases leading to launch and early operations of space systems.

SPACE MISSION DEVELOPMENT – SATELLITE COMMUNICATIONS PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicator**
Space mission proposals that efficiently, effectively and economically progress to subsequent operations phases in accordance with objectives, requirements, initial or revised specifications.	1. Percentage of projects requiring more than one EPA (Effective Project Approval) or an amendment to initial EPA over the total number of projects.
Expected Result #2	**Performance Indicator**
The CSA's in-house personnel are highly qualified, with recognized expertise, and are supported by a high-technology infrastructure that is suited to all Space Mission Development projects.	1. Rate of expertise matrix support to all of CSA's program activities.

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	5.6	4.0	0.9
HUMAN (FTEs)	14.2	13.1	13.1

1- SC Projects – Objective: Ensure the development, delivery and commission of space-qualified systems for Satellite Communications (SC) missions including search and rescue, and satellite navigation through effective project, quality and engineering management.

Expected Result #1	Performance Indicators
SC projects' deliverables are met.	1. Project milestones are met as defined in the detailed work plan. (Target: 75% of milestones achieved versus planned) 2. Project cost is maintained within authorized levels. (Target: 100%) 3. Risks are identified and mitigation plans prepared for each project. (Target: 100%)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	5.6	4.0	0.9
HUMAN (FTEs)	14.2	13.1	13.1

Highlights of Expected Accomplishments – Space Mission Development (SC)

- In 2004-2005, as part of the CASSIOPE Mission Contribution Program, the CSA initiated the development and demonstration of the Cascade telecommunications payload on a small satellite bus. This small satellite spacecraft will be fully designed and constructed by Canadian companies. Environmental testing of the spacecraft will be completed in 2009 and the launch is scheduled for the end of 2009. Cascade is the precursor of a communication satellite constellation that will help position Canadian industry on the international market, both as a supplier of advanced components and as a service provider of high-volume, high-data-rate telecommunications anywhere in the world.

- CSA and the Department of National Defence are partnering to manage M3MSat, a second micro-satellite project (the first one being NEOSSat) which payloads will be an Automatic Identification System (AIS) supported on a micro-satellite bus. This project will demonstrate and further develop a multi-mission micro-satellite bus capability; will establish micro-satellites as operationally cost effective; will allow optimization of the AIS payload in maritime traffic identification; will significantly support Canadian industry business development strategies in a global market context; and will be a complement with CSA's RADARSAT-Constellation program and with DND's Polar Epsilon program. Detailed design will be finalized and manufacturing will start in 2009. The launch is planned for mid 2010 and the mission demonstration should end in 2012.

Program Activity: Generic Technological Activities in support of Earth Observation, Space Science and Exploration, and Satellite Communications

Program Activity Priority: Provide leadership, coordination or support to Earth Observation, Space Science and Exploration, and Satellite Communications through activities that are generic in their nature since they contribute to all three program activities.

GENERIC TECHNOLOGICAL ACTIVITIES (GTA) IN SUPPORT OF EO, SE, AND SC PROGRAM ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicators**
Canada's industrial technological capabilities can meet the needs of future space missions and activities.	1. Ratio of the number of priority technologies identified for future EO, SE and SC missions to the number of priority technologies developed in GTA. 2. Number of priority technologies supported that are ready to be used.
Planning and Reporting Continuity: RPP 2008-2009 and DPR 2007-2008: http://www.asc-csa.gc.ca/asc/eng/resources/publications/default.asp#parliament	

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	53.8	55.6	57.8
HUMAN (FTEs)	137.7	151.8	156.1

To learn more about Generic Technological Activities Supporting Earth Observation, Space Science and Exploration, and Satellite Communications, go to:
http://www.asc-csa.gc.ca/asc/eng/industry/technology.asp

To learn more about the David Florida Laboratory, go to:
http://www.asc-csa.gc.ca/asc/eng/dfl/default.asp

The programs under this Program Activity are divided into three Sub-Activities: Enabling Research, Space Mission Development and Space Mission Operations. However, Space Mission Operations has no activities planned for 2009-2010 and will not be mentioned in this report.

Program Sub-Activity: Enabling Research – Generic Technological Activities in support of EO, SE, SC

Objective: Provide leadership, coordination or support to Earth Observation (EO), Space Science and Exploration (SE) and Satellite Communications (SC) applied research and experimental development in line with the CSA's priorities and stakeholders' expectations in order to increase the knowledge base and devise new applications through space missions, and to allow the transfer of intellectual property and proven technologies to Canadian industry, academia, and government organizations.

ENABLING RESARCH – GENERIC TECHNOLOGICAL ACTIVITIES PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT			
Expected Result #1		**Performance Indicator**	
Space technology concepts that support projects/missions related to Agency's priorities.		1. Rate of adherence to the technology development plan/track records.	
Expected Result #2		**Performance Indicators**	
Canadian industries and research organizations that are actively involved in space R&D.		1. Number of requests received vs. the number of requests accepted. 2. Number of requests received vs. the number of requests funded.	
RESOURCES	**2009-2010**	**2010-2011**	**2011-2012**
FINANCIAL ($ in millions)	46.2	46.0	46.0
HUMAN (FTEs)	94.7	108.8	113.1

1- Space Technology Development Program: Support the development and transfer of advanced space technologies by industry, government, and academia in support of EO, SE and SC activities.

Expected Result #1	Performance Indicators
Development of advanced space technologies by industry, government, academia, and not-for-profit organizations in support of EO, SE, and SC activities.	1. Number of technologies brought to higher readiness levels. (Target: 40) 2. Number of technologies chosen to enable future space missions of interest to Canada. (Target: between 1 and 3)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	19.9	16.8	16.6
HUMAN (FTEs)	16.0	16.0	16.0

2- ESA Programs in Generic Space Technologies: Through key international partnerships, enhance the Canadian industry's technological base and provide access to European market for value added products and services in the field of generic space technologies. This is achieved through a financial contribution by the Agency to optional ESA programs in the field of generic space technologies.

Expected Result #1	Performance Indicator
Successful development and demonstration of advanced technologies, systems, components or studies provided for in the contracts awarded to Canadian firms under mainly two ESA Programs.	1. Canadian industrial return in ESA optional programs, and at the overall level. (Target: overall Canadian industrial return in ESA mandatory programs of 94% or higher)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	11.5	11.8	11.5
HUMAN (FTEs)	2.7	2.7	2.7

3- Commercialization and Transfer of Technologies: Promote the commercial potential and support the transfer of space technologies to maximise the social and economic benefits for Canadians.

Expected Result #1	Performance Indicator
Transfer of space technologies generated by the CSA in support of EO, SE and SC activities to industry, government, academia and not-for-profit organizations.	1. Number of licenses granted for space technologies owned by the CSA. (Target: 5)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	1.5	1.5	1.5
HUMAN (FTEs)	7.0	7.0	7.0

4- Mission Related Expertise and Technology Development: Ensure the development and maintenance of scientific and technical expertise in the CSA, the Government, industry and universities to initiate projects and provide support to EO, SE and SC missions.

Expected Result #1	Performance Indicator
Maintenance of in-house scientific and technical expertise, within the CSA and for the benefit of government, industry and universities, in support of EO, SE and SC activities.	1. Number of specialized personnel across the Agency supporting CSA projects and/or programs. (Target: 80)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	13.3	15.9	16.3
HUMAN (FTEs)	69.0	83.1	87.4

Highlights of Expected Accomplishments – Enabling Research - Generic Technological Activities in support of EO, SE, and SC

- The CSA will produce long-term roadmaps for space technology development based on the needs of future missions. Niche areas will be selected after consultation with Government, industry and academia. This process will foster partnership between academia, industry and government. It will enhance the coordination of technology development activities throughout government departments.
- Through different procurement mechanisms, the Space Technology Development Program will continue to bring industry and research organizations to propose innovative technologies, retire risk on the critical technologies required for future missions of Canadian interest, and contribute to the enhancement of Canadian capabilities. Examples of STDP activities in 2009-2010 includes:
    - Development of Middle Earth Orbit Search-and-Rescue (MEOSAR). The objective is to use navigation satellites such as GPS and Galileo to relay in near real-time signals from activated distress beacons located in ships, plane or on a single individual needing help;
    - Development of technologies that will serve to demonstrate the concept feasibility of lunar vehicles, Mars' Rovers, and Rendez-vous technology;
    - Development of an ultra miniature electronic module to eliminate the need for a bulky centralized power converter for spacecraft energy management;
    - R&D on Self Healing Carbon Fiber Structures to address the challenge facing space missions once a material is damaged it is hardly repairable in space; and,
    - Development of a satellite Spot Beam Forming Network that will allow satellites to communicate with mobile users via energy beams that can dynamically adapt the available satellite energy to best cater to traffic demands.

- By using the Partnership Support Program and Natural Sciences and Engineering Research Council of Canada's (NSERC) Collaboration R&D Program, the CSA and NSERC will continue to foster closer collaboration between industry, universities and government in space research and technology development.
- The CSA will manage its portfolio of patents and intellectual property licenses and conduct commercialization assessments in order to support the transfer of space technologies and their applications to other sectors of the economy and enhances Canada's industrial competitiveness.

Program Sub-Activity: Space Mission Development Generic Technological Activities in support of EO, SE, SC

Objective: Provide coordination or support to the development of Earth Observation (EO), Space Science and Exploration (SE) and Satellite Communications (SC) space missions in line with CSA's priorities and stakeholders' expectations through the definition, critical design, manufacturing, integration, testing and delivery phases leading to launch and early operations of space systems.

SPACE MISSION DEVELOPMENT – GENERIC TECHNOLOGICAL ACTIVITIES PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicator**
The CSA's in-house personnel are highly qualified, with recognized expertise, and are supported by a high-technology infrastructure that is suited to all Space Mission Development projects.	1. Number of aerospace related missions, projects/activities supported by David Florida Laboratory (DFL) facilities.

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	7.6	9.6	11.8
HUMAN (FTEs)	43.0	43.0	43.0

1- David Florida Laboratory (DFL) supporting the Canadian Space Plan

– Objective: Provide world-class space qualification services on a national scale, including facilities and expertise in support of the Canadian Space Program (CSP) and international Earth Observation (EO), Space Science and Exploration (SE) and Satellite Communications (SC) missions.

Expected Result #1	Performance Indicator
Development, provision of expertise and supply of space qualification services, functional, and environmental testing of space hardware primarily for CSA sponsored programs and projects, and subsequently to the Canadian space industry and other private and public sector clients.	1. Percentage of satisfied clients. (Target: based on client feedback and customer satisfaction surveys, achieve a client satisfaction rating of 95% or more)

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	6.3	6.4	6.4
HUMAN (FTEs)	43.0	43.0	43.0

Highlights of Expected Accomplishments – Space Mission Development – Generic Technological Activities in support of EO, SE, and SC

- David Florida Laboratory will continue to provide world-class and cost-effective environmental space qualification services for the assembly, integration and testing of spacecraft systems and sub-systems to all of the CSA's programs. The hardware for many priority projects will be assembled and tested at DFL – such as:

    - Science and Exploration: CASSIOPE ePOP mission; NEOSSat; James Webb Space Telescope Space Telescope (JWST); and the UltraViolet Imaging Telescope (UVIT);
    - Satellite Communications: CASSIOPE Cascade mission, M3MSat;
    - Commercial Programs: MDA (SSRMS & SRMS), TenXc Wireless (PCS Antennas), Inmarsat Aeronautical Antennas, CASA and RMSA, Spain (Galileo), Thales Alenia Spazio (ESA-Biomass, SICRAL IB); S.G. Microwave (INTELSAT Feeds): MDA (Space Station Japanese Experimental Module); and,
    - OGD: DND (Sapphire); DND & L3 Communications (CF-18 Radome Characterization Project).

Program Activity: Space Awareness and Learning

Program Activity Priority: The program activity objective is to further public understanding and engagement with regards to space related issues, ultimately leading to improving the scientific literacy of Canadians.

SPACE AWARENESS AND LEARNING PROGRAM ACTIVITY PERFORMANCE MEASUREMENT			
Expected Result #1	**Performance Indicator**		
Targeted level of awareness of space among Canadians is reached.	1. Survey results obtained every 3 years.		
Planning and Reporting Continuity: RPP 2008-2009 and DPR 2007-2008: http://www.asc-csa.gc.ca/asc/eng/resources/publications/default.asp#parliament			
RESOURCES	**2009-2010**	**2010-2011**	**2011-2012**
FINANCIAL ($ in millions)	8.9	8.8	8.8
HUMAN (FTEs)	26.0	24.0	24.0

To learn more about Space Awareness and Learning program activity, go to:
http://www.asc-csa.gc.ca/asc/eng/resources/publications/default.asp#parliament

To learn more about Space Awareness and Learning, go to:
http://www.asc-csa.gc.ca/asc/eng/media/default.asp; and,
http://www.asc-csa.gc.ca/asc/eng/educators/default.asp

The programs under this Program Activity are divided into two Sub-Activities: Awareness and Learning.

Program Sub-Activity: Awareness

Objective: Increase public awareness and understanding of how space affects and improves the quality of life.

AWARENESS PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT			
Expected Result #1		**Performance Indicator**	
Target audience is reached through outreach activities.		1. Number of initiatives according to targeted audiences.	
RESOURCES	**2009-2010**	**2010-2011**	**2011-2012**
FINANCIAL ($ in millions)	5.9	5.9	5.9
HUMAN (FTEs)	21.0	19.0	19.0

Highlights of Expected Accomplishments – Awareness

The major communications activities will focus on the following:

- Awareness campaigns for two Canadian astronaut missions; Dr. Robert Thirsk will be taking part in Expedition 20, becoming the first Canadian to remain on the International Space Station for a long stay, living there for 4 to 6 months and Julie Payette will be on the Space Shuttle Endeavour for mission STS-127, with launch planned for spring/summer 2009.

- A series of awareness activities surrounding the International Year of Astronomy.

- Awareness campaigns related to the launches of European Space Agency's Herschel / Planck spacecraft (Canada is contributing to two of Herschel's three instruments) and Canada's NEOSSAT, the world's first space telescope designed to detect and track asteroids as well as satellites.

- Awareness campaign related to the launch of Canada's hybrid small satellite mission CASSIOPE, which contains a high-speed large-capacity data communications module (Cascade), and an atmospheric science instrument (ePOP).

Program Sub-Activity: Learning

Objective: Direct a sustained multi-dimensional and inter-active learning program to build knowledge and enhance interest in space science and technology.

LEARNING PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT			
Expected Result #1		**Performance Indicators**	
Canadian educators and students further their learning related to science and technology through the space theme.		1. Number of educators reached through professional development initiatives. 2. Number of students reached through learning activities.	
RESOURCES	**2008-2009**	**2009-2010**	**2010-2011**
FINANCIAL ($ in millions)	3.0	2.9	2.9
HUMAN (FTEs)	5.0	5.0	5.0

Highlights of Expected Accomplishments – Learning

- Professional development workshops and teaching initiatives such as satellite enabled or Web-based assisted tele-learning opportunities for educators.

- Partnered initiatives with schools, youth organizations and other institutions to expand student and educator access to the space science and technology community and space-learning materials.

- Targeted space-focused learning materials and teaching modules for educators and students at the primary and secondary level.

- Targeted grants, contribution and sponsorship programs in partnership with other federal departments and agencies to support awareness, research, development and training in space science and technology.

Program Activity: Internal Services

Program Activity Priority: To implement the government's commitment to modern public service management in accordance with the Management Accountability Frameworks expectations.

INTERNAL SERVICES PROGRAM ACTIVITY PERFORMANCE MEASUREMENT	
Expected Result #1	**Performance Indicators**
Internal Services provide an added value to CSA managers in the performance of their duties.	1. Internal Services provided meet standards set under government-wide policies. 2. CSA's rating against MAF criteria based on Round VI assessment.
Expected Result #2	**Performance Indicator**
The four highest priority risks identified in the CSA corporate risk profile are addressed and mitigated.	1. Mitigation action plans are implemented against the four corporate risks identified as highest priority.
Planning and Reporting Continuity: RPP 2008-2009 and DPR 2007-2008: http://www.asc-csa.gc.ca/asc/eng/resources/publications/default.asp#parliament	

RESOURCES	2009-2010	2010-2011	2011-2012
FINANCIAL ($ in millions)	43.0	41.6	41.7
HUMAN (FTEs)	263.4	267.7	266.8

Program Sub-Activity: Internal Services

This program activity has three program sub-activity levels: Governance and Management Support, Resources Management Services and Asset Management Services. However, the sub-activity Asset Management Services is not presented in this report.

Program Sub-Activity: Governance and Management Support

Objective: Implement the government's commitment to modern public service management in the area of governance and management support in accordance with the Management Accountability Framework's expectations.

RESOURCES	2008-2009	2009-2010	2010-2011
FINANCIAL ($ in millions)	10.3	10.5	10.6
HUMAN (FTEs)	60.0	64.9	65.0

Highlights of Expected Accomplishments – Governance and Management Support

- In order to align the CSA's strategies, planning priorities, funding levels, and operations, the Long Term Space Plan will be integrated in the corporate finances, work planning, and performance measurement information systems for the planning of 2010-2011. In the mean time, the CSA data analysis capacity will be upgraded to meet the 2010-2011 performance reporting requirements.
- In order to ensure that ongoing departmental operation control processes are audited, the CSA, in collaboration with TBS, will put in place a departmental auditing committee. This committee will be responsible to follow-up on the action plans prepared after internal audit reports.
- In order that project and program management meets standards set by the new Government wide Project Management Policy, the CSA will submit TBS a Project Capacity and Risk Assessment in 2009-2010.

Program Sub-Activity: Resources Management Services

Objective: Implement the government's commitment to modern public service management in the area of resource management support in accordance with the Management Accountability Framework's expectations.

RESOURCES	2008-2009	2009-2010	2010-2011
FINANCIAL ($ in millions)	18.8	17.2	17.2
HUMAN (FTEs)	169.0	167.8	166.8

Highlights of Expected Accomplishments – Resources Management Services

- In order to align the CSA's strategies, planning priorities, funding levels, and operations, the Long Term Space Plan will be integrated in the corporate financial operation and control system at the beginning of 2010-2011.
- The CSA will fine tune its internal control procedures to assure its managers that all payments are compliant with current financial policies.
- In order to attract and retain a qualified workforce to deliver its mandate, the CSA will continue the implementation of its 2007-2010 Integrated Corporate Human Resources Plan and will integrate the key leadership competency profile into its human resources strategies and management activities.

SECTION 3: SUPPLEMENTARY INFORMATION

CANADIAN SPACE AGENCY CONTRIBUTIONS TO GOVERNMENT OF CANADA OUTCOMES

GOVERNMENT OF CANADA OUTCOMES		
Economy	**Social**	**International**
1. ***An Innovative and Knowledge-Based Economy***	1. ***Safe and Secure Communities***	1. ***A Strong and Mutually Beneficial North American Partnership***
2. ***A Clean and Healthy Environment***	2. ***A Vibrant Canadian Culture and Heritage***	2. A Safe and Secure World Through International Co-operation
3. Strong Economic Growth	3. Healthy Canadians	3. A Prosperous Canada Through Global Commerce
4. Income Security and Employment for Canadians		

CSA Strategic Outcome

Canada's presence in space meets the needs of Canadians for scientific knowledge, space technology and information.

The Canadian Space Agency contributes to the ten Government of Canada Outcomes listed above out of the thirteen measured in the annual *Canada's Performance Report* to Parliament. However, in order to create an even match between the CSA's program activities and Government of Canada Outcomes, only the five outcomes highlighted are recorded in the *Canada's Performance Report*. In doing so, the CSA's spending contributes to three key policy areas: Economic Affairs, Social Affairs and International Affairs.

CSA Contributions to Canada Economic Outcomes

The CSA strategic outcome contributes to the development of Canada's economy as measured against the following outcomes outlined in *Canada's Performance* report:

- an innovative and knowledge-based economy;
- a clean and healthy environment;
- strong economic growth; and,
- an income security and employment for Canadians.

The space industry contributes to Canada's economic well-being and helps achieve a higher standard of living and quality of life for all Canadians.

Through its R&D investments and the resulting transfers of applications to the private and public sectors, the CSA's programs and activities attract highly skilled labour that contributes to Canada's knowledge-based economy; helps enhance the Canadian space industry's competitiveness by encouraging dynamic trade relationships with other nations; and increases Canada's ability to compete in the global marketplace.

Earth observation missions drive many of the changes that are improving our quality of life by helping our government deliver on priorities such as protection of the environment, sustainable development, management of natural resources, understanding climate change, monitoring air quality, and providing support for disaster management.

Satellite communications missions are a key element in linking all Canadians in a communication network including remote and northern communities.

CSA Contributions to Canada Social Outcomes

The CSA strategic outcome contributes to Canada's social foundations as measured against the following outcomes outlined in *Canada's Performance* report:

- safe and secure communities;
- a vibrant Canadian culture and heritage; and,
- healthy Canadians.

Earth observation, communication and navigation satellites drive many of the changes that improve the quality of life of Canadians by helping our government on managing issues relating to the environment as well as to the safety and security of our population. It contributes to the monitoring of parameters relating to the maintenance of a healthy environment over Canadian territory, and supports disaster management in situations such as floods, forest fires and earthquakes. These satellites also provide essential communication tools to support law and order, enforcement interventions and enhance search and rescue capabilities.

In today's context of environmental change and resource depletion, fundamental and applied research in physical and life sciences and in space exploration is predicted to bring about socio-economic benefits in ways that will greatly improve how we live, prosper, and evolve on our planet. For instance, the development of a surface mobility capability on the Moon will require the use of solar-powered electrical propulsion vehicles, which, in turn, could well lead the way toward spin-off commercialisation of green technologies for the transport vehicles of the future.

Space infrastructure allows access and dissemination of timely health, cultural, security and safety related information to all Canadians no matter where they live in Canada. Satellite communication is essential to provide Canadians living in remote areas with timely access to expert knowledge and expertise related to health and education through a range of non-commercial services including: e-government, e-learning, tele-justice, tele-education, as well as tele-medicine in areas such as tele-psychiatry, tele-radiology, tele-surgery, and tele-consultations.

CSA Contributions to Canada International Outcomes

The CSA strategic outcome contributes to establishing Canada's international presence as measured against the following outcomes outlined in *Canada's Performance* report:

- a strong and mutually beneficial North American partnership;
- a safe and secure world through international co-operation; and,
- a prosperous Canada through global commerce.

Space is an essential and strategic tool for Canada to meet its social, economic and foreign policy objectives. Through the development of its space infrastructure, not only is Canada meeting its specific national needs, it is also paving the road for Canada to play a tangible and visible role in responding to issues of interest to the international community.

With its space exploration, science and technology endeavours, which often involve international partners, the CSA plays an influential role in building strong and mutually beneficial partnerships with an increasing number of space faring countries. In striving to become one of the most advanced, connected and innovative nations in the world, Canada offers and shares tremendous opportunities for the prosperity of global commerce and the safety of the global community through the peaceful use of space.

SECTION 4: INDEX

AIS
The Automated Identification System (AIS) is a payload used for identifying and locating ships vessels. CSA and Department of National Defense are jointly developing a small satellite in low earth orbit called M3MSat that will carry a AIS capable of identifying and tracking ships for maritime monitoring and surveillance.

APXS
The Alpha-Particle-X-Ray-Spectrometer (APXS) is an instrument for the Mars Science Laboratory. The Canadian contribution will help scientists to determine the chemical composition of various soil, dust and rock samples on the planet.

Anik F2
The Anik F2, Telesat Canada's innovative, high-speed Ka-Band, multimedia telecommunications satellite is one of the largest, most powerful communications satellites ever built. It is designed to support and enhance North American voice, data, and broadcast services. Through its support of Anik F2, the Government of Canada has secured a Government Capacity Credit access worth $50 million over 11 years to support the connectivity for remote and underserved northern rural communities.

AQUARIUS
NASA's AQUARIUS mission is a focused satellite to measure global sea surface salinity (SSS). Scientific progress is limited because conventional *in situ* sampling is too sparse to give the global view of salinity variability that only a satellite can provide. AQUARIUS will resolve missing physical processes that link the water cycle, the climate, and the ocean.

BISE
The Bodies in Space Environment (BISE) experiment measures the relative contributions of internal and external cues to self-orientation before, during and after microgravity exposure. The project aims to better understand the importance of different types of cues in the neurological process that tell astronauts which way is "up" in a microgravity environment. Illusions and other phenomena could interfere with routine operational processes as well as emergency procedures on platforms such as the International Space Station (ISS).

BLAST
In June 2005, a team of researchers from Canada, the U.S., the U.K. and Mexico has launched the Balloon-borne Large Aperture Sub-millimetre Telescope (BLAST) to probe the heavens to identify starburst galaxies and enabling researchers to study the formation and evolution of stars, galaxies and star clusters.

CADC/HUBBLE
The Canadian Astronomy Data Center (CADC) is a data archiving and access facility to support science done by Canadian astronomers and to contribute to international astronomy research. CADC archives astronomical images and data from major ground based observatories, from CSA missions as well as from the Hubble Space Telescope.

CAMBIUM
The objective of the CAMBIUM experiment is to determine the role of gravity in the formation of "tension wood" forming after tilting or looping of the stem. The experiment has implications for fundamental plant responses to gravity and to the understanding and potential control of tension wood formation, which is important to the forestry industry.

CASSIOPE
The Cascade Demonstrator, Smallsat Bus and Ionospheric Polar Explorer (CASSIOPE) is a small hybrid satellite that includes the telecommunication instrument Cascade, which will provide the very first digital broadband courier service for commercial use, and the scientific payload enhanced Polar Outflow Probe (ePOP), which will be used to study the ionosphere.

CCISS
The experiment Cardiovascular and Cerebrovascular Control on return from ISS (CCISS) will study cardiovascular and cerebrovascular adaptations to microgravity to improve astronaut function and capacities upon return into planetary gravity.

CGSM
The Canadian GeoSpace Monitoring (CGSM) system is a Canadian network of ground-based instruments to monitor and study geomagnetic activity near Earth, as well as space weather. It includes high-frequency radars, sky imagers, computer models and data portals located across the country. Canada is especially vulnerable to the effects of space weather and solar storms and CGSM provides data, knowledge and information to protect critical and expensive space and ground communication and navigation assets from space weather.

CHENSS
The Canadian High Energy Neutron Spectrometry System (CHENSS) will increase scientific understanding of the high-energy neutron spectrum in space. This will help understand and plan mitigations for radiation risk to astronauts during long term space missions.

Chinook
Chinook is the Canadian-led atmospheric Research Satellite Mission that will be carrying two experiments: Stratosphere Wind Interferometer For Transport studies (SWIFT) and Atmosphere Research with GPS Occultation (ARGO). This mission will increase our understanding of our atmosphere and will lead to advances in weather and climate prediction models that are key tools to provide answers on the health of the ozone layer and climate change.

CIMEX
The Convection and Interfacial Mass Exchange (CIMEX) experiment will investigate fundamental and applied aspects of mass transfer through fluid interfaces (mainly evaporating liquids). Improved understanding of this process can be achieved through microgravity experiments because of the lack of convection. The results can be applied to heat-exchange pipe design and design of evaporators.

CloudSat
CloudSat will be doing the first comprehensive three-dimensional study of clouds. It will gather data on their structure, frequency and volume, and will help improve our understanding of how they influence the weather. It will use a radar hyperfrequency device to probe the cloud cover.

CRYSYS
CRYSYS is a multi-year project of Environment Canada that focuses on using existing and new sensors such as AMSR, Cryosat and ICESat to address cryosphere / climate / hydrological issues for monitoring and understanding the cryosphere in Canada (snow, ice, permafrost and glaciers).

ELERAD
The ELERAD study will assess radiation damage on long duration flights. A genetically engineered strain of *C. elegans* worms is currently onboard the ISS to test if it can be used as a biological dosimeter. Upon return, the worms will be analyzed to assess the genetic alterations caused by radiation in Low Earth Orbit. The experiment will be carried out in a scientific/educational mission sponsored by NASA and the Malaysian Space Agency.

EMMA
EMMA is a mission concept consisting of a microsatellite in low earth orbit measuring and monitoring the electromagnetic spectrum, analyzing radio transmissions and spectrum usage.

eOSTEO
The goal of the eOSTEO mission is to better understand the fundamental causes of bone loss in microgravity using an automated cell culture system. The eOSTEO is made of three Canadian experiments to study how bone cells in microgravity react to signals that increase and decrease bone formation; whether microgravity compromises bone cell architecture; and whether a hormone that promotes bone creation can, in weightless conditions, prevent the death of cells that build bone. Applications of the research are expected for development of better treatments for osteoporosis on Earth and during long duration space missions.

ESA-ADM/Aeolus

The Atmospheric Dynamics Mission (ADM) is a European Space Agency (ESA) Explorer Core mission, which will probe the lowermost 30 km of the atmosphere from 400 km above the Earth's surface using a high power Doppler wind lidar. The measured data will improve the accuracy of numerical weather forecasting and advance our understanding of atmospheric dynamics and processes relevant to climate variability and modeling.

ESA-Cryosat

Cryosat will measure changes in the sea-ice thickness and variations in snow depth to better understand the influence that climate change is having on the Earth's polar ice masses. It is one of six missions being developed under ESA Earth Explorer Opportunity mission.

ESA - EarthCARE

The ESA Earth Clouds, Aerosols and Radiation Explorer (EarthCARE) mission is being implemented in cooperation with JAXA (Japanese Space Agency). The payload consists of instruments for measuring clouds (Cloud Profiling Radar and multispectral imager) and aerosol properties (atmospheric lidar), and a broadband radiometer to measure top-of-the atmosphere radiances and fluxes.

ESA- ENVISAT

ENVISAT, is the European Space Agency's (ESA) most ambitious Earth Observation (EO) satellite, which was launched successfully in 2002. It carries a suite of 10 instruments including an Advanced Synthetic Aperture Radar (SAR), scatterometer, altimeter, and passive optical instruments for atmospheric chemistry, ocean and sea surface temperature observations. There are 28 Canadian scientific teams currently participating in exploiting the data, and its mission duration has been extended to 2013.

ESA-ERS-2

ESA Earth Observation satellite was launched in 1995 and is carrying similar set of instruments as the ENVISAT satellite. It is still operating and providing useful data to many scientific teams. Canada participated in development of the satellite for ERS-1 and ERS–2. This participation also played an important role in the building of Canadian RADARSAT-1.

ESA-GOCE

The ESA Gravity field and steady-state Ocean Circulation Explorer (GOCE) mission is dedicated to measuring the Earth's gravity field and modeling the geoid with unprecedented accuracy and spatial resolution. This mission will advance our knowledge of ocean circulation, which plays critical role in energy exchanges, sea level change and Earth interior processes. GOCE will also make significant advances in the field of geodesy and surveying.

ESA-Sentinel-1
The Sentinel-1 mission is being built under ESA Global Monitoring for Environment and Security (GMES) program. Its payload consists of a C-band Synthetic Aperture Radar (SAR) (Similar to RADARSAT-2) to provide operational data continuity beyond existing C-band SAR.

ESA-SMOS
The ESA Soil Moisture and Ocean Salinity (SMOS) mission objective is to measure soil moisture and ocean salinity using a novel technique of aperture synthesized radiometry in L-band. The measures will be used for weather/climate prediction.

ESA-Swarm
The ESA Swarm mission is a constellation of three satellites that will provide high-precision and high-resolution measurements of the strength and direction of the Earth magnetic field. Canada is providing an Electric Field Instrument (EFI).

FPEF
The Fluid Physics Experiment Facility (FPEF) is installed on the ISS. Its objective is to collect important experimental data on the role of a liquid bridge in material solidification, an important system used in semiconductor manufacturing. The role of gravity complicates industry's understanding of this system on Earth, and different inserts will allow researchers to study various liquids and liquid bridge dimensions.

FUSE
NASA's Far Ultraviolet Spectroscopic Explorer (FUSE) mission terminated in October 2007 after nine successful years of operations. Canadian scientists have obtained the data in exchange of the CSA contributing the Fine Error Sensors to the telescope.

Galileo
Galileo is a joint program of the European Space Agency and the European Union that will create a system of 32 satellites to improve and complement satellite navigation and positioning systems such as the US-led GPS and Russia's Glonass. Canada was the first non-European country to join the program in 1999.

Herschel/Planck
The Herschel Space Observatory will help scientists determine how early galaxies formed and evolved. The observatory has three instruments and Canada is contributing to two of them: the Heterodyne Instrument for the Far Infrared (HIFI) and the Spectral and Photometric Imaging Receiver (SPIRE). Planck is a European Space Agency medium-sized mission that will be launched with the Herschel Space Observatory. It is a survey instrument that will map the entire sky. Canada is involved mainly in the development of Quick Look Analysis software and Real Time Analysis software for scientific checkout of the data at early stages.

H-Reflex
It is Canada's first International Space Station (ISS) science experiment. It studies the effect of space travel on our nervous system.

JC2SAT
JC2Sat is a Canada-Japan collaborative research and engineering project to develop a pair of nano-satellites. The objective of the mission is to demonstrate innovative technologies as well as formation flying techniques using very small spacecraft.

ICAPS
The Interactions of Cosmic and Atmospheric Particles (ICAPS) experiment will study, the interactions of cosmic and atmospheric particle systems under microgravity conditions. ICAPS has applications to particle physics, atmospheric science, and planetary science

ICE-First
The project ICE-First focuses on genetic repair mechanisms using *C. elegans*, a small worm widely used for genetics research. Half of *C. elegans*' genes have human counterparts. This worm can also mate, reproduce and develop normally during space flight, making it an ideal subject to study the effects of space travel on living organisms.
The project will measure the amount of radiation, its effects on genes, and to eventually develop a biological radiation dosimeter for measuring how much damage radiation causes to living cells on long flights.

ISS
The International Space Station (ISS) is the most ambitious engineering project ever undertaken by humanity. Canada is contributing the Mobile Servicing System (MSS), a space robotics system astronauts use to assemble, maintain the ISS. The MSS consists of three main elements: the Space Station Remote Manipulator System (SSRMS), known as Canadarm2, the Mobile Base System (MBS), and the Special Purpose Dexterous Manipulator (SPDM), known as Dextre.

IVIDIL
The Influence of Vibration on Diffusion in Liquids (IVIDIL) experiment will help understand and acknowledge the effects of vehicle vibration on microgravity experiments on double diffusion. Double molecular and thermal diffusion often occurs in hydrocarbon reservoirs, making assessment of reservoir composition difficult. Microgravity experiments can improve such assessments.

JWST
The James Webb Space Telescope (JWST) is a joint mission involving NASA, ESA, and the CSA. This major facility-class space observatory will be a successor to the Hubble Space Telescope. The JWST will be used to observe targets that range from objects within our Solar System to the most remote galaxies, which are seen during their formation in the early universe.

M3MSat

CSA and the Department of National Defence are partnering to manage the Maritime Monitoring and Messaging Microsatellite (M3MSat) which payload will be an Automatic Identification System (AIS) supported on a micro-satellite bus. This project will demonstrate a multi-mission micro-satellite bus capability and will allow optimization of the AIS payload in maritime traffic identification

Matroshka-R

The Matroshka-R experiment investigates how much radiation different organs in the human body receive in space over prolonged periods of time. The data gained from Matroshka-R will be vital to estimate health risks to astronauts aboard the ISS and on longer space missions since the total radiation risk depends largely on the dose received by the internal organs. It will also increase understanding of the distribution of different types of radiation within the ISS and within the human body.

MIM/ATEN

The Microgravity Vibration Isolation Mount (MIM) is an ISS hardware that isolates experiments from onboard vibrations, providing a more "pure" microgravity. ATEN is used with the MIM Base Unit. It is a furnace designed to meet a wide range of scientific requirements on the ISS.

MOPITT

One of five instruments on NASA's Terra satellite, MOPITT (Measurements of Pollution in the Troposphere) contributes to our understanding of the sources and pathways of atmospheric pollutants.

MOST

The Microvariability and Oscillations of Stars (MOST) microsatellite is Canada's first space telescope launched in 2003. It measures tiny fluctuations in light intensity from stars, enabling scientists to probe star interiors seismically and to set a lower limit on the age of the Universe. MOST is also sensitive to the light variations caused by planets around other stars, giving us unique information about these distant worlds.

MVIS

Canada has developed key technology that will help isolate experiments from the harmful effects of these vibrations. The compact Canadian-built Microgravity Vibration Isolation Subsystem (MVIS) is a control system that is integrated into the European Space Agency’s Fluid Science Lab protecting it from the daily shakes and trembles onboard the ISS. It uses a magnetic field to suspend a container for experiments.

NEOSSat

The Near Earth Orbit/Object Surveillance Satellite (NEOSSat) is a joint CSA-DND mission. It is a combination of the Near Earth Space Surveillance (NESS) and the High Earth Orbit Surveillance (HEOS) projects. It will be used to observe the inner portion of the solar system to discover, track and study asteroids and comets, and will also be used to track satellites in high-Earth orbit to update the orbit parameters of known satellites flying over the Canadian territory.

NEQUISOL
The Non-equilibrium Solidification, Modeling for Microstructure Engineering of Industrial Alloys (NEQUISOL) study aims to use microgravity experiments to improve models of solidification of "under cooled" alloys, in order to better predict conditions required for the production of superior materials.

ORBITALS
The Outer Radiation Belt Injection, Transport, Acceleration, and Loss Satellite (ORBITALS) is a Canadian space physics mission that aims at studying the harsh space weather phenomena in the outer radiation belts. That part of space is intensely radioactive and experiences occasional severe storms that can damage expensive and critical space assets. Understanding and predicting the radiation phenomena in this part of near-earth space is also essential to support long-duration human space flights and robotic missions.

OSIRIS
ODIN Swedish satellite carries the Optical Spectrograph and Infra-Red Imaging System (OSIRIS). It measures the concentration of various gases in the stratosphere, thereby allowing our scientists to make a significant contribution to the global understanding of stratospheric ozone depletion processes.

PCW
The Polar Communications and Weather (PCW) mission is to put a constellation of satellites in highly elliptical orbit over the North Pole to provide communication services and monitor weather in the Arctic region. The CSA will complete the assessment of the requirements of the Canadian government users for a polar satellite system as part of a joint study with DND and Environment Canada.

Phoenix
The Phoenix Mars Lander will be the first mission to explore a polar region of Mars at ground level. Phoenix landed near Mars's northern polar cap on May 25, 2008, and will then spend 90 days probing Mars's soil and atmosphere to determine if the environment could be hospitable to life. Canada's contribution to Phoenix is a meteorological station that will record the daily weather using temperature, wind and pressure sensors, as well as a light detection and ranging instrument.

PMDIS
The Perceptual Motor Deficit in Space (PMDIS) experiment will demonstrate the cause of the hand-eye coordination dysfunction seen early in space missions and indicate countermeasures to reduce or eliminate the problem. PMDIS is the first experiment to use the ISS allocation rights.

PROBA
The Project On-Board Autonomy (PROBA) was launched in 2001, as a technology demonstration mission and it is now operating as an Earth Observation mission. PROBA performs autonomous guidance, navigation, control, onboard scheduling and payload resources management. Its payload includes a compact multi-spectral imager and high-resolution camera. PROBA also aims to use and demonstrate automatic functions, both onboard and in the mission ground segment.

QuickSat
QuickSat is a microsatellite platform that was designed and built by CSA engineers and by students, in collaboration with industry. The platform has reached the stage where it is available to accommodate a payload and to transit into a CSA mission.

RADARSAT-1
RADARSAT-1, Canada's first Earth Observation satellite is the only fully operational civilian remote sensing satellite that carries Synthetic Aperture Radar (SAR). This technology, contrary to optical sensor satellites, has the capacity to image day and night, in all weather conditions, regardless of cloud cover, smoke, haze and darkness. Launched in November 1995, RADARSAT-1 was meant to operate for five years. RADARSAT-1 has continued to supply SAR data to clients in its extended mission.

RADARSAT-2
RADARSAT-2 was launched on December 14, 2007. RADASART-2 is a Canadian satellite from the next generation with its Synthetic Aperture Radar (SAR) technology and the most advanced satellite of its kind in the world. It incorporates new capabilities that ensure Canada's continued leadership in the global marketplace for radar image data by leveraging the knowledge and experience gained through the RADARSAT-1 mission.

RADARSAT Constellation
The RADARASAT Constellation is the evolution of the RADARSAT Program with the objective of ensuring data continuity, improved operational use and improved system reliability over the next decade. The three-satellite configuration will provide complete coverage of Canada's land and oceans offering an average daily revisit at 50m resolution, as well as a significant coverage of international areas for Canadian and international users. It will also offer average daily access to 95% of the world.

SCCO
The Soret Coefficient in Crude Oil (SCCO) experiment will determine the diffusion coefficient of crude oil under microgravity conditions in order to improve extraction processes.

SCISAT
The Space Science Satellite (SCISAT) is Canada's first scientific satellite in 30 years. SCISAT focuses on polar ozone budget and dynamics but also contributes to measurements and modeling of mid latitude ozone and upper troposphere chemistry as well as Chlorinated Fluorocarbons' (CFC) greenhouse gases. SCISAT has continued to produce large volumes of very-high quality space data for climate, weather and pollution studies.

THEMIS
The THEMIS mission stands for "time history of events and macroscale interactions during substorms". The CSA is funding the participation of Canadian scientists in the NASA THEMIS mission comprised of a system of 5 satellites for the study of northern lights phenomena. THEMIS will help to pinpoint where in the magnetosphere the energy of the solar wind transforms explosively into auroras.

TRAC
The Test of Reaction and Adaptation Capability (TRAC) is to determine if the degradation of human manual skills during spaceflight occurs because the process of adaptation to spaceflight consumes a substantial portion of available computational resources in the brain, leaving fewer resources to carry out skilled manual actions. TRAC is carried out on the International Space Station (ISS).

UVIT-ASTROSAT
The ASTROSAT satellite is a Multi-wavelength Space Borne Observatory for carrying out astronomical research. The Ultra-Violet Imaging Telescope (UVIT) aims to image selected parts of the sky in three distinct spectral regions (Far UV, Near UV and Visible) using two nearly identical telescopes. The CSA has agreed to provide to the Indian Space Research Organization (ISRO) the Flight Detector Subsystem. Our participation in the mission ensures that Canadian astronomers have observation time on ASTROSAT, providing new opportunities for astronomical research and discoveries.

Vascular
The Cardiovascular health consequences of long-duration space flight (Vascular) project will investigate vascular inflammation occurring during space flight and support the development of countermeasures to improve astronaut health upon return to gravity.

V-Band Experimental Payload
Following the successful deployment of broadband, multimedia services using Ka- Band technology on the Canadian Anik F2 satellite operated by Telesat, the objective of this mission will be to demonstrate new telecommunications services using extremely high frequencies, thereby allowing new niche expertise for Canadian industry and improved, faster two-way internet service in all regions of Canada.

WISE
The Women International Space Simulation for Exploration (WISE) study is to assess the roles of nutrition and combined physical exercise in countering the adverse effects of extended gravitational unloading through bed rest. Bed rest studies have been used for decades to reproduce on Earth the impact of weightlessness or weight unloading that is experienced by astronauts in orbit or during space flight. Results will prove valuable in planning long-duration human missions in space. This research will also have clinical significance on Earth, advancing knowledge and pointing to improved methods of assisting recovery by bedridden patients.