



THE CANADIAN SPACE AGENCY

2012-2013 Estimates

Report on Plans and Priorities

SECTION 2:

Analysis of Program Activities by Strategic Outcome

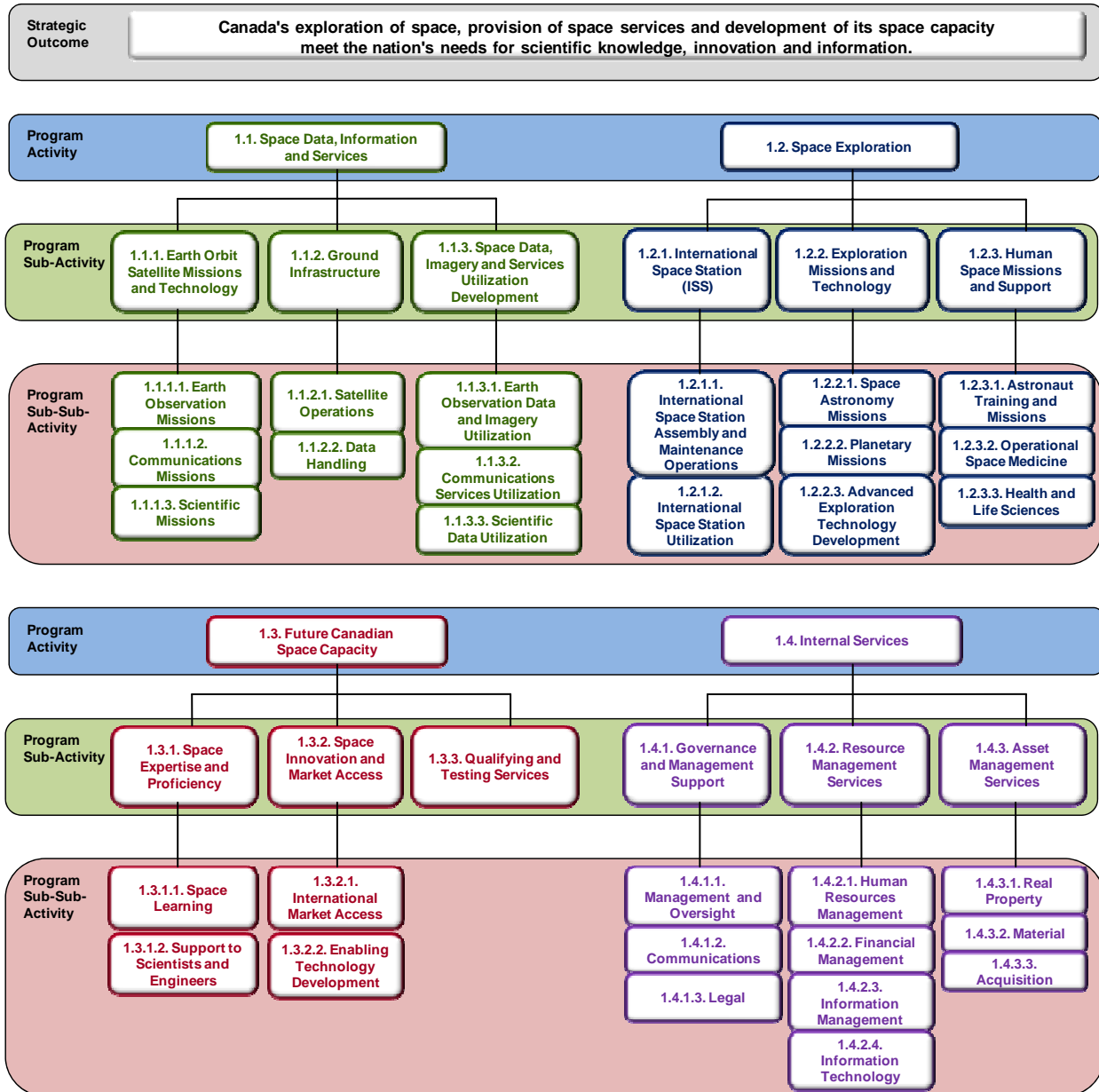
- Detailed Information -

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SECTION 2: ANALYSIS OF PROGRAM ACTIVITIES BY STRATEGIC OUTCOME

Canadian Space Agency's 2012-2013 Program Activity Architecture (PAA)



CANADIAN SPACE AGENCY STRATEGIC OUTCOME

Canada's exploration of space, provision of space services and development of its space capacity meet the nation's needs for scientific knowledge, innovation and information.

PERFORMANCE INDICATORS

1. Depth and width of needed scientific knowledge

The depth and width of knowledge, generated in part through the CSA's support, is primarily based on the analysis of the following factors:

- Production of knowledge is measured by the number of publications and can be broken down by field of knowledge and referred to invested funds.
- Dissemination of knowledge is measured by the number of cited publications which can also be broken down by field of knowledge and by type and extent of the audience reached.
- Relevance of knowledge is measured, among others, by the number of publications listed under areas of knowledge previously targeted by the CSA.

2. Space generated innovation index

Innovation, generated in part through the CSA's support, is primarily based on the analysis of the following factors in the specific context of space:

- Idea generation which results in the creation of new knowledge, technologies, processes or their subsequent improvements.
- Idea development that can take the form of prototypes, scientific instruments and experiments.
- Commercialization and utilization measured by the number of applications developed and used or data requested and provided.

3. Acknowledgement/success stories by Government of Canada organizations of impact on mandate delivery

The recognition by Government of Canada (GoC) organizations of the impact on quality of programs and services delivery attributable to data utilization, information, research results, or space services lies in monitoring of Web information and public documents and depends on the cooperation of participating organizations.

Space Data, Information and Services

Description: This Program Activity includes the provision of space-based solutions (data, information and services) and the progression of their utilization. It also serves to install and run ground infrastructure that processes the data and operates satellites. This Program Activity utilizes space-based solutions to assist Government of Canada (GoC) organizations in delivering growing, diversified or cost-effective programs and services within their mandate, which is related to key national priorities, such as sovereignty, defence, safety and security, resource management, environmental monitoring and the North. It also provides academia with data required to perform its own research.

The services delivered through this Program Activity are rendered, and the data and information are generated and processed, with the participation of the Canadian space industry, academia, GoC organizations, national and international organizations, such as foreign space agencies, not-for-profit organizations, as well as provincial and municipal governments. This collaborative effort is formalized under national and international partnership agreements, contracts, grants or contributions.

| SPACE DATA, INFORMATION AND SERVICES | | | |
|---|---|-----------|-----------|
| PROGRAM ACTIVITY PERFORMANCE MEASUREMENT | | | |
| Expected Result #1 | Performance Indicator | | |
| The GoC organizations offer more diversified or cost-effective programs and services due to their utilization of space-based solutions. | 1. Number of GoC programs and number of different themes serviced by space-based solutions. New success stories of improved efficient/effective departmental mandate delivery due to space-based solutions. | | |
| Planning and Reporting Continuity: | | | |
| RPP 2011-2012 and DPR 2010-2011: http://www.asc-csa.gc.ca/eng/publications/default.asp#parliament | | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 173.7 | 98.7 | 78.4 |
| HUMAN (FTEs) | 107.4 | 104.6 | 100.6 |

Space Data, Information and Services programs are grouped into three Sub-Activities:

- **Earth Orbit Satellite Missions and Technology;**
- **Ground Infrastructure; and,**
- **Space Data, Imagery and Services Utilization Development.**

Program Sub-Activity: 1.1.1. Earth Orbit Satellite Missions and Technology

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

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

| EARTH ORBIT SATELLITE MISSIONS AND TECHNOLOGY | | | |
|---|---|------------------|------------------|
| PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT | | | |
| Expected Result #1 | Performance Indicators | | |
| GoC organizations expressed needs for space-based solutions are fulfilled by CSA. | 1. Ratio of GoC organizations requests vs CSA response through missions, instruments and/or partnerships. 2. Number of needs (by theme) linked to Sun-Earth System Science fulfilled by CSA through missions, instruments and/or partnerships. | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 146.2 | 67.5 | 44.9 |
| HUMAN (FTEs) | 68.5 | 64.7 | 60.4 |

This Sub-Activity is further divided into three Sub-Sub-Activities.

Program Sub-Sub-Activity: 1.1.1.1. Earth Observation Missions

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

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

| Expected Result #1 | Performance Indicators | | |
|---|--|-----------|-----------|
| Maximized access to Canadian and foreign EO data. | 1. Number of EO missions/instruments in development and projected capacity of data availability to GoC organizations. (Target: 1 mission in phase BCD (development): RCM. Projected capacity: Benchmarking). 2. Number of EO missions/instruments in operation, number of partnerships signed and current capacity of data availability to GoC organizations. (Target: 4 missions in phase E (ERS2, RADARSAT-1, RADARSAT-2, ENVISAT ARAS and ENVISAT MERIS). Current capacity : Benchmarking) | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 137.9 | 59.3 | 31.2 |
| HUMAN (FTEs) | 47.8 | 45.2 | 42.1 |

Program Sub-Sub-Activity: 1.1.1.2. Communications Missions

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

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

| Expected Result #1 | | Performance Indicators | | |
|--|--|---|------------------|------------------|
| Maximized access to Canadian and foreign Satellite Communications data and services. | | 1. Number of Satellite Communications missions/instruments in development and projected capacity of data and services availability to GoC organizations. (Target: 2 (CASSIOPE/ M3MSAT). Projected capacity : Benchmarking) 2. Number of missions/instruments in operation, number of partnerships signed and current capacity of data and services availability to GoC organizations. (Target: 1 (Anik-F2). Current capacity : benchmarking) | | |
| RESOURCES | | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | | 5.9 | 5.6 | 7.4 |
| HUMAN (FTEs) | | 11.8 | 10.6 | 10.0 |

Program Sub-Sub-Activity: 1.1.1.3. Scientific Missions

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

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

| Expected Result #1 | Performance Indicators | | |
|--|---|-----------|-----------|
| Maximized access to Canadian and foreign Solar and Earth System Sciences data. | 1. Number of Solar and Earth System Sciences missions/instruments in development and projected capacity of data availability to GoC organizations. (Target: 2: (SWAP, Swarm). Projected capacity: Benchmarking) 2. Number of Solar and Earth System Sciences missions/instruments in operation, number of partnerships signed and current capacity of data availability to GoC organizations. (Target: 6: (SCISAT, MOPITT, OSIRIS, CGSM, THEMIS, NIRST). Current capacity: Benchmarking) | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 2.4 | 2.6 | 6.2 |
| HUMAN (FTEs) | 8.9 | 8.9 | 8.4 |

Program Sub-Activity: 1.1.2. Ground Infrastructure

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

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

| GROUND INFRASTRUCTURE | | | |
|---|--|---|------------------|
| PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT | | | |
| Expected Result #1 | | Performance Indicator | |
| Expressed Canadian and foreign data needs are fulfilled by ground infrastructure. | | 1. Volume of response to data requests fulfilled by ground infrastructure operations. | |
| Expected Result #2 | | Performance Indicator | |
| National ground infrastructure is reliable. | | 1. Percentage of reliability. | |
| RESOURCES | | 2012-2013 | 2013-2014 |
| FINANCIAL (\$ in millions) | | 15.5 | 16.6 |
| HUMAN (FTEs) | | 25.6 | 26.6 |
| | | | 2014-2015 |
| | | | 18.0 |
| | | | 27.0 |

This Sub-Activity is further divided into two Sub-Sub-Activities.

Program Sub-Sub-Activity: 1.1.2.1. Satellite Operations

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

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

| Expected Result #1 | Performance Indicators |
|---|--|
| CSA's satellites are functioning as per operational requirements. | 1. Number of satellite anomalies successfully handled during flight operation maintaining satellite health. (Target: Satellite system availability maintained better than 85% by successfully resolving anomalies) 2. Number of Canadian satellites operated by CSA as per operational requirements. (Target: One satellite: NEOSSat) |

| Expected Result #2 | Performance Indicator |
|---|---|
| Foreign satellite missions are supported. | 1. Number of ground station support contracts provided to foreign satellite missions. (Target: At least one foreign mission supported through 10 ground stations contracts) |

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|----------------------------|-----------|-----------|-----------|
| FINANCIAL (\$ in millions) | 10.7 | 12.6 | 14.0 |
| HUMAN (FTEs) | 24.5 | 25.4 | 25.9 |

Program Sub-Sub-Activity: 1.1.2.2. Data Handling

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

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

| Expected Result #1 | Performance Indicators |
|---|--|
| Satellite data provided as per data requirements. | <p>1. Volume of data from various missions delivered to GoC organizations and other customers. (Target: 150 Gbytes from SCISAT-1; 4 000 minutes from RADARSAT-1; 15 000 frames from RADARSAT-2)</p> <p>2. Volume of data archived. (Target: 150 Gbytes from SCISAT-1; 4 000 minutes from RADARSAT-1; 10 000 frames from RADARSAT-2)</p> <p>3. Number of different satellites from which data is received. (Target: Four satellites – RADARSAT-1, SCISAT 1, RADARSAT-2 and NEOSSat)</p> |

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|----------------------------|-----------|-----------|-----------|
| FINANCIAL (\$ in millions) | 4.8 | 4.0 | 4.0 |
| HUMAN (FTEs) | 1.1 | 1.1 | 1.1 |

*Note: Operations are not carried out by CSA personnel.

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

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

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

| SPACE DATA, IMAGERY AND SERVICES UTILIZATION DEVELOPMENT PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT | |
|--|--|
| Expected Result #1 | Performance Indicators |
| The ability of GoC organizations to use space-based solutions is enhanced. | 1. Number of GoC organizations using space-based solutions. 2. Volume of space-based solutions available /requested. 3. Number of peer-reviewed papers related to data utilization produced in academia and R&D community in Canada. |

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|-----------------------------------|------------------|------------------|------------------|
| FINANCIAL (\$ in millions) | 12.0 | 14.6 | 15.6 |
| HUMAN (FTEs) | 13.3 | 13.3 | 13.1 |

*Note: Operations are not carried out by CSA personnel.

This Sub-Activity is further divided into three Sub-Sub-Activities.

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

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

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

| Expected Result #1 | Performance Indicator |
|---|--|
| The ability of GoC organizations to turn Earth Observation data into useable products is enhanced. | 1. Number of Earth Observation data utilization development activities supported. (Target : 20 for GRIP) |
| Expected Result #2 | Performance Indicator |
| The ability of the scientific community to perform high-level research with Earth Observation data is enhanced. | 1. Number of Earth Observation data utilization development activities supported. (Target: 20 for SOAR) |

| Expected Result #3 | | Performance Indicator | | |
|--|-----------|---|-----------|--|
| A Canadian industry that turns Earth Observation data into useable products is enhanced. | | Number of Earth Observation data utilization development activities supported. (Target: 20 for EOADP) | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 | |
| FINANCIAL (\$ in millions) | 10.0 | 12.9 | 13.6 | |
| HUMAN (FTEs) | 11.4 | 11.4 | 11.4 | |

*Note: Operations are not carried out by CSA personnel.

Program Sub-Sub-Activity: 1.1.3.2. Communications Services Utilization

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

This SSA engages the participation of the Canadian space industry and is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

| Expected Result #1 | | Performance Indicator | | |
|--|-----------|---|-----------|--|
| The ability of GoC organizations to turn Satellite Communications data and services into useable products is enhanced. | | 1. Number of Satellite Communications data and services utilization development activities supported. (Target: 0 = Activity under review) | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 | |
| FINANCIAL (\$ in millions) | 1.7 | 1.6 | 1.6 | |
| HUMAN (FTEs) | 1.8 | 1.8 | 1.6 | |

*Note: Operations are not carried out by CSA personnel.

Program Sub-Sub-Activity: 1.1.3.3. Scientific Data Utilization

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

This SSA engages the participation of the Canadian space industry, academia and GoC organizations scientists, and is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

| Expected Result #1 | | Performance Indicator | |
|---|------------------|--|------------------|
| The ability of GoC organizations to turn Solar and Earth System Sciences data into useable products is enhanced. | | 1. Number of Solar and Earth System Sciences data utilization development activities supported. (Target : 6 : (3 Solar-Terrestrial/3 Atmospheric)) | |
| Expected Result #2 | | Performance Indicator | |
| The ability of the scientific community to perform high-level research with Solar and Earth System Sciences data is enhanced. | | 1. Number of Solar and Earth System Sciences data utilization development activities supported. (Target: 26 (14 Solar-Terrestrial/12 Atmospheric)) | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 0.3 | 0.2 | 0.4 |
| HUMAN (FTEs) | 0.1 | 0.1 | 0.1 |

*Note: Operations are not carried out by CSA personnel.

Highlights of Expected Accomplishments for Space Data, Information and Services

Earth Observation

- Complete the design of the RADARSAT Constellation Mission (RCM) with a Mission Critical Design Review (CDR) approved by stakeholders. The launch of the first satellite is planned to occur in fiscal year 2016-2017 followed a year later by the other two satellites. While ensuring continuity of space data from its predecessors RADARSAT-1 and -2 for many government departments, the RCM will enhance Canada's ability to use space-based solutions 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 CSA will keep managing and optimizing the remaining \$ 321million of the \$445 million worth of prepaid RADARSAT-2 data allocation to ensure that the needs for Synthetic Aperture Radar (SAR) data by operational Government users are met in a sustainable way. Fourteen departments are taking advantage of RADARSAT many capabilities and making long term investments to develop new capabilities within the departments by either bringing applications closer to an operational status or by finding ways to improve the use of the data in order to better fulfill their mandate. The Department of National Defence (DND) Project Epsilon is expected to become one of the largest users of SAR data in Canada together with Environment Canada.
- The CSA will keep operating RADARSAT-1 to supply radar imagery data to the existing client base with a high performance for satellite reliability, data delivery, and image quality. RADARSAT-1 is instrumental in assuring data continuity and user's satisfaction, when conflicting requests arise with RADARSAT-2.
- The CSA will continue satellite data application development and EO utilization activities, to support the growth of EO needs or capabilities within Government of Canada and the service industry. With 22 ongoing contracts, including ten to develop innovative applications to support water management, the industry will have many opportunities to provide high-value solutions to the Government of Canada while improving their competitiveness. The SARWind project with Environment Canada will be of particular interest. Building on the accomplishments and success of the MENTOR project initiated by the private sector, it will be the year of final integration and validation before becoming operational within Meteorological Services Canada. Once completed, it will be the first operational SAR satellite space-based monitoring for improving wind analysis and short-range prediction over large marine areas, and especially in the coastal zones.
- In support for the growing demand of SAR data by the Canadian government and to reduce the number of data acquisition conflicts for SAR data, the CSA will continue to manage an agreement with the European Space Agency and a processing contract with the private sector, to secure access to ENVISAT SAR data. The Ice Services of Environment Canada and the new SARWind project will be the largest beneficiaries

of this agreement that adds up to 800 images per month at the disposal of the Canadian Government. In addition to supporting the contingency plan in case of Canadian satellites failure, the added volume of SAR data will extend the length of the RADARSAT-2 data government allocation.

- The CSA will pursue discussions for an agreement with the European Commission to ensure continued participation of Canadian companies in supplying space and ground segment subsystems for the missions Sentinel-1, 2 and 3 of the European Global Monitoring for Environment and Security (GMES) space component program. Sentinel missions will provide useful data to an array of Canadian users including Canadian Government departments such as the Canada Centre for Remote Sensing (CCRS) as well as the Natural Resources Canada (NRCan) for Sentinel-2 and-3 data for maritime surveillance, land cover and forestry applications to name a few, and the Department of Fisheries and Oceans (DFO) for Sentinel-3 data for ocean colour application. Canadian ground stations will likely play an essential role in receiving and deliver the Sentinel data to the national users.
- The CSA will continue to develop promising mission concepts for space-borne observations and satellite communications, both for operational and scientific purposes. These mission concepts will be for Canadian instruments on foreign as well as Canadian spacecrafts. Implementation approaches to meet users needs will be studied, notably the use of micro and small satellite platforms.
- The CSA will continue to leverage international efforts by playing a tangible role and being a reliable partner in international organizations.
 - The CSA is holding chairmanship of the International Charter *Space and Major Disasters*, to use Earth Observation (EO) satellites in response to disasters until mid-2012. The CSA continues to regularly provide RADARSAT-1 and 2 data and strategic EO-derived information products upon Charter activation, thus contributing to help mitigating the effects of disasters on human life.
 - The CSA is vice-Chair of the Committee on Earth Observation Satellites (CEOS), preparing for chairmanship in 2013. This will be in opportunity for Canada to guide this international body aiming at proper international coordination of Earth observation programs and the maximum utilization of their data and to propose a theme that fosters collaboration among national and international stakeholders.

- The CSA will also continue to lead initiatives on disaster management and support the implementation of others, such as JECAM (Joint Experiment for Crop Assessment and Monitoring) for space-based monitoring of agriculture, the Forest Carbon Tracking and Global Forest Observation Initiative (GFOI) and the second phase of the Caribbean Flood Pilot Project (CSDP) aiming at improving the capacity for mitigation, management and coordinated response to natural hazards.

Earth System and Space Environment

- The CSA will continue to develop the CASS (Chemical and Aerosol Sounding Satellite) mission concept which is a follow-on to the successful SCISAT-1 mission, that the CSA keeps operating for the 9th year. This mission will continue the atmospheric composition and air quality measurements, monitor the chemistry influencing ozone recovery, and provide new science on how the surface climate influences the upper troposphere/lower stratosphere region. This mission concept can apply to Canadian instruments on foreign as well as Canadian spacecraft.
- The CSA will continue to support the development of a sophisticated Enhanced Interaction Klystron (EIK) that could be at the heart of the interferometric radar instrument on the Surface Water and Ocean Topography (SWOT) mission being developed by NASA/JPL and CNES for launch in 2019. SWOT will allow measurement of lake level and ocean circulation features and will be of great utility to Environment Canada for hydrological and meteorological monitoring and forecasting, and to Fisheries and Oceans Canada for ocean science and forecasting.
- The CSA will continue to support Canadian scientists in validation of greenhouse gas measurements made with foreign spacecraft (e.g. Japanese GOSAT) and in the development of capabilities to assimilate and utilize greenhouse gas observations.
- The CSA will continue collaborating with the Meteorological Service of Canada and with the National Research Council of Canada in the development of new data products from CloudSat and EarthCARE, and in establishing requirements for future cloud and precipitation radars such as the SnowSat mission.
- The CSA continues to support MOPITT and OSIRIS, two major Canadian science instruments that are currently orbiting Earth and collecting atmospheric environment data. MOPITT, on NASA's Terra satellite, measures pollutants in the troposphere, providing a wealth of data on global transport of pollutants 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 support the ESA Swarm mission, which will launch in July 2012, by enabling the University of Calgary to participate in the calibration, verification and validation of the Canadian Electric field instrument. The Swarm mission is primarily a magnetic surveying mission, but the Canadian scientists will use the electric field measurements performed from the 3 Swarm spacecrafts in conjunction with the Canadian Geospace Monitoring ground instruments to help understand the ionospheric plasma convection processes.
- The CSA is collaborating with Environment Canada and with Agriculture and Agri-Food Canada to support the Canadian Science and Applications Plan for NASA's Soil Moisture Active Passive (SMAP) mission. Canadian scientists from EC, AAFC and five Canadian universities, will participate in pre- and post-launch data calibration/validation and algorithms development activities as well as testing, demonstration, and implementation of SMAP data and algorithms for Canadian regional products and other related activities. SMAP data will improve the representation of energy, water and carbon cycles in Canadian environmental analysis and prediction systems using soil moisture and freeze/thaw data. SMAP will be launched in November 2014.
- The CSA is collaborating with Environment Canada to support the development of a Carbon Assimilation System. This activity will allow EC, in collaboration with Canadian university scientists, to develop the capacity and assess the operational feasibility of using spaceborne atmospheric CO₂ observations and a transport model to infer surface fluxes. The EC-CAS system will also be useful for assessment of future space-borne greenhouse gas observation requirements.
- The CSA is collaborating with the Canadian Forest Service in developing and testing an Active Fire Product to be derived from radiance measurements made by the NIRST instrument on the SAC-D/Aquarius satellite (launched 2011). The CSA contributed unique uncooled microbolometers detectors to this instrument that should improve the estimation of biomass fire emissions through the measurement of Fire Radiative Power.

Satellite Communications

- The CSA will continue the analysis of delivery mechanisms for the Polar Communications and Weather (PCW) Mission, including Private-Public-Partnership (PPP) in order to find the most efficient way to respond to the needs expressed by other government departments and Northern communities in Canada. If approved, the mission will facilitate Canadian operations in the North and support Canadian sovereignty by providing reliable communications services and timely meteorological information for civilian and military operations.

- The CSA will finalize the manufacturing, integration and testing of the M3MSat Satellite and initiate the manufacturing, integration and testing. This joint CSA-DND micro-satellite project will demonstrate and further develop a multi-mission micro-satellite bus capability, establish micro-satellites as operationally cost effective, allow optimization of the AIS payload in maritime traffic identification and significantly support Canadian industry business development strategies in a global market context. A complement to CSA's RADARSAT Constellation and DND's Polar Epsilon missions, it will be launched in 2013.
- The CSA prepares for the launch of CASSIOPE, a mission that will demonstrate both the small satellite bus capability and the future space-based digital courier system CASCADE and bring scientific returns specifically with the ePOP instrument that will help understand particle exchange and energy coupling processes between the Earth's atmosphere and space environment.
- The CSA will continue to chair and actively participate in the newly created Federal GNSS Coordination Board (FGCB) to support the Government of Canada's effort on global navigation satellite systems activities.

Ground Infrastructure

- The CSA will continue to take advantage of Canada's favourable northern location by:
 - Pursuing the feasibility of hosting satellite data reception stations in the North.
 - Continued funding of the operation of the 16 Canadian Ground Based observatories for the THEMIS mission, complementing the observations from the 4 Alaska based observatories and 5 NASA spacecrafts to better understand the processes that lead to geomagnetic storms and auroral intensification. Canada is the preferred location for studying space weather processes due to its proximity to the magnetic North Pole.

Space Exploration

Description: This Program Activity provides valuable Canadian science, signature technologies and qualified astronauts to international space exploration endeavours. This Program Activity contributes to the Government of Canada's Science and Technology Strategy. It fosters the generation of knowledge as well as technological spin-offs that contribute to a higher quality of life for Canadians. It generates excitement within the population in general and contributes to nation-building. This Program Activity appeals to the science and technology communities. It is targeted mostly towards Canadian academia and international space exploration partnerships. Canadian industry also benefits from the work generated within this Program Activity.

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

| SPACE EXPLORATION | | | |
|---|---|------------------|------------------|
| PROGRAM ACTIVITY PERFORMANCE MEASUREMENT | | | |
| Expected Result #1 | Performance Indicator | | |
| Expansion of scientific knowledge acquired through space exploration endeavours. | 1. Number of peer-reviewed scientific publications, reports and conference proceedings using space exploration information and produced by researchers (sciences and technologies) in Canada. | | |
| Expected Result #2 | Performance Indicator | | |
| Multiple use and applications of knowledge and know-how acquired through space exploration endeavours. | 1. Number of terrestrial applications and of space re-utilization of knowledge and know-how acquired through space exploration endeavours. | | |
| Planning and Reporting Continuity: | | | |
| RPP 2011-2012 and DPR 2010-2011: http://www.asc-csa.gc.ca/eng/publications/default.asp#parliament | | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 106.3 | 93.6 | 93.0 |
| HUMAN (FTEs) | 196.1 | 192.3 | 188.0 |

Space Exploration programs are grouped into three Sub-Activities:

- **International Space Station;**
- **Exploration Missions and Technology; and,**
- **Human Space Missions and Support.**

| |
|---|
| Program Sub-Activity: 1.2.1. International Space Station (ISS) |
|---|

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

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

| INTERNATIONAL SPACE STATION (ISS) | | | |
|--|------------------|---|------------------|
| PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT | | | |
| Expected Result #1 | | Performance Indicator | |
| Development of operational and technological know-how related to long-duration space missions (with potential Earth application) acquired through participation in the International Space Station (ISS) operations and laboratory missions. | | 1. Number and percentage (and description) of Canadian missions/solutions/instruments flown on ISS that met their mission requirements. | |
| Expected Result #2 | | Performance Indicator | |
| Canada, a well-positioned partner, influences the ISS program direction (where each partner has an equal vote). | | 1. Number of CSA participation in ISS programs boards and panels. | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 44.3 | 50.2 | 55.9 |
| HUMAN (FTEs) | 102.6 | 103.1 | 103.2 |

This Sub-Activity is further divided into two Sub-Sub-Activities.

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

Description: This Program Sub-Sub-Activity (SSA) includes the provision and operation of the Canadian Mobile Servicing System (MSS), composed of three Canadian robots – Canadarm2, Dextre and the Mobile Base System. MSS operations and maintenance services are conducted by Canadian or foreign astronauts on board the International Space Station (ISS) and by ground controllers and engineers located in established facilities at the Canadian Space Agency (CSA) and the National Aeronautics and Space Administration (NASA) – Johnson Space Center. This SSA also includes the provision of specialized MSS training, systems engineering and software services, flight procedures development as well as the facility infrastructure necessary to operate the MSS through its life cycle. This SSA is necessary to fulfill Canada's ongoing commitment to the international partnership to assemble and maintain the ISS, a legally binding obligation under the Canadian *Civil International Space Station Agreement Implementation Act*.

| Expected Result #1 | | Performance Indicator | | |
|---|-----------|--|-----------|--|
| The Canadian contribution (Mobile Servicing System) meets the planned operational requirements identified in the ISS Increment Definition Requirements Document (IDRD) in accordance with the Intergovernmental Agreement (IGA) and the NASA/CSA Memorandum of Understanding (MOU). | | 1. The Mobile Services System (MSS) fulfills its operational requirements. (Target: Scheduled MSS operations conducted in accordance with ISSP requirements) | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 | |
| FINANCIAL (\$ in millions) | 38.6 | 39.4 | 39.5 | |
| HUMAN (FTEs) | 85.7 | 87.1 | 86.9 | |

Program Sub-Sub-Activity: 1.2.1.2. International Space Station Utilization

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

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

| Expected Result #1 | | Performance Indicators | | |
|---|-----------|---|-----------|--|
| Optimal utilization of the International Space Station (ISS). | | 1. Ratio of programmatic objectives achieved through ISS utilization. (Target: 5/5) 2. Number of Canadian stakeholders involved in activities on the ISS. (Target: 2) 3. Proportion of ISS resources used. (Target: 100%) | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 | |
| FINANCIAL (\$ in millions) | 5.7 | 10.8 | 16.4 | |
| HUMAN (FTEs) | 16.9 | 16.0 | 16.3 | |

Program Sub-Activity: 1.2.2. Exploration Missions and Technology

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

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

| EXPLORATION MISSIONS AND TECHNOLOGY PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT | |
|---|---|
| Expected Result #1 | Performance Indicator |
| Technological know-how acquired through Space Exploration endeavours (astronomy and planetary). | 1. Proportion of CSA's missions/solutions/instruments that met their mission performance requirements at acceptance review and/or at commissioning. |

| Expected Result #2 | | Performance Indicator | |
|---|-----------|---|-----------|
| Canada maintains a strategic positioning which supports its capacity to influence space exploration missions and decision making process in key international space exploration forums. | | 1. Number of CSA's sponsored highly qualified personnel (HQP) nominated on the International Space Exploration Decision bodies. | |
| Expected Result #3 | | Performance Indicator | |
| CSA's participation in space exploration missions provides access to scientific data about the Solar system and the universe. | | 1. Number of CSA's sponsored space astronomy and planetary missions' providing data to Canadian scientific community. | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 57.8 | 39.1 | 33.0 |
| HUMAN (FTEs) | 75.9 | 72.1 | 68.4 |

This Sub-Activity is further divided into three Sub-Sub-Activities.

Program Sub-Sub-Activity: 1.2.2.1. Space Astronomy Missions

Description: This Program Sub-Sub-Activity (SSA) encompasses the definition, design, technology development, implementation and use of complete Canadian space telescope systems and the provision of Canadian instruments, sensors and sub-systems to international space telescope or probe missions. This SSA is necessary to generate scientific data about the universe through the observation of the solar system and deep space.

This SSA is performed in collaboration with foreign space agencies, Government of Canada (GoC) organizations and through consultation with the Canadian Astronomical Society. This collaborative effort takes shape under contracts, grants, contributions and/or international partnership agreements.

| Expected Result #1 | | Performance Indicator | |
|--|-----------|--|-----------|
| Canadian know-how and expertise allow Canada to lead or participate in international space astronomy missions. | | 1. Number of technological and scientific solutions being developed by the CSA in the context of astronomy missions. (Target: 2) | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 17.5 | 12.6 | 12.2 |
| HUMAN (FTEs) | 23.7 | 25.3 | 19.3 |

Program Sub-Sub-Activity: 1.2.2.2. Planetary Missions

Description: This Program Sub-Sub-Activity (SSA) encompasses the definition, design, technology development, implementation and use of Canadian exploration signature technologies and scientific instruments made available to international exploration missions. The SSA is necessary to reach remote bodies (planets, asteroids, etc.) and to conduct detailed observations and science.

This SSA is performed in collaboration with the International Space Exploration Coordination Group, Government of Canada (GoC) organizations and foreign space agencies. This collaborative effort takes shape under contracts, grants, contributions and/or international partnership agreements.

| Expected Result #1 | | Performance Indicator | | |
|--|-----------|--|-----------|--|
| Canadian know-how and expertise allow Canada to participate in planetary exploration missions. | | 1. Number of technological and scientific solutions being developed by the CSA in the context of planetary missions. (Target: 1) | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 | |
| FINANCIAL (\$ in millions) | 23.7 | 15.3 | 14.6 | |
| HUMAN (FTEs) | 12.5 | 12.3 | 12.9 | |

Program Sub-Sub-Activity: 1.2.2.3. Advanced Exploration Technology Development

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

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

| Expected Result #1 | | Performance Indicator | | |
|---|--|--|-----------|-----------|
| Maturing science, technology and operational solutions for planning and strategic positioning purposes. | | 1. Number of science, technology and operational solutions that are under development in conformity with the orientations and conclusions of the Canadian Space Exploration plan. (Target: 11) | | |
| RESOURCES | | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | | 16.6 | 11.1 | 6.2 |
| HUMAN (FTEs) | | 39.7 | 34.5 | 36.2 |

Program Sub-Activity: 1.2.3. Human Space Missions and Support

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

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

| HUMAN SPACE MISSIONS AND SUPPORT | | | | |
|--|--|--|-----------|-----------|
| PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT | | | | |
| Expected Result #1 | | Performance Indicator | | |
| Human space flight generates “unique” health and life sciences knowledge, and technological know-how to sustain life and mitigate health risk during long-duration space flight. | | 1. Number of activities that lead to health risk mitigation strategies, technologies and/or countermeasures. | | |
| RESOURCES | | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | | 4.2 | 4.3 | 4.1 |
| HUMAN (FTEs) | | 17.6 | 17.1 | 16.4 |

This Sub-Activity is further divided into three Sub-Sub-Activities.

Program Sub-Sub-Activity: 1.2.3.1. Astronaut Training and Missions

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

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

| Expected Result #1 | | Performance Indicator | | |
|---|-----------|---|-----------|--|
| Canadian astronaut corps is ready to assume any responsibilities on an expedition to the International Space Station (ISS). | | 1. Number of astronaut activities undertaken in preparation for eventual ISS mission assignments. (Target: 3) | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 | |
| FINANCIAL (\$ in millions) | 3.2 | 3.0 | 2.6 | |
| HUMAN (FTEs) | 14.6 | 14.2 | 13.0 | |

Program Sub-Sub-Activity: 1.2.3.2. Operational Space Medicine

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

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

| Expected Result #1 | | Performance Indicator | | |
|---|-----------|--|-----------|--|
| Astronauts' health is optimized to meet mission requirements. | | 1. Number of active astronauts medically certified for ISS assignment and duties. (Target: 3/3) | | |
| Expected Result #2 | | Performance Indicator | | |
| Astronauts' long-term health is monitored following their active careers. | | 1. Ratio of eligible astronauts invited and sponsored to participate in their long-term health monitoring. (Target: 5/7) | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 | |
| FINANCIAL (\$ in millions) | 0.6 | 0.8 | 0.9 | |
| HUMAN (FTEs) | 1.8 | 1.7 | 1.8 | |

Program Sub-Sub-Activity: 1.2.3.3. Health and Life Sciences

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

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

| Expected Result #1 | | Performance Indicators | | |
|--|-----------|--|-----------|--|
| Performance of space life sciences studies with potential benefits for Canadians and to enable human exploration of space. | | 1. Number of studies aiming at the development of countermeasures and enhanced human performance and life support. (Target: 3) | | |
| | | 2. Number of partnerships addressing potential terrestrial healthcare solutions. (Target: 1) | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 | |
| FINANCIAL (\$ in millions) | 0.4 | 0.5 | 0.5 | |
| HUMAN (FTEs) | 1.2 | 1.2 | 1.6 | |

Highlights of Expected Accomplishments for Space Exploration

ISS OPERATIONS AND UTILIZATION

- The CSA will continue to fulfill its International Space Station obligations operating the Mobile Servicing System (MSS). This involves maintaining and providing technical support for the MSS hardware and software, continuing the repair and overhaul of failed hardware, providing MSS related training and qualification for 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, Québec.
- The CSA will continue to maintain MSS operational preparedness to carry out ISS assembly and maintenance operations. This will entail the development and certification of new flight products and procedures to support MSS operations. The CSA will also continue to expand the use of ground control operations to free up on-orbit crew time. The development of expanded ground control capabilities for future Dextre operations will enable more efficient on-orbit utilization of this new element and thereby significantly reduce astronaut time requirements.
- The CSA, along with its ISS International partners, will continue the assessment of how to extend the operating life of the Mobile Servicing System to 2020. Initially, the MSS was designed to operate for a 15 year period. Currently, each element of the MSS (Canadarm2, MBS and Dextre) stated design requirements operational lives will terminate in 2016, 2017 and 2023 respectively.
- The CSA will release new MSS software, which will provide further capabilities to reduce the amount of analysis required during mission preparation and also provide more autonomy to the operators of the MSS.
- The CSA will continue its collaboration with NASA for on-orbit technology demonstration experiments using Dextre on the International Space Station, including the on-orbit Robotic Re-fueling Mission.
- The CSA will further ISS utilization through the development and support of scientific research, technology demonstrations and educational activities such as:
 - In collaboration with Natural Resources Canada, the APEX-CSA2 experiment used white spruce, an economically important species for the forest industry, to determine the effects of gravity on gene expression. The on-orbit activities have been successfully completed and the remaining activities consist of laboratory analysis and interpretation of the plant material flown in space and on Earth. Both Cambium and APEX-CSA2 resulted from a close collaboration with the Kennedy Space Centre of NASA.

- Three experiments, namely called Bodies in the Space Environment (BISE), Vascular and Hypersole, will attempt to better understand the effects of long-duration exposure to microgravity on human adaptability and health. The Hypersole experiment, led by scientists at the University of Guelph (Ontario), uses shuttle crew members to study the changes in the foot sole skin sensitivity that occur during spaceflight, to better understand balance control. This data collection phase was completed with the final shuttle flight in the summer of 2011. The research team is currently analyzing the data. This knowledge is key to supporting future human space exploration as well as having Earth benefits.
- The Cardiovascular and Cerebral control on ISS (CCISS) experiment aims to uncover the root causes for the susceptibility to fainting observed when astronauts return to Earth. This experiment's results, as well as those of BISE, Vascular and Hypersole, will be used to develop new strategies for addressing the adverse effects of spaceflight on humans, thus leading to decreased risk in future exploration studies. They all also hold relevancy and application to disease conditions and disease risks on Earth.
- BCAT-C1 (Binary Colloid Alloy Test) is a continuation of the successful BCAT-5 (NASA-CSA collaboration) experiment, which gathers unique data on the physical characteristics of colloids which are important constituents of many commercial products such as paints and pharmaceuticals. Hitherto unseen crystalline structures were observed during BCAT-5 and further novel discoveries are expected in this follow-on experiment.
- The purpose of the Microflow1 project is to miniaturize and simplify flow cytometry for space and assess its performance in the ISS environment. Flow cytometry enables scientists and physicians to quantify molecules (such as hormones) and cells in blood or other body fluids. Specific ISS medical requirements such as blood cell counts cannot be implemented in flight. A successful demonstration of the Microflow1 during the flight of Canadian astronaut Chris Hadfield on the space station could become the first step into providing future capacity to perform real-time medical care of crewmembers, as well as an essential tool for research in physiology and biology.
- The CSA will continue to collect neutron radiation exposure data through the collaborative project RADI-N2 with International Partners on ISS using Canadian made radiation dosimeter (Bubble Detectors). Specifically, another set of sessions is planned for C2 Mission between Dec 2012 and May 2013.

- Through the International Space Life Sciences Working Group (ISLSWG), the CSA works with the European Space Agency (ESA), the Japan Aerospace and Exploration Agency, NASA, the German Space Agency (DLR), the French Space Agency (CNES) and the Italian Space Agency (ASI) to coordinate space life sciences and multinational world-class scientific research on the ISS. Proposals that were selected during the 2009 International Life Sciences Research Announcement will be developed for execution on the ISS in the 2012-2014 timeframe. Through participation in this working group, efficiencies are found through collective peer review, as well as space hardware and data sharing.

EXPLORATION MISSION AND TECHNOLOGY

- Canada is participating in the James Webb Space Telescope (JWST), a major facility-class space observatory that will be launched in 2018. The JWST is a successor to the highly successful Hubble Space Telescope. 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 for the design and construction of a science instrument named NIRISS (Near Infrared Imager and Slitless Spectrograph). The manufacturing and testing of the FGS and NIRISS will continue in 2012 in order to be delivered to NASA during the year. By virtue of CSA's contribution, Canadian astronomers will have guaranteed access to 5% of the observing time of the James Webb Space Telescope.
- The CSA will continue to support the integration of the Flight Detector Subsystem for the Ultra Violet Imaging Telescope (UVIT) on board the ASTROSAT satellite of the Indian Space Research Organization (ISRO). The subsystem was delivered to ISRO in February 2010. ASTROSAT is scheduled for launch in 2012. The CSA's participation will guarantee 5% of the observing time for Canadian scientists and access to ASTROSAT's astronomic data.
- The CSA will support the operations of the Alpha Particle X-ray Spectrometer (APXS) for the Mars Science Laboratory (MSL) that was launched on November 26, 2011. The MSL rover, Curiosity, is scheduled to land on Mars in August 2012. The Canadian contribution will help scientists to determine the chemical composition of various soil, dust and rock samples on Mars.
- The CSA will continue the design of an instrument called MATMOS (Mars Atmospheric Trace Molecule Occultation Spectrometer) for the detection, profiling, and mapping of trace gases in the MARS atmosphere. This Canadian instrument will be part of the 2016 joint ESA/NASA Exomars Trace Gas Orbiter mission, aimed at reaching a better understanding of the Martian atmosphere and its evolution over time.

- The CSA will complete the feasibility study and will begin the design of an instrument called OSIRIS-Rex Laser Altimeter (OLA), an advanced scanning lidar that will provide global topographic mapping of an asteroid surface, assist the mission as a navigation aid, and provide scale for images and spectra for the OSIRIS-Rex mission, part of the NASA New Frontiers program. The OSIRIS-Rex mission will launch in 2016 and will be the first U.S. mission to return samples from an asteroid. This will also constitute a first for Canada.
- The CSA will begin the design of a metrology system for participation in JAXA's lead ASTRO-H mission, an X-ray space astronomy telescope, scheduled for launch in 2014. This mission also includes participation from Europe and NASA. The CSA's participation will enable Canadian scientists to apply for observation time on the telescope.
- With the successful launch of ESA's Herschel and Planck space telescope, in May 2009 to study how galaxies were formed in the early universe and how stars have been created throughout the history of time, CSA will continue to support the Canadian science teams involved in the operations and utilization of instruments on board this space observatory.
- The CSA will continue to support the Canadian science team with the operations and utilization of MOST, a micro-satellite, carrying a space telescope to study Micro-variability & Oscillations of Stars. Since its launch in 2003, MOST has vastly exceeded expectations by observing over 2000 targets during 8 years of operations.
- As part of the ADAMS project, the CSA will continue the development of a tool called PRET (Performance Readiness Evaluation Tool) aimed at assessing the neurocognitive functions and readiness to perform complex tasks, an internationally approved medical requirement of the ISS that is yet to be fully met. Validation of the tool will be done by a Canadian University.
- In 2012-2013, the CSA will continue to work with its industrial contractor team to deliver the second of two projects under the *Stimulus* initiative on space robotics announced as part of Canada's Economic Plan. The *Stimulus* initiative, to be completed in 2012-2013 using CSA's own funding, is developing terrestrial prototypes of different rovers and their associated technologies for Moon and Mars exploration. Using the Exploration Core funding, the CSA plans to support analogue mission deployments.
- The CSA will continue to participate actively to the International Space Exploration Coordination Group (ISECG). This group was created in 2007 to promote coordination of Moon and Mars exploration between 14 space agencies around the world. In 2012, the ISECG will be chaired by CSA and its work will focus on refining the Global Exploration Roadmap for robotics and human exploration of the Moon, Mars and asteroids prepared in 2011. The results will be presented to the Head of the space exploration programs during a meeting hosted by CSA. The ISECG will also develop a first version of an international framework to measure the benefits of space exploration.

- The CSA will collaborate with the European Space Agency on operations and analysis of bed-rest studies through the ELIPS Program. Bed-rest is an excellent simulation of spaceflight with regards to physiological effects; it provides both improved understanding of the response of the human body to lack of gravity, and provides the ability to test new spaceflight countermeasures on the ground.
- The Mars 2018 Mission is a proposed NASA/ESA Mars rover mission that would launch in 2018. The CSA will evaluate different concepts for a potential Canadian Robotic Manipulator contribution to this rover mission. The goal of the proposed rover would be to pursue exobiology through surface and subsurface sampling and in-situ analysis and to collect and cache samples of interest for a potential return to Earth by a future mission. As such, the NASA/ESA Mars 2018 mission can be considered as the first component of the joint NASA/ESA Mars Sample Return (MSR) mission.
- CSA will continue to develop a Canadian signature technology – space-based Light Detection and Ranging (LIDAR) – through a competitive RFP for a LIDAR sensor to demonstrate rendezvous and docking on the ISS in addition to an ISS inspection capability. Many previous success stories such as the Canadian Laser Camera System that was used to inspect the Space Shuttle tiles have branded Canada as a world leader. The advancement opportunity is to demonstrate a LIDAR vision sensor on the ISS. The initial phase of this technology demonstration application will be started next year.
- The CSA will evaluate potential contributions to the ESA Cosmic Vision Medium-Class Euclid mission, a space observatory dedicated to investigate the nature of Dark Energy by mapping the distribution of matter in the universe using extensive imaging surveys. The involvement of the CSA in this mission will enable Canadian scientists to be part of the mission science team that may unveil the mystery of the Dark Energy.
- The CSA will see the launch of the Near Earth Object Surveillance Satellite (NEOSSat) on an Indian PSLV launch vehicle. The NEOSSat is a microsatellite jointly sponsored by CSA and Defence Research and Development Canada (DRDC) to acquire useful metric (position/time) data on Near Earth-orbiting objects (asteroids) and man-made objects (spacecraft and space debris). Hundreds of images per day will be downloaded and analyzed by the University of Calgary's NEOSSat science operations centre. Through NEOSSat, Canada is contributing to the international effort to both catalogue the near-Earth population of asteroids producing information crucial to targeting new destinations for future space exploration missions and to maintain the safety of Canadian and international assets, both civilian and military.

HUMAN SPACE MISSIONS AND SUPPORT

- Canadian astronaut Chris Hadfield has been assigned to the second Canadian long-duration mission to the ISS. Mr Hadfield will live and work on the ISS for 6 months from November 2012 to May 2013 and will become the first Canadian to command the vehicle and its crew.
- The CSA will maintain its human space flight expertise to meet the requirements of the CSA's exploration program. The two newest Canadian astronauts have successfully completed the basic training requirements and are now eligible for long-duration space flight assignments to the International Space Station. They continue training on various ISS Partners' segments while assuming collateral duties in support to the ISS Program and CSA priorities. The Canadian astronaut corps will adapt to the new reality of fewer flight opportunities as a result of the Shuttle retirement and will continue to utilize the expertise and skill set of flown astronauts to advance and position the Canadian Human Space flight program.
- The CSA will continue preparations for the medical support for the second Canadian long-duration mission scheduled to launch in November 2012. For this purpose the lessons learned from the 2009 long-duration mission are taken into account. The CSA will also continue the monitoring and coordination of medical support with international partners and actively support the ISS Medical committees. Part of this effort includes the assessment of neutron radiation aboard the ISS within the framework of Radi-N study; this study is performed in collaboration with Russia and measurements are planned in 2012-2013.
- Through the Advanced Astronaut Medical Support project, the CSA will continue to explore the development of medical Concepts of Operations as well as medical technologies and procedures that would enable human exploration. The CSA will explore solutions to the delivery of healthcare on future long duration exploration-class missions and how these solutions can help improve healthcare delivery on Earth through collaborative agreements and the transfer of space technologies.
- In order to maintain astronaut health and performance, it is necessary to identify and characterize the spaceflight risks. These are largely associated with the long-term effects of reduced gravity, radiation, and other aspects of the space environment on systems ranging from the cell to the whole body. Space can provide an intriguing model for aging. Since there are important similarities between the effects of space on humans and the process of aging, two workshops are planned in order to foster the establishment of partnerships between space and aging & health research sectors. One of these workshops will also showcase the potential of the International Space Station (ISS) to provide research services to Canadian government departments and agencies other than the CSA.
- Still looking into astronaut adaptation to space, CSA will initiate the See-Jitter mission, an ISS mission led by University of Toronto researcher H. Jenkins to better understand perception of self motion in microgravity. This will provide insight on how to mitigate problems with motion sickness.

Future Canadian Space Capacity

Description: This Program Activity attracts, sustains and enhances the nation's critical mass of Canadian space specialists, fosters Canadian space innovation and know-how, and preserves the nation's space-related facilities capability. In doing so, it encourages private-public collaboration that requires a concerted approach to future space missions. This Program Activity secures the nation's strategic and on-going presence in space in the future and to preserve Canada's capability to deliver internationally renowned space assets for future generations. It is targeted at Canadian academia, industry and youth, as well as users of Canadian space solutions (Government of Canada (GoC) organizations) and international partners.

This Program Activity is conducted with the participation of funding agencies, GoC organizations along with government facilities and infrastructure, foreign space agencies, not-for-profit organizations and provincial governments. This collaborative effort is formalized under contracts, grants, contributions or national and international partnership agreements.

| FUTURE CANADIAN SPACE CAPACITY | | | |
|---|--|------------------|------------------|
| PROGRAM ACTIVITY PERFORMANCE MEASUREMENT | | | |
| Expected Result #1 | Performance Indicators | | |
| Canada has a space community (academia, industry and government) able to contribute to the sustained and strategic Canadian use of space. | 1. Vitality index of the Canadian space community-measured in terms of: Number of HQP/total of FTE; Value of public and private R&D investments; Value of public and private development facilities; Number of technology domains covered; Number of university space related programs. 2. Degree of match between workforce supplied and space community (industry and government) workforce requirements. | | |
| Planning and Reporting Continuity: | | | |
| RPP 2011-2012 and DPR 2010-2011: http://www.asc-csa.gc.ca/eng/publications/default.asp#parliament | | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 63.3 | 70.8 | 70.9 |
| HUMAN (FTEs) | 116.5 | 122.2 | 122.8 |

Programs under Future Canadian Space Capacity are grouped into three Sub-Activities:

- **Space Expertise and Proficiency;**
- **Space Innovation and Market Access; and,**
- **Qualifying and Testing Services.**

Program Sub-Activity: 1.3.1. Space Expertise and Proficiency

Description: This Program Sub-Activity (SA) includes the development and enhancement of Canada’s space capacity through people. To do so, it supports research in private or public organizations and includes learning activities targeted at Canadian youth. This is accomplished by encouraging scientists and engineers to pursue relevant space science and technology development activities with attractive initiatives and top facilities, and by promoting scientific and technical studies with Canadian students. This SA is necessary to create and sustain a pool of space expertise and proficiency that will form the next generation of space professionals and workers, continuously able to provide solutions for future Canadian space endeavours. The activities are carried out mostly by Canadian academia, under the leadership of, in collaboration with, and with the support of the CSA and/or industry.

This SA is delivered with the participation of funding agencies, Government of Canada (GoC) organizations, foreign space agencies, not-for-profit organizations and provincial governments. This collaborative effort is formalized under grants, contributions or national and international partnership agreements or contracts.

| SPACE EXPERTISE AND PROFICIENCY | | | |
|--|---|------------------|------------------|
| PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT | | | |
| Expected Result #1 | Performance Indicators | | |
| A pool of space experts and professionals is sustained and enhanced. | 1. Number of organizations that incorporate the space theme in their program planning (such as universities, research centers, etc.). 2. Number of registrations in space relevant learning activities (post-secondary levels). 3. Number of scientists and engineers pursuing space research and activities. | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 18.2 | 22.5 | 22.3 |
| HUMAN (FTEs) | 66.2 | 71.9 | 72.4 |

This Sub-Activity is further divided into two Sub-Sub-Activities.

Program Sub-Sub-Activity: 1.3.1.1. Space Learning

Description: This Program Sub-Sub-Activity (SSA) uses space to increase interest in science and technology among Canadian students and educators and promotes the development of hands-on expertise. This SSA reaches primary, secondary, college and university students through the development of curriculum-based educational materials; through on-site and off-site presentations and training, in class or via distance learning; and through educator professional development, training conferences and workshops. This SSA is necessary to attract and develop tomorrow's space experts and professionals.

This SSA is delivered in collaboration with Provincial and Territorial Ministries or Departments of Education, Boards of Education, and not-for-profit organizations, and is formalized through grants, contributions, and collaborative agreements and contracts.

| Expected Result #1 | | Performance Indicator | | |
|---|--|--|------------------|------------------|
| Educators further their professional development through the space theme. | | 1. Number of educators reached through professional development initiatives. (Target: TBC) | | |
| Expected Result #2 | | Performance Indicator | | |
| Students further their learning related to science and technology through space-related themes. | | 1. Number of students reached through space-related learning opportunities. (Target: TBC) | | |
| Expected Result #3 | | Performance Indicator | | |
| Space training and academic programs, initiatives, activities or other opportunities offered are used by targeted institutions. | | 1. Number of institutions that use space-related themes in their activities. (Target: TBC) | | |
| RESOURCES | | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | | 1.8 | 2.0 | 2.1 |
| HUMAN (FTEs) | | 3.4 | 3.4 | 3.4 |

Program Sub-Sub-Activity: 1.3.1.2. Support to Scientists and Engineers

Description: This Program Sub-Sub-Activity (SSA) includes supporting graduate university students and working professionals through shorter lead-time and small-scale missions that allow frequent flight opportunities and through the upgrade of world-class space research and training facilities that secure Canada’s ongoing strategic presence in space. These actions encourage private and public research establishments to devote portions of their activities to space research. This SSA is necessary to attract scientists and engineers to the space sector and encourage them to develop their space know-how.

This SSA is delivered with the participation of funding agencies, Government of Canada (GoC) organizations, foreign space agencies, not-for-profit organizations and provincial governments. This collaborative effort is formalized under grants, contributions, or national and international partnership agreements or contracts.

| Expected Result #1 | | Performance Indicators | | |
|---|-----------|--|-----------|--|
| Scientists and engineers advance their space proficiency and know-how through the opportunities offered in priority space science and technology areas. | | 1. Number of scientists and engineers involved through opportunities provided by the program. (Target: 750) 2. Number of opportunities offered per year to scientists and engineers. (Target: 9) 3. Number of collaborative research agreements (in place or in development). (Target: 10) | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 | |
| FINANCIAL (\$ in millions) | 16.4 | 20.6 | 20.2 | |
| HUMAN (FTEs) | 62.8 | 68.4 | 69.0 | |

Program Sub-Activity: 1.3.2. Space Innovation and Market Access

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

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

| SPACE INNOVATION AND MARKET ACCESS | | | |
|---|------------------|--|------------------|
| PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT | | | |
| Expected Result #1 | | Performance Indicator | |
| Through innovation and international arrangements, Canadian industry is well positioned on international commercial and government markets. | | 1. Number of Canadian companies (size) exporting space-related goods and services (value). | |
| Expected Result #2 | | Performance Indicator | |
| Enhanced Canadian industry competitiveness. | | 1. Number of Canadian companies successfully obtaining national/international work orders. | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 38.6 | 41.7 | 42.1 |
| HUMAN (FTEs) | 15.9 | 16.0 | 16.0 |

This Sub-Activity is further divided into two Sub-Sub-Activities.

Program Sub-Sub-Activity: 1.3.2.1. International Market Access

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

This SSA is delivered through concluding international agreements, trade measures, or other mutually beneficial arrangements that create a favourable political or trade environment that facilitates access to global markets.

| Expected Result #1 | Performance Indicator |
|---|--|
| Canadian investments through the ESA Agreement allow Canadian industry to access the institutional European market. | 1. Ratio between the actual value of contracts awarded by ESA to Canadian organizations and the ideal value of contracts awarded by ESA to Canadian organizations (Canadian industrial return coefficient). (Target: 0.95 or higher) |

| Expected Result #2 | | Performance Indicator | | |
|---|--|---|-----------|-----------|
| The Canadian industry has access to flight opportunities for its technologies/components. | | 1. Number of technologies or components developed by Canadian industry which have been space qualified and/or acquired flight heritage-through Canada's participation in ESA Programs. (Target: 5 opportunities over the duration of the agreement) | | |
| RESOURCES | | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | | 29.6 | 29.0 | 29.2 |
| HUMAN (FTEs) | | 4.1 | 4.1 | 4.1 |

Program Sub-Sub-Activity: 1.3.2.2. Enabling Technology Development

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

This SA is performed with industry and is formalized under contracts or contributions.

| Expected Result #1 | | Performance Indicator | | |
|--|--|---|-----------|-----------|
| Increased technological capability of Canadian industry. | | 1. Number of different technologies addressed and their progression against the technology development plan. (Breakdown by mechanism). (Target: 13) | | |
| RESOURCES | | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | | 9.0 | 12.6 | 12.9 |
| HUMAN (FTEs) | | 11.9 | 11.9 | 11.9 |

Program Sub-Activity: 1.3.3. Qualifying and Testing Services

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

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

| QUALIFYING AND TESTING SERVICES | | | |
|--|------------------|--|------------------|
| PROGRAM SUB-ACTIVITY PERFORMANCE MEASUREMENT | | | |
| Expected Result #1 | | Performance Indicators | |
| Test results of space hardware prove to be reliable in demonstrating suitability for launch and space environment. | | 1. Maintenance of DFL's certification and conformance to the ISO 9001:2008 standard. 2. Client satisfaction surveys measuring the quality of the services provided. | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 6.5 | 6.6 | 6.6 |
| HUMAN (FTEs) | 34.4 | 34.4 | 34.4 |

Highlights of Expected Accomplishments for Future Canadian Space Capacity

SPACE EXPERTISE AND PROFICIENCY

- Signature of Memorandum of Understanding with the Ministry of Education, Culture and Workforce Development of the Northwest Territories enhancing collaboration and use of space-science-and-technology-focused curriculum, tele-learning, and educators development activities.
- Signature of a Memorandum of Understanding with the *Association québécoise autochtone en science et en ingénierie* to expand space-focused learning opportunities for First Nations and Inuit students and educators in the province of Quebec.
- Implementation of a Memorandum of Understanding with the Air Cadet League of Canada to increase youth exposure to extracurricular space learning opportunities.
- Leveraging the interests and expertise of university level students trained and acting as Canadian Student Space Ambassadors, who will deliver learning workshops in primary and secondary classrooms across the country.
- Space Educator professional development workshops and an annual conference will expand educator awareness, while providing them with accurate, up-to-date and pedagogically appropriate tools helping them to effectively engage student interest and learning through space science, engineering, mathematics and technology.
- Partnered space-focused learning initiatives led by academia, private sector organizations, not-for-profit groups, and Government of Canada (GoC) organizations will increase the scientific literacy of students and educators in communities across the country.
- Space-focused pedagogical materials and teaching modules will be produced to meet the needs of Provinces and Territories for use by educators and students at the primary and secondary level.
- Web-based learning products will be designed as extra-curricular activities for youth, students and families facilitating a concrete understanding of abstract concepts, and expanding understanding of space science and technology at all levels.
- Attribution of grants and contributions supporting the development of students, and educators who will benefit from learning initiatives, activities, or conference participation related to space science and technology; and, not-for-profit organizations offering national and community space-based science and technology programs targeting Canadian youth, educators and families.

- The CSA is providing support to scientists and engineers through two new initiatives: the selection and creation of Research Clusters and the selection of projects to fly on sub-orbital platforms, both through competitive announcements of opportunity. Funding began in 2011-2012, with approximately 20 new projects funded, for a period of 3 years.
- A new stratospheric balloon launch infrastructure will begin development by CSA in Timmins, Ontario to support the access to balloon flights for the training of scientists and engineers, as well as for the creation of science opportunities, in collaboration with the French space Agency (Centre national d'études spatiales).
- The BRITE-Canada nanosatellite mission is in its final year of development, supported through a contribution agreement with the University of Toronto. Launch is scheduled for 2013.
- A new collaborative research initiative will be kicked off to carry out joint R&D with industry and academia in areas of strategic interest to Canada in space science and engineering.
- Consultations will continue with Canadian academic institutions that include Space as a strategic thrust, in the aim of aligning investments in areas of common strategic interest.
- CSA has implemented a 2-year Engineering Development Program and recruited 8 new junior engineers (ENG-02) in various disciplines with expected graduation dates between November 2012 and February 2013. The ENG-02 recruits will do 6-month internships in various sectors of the Agency, at the request of these sectors.
- CSA will expand the technical proficiency of its workforce by maintaining a Professional Development Program and delivering specialized training in space science and technology. In-house experts will give various training sessions of space technology fundamentals and will train on average 25 Agency employees per session.

INNOVATION AND MARKET ACCESS

- Canada's participation in the European Advanced Research in Telecommunications Systems (ARTES) will continue to allow our industry to access forward-looking studies on new telecommunications services, develop new broadband satellite, technologies, equipment and applications in multi-media, inter-satellite and mobile communications, and demonstrate satellite-based communications services such as interactive communications services for remote communities and for disaster management in partnership with their European industry partners.

- Through the participation in European Space Agency (ESA) Earth Observation programs, CSA continues to support Canadian companies to be involved in development of advanced space-borne instrument and sub-systems, user-oriented applications, and ensuring access to the data for Canadian uses such as:
 - The development of the Electric Fields Instrument, designed to monitor the ionosphere for the SWARM mission.
 - Microbolometer detector in Broad-Band radiometer of EarthCARE mission.
 - Synthetic aperture Radar (SAR) antenna and processor for Sentinel missions.
 - The participation of Canadian scientists in the areas of next generation precipitation observation from space high latitude precipitation measurements.
 - The development of applications in the field of aquaculture, forestry and subsidence, global wetland and Polar monitoring.
 - Access to Sentinel mission data by participating in data policy formulation and coordinating adequate Canadian ground facility to receive and process the data.

- 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 Aurora planetary exploration programs, the Lunar Lander mission and to the physical and life sciences ELIPS-2 and ELIPS-3 programs.

- CSA will consult the Canadian space sector (industry and academia) and relevant GoC organizations as part of the Program selection process in preparation for the 2012 ESA Ministerial Council meeting during which ESA Member states and Canada will announce new contributions to the proposed ESA Programs.

- 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 close collaboration between industry, universities and government in space research and technology development, and to develop a critical mass of researchers and highly qualified people in Canada in areas relevant to the priorities of the Canadian Space Agency.

- Using the results for the CSA's long-term roadmaps exercise for space technology development based on the needs of future missions, the CSA will issue R&D contracts in areas that have been selected after consultation with Government, industry and academia. The CSA will therefore continue to ask industry and research organizations to work on identified priority technologies in order to retire risk on the technologies required for future missions of Canadian interest, and contribute to the enhancement of Canadian capabilities. Examples of projected science and technology development activities in 2012-2013 are:
 - Critical technologies to reduce risks and enable implementation of the Polar Communications and Weather (PCW) and similar HEO missions;
 - New generation of imaging sensors operating the visible and near infrared region for astronomical instruments' improvements;

- "Lab-on-a-chip" Technology for in-situ cellular or molecular analysis required for long duration space missions;
- Announcement of Opportunity for technology demonstrations on the International Space Station in the areas of smart/functional textiles, bioanalysis and biodiagnostics. This will identify and mature technologies essential for fulfilling the mandate of ensuring astronaut health and performance in space.
- Digital beam forming antenna prototype for multi-satellite acquisition; and,
- Thermo-mechanical detector for the spatial heterodyne observation of water.
- The CSA will continue technology development for risk reduction on the QuickSat microsatellite bus. Mission options have been proposed to take advantage of the flight opportunity offered by this platform, and activities to confirm its feasibility and target performance have been initiated. Activities to adjust the microsatellite bus to the selected mission will be initiated.
- The CSA will continue to participate actively in the International Space Debris Coordination Committee (IADC). This committee is an international government forum of 12 Space Agencies, for the global coordination of research activities related to growing threat from man-made and natural debris in space. CSA access to the latest space debris research activities will minimize potential threats to Canadian satellites and other space assets. Canada will host the next IADC annual meeting in May 2012.

The CSA will evaluate the impact of increased frequency in satellite-debris collision avoidance maneuvers, and explore space debris protection and mitigation strategies to safeguard Canadian space assets and reduce operational risks.

- The CSA will continue on a best effort basis Phase 0/A of the Concurrent Design Facility (CDF) which is a computer-based system that facilitates fast and efficient design of space missions by gathering all engineering disciplines in the same room, thus allowing concurrent design and validation of space missions. Combining calculation, simulation and visualization tools, the CDF will provide the CSA, industry and academia the capability to perform higher quality and detailed feasibility studies in a few weeks.
- The CSA will continue to honor its collaborative agreement with the Canadian Institute of Health Research to jointly fund research related to nanotechnology-based diagnostic and treatment systems for health on Earth and in space.
- The CSA reviewed its entire portfolio of technologies and evaluated the relevance of keeping patent protection for some of them. The CSA is up-to-date for the monitoring of intellectual property licenses obligations supporting the commercialization of space technologies and the transfer of space technologies and their applications to other sectors of the economy to enhance Canada's industrial competitiveness.

QUALIFYING AND TESTING SERVICES

The CSA intends to make its David Florida Laboratory (DFL) research facilities more accessible and available to academia and the Canadian space industry. The DFL will continue to provide world-class and cost-effective environmental space qualification services for the assembly, integration and testing of spacecraft systems to CSA's programs, as well as national and international clients. The DFL will continue to maintain its new International Clean Room Standard ISO 14644 – Class 7 to stay on par with other world class facilities at the international level to remain competitive as a world class spacecraft testing facility. Significant infrastructure modifications and equipment updating will have to commence in 2012 in order to fulfil the requirements foreseen for 2014 and beyond.

The hardware for many priority projects in 2012-2013 will be assembled and tested at DFL:

- Space Exploration: The DFL will complete testing activity on the James Webb Space Telescope Fine Guidance Sensor and continue to support the environmental test campaigns for the Exploration Surface Mobility Program, initially at the sub-system level and progressing through to the full rovers.
- Satellite Communications: M3MSat testing has moved into fiscal year 2012-2013 with the majority of testing to be completed in the first half of the fiscal year.
- Earth Observation: On the RADARSAT Constellation Mission (RCM), the DFL will be involved in both component and subsystem level testing on RCM prior to the initiation of the environmental test campaign on the all-up spacecraft scheduled for fiscal year 2013-2014 through to fiscal year 2015-2016.
- Commercial Programs will be supported such as:
 - MDA / Space Systems Loral (S/C L, S/C M)
 - MDA (Express AM5/EM6, HYLAS, Turksat, SES 6), various antennas and reflectors
 - MDA/IberEspacio (Spain) – deployable heat pipe radiator
 - Alenia –SICRAL 2 UTAN UHF Tx Antenna (flight model)
 - Neptec – TRIDAR
 - CMC Electronics – Inmarsat Satcom
 - COMDEV – spacecraft switch(es)
 - Dowkey – spacecraft switch(es)
 - CarlisleIT/ECS – cables
 - EMS Satcom/Ottawa – Inmarsat Satcom
 - Lockheed Martin – CP-140
 - RYMSA – antennas
 - TenXc Wireless – Wireless Communications Systems
- Government of Canada (GoC) organizations: Department of National Defence (DND) and L3 Communications (CF-18 Radome Characterization Projects).

Internal Services

Description: In accordance with the Management Accountability Framework this Program Activity serves to implement the government’s commitment to modern Public Service management. Internal Services include only those activities and resources that apply across an organization in the areas of Governance and Management Support which includes Management and Oversight Services, Communications Services, and Legal Services; Resource Management which includes Human Resources Management Services, Financial Management Services, Information Management Services and Information Technology Services; and Asset Management which includes Real Property Services, Material Services and Acquisition Services.

| INTERNAL SERVICES | | | |
|---|---|-----------|-----------|
| PROGRAM ACTIVITY PERFORMANCE MEASUREMENT | | | |
| Expected Result #1 | Performance Indicator | | |
| Internal Services provide an added value to CSA managers in the performance of their duties. | 1. CSA's rating against MAF criteria based on Round XIX assessment. | | |
| Planning and Reporting Continuity: | | | |
| RPP 2011-2012 and DPR 2010-2011: http://www.asc-csa.gc.ca/eng/publications/default.asp#parliament | | | |
| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
| FINANCIAL (\$ in millions) | 45.0 | 46.6 | 46.8 |
| HUMAN (FTEs) | 267.0 | 267.9 | 275.7 |

Internal Services are grouped into three Sub-Activities:

- **Governance and Management Support;**
- **Resource Management Services; and,**
- **Asset Management Services.**

Program Sub-Activity: 1.4.1. Governance and Management Support

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|-----------------------------------|-----------|-----------|-----------|
| FINANCIAL (\$ in millions) | 16.3 | 17.1 | 16.8 |
| HUMAN (FTEs) | 97.9 | 98.4 | 105.3 |

This Sub-Activity is further divided into three Sub-Sub-Activities. *Legal Sub-Sub-Activities* doesn't appear in this report.

Program Sub-Sub-Activity: 1.4.1.1. Management and Oversight

Description: Management and Oversight services involve activities undertaken for determining strategic direction and governance, program planning and design; representing values and ethics; and allocating resources and taking investment and intellectual property management decisions; as well as those activities related to analyzing exposure to risk and determining appropriate countermeasures. They ensure that the service operations and programs of the federal government comply with applicable laws, regulations, policies and/or plans.

Service groupings for Management and Oversight services include: Strategic Policy, Planning and Government Relations (incl. Federal/Provincial/Territorial/International); Executive Services; Corporate Policy, Standards, Guidelines; Investment Planning; Project Management; Risk Management; Intellectual Property and Technological Transfer Management; Performance and Reporting; and, Internal Audit and Evaluation.

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|-----------------------------------|------------------|------------------|------------------|
| FINANCIAL (\$ in millions) | 10.6 | 11.3 | 11.1 |
| HUMAN (FTEs) | 79.2 | 79.7 | 86.6 |

Program Sub-Sub-Activity: 1.4.1.2. Communications

Description: Communications services involve activities undertaken to ensure that Government of Canada communications are effectively managed, well coordinated and responsive to the diverse information needs of the public. The communications management function ensures that the public – internal or external – receives government information, and that the views and concerns of the public are taken into account in the planning, management and evaluation of policies, programs, services and initiatives.

Service groupings for Communications services include: Public Opinion Research; Corporate Identity; Consultations; Media Relations; Advertising, Fairs, Exhibits; In-Person Service, Telephone, Facsimile, Mail, Internet; Translation; and Publications.

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|-----------------------------------|------------------|------------------|------------------|
| FINANCIAL (\$ in millions) | 5.3 | 5.4 | 5.2 |
| HUMAN (FTEs) | 18.3 | 18.3 | 18.3 |

Program Sub-Activity: 1.4.2. Resource Management Services

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|----------------------------|-----------|-----------|-----------|
| FINANCIAL (\$ in millions) | 16.4 | 15.6 | 15.9 |
| HUMAN (FTEs) | 140.0 | 140.5 | 141.2 |

This Sub-Activity is further divided into four Sub-Sub-Activities.

Program Sub-Sub-Activity: 1.4.2.1 Human Resources Management

Description: Human Resources Management services involve activities undertaken for determining strategic direction, allocating resources among services and processes, and activities relating to analyzing exposure to risk and determining appropriate countermeasures. They ensure that the service operations and programs of the federal government comply with applicable laws, regulations, policies, and/or plans.

Service groupings for Human Resources Management services include: HR Planning, Work, Organization Design and Reporting; Job and Position Management; Employee Acquisition and Orientation; Total Compensation; Employee Performance, Learning, Development and Recognition; Permanent and Temporary Separations; and Workplace Management.

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|----------------------------|-----------|-----------|-----------|
| FINANCIAL (\$ in millions) | 4.0 | 4.1 | 4.1 |
| HUMAN (FTEs) | 41.4 | 41.4 | 41.4 |

Program Sub-Sub-Activity: 1.4.2.2. Financial Management

Description: Financial Management services involve activities undertaken to ensure the prudent use of public resources, including planning, budgeting, accounting, reporting, control and oversight, analysis, decision support and advice, and financial systems.

Service groupings for Financial Management services include: Financial Planning and Budgeting; Accounting Management; Expenditure Control; Payments Service; Collections and Receivables Service; and, Asset and Liability Management Service.

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|----------------------------|-----------|-----------|-----------|
| FINANCIAL (\$ in millions) | 6.3 | 5.0 | 5.0 |
| HUMAN (FTEs) | 53.2 | 53.2 | 53.2 |

Program Sub-Sub-Activity: 1.4.2.3. Information Management

Description: Information Management services involve activities undertaken to achieve efficient and effective information management to support program and service delivery; foster informed decision making; facilitate accountability, transparency, and collaboration; and preserve and ensure access to information and records for the benefit of present and future generations. Information management is the discipline that directs and supports effective and efficient management of information in an organization, from planning and systems development to disposal or long-term preservation.

Service groupings for Information Management services include: Information Design Services; Data Management Services; Records and Document Management Services; Library Services; Content Management Services; Archival Services; Business Intelligence and Decision Support Services; Access to Information; and Privacy Services.

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|----------------------------|-----------|-----------|-----------|
| FINANCIAL (\$ in millions) | 3.7 | 4.1 | 4.4 |
| HUMAN (FTEs) | 35.6 | 36.1 | 36.9 |

Program Sub-Sub-Activity: 1.4.2.4. Information Technology

Description: Information Technology services involve activities undertaken to achieve efficient and effective use of information technology to support government priorities and program delivery, to increase productivity, and to enhance services to the public. The management of information technology includes planning, building (or procuring), operating and measuring performance.

Service groupings for Information Technology services include: Distributed Computing; Application/Database Development and Maintenance; Production and Operations Computing; Telecommunications Network – (Data and Voice); and IT Security.

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|----------------------------|-----------|-----------|-----------|
| FINANCIAL (\$ in millions) | 2.3 | 2.4 | 2.4 |
| HUMAN (FTEs) | 9.8 | 9.8 | 9.8 |

Program Sub-Activity: 1.4.3. Asset Management Services

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|----------------------------|-----------|-----------|-----------|
| FINANCIAL (\$ in millions) | 12.4 | 13.8 | 14.1 |
| HUMAN (FTEs) | 29.1 | 29.1 | 29.1 |

This Sub-Activity is further divided into three Sub-Sub-Activities. *Material Sub-Sub-Activities does not appear in this report.*

Program Sub-Sub-Activity: 1.4.3.1. Real Property

Description: Real Property services involve activities undertaken to ensure real property is managed in a sustainable and financially responsible manner, throughout its life cycle, to support the cost-effective and efficient delivery of government programs. Real property is defined as any right, interest or benefit in land, which includes mines, minerals and improvements on, above or below the surface of the land.

Service groupings for Real Property Services include: Acquisition; Operations and Management; and Disposal.

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|----------------------------|-----------|-----------|-----------|
| FINANCIAL (\$ in millions) | 11.6 | 13.0 | 13.3 |
| HUMAN (FTEs) | 16.9 | 16.9 | 16.9 |

Program Sub-Sub-Activity: 1.4.3.3. Acquisition

Description: Acquisition services involve activities undertaken to acquire a good or service to fulfill a properly completed request (including a complete and accurate definition of requirements and certification that funds are available) until entering into or amending a contract.

Service groupings for Acquisition services include: Goods Acquisitions; Services Acquisitions; Construction Acquisitions; and Other Acquisitions (acquisitions that fall outside the definitions of goods or services).

| RESOURCES | 2012-2013 | 2013-2014 | 2014-2015 |
|----------------------------|-----------|-----------|-----------|
| FINANCIAL (\$ in millions) | 0.8 | 0.9 | 0.9 |
| HUMAN (FTEs) | 12.2 | 12.2 | 12.2 |

Highlights of Expected Accomplishments for Internal Services

In order for the CSA to have its management practices meet the standards set by the Government wide policies, the following actions will be undertaken in 2012-2013:

- The renewal of the CSA's external and internal governance.
- The approval and implementation of its Investment Plan in accordance with TBS policies on investment planning, acquired assets and management of projects.
- The update and implementation of the CSA Corporate risk profile.
- The measurement of the CSA's PAA Performance Measurement Framework to be reported for the first time in the 2011-2012 Departmental Performance Report.
- The implementation of a five-year Evaluation Plan applicable to the CSA's 2011-2012 Program Activity Architecture.
- The implementation of the three-year (2011-2014) risk-based audit plan.

Based on lessons learned from the Management Accountability Framework assessments, and Internal Audit recommendations, the following actions will be undertaken in 2012-2013:

- The development of an integrated planning approach in order to align human, financial and technical resources with the CSA's strategies, priorities and operations.
- The continued implementation of the 2010-2013 Integrated Corporate Human Resources Plan in line with the Program Activity Architecture and development of the 2013-2016 Plan in order to attract and retain a qualified workforce to deliver its mandate.
- During the exercise, a reviewed policy combining three existing policies concerning intellectual property was approved and will be implemented in 2012.
- The management of information assets created by or for the CSA in order to guarantee access for decision making, protection for security access and to conform to Canadian regulations, and to assure conservation for historical purposes.
- The assessment of management requirements to allow public access to space data produced by satellites and scientific experiments.
- The development and implementation of the CSA's Departmental Security Plan as required in the Policy on Government Security and evaluated with the Management Accountability Framework 2012/2013.
- Continuous monitoring of management action plans developed in response to audit and evaluation recommendations.

SECTION 3: SUPPLEMENTARY INFORMATION

3.1 FINANCIAL HIGHLIGHTS

3.1.1 Financial Statements

The Future-Oriented Financial Statements (FOFS) presented in this RPP are intended to serve as a general overview of the CSA's financial operations. The FOFS are prepared on an accrual basis to strengthen accountability and improve transparency and financial management.

Information on CSA's Financial Statements is at the following address:

<http://www.asc-csa.gc.ca/eng/publications/default.asp#parliament>

3.1.2 Supplementary Information Tables

All electronic supplementary information tables found in the 2012-2013 Report on Plans and Priorities can be found on the Treasury Board of Canada Secretariat's Website at: <http://www.tbs-sct.gc.ca/est-pre/estime.asp>

- Annexe 1: Details on Transfer Payment Programs (TPPs)
- Annexe 2: Sources of Respendable and Non-Respendable Revenue
- Annexe 3: Status Report on Transformational and Major Crown Projects
- Annexe 4: Summary of Capital Spending by Program Activity
- Annexe 5: Upcoming Internal Audits and Evaluations over the next three fiscal years

3.2 CSA CONTRIBUTIONS TO GOVERNMENT OF CANADA OUTCOMES

CSA contributes to two of the Government of Canada outcomes.

1 - WELL-MANAGED AND EFFICIENT GOVERNMENT OPERATIONS

Mainly two of the CSA's Program Activities contribute to this outcome.

PROGRAM ACTIVITY SPACE DATA, INFORMATION AND SERVICES

The contributions of this Program Activity are an expanded use of space data, applications and information by Government departments and Agencies to better deliver their policy, programs and operational responsibilities. This calls for a strong partnership between the Canadian Space Agency and Government of Canada (GoC) organizations.

Together with the GoC organizations, the CSA ensures that the country strategically select, build and operate the space assets and ground infrastructure that Canada needs to address national priorities, perform world-class science in and from space in priority areas and in order to provide high-quality space data, applications and services. Canada will contribute to international space missions when it is a cost-effective way to obtain the data needed to meet its priorities. The Canadian space community is called upon to innovate technically, scientifically, financially, as well as through a broader range of business practices.

BENEFITS FOR CANADIANS

Space assets generate multiple benefits for Canadians. More concretely, here are a few examples of the positive impacts generated from synergistic collaboration between the CSA and Government of Canada (GoC) organizations.

The Department of National Defence is rapidly increasing its capacity to use space assets to deliver its mandate with the construction and operation of satellite data reception stations in Canada. The key objectives are to use space capabilities to contribute to the security and defence of Canadians, both at home and abroad.

Environment Canada is the largest user of satellite data within the Government of Canada. Space data is critical to its core mandate, including weather and air quality forecasting, environmental and ice monitoring, enforcement of environmental laws and regulations, climate change studies and the science needed to improve weather and environmental forecasts for Canadians.

Natural Resources Canada (NRCan) is a key user and provider of space data within the Government of Canada as it is mandated under the Department of Natural Resources Act to '*promote the development and use of remote sensing technology*'. In doing so NRCan receives, uses, archives and disseminates satellite data in order to deliver its core mandate of mapping the Canadian landmass, managing natural resources, assessing natural hazards and maintaining the Canadian spatial reference system.

The Department of Fisheries and Oceans uses space data and information to support safe navigation, maritime surveillance, and ocean science and observations. It relies on accurate and timely satellite imagery of ice allowing the Canadian Coast Guard to direct icebreaking activities in a more efficient and effective way.

PROGRAM ACTIVITY INTERNAL SERVICES

The contribution of this Program Activity is a better management of programs and services in accordance with the Management Accountability Framework.

BENEFITS FOR CANADIANS

Canadians will benefit from well-managed and efficient government operations while maintaining rigorous stewardship over financial resources, assets, and human resources, as well as of a transparent, accountable, and responsive federal government.

2- AN INNOVATIVE AND KNOWLEDGE-BASED ECONOMY

Mainly two of the CSA's Program Activities contribute to this outcome.

PROGRAM ACTIVITY SPACE EXPLORATION

The contributions of this Program Activity are advances in knowledge, exploration, technologies and expertise and an increased use of this knowledge and know-how both in space and on Earth.

The CSA ensures that the country remains a key partner in international initiatives to explore our solar system and perform science in space. Canada strives to make optimal use of its access rights to the International Space Station. International partnerships, a hallmark of the Canadian approach to space exploration, will be core to the pursuit of this vision. The achievement of the endeavours is strongly dependant on international consensus and on decisions by international partners in general and the United States and Europe in particular.

BENEFITS FOR CANADIANS

The International Space Station is an excellent example of mutually beneficial collaboration among space faring countries. Through our contribution of specialized technologies, Canadian astronauts and scientists have a privileged access to a unique microgravity laboratory to conduct scientific and engineering studies. These priority research areas have great potential to bring about new knowledge that will improve how we live, prosper, and evolve on our planet.

Space exploration, science and technology endeavours, provide opportunities for Canada to take part in the exploration of Mars. Increasing our understanding of Mars would almost certainly increase our understanding of the Earth, particularly about our atmosphere and magnetic field.

In parallel to the scientific advancements stemming from planetary exploration, the development of exploration vehicles and their associated robotic technologies challenges the use, for example, of solar-powered electric propulsion, which, in turn, could lead the way toward spin-off commercialization of green technologies.

Space astronomy provides an additional platform for Canadian astronomers and space industry to build on existing strengths and achieve global levels of excellence. The James Web Space Telescope is a perfect example with Canada's contribution of two very advanced instruments namely the Fine Guiding System (FGS) and the Tunable Filter Imager (TFI).

PROGRAM ACTIVITY FUTURE CANADIAN SPACE CAPACITY

The contributions of this Program Activity are the maintenance of the critical mass of academic, industrial and business expertise needed to address future national needs and priorities in space, as well as an increased pace of discovery, and innovation.

The CSA leverages the innovation capability of industry by enhancing synergy through partnerships. The means to encourage leveraging are the creation of clusters of excellence, the promotion of closer links between universities and industry in priority areas to facilitate knowledge and technology transfer, and the development of industrial policies that foster the emergence and continued growth of innovative small and medium-size enterprises. Canada also relies on its collaboration with the European Space Agency to enhance its technology base and improve access to European markets. These achievements call for greater coordination between the Agency and the Granting Councils to foster collaboration between Canadian Universities working in partnership with space industry and Government to grow and develop our future space expertise and capacity.

BENEFITS FOR CANADIANS

Canada's future space capacity resides within academia, the space industry and GoC organizations and agencies. By investing in programs that stimulate innovation within the space community, and encouraging the competitiveness of our high-tech companies, the CSA contributes to the creation and sustainability of Canada's knowledge-based economy. However, it is important to note that the results of these investments in terms of benefits require a certain amount of time before being felt.

For example, the CSA's program "Space Expertise and Proficiency" encourages the education and training of tomorrow's highly educated and highly skilled labour. The CSA's program "Space Innovation and Market Access" encourages dynamic trade relationships with other nations and therefore increases the ability our Canadian companies over the medium and long run to compete in the global marketplace. There are significant benefits for Canada in terms of revenues and Canadians in terms of quality of life in a steadily expanding space industry currently comprised of 200 organizations and more than 7,500 highly skilled engineers, scientists and researchers.

The CSA will also work at maintaining and developing the capacity and expertise of its scientific and technical staff by providing opportunities to contribute to leading-edge priority activities in collaboration with academia, industry and GoC organizations.

3.3 INDEX OF CSA SPACE MISSIONS

Each year, at the time of the Departmental Performance Reporting, the Canadian Space Agency presents a list of space missions to which it actually contributes or plans to contribute. The fact that a mission appears on the list does not mean that it will be completed. Any mission must necessarily follow many critical steps depicted in a simple manner as such:

- **Mission under review:** A mission that is subject to concept of feasibility studies. At the end of this step, a decision is made whether to continue, to cancel or to postpone the participation to the mission.
- **Mission in development:** The participation implies that activities produce assets which are not yet operational. The final milestones prior to operation are the launch and the full commissioning of the mission.
- **Mission in operation:** The mission is operational, delivering results until being fully completed. By virtue of being in operation, a mission will spark scientific, technological and operational activities in order to reach its objectives.

ADAMS – In development

Advanced Astronaut Medical Support (ADAMS) project can contribute to human exploration. Specifically, CSA has continued to explore solutions to the delivery of health care on future long duration exploration-class missions and how these solutions can help improve health care delivery on Earth through the transfer of space technology.

AIS Constellation – Under review

The Integrated Automatic Identification System (AIS) Constellation is a payload that would eventually be built and placed on the satellites of the RADARSAT Constellation Mission (RCM). Currently under feasibility study, the payload would be used for identification of ships in the maritime approaches to Canada, including the Arctic and in maritime areas of interest for the Department of National Defence.

Anik F2 – In operation

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.

ASTRO-H – In development

Scheduled for launch in 2014, Astro-H is a Japanese Aerospace Exploration Agency (JAXA) X-ray Space Observatory spacecraft. The satellite will be equipped with hard X-ray imager, soft X-ray imager, a spectrometer and a gamma-ray detector, to explore structure and evolution of the Universe. With a total length of 14 m, the spacecraft will deploy an extensible boom holding the hard X-ray imager. Canada is considering providing a metrology system that will measure precisely the vibration of the boom in order to improve the performance of the imager.

Astronauts: Expedition 34/35 (C2) - In development

Scheduled for November 2012, Canadian Astronaut Chris Hadfield will launch aboard a Soyuz spacecraft to reach the International Space Station (ISS) where he will live and work for six months as part of the crew of Expedition 34/35. During the second half of his mission Hadfield will become the first Canadian Commander of the ISS—a milestone for Canadian space exploration. In addition to overseeing operations as Commander, he will carry out scientific experiments, operate Canadarm2 and perform various robotics tasks.

BCAT-5 / BCAT-C1 – Completed/In development

The Binary Colloid Alloy Test 5 (BCAT C-5) is a Canadian experiment concept that will study the effect of phase separation on crystal growth in the ISS microgravity environment using samples consisting of colloidal suspensions with added polymer. On Earth, gravity causes the colloids to settle making such a study particularly difficult. Improved understanding of crystal growth will lead to more refined manufacturing processes and commercial products. During the Expedition 20/21 (mission C1), Canadian Astronaut Dr. Robert (Bob) Thirsk has performed colloid experiments aboard the ISS where visual information will be transmitted to scientists on the ground for data analysis.

BP-Reg – In development

Blood Pressure Regulation (BP-Reg) will consist in a Leg Cuff test that will challenge blood pressure regulation by inducing a brief drop in blood pressure following the release of a short occlusion of blood flow to the legs. The change in blood pressure from pre-flight to in-flight will be used to predict those astronauts who will experience the greatest drop in the post-flight stand test.

BRITE – In development

BRight Target Explorer (BRITE) is a nano-satellite developed by Space Flight Lab of University of Toronto's Institute for Aerospace Studies. The nano-satellite will carry a small telescope to observe very precisely the brightness variation of many bright stars from space. The uninterrupted observations over a long duration, with similar science objectives as MOST, will help to understand the structure and evolution of massive stars that create the heavy elements in our galaxy. The mission includes a constellation of 6 nano-satellites, 2 provided by Canada, 2 by Austria and 2 by Poland. CSA plans to fund this project through a contribution agreement in 2010. Launch is planned for 2012.

CADC/HUBBLE – In operation

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.

CanALSS – Under review

The Canadian Advanced Life Support System (CanALSS) is a CSA mission concept to supply the Higher Plant Chamber as one component of an international bioregenerative life support system by the year 2050. CanALSS is based on Canadian technologies currently being developed and will allow Canada to expand on this capability where it is recognized as a world leader.

CANSOC – Under review

CANSOC (Canadian Satellite Operation Centre) is a multi-mission control centre with ground stations for telemetry, tracking and commanding and data reception, and it is composed of data ordering and planning, flight control, data archiving and cataloguing, data processing and quality control, and communications networks systems, and it is responsible for end-to-end operations and management of satellite missions.

CASS – Under review

The Chemical and Aerosol Sounding Satellite (CASS) mission is a partnership concept study composed of a CSA instrument and a companion instrument on a small satellite that will provide solar occultation measurements that address issues of stratospheric ozone recovery and impacts of climate change. CASISS is the implementation of the same CSA instrument on the International Space Station.

CASSIOPE – In development

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.

CCAP – Under review

The Cell Culture and Analysis Payload (CCAP) is to be a wide-use automated cell and tissue culture facility that will be capable of obtaining sufficient science data such that it will not be necessary to return the biological specimens to ground for post-processing. CCAP is intended for installation and application on the International Space Station.

CGSM – In operation

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 – Under review

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.

CIMEX – Under review

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 – In operation

CloudSat is the first space-based radar allowing for the comprehensive three-dimensional study of clouds. It gathers data on their structure, frequency and volume, and helps improve our understanding of how they influence the weather and climate. It uses a radar hyperfrequency device to probe the clouds and light precipitation.

DynAMO – Under review

The Dynamic Atmosphere Mars Observer (DynAMO) is CSA concept of an instrument proposed as a key element in the 2016 Mars Science Orbiter program for characterization of the Martian Atmosphere. DynAMO would be capable of measuring winds globally on Mars.

EBEX – In development

NASA's E and B EXperiment (EBEX) is a mission using a high-altitude balloon-borne instrument to study the sky in the far infra-red (FIR) and measure the polarization of the cosmic microwave background which is the signature of the Big Bang. Canada will provide a state-of-the-art digital electronic readout system for use with large arrays of FIR bolometers.

ESA - ADM/Aeolus – In development

The Atmospheric Dynamics Mission (ADM) is an 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 – Alphasat – In development

The primary objective of ESA under the Alphasat Program is to facilitate an early first flight, and in-orbit validation of the Alphasat platform, currently under development with European industry. The Alphasat mission will extend the capabilities of geostationary satellite infrastructure, both in terms of performances and capacity, resulting in an enhancement in the current services and additional capacity for new services.

ESA-Bed Rest – In operation

Bed rest studies are a good model for studying the impact of weightlessness on certain physiological systems. The CSA is participating in bed rest studies being conducted within European facilities in France and Germany through our contribution to the ELIPS program. The CSA is funding studies in the cardiovascular, musculoskeletal and neurophysiological fields. This knowledge will be useful for reducing the risks associated with space exploration. A number of these changes also mirror those found in an ageing population or in people who are put on bed rest for an extended period of time (e.g. during hospitalization or a period of convalescence).

ESA - Cross Scale – Under review

Cross-Scale is an ESA mission concept to study multi-scale coupling in space plasmas. Its objectives are the quantification of fundamental plasma processes (shocks, reconnection, and turbulence) that operate universally in astrophysical and laboratory plasmas but are only accessible to direct sampling of particles and fields in near-Earth space. Possible Canadian participation would be through instrument contribution.

ESA - Cryosat – In operation

CryoSat-2 measures 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/JAXA - EarthCARE – In development

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 – In operation

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 – In operation

ESA Earth Observation satellite was launched in 1995 and is carrying similar set of instruments as the ENVISAT satellite. After providing useful data to many scientific teams for 16 years, ERS02 has been retired in July 2011. 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 - EXOMARS – In development

ExoMars is a European-led space exploration mission, currently under development by the European Space Agency (ESA) that will send a robotic rover to the surface of Mars. The mission began as part of ESA's Aurora program. ExoMars will combine technology development with investigations of major scientific interest. It is a robotic mission which will provide Europe with new technologies for the exploration of Mars, specifically the Entry, Descent and Landing System (EDLS), the surface Rover and its Drill and Sample Preparation and Distribution System (SPDS).

ESA - Galileo – In development

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. Specifically, Galileo targets the design and development of four satellites to prove the In-Orbit Validation (IOV) concept of the Galileo GNSS Constellation.

ESA - GOCE – In operation

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 - Herschel-HIFI/Spire – In operation

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).

ESA - MICAST – In operation

The MICAST (Microstructure in CASTings) European Space Agency project is a ground-based and microgravity experiments. Canadian members of the MICAST team will be carrying out specific ground-based solidification of aluminum experiments under combined magnetic fields (with strong static and weak rotating magnetic fields) using the existing state-of-the-art experimental facility at the University of Victoria Crystal Growth Laboratory.

ESA - NEQUISOL – Under review

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.

ESA - Planck – In operation

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.

ESA - Sentinel-1 – In development

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 - Sentinel-2 – In development

The Sentinel-2 mission is developed within ESA Global Monitoring for Environment and Security (GMES) space component program. Its payload consists of a multispectral optical imaging mission as follow-on to LandSat and SPOT missions for monitoring of land cover application. The mission consists of two satellite constellation.

ESA - Sentinel-3 – In development

The Sentinel-3 mission is developed within ESA Global Monitoring for Environment and Security (GMES) space component program. Its payload consists of an instrument suite providing data from visible to thermal at medium (200 m) to modest spatial resolution (1 km) for ocean color, sea surface temperature and global land mapping (data continuation of MODIS and MERIS), an interferometric SAR altimeter for ocean observation. The mission consists of two satellite constellation.

ESA - Sentinel-5 Precursor – In development

The Sentinel-5 Precursor mission is developed within ESA Global Monitoring for Environment and Security (GMES) space component program. It is designed as a gap filler mission to ensure the continuity of data of Sentinel-5 which will be launched in 2019 as part of Post-EPS mission of EUMETSAT. The mission is to monitor atmospheric composition covering spectral range from UV, VIS NIR and SWIR. The UN-VIS-NIR spectrometer is based on the TROPOMI developed by the Netherland.

ESA - SMOS – In operation

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 – SODI DSC – In operation

This mission is dedicated to the study of the movement of molecules in liquids due to temperature gradients (thermodiffusion). Thermodiffusion is a process common to various industrial processes including petroleum extraction from deep reservoirs such as Hyberia off the East coast of Canada. This European-led long-duration mission onboard the International Space Station will allow Canadian and international scientists to further understand the role of gravity in molecular movement important for Canadian industry. The predecessor of the DSC experiment, known as IVIDIL, was assembled and commissioned by CSA Astronaut Bob Thirsk in 2009. Both missions involve Canadian co-investigator Professor Ziad Saghir from Ryerson University in Toronto, Canada.

ESA - Swarm – In development

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).

EVIS – Under review

The Extraction Vehicle for In Situ Resource Utilization (EVIS) is a CSA concept study to create a concept definition and high level requirements for the systems, technologies and materials required for an extraction vehicle. In particular, this concept study will address the operating and design concepts for a mobility platform focused on In Situ Resource Utilization and associated accessories and instrumentation.

FPEF – In operation

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.

FPNS – Under review

The Feature-based Planetary Navigation System (FPNS) is a CSA concept study of a camera and Lidar-based navigation system that uses surface features to provide absolute navigation capability to planetary orbiters and landers. These are functionally similar to GPS and GNSS on Earth but without the cost and complexity of a GPS constellation. The FPNS aims to integrate Canadian Lidar Technology, space-qualified cameras and advanced algorithms into a self-contained navigation subsystem that will meet the requirements of a large number of future planetary missions.

GPR – Under review

The Ground Penetrating Radar (GPR) is a CSA concept study to examine the scientific, technical and programmatic aspects of using radar to explore the lunar subsurface. While current lunar missions are focusing on global-scale mapping and understanding of geological processes, future efforts will require detailed site-scale characterization of local geology and resource potential. The GPR would yield a greater understanding of the structure and composition of the shallow subsurface at targeted sites of interest.

Halo – Under review

The CSA Hyperspectral And Luminescence Observer concept study will examine the combination of an orbital hyperspectral imager and rover-borne luminescence instrument for Mars in the context of the Mars Sample Return mission. Data analysis techniques will be developed to solve the data volume problem associated with this type of instrumentation for the particular case of the robust identification and mapping of predefined, targeted, water-related mineral deposits on the surface of Mars, supported directly by ground/rock truth data from in-situ luminescence measurements.

Hypersole – In operation

The proposed study aims to use monofilament (vonFrey Hairs) and vibration testing to determine changes in skin sensitivity post space flight. The results will formally document changes in skin sensitivity post-space flight and will contribute to our knowledge of current theories on skin contribution to postural control on Earth which could have an impact on crew safety upon return to gravity and/or public health.

ICAPS – Under review

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

ILN – Under review

The CSA Canadian International Lunar Network (ILN) mission concept study is to examine the scientific and technical feasibility of creating a stand-alone Canadian ILN node. Along with the base ILN science objectives, the project will identify the scientific questions that Canadian scientists will explore on the mission. The project will then define a conceptual mission capable of delivering the international and Canadian scientific payloads to the lunar surface and show how the resultant technologies are re-usable for future space missions and for terrestrial applications.

Insect Habitat – Under review

The CSA Insect Habitat (IH) instrument provides the systems required to support a wide range of fundamental gravitational biology research on the ISS. It is a facility intended to house insect specimens for long duration exposure to a microgravity environment.

ISRU – Under review

The Drilling Systems in Support of In-Situ Resource Utilization (ISRU) is a CSA concept study of a sample acquisition system based upon drilling and coring technology. ISRU would characterize the form and concentration of the resources available, understand the environment the resource is found in, and adequately validate that the processes required for extracting and processing the resource will operate in the environment for the desired mission duration.

ISS – In operation

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 and 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.

ISWEAT – Under review

The Ionospheric Space Weather Effects in the Auroral Thermosphere (ISWEAT) micro-satellite is an instrument to measure thermospheric composition, density and velocity of solar winds. The primary objective of ISWEAT is to use these measurements to study the effects of thermospheric expansion and associated ionospheric changes on “anomalous” satellite drags at auroral latitudes during magnetic storms and sub storms.

JDEM – Under review

The Joint Dark Energy Mission (JDEM) is a joint mission between NASA and the U.S. Department of Energy (DOE) proposes to investigate the Dark Energy. The recently released US Decadal survey of Astronomy and Astrophysics recommends that a dark energy mission be the top priority in space astronomy over the next decade. The report refers to a mission named WFIRST (Wide Field Infrared Survey Telescope) which is based on one of the designs proposed for JDEM. It is a similar concept of the ESA Euclid mission, retained in the Cosmic Vision program. Neither missions are officially approved, but concept development continues and may result in further collaboration mission. CSA has supported a mission concept study (2010) to identify potential contribution to such a mission. Launch would be in the late 2010's.

JWST – In development

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. The CSA is contributing with the development of two instruments; a Tunable Filter Imager (TFI) and a Fine Guidance Sensor (FGS).

LEMUR – Under review

The Lunar Exploration Manned Utility Rover (LEMUR) is a CSA exploration concept that could lead to a critical and central Canadian contribution to the lunar surface mobility architecture. LEMUR is a small, agile, unpressurized surface mobility system. When driven manually, it accommodates two suited astronauts. In addition, LEMUR accommodates small payloads (such as luggage and small scientific instruments) with expansion capabilities for larger payloads (such as cargo and full suites of scientific instruments).

LiteArm – Under review

The Lightweight, Scalable Manipulator Family for Exploration (LiteArm) is a CSA concept study focused on potential Canadian manipulator participation in future surface exploration missions. This study would provide an overview of present and planned surface exploration missions which could require manipulator systems, and Canada's potential role in them. Additionally, this study would provide architectures for an optimal number of manipulator classes that satisfy the range of capabilities required to meet the objectives of these surface missions and their associated costs and development schedules.

LORE – Under review

The CSA Lunar Origins and Resource Explorer concept study will examine the scientific and technical feasibility of investigating the lunar polar environment, determining surface and near-surface solar wind-implanted ions, ilmenite abundances, surface and subsurface ice distribution, dust physical and compositional properties, mineralogy, and dust levitation using Ultra-violet (UV), Visible (VIS) and Mid-InfraRed (MIR) reflectance spectroscopy and a Complementary Metal-Oxide Semiconductor (CMOS) micro-imager for target morphology and grain size.

LSC – Under review

The Lunar Surface Communications (LSC) is a CSA study of requirements, architecture and a design concept for a Moon surface communication system that enables wireless surface operational support. The proposed lunar network comprises a combination of orbiter relay, direct to Earth links and surface radio communications. This study would focus on defining a Moon surface communication architecture and design concepts that would enable future surface communication.

Luna - Resource – Under review

Each of these two studies developed a concept design of an innovative dual-use vision system, which can be used for both rover navigation and scientific investigations, as a possible Canadian contribution to a future Russian-led mission to the Moon. To plan the development of such concept design to a flight system, a roadmap has been devised including cost, schedule, manufacturing process, and programmatic considerations.

Lunar Rover – Under review

The CSA Lunar Rover Concept Study is an operational concept for a rover and associated subsystems that would fit into the published NASA Lunar Exploration Architecture. The proposed concept is a general-purpose, configurable rover that satisfies mission requirements ranging from short one and two-day sortie missions to longer multi-day outpost missions.

M3MSat – In development

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.

Marangoni – Under review

The JAXA's Marangoni experiment will be carried out on the ISS. The Canadian scientific contribution is an advanced three-dimensional numerical model that will be developed and used with the g-jitter data from the ISS to predict vibration-induced surface oscillations of a liquid bridge undergoing oscillatory Marangoni convection that can affect adversely the synthesis of new materials such as semi-conductor crystals.

MCAP – Under review

The Mission for Climate and Atmospheric Pollution (MCAP) is a CSA concept study composed of four nadir-viewing instruments on a small satellite for the acquisition of a global precise dataset of atmospheric composition measurements (trace gases and aerosols) that are important for climate process and air quality studies.

MEMS LIDAR – Under review

The CSA Micro-Electro-Mechanical Systems and Light Detection And Ranging (MEMS LIDAR) concept study will focus on the Canadian contribution of a 3D active vision sensing capability based on the needs for rover operations on the JAXA SELENE-2 Lunar mission.

MEOS – Under review

The Miniature Earth Observing Satellite (MEOS) mission is a CSA concept study composed of several miniaturized limb and nadir-viewing instruments on a micro satellite focusing on the measurement of greenhouse gases, aerosols and clouds. It will permit the study of terrestrial vegetation absorption and emission of tropospheric gases.

MEOSAR – Under review

Middle Earth Orbit Search-and-Rescue (MEOSAR) will 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 for search and rescue missions. Its payload will support the COSPAS-SarSat Search-and-Rescue satellite system.

M-FTSIS – Under review

The Mars Fourier Transform Spectrometer Interferometer Subsystem (M-FTSIS) is a CSA concept of an occultation Fourier Transform Spectrometer for measuring the atmosphere of Mars based on Canada's experience with the Atmospheric Chemistry Experiment Fourier Transform Spectrometer on Canada's SCISAT satellite. A solar occultation spectrometer has the potential to significantly increase knowledge of the atmosphere of Mars and provides a unique Canadian opportunity to perform international cutting-edge research in space exploration.

MIM/ATEN – Under review

The Microgravity Vibration Isolation Mount (MIM) is an ISS hardware that isolates experiments from on board 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.

MLM – Under review

The Manned Lunar Mission (MLM) is a CSA concept study that will provide a budgetary Rough Order of Magnitude (ROM) cost for a core mobility system concept as the foundation of Canada's contribution to the international exploration architecture. It will establish a Canadian Lunar Mobility Architecture to aid definition of architectures by international partners and provide CSA with the prerequisites to kick-start rover technology developments.

MOPITT – In operation

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.

MOPITT-2 – Under review

Concept studies to develop the next generation of instruments for the measurements of pollution in the troposphere. This is one of the instruments being proposed as part of the Mission for Climate and Air Pollution (MCAP), one of the CSA mission concepts being completed in 2009.

MORSE – Under review

This initiative aims at developing and demonstrating the usefulness of EO data for monitoring coastlines and coastal processes in the Arctic focusing on the information needs of Arctic coastal users in government, industry and in scientific organizations. It supports, enhances and stimulates coordination among Arctic coastal communities having common Earth observation-related information needs and activities across sectors and across disciplines.

MOST – In operation

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.

MSL - APXS – In development

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.

MSO - FTIR – Under review

The CSA study will focus on increasing the level of readiness of the science and the technology associated with the solar occultation Fourier Transform InfraRed (FTIR) spectrometer of the Mars Science Orbiter (MSO). The long-term goal is to propose the successful Canadian technology to that NASA mission.

MSO - SAR – Under review

The Synthetic Aperture Radar (SAR) Payload for Mars Science Orbiter is a CSA study to advance the payload concept of a dual-band SAR instrument and radiometer for the exploration of Mars. This study targets the MSO opportunity in 2013 as a possible Canadian-built SAR instrument mission.

MSR - NET – Under review

The CSA concept study Vision system for Mars Sample Return (MSR) will focus on vision system technology needs for the automated rendezvous and capture operations of the MSR mission while simultaneously introducing key technology components for next generation 3D vision sensors.

MSS: Increment 27 – In development

Increment 27 began with the undocking of 24 Soyuz on March 2011 and ended with the undocking of 25 Soyuz in May 2011. Flights and major activities during I-27 were as follows:

- 2 assembly and utilization Shuttle flights (STS-134/ULF-6 and STS-135)/ULF-7;
- Attachment of the Alpha Magnetic Sensor (AMS) and External Light Carrier (ELC-3) during ULF-6;
- Undocking of HTV-2;
- 2 Soyuz Flights (26S and 27S);
- 3 Progress flights (42P, 43P and 44P); and
- 1 Russian Stage Extra Vehicular Activity (EVA).

MVIS – In operation

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 on board the ISS. It uses a magnetic field to suspend a container for experiments.

MWD – Under review

The Measure While Drilling (MWD) is a CSA concept study that would examine the potential for combining information from sensors attached to the drill with intelligent algorithms as a tool for identifying prospective lunar resources. This technology would involve monitoring specific characteristics of the drilling process, analyzing and interpreting this data and implementing algorithms to efficiently extract knowledge from these large data sets. The sensors would monitor drilling parameters such as drill rotational speed, dynamic thrust forces, rate of penetration and real-time power consumption of the drill.

NEOSSat – In development

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.

NEW FRONTIERS – Under review

New Frontiers is a NASA program to explore the solar system with frequent, medium class spacecraft missions that will conduct high-quality, focused scientific investigations designed to enhance our understanding of the solar system. The program objective is to launch high-science-return planetary science investigations on an average of once every 36 months. Added to the NASA budget for the first time in 2003, New Frontiers will build on the innovative approaches used in NASA's Discovery and Explorer Programs, but will provide a mechanism for identifying and selecting missions that cannot be accomplished within the cost and time constraints of Discovery.

NEXT GEN – Under review

Advanced Broadband: First experimental payload on board, a commercial satellite in GEO to provide ultra-high speed connectivity.

NIRST (Aquarius/SAC-D) – In development

The New Infra Red Sensor Technology (NIRST) is a CONAE (Comision Nacional de Actividades Espaciales) instrument to which CSA contributed detectors that use advanced Canadian microbolometer technology. NIRST is carried on the Aquarius/SAC-D satellite, a partnership mission being developed by NASA and CONAE. The NIRST instrument will acquire thermal imagery that will be especially useful for measuring the radiative power of biomass fires, an indication of emission type and quantity. NASA's Aquarius instrument will measure global sea surface salinity (SSS). The observations it makes will fill the gaps between conventional in situ sampling to give a global view of salinity variability. Aquarius will help us understand the physical processes that link the water cycle, the climate, and the ocean.

OCLE-DOCLE – Under review

Oort Cloud Dynamic Occultation Experiment (OCLE-DOCLE) is a payload concept study done for CSA in 2009. The study considered a micro-satellite platform for 30 cm telescope to observe transient events – occultation of Oort cloud and Kuiper belt objects (small bodies at edge of the solar system), in order measure their distribution and better understand the model of our solar system.

ORBITALS – Under review

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 – In operation

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 – Under review

The Polar Communications and Weather (PCW) mission is to position a constellation of satellites in highly elliptical orbit over the North Pole to provide robust 24/7 two-way communications capability to all of the Canadian North for high data rate (HDR) data and information products, potentially also low-data rate (LDR) communications capability, and also near-real time (NRT) meteorological information products 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.

PHEMOS – Under review

Polar Highly Elliptical / Molniya Orbit Science (PHEMOS) aims at developing a secondary Science payload that could potentially be accommodated on the «Polar Communication and Weather» (PCW) Mission. The PCW platform and its highly elliptical orbit provide significant potential to advance science payload concepts that address certain topics in Atmospheric Remote Sensing, Geospace Imaging and In-situ Space Environment Science. The PHEMOS Atmospheric Remote Sensing concept studies will assess the feasibility of measuring gases and aerosols that are important for climate warming and for air quality.

PRET – In development

This exploration mission is planned to take place from September 2010 to November 2011. CSA has developed a prototype of a Performance Readiness Evaluation Tool (PRET) to provide neurocognitive assessment capability using a 3D virtual reality simulator with embedded neurocognitive tests. This activity is the result of the medical evaluation requirement for long-duration missions to the International Space Station which stipulates that astronauts must undergo neurocognitive assessment before, during and after the flight to detect any indications of a reduced performance state. The prototype is planned to be tested in the Russian Isolation Study, Mars-500.

PROBA – In operation

The PRoject OnBoard 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, on board 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 on board and in the mission ground segment.

PROBA-2 – In operation

Launched for a two-year mission on November 2, 2009, PROBA-2 is a small but powerful satellite focusing on solar observations and space weather. Being the second in European Space Agency's (ESA) series of microsattellites, PROBA-2 will allow its users to test, in orbit, new technologies that are not mature enough to be initiated on operational missions while providing groundbreaking scientific data with the potential to expand understanding of the processes that affect our climate. Among its many applications, PROBA-2 is dedicated to surveying the behaviour of the sun, including its interaction with the Earth through the magnetosphere and its effects on space weather. This interaction can have important ramifications on communications and electrical infrastructure both on Earth and in orbit. A more thorough understanding of this process could better protect these critical systems and enhance future space exploration and the development of Earth-based technologies.

QUICKSAT – Under review

QuickSat is a microsattellite 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 – In operation

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 – In operation

RADARSAT-2 was launched on December 14, 2007. RADARSAT-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 (RCM) – In development

The RADARSAT Constellation also known as RCM is the evolution of the RADARSAT missions 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.

RADI-N 1 and 2 – Completed/In development

Radi-N is the next generation bilateral Russia-CSA radiation study, based on and following Matroshka-R project. The CSA continued to collect radiation exposure data through a collaborative project with International Partners on ISS using Canadian made radiation dosimeters. Specifically, CSA implemented project RADI-N during ISS Expedition 20/21 (Mission C1). During this expedition, Astronaut Robert Thirsk conducted 4 sessions during which he collected neutron radiation data on the ISS using Canadian made Bubble Detectors. This data is currently being analyzed and will continue until May 2011. Another set of sessions is planned for C2 Mission in 2012-2013.

RAO – Under review

The Robotics and Automation for Orion (RAO) is a CSA concept study of Canadian participation in future NASA Constellation Program missions centered on the Orion Crew Exploration Vehicle (CEV). The study would include a comprehensive overview of planned exploration missions which require in-space automation and robotics. This study would propose a highly configurable robotic system concept that can be tailored to suit the launch constraints imposed by the various missions.

RAPIER – Under review

The Robotic Assistant & Precursor Investigation and Exploration Rover (RAPIER) is a CSA concept of a small rover with a “plug-and-play” reconfigurable chassis and built-in provisions for communication, power and variable autonomy tele-operation guidance and navigation. It is capable of operating as an investigative scout, astronaut assistant and mobile infrastructure platform in support of returning astronauts to the Moon. This concept could lead to a critical and central Canadian contribution to the lunar surface mobility architecture. “

RAVENS – Under review

Recurrent Auroral Visualization of Extended Northern Storms (RAVENS) is a concept study submitted to the CSA from a proposed Canadian-led space science mission which would use UV cameras on two polar-orbiting satellites to study space weather over Canada.

REMOTE CARE HEALTH – Under review

The CSA concept study entitled "Training Development and Maintenance of a Competence Program for Remote Care Health Providers" focuses on optimal ways of providing autonomous medical support for exploration space missions. Some of the top medical challenges for Moon exploration space missions and beyond that have been identified include clinical training and maintenance of skills for crew medical providers. The study explores the concept of Medical Autonomy as part of a possible infrastructure contribution that could be made by Canada to a global partnership for exploration missions.

ROSM – Under review

The CSA Robotic Orion/Orbital Service Module (ROSM) study will perform an evaluation of concepts for a robotic service module for NASA-Orion and ESA Exploration Missions and other commercial missions. It will define fielding concepts for manned and unmanned missions, interface definition and resource requirements, technology development requirements, roadmap for the development and fielding, and development of preliminary system design requirements.

SBIS – Under review

The Surface-Base Infrared Sensor (SBIS) is a CSA concept of an optical payload based on a Fourier Transform spectrometer operating in the infrared that will be used to map and classify minerals on the surface of the Moon. The payload will operate on the surface from a rover or other platform, and will measure spectra of the radiance reflected and emitted by the surface.

SCISAT – In operation

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.

SCOPE – Under review

SCOPE is a JAXA mission concept involving five spacecraft flying in a tetrahedral formation with an apogee of 30 earth radii in the magnetosphere. The mission proposes to untangle the fundamental physics underlining energy storage and release processes behind space weather. Possible Canadian participation would be contribution of instrumented spacecraft.

See-Jitter – In development

This study will explore how astronauts sense their own self-motion in earth normal gravity and in microgravity conditions based on vision cues. It will also test the prevailing model of how humans combine signals for self-motion from vision with those from the organs of balance in the inner ear. Potential benefits of this work include an improved understanding of how humans judge their self-motions, advances in the treatment of dizziness and motion sickness, and improved astronaut safety and effectiveness.

Si Si-Ge Alloys – Under review

The Silicon in Silicon-Germanium Alloys (Si Si-Ge Alloys) study is dedicated to understanding the role of gravity in the solidification of semiconductor materials. Understanding the gravitationally-induced microscopic movements of liquid molecules in the semiconductor fabrication process is important for both scientific and industrial communities, as well as for the Canadian economy. This Canadian study prepares the Canadian scientific community for mission opportunities onboard the International Space Station. The Principal Investigator of the study is Prof. Daniel Labrie from Dalhousie University in Halifax, NS.

SMAP – Under review

The NASA's Soil Moisture Active and Passive (SMAP) mission will measure soil moisture and surface freeze/thaw with the accuracy, resolution, and coverage that are required to further our understanding of the Earth's water, energy, and carbon cycles.

SNOWSAT – Under review

SnowSat is a CSA mission concept study composed of a cloud/precipitation radar instrument on a small satellite (or as a contribution to a partner platform) to measure clouds, snowfall and light precipitation. The advanced instrument concept builds on the experience of CloudSat and EarthCARE.

SOAR – Under review

The Solar Occultation for Atmospheric Research (SOAR) mission is a CSA concept study composed of two instruments on a small satellite that will study the changes occurring in our atmosphere, specifically those related to climate change and air quality. The satellite will use an advanced Fourier Transform Spectrometer in solar occultation to provide vertical profiles of atmospheric composition, both trace gases and aerosols.

SPICA – Under review

SPICA is a JAXA & ESA lead mission to discover the origins of galaxies, stars and planets. SPICA offers an improvement in sensitivity over Herschel Space Observatory by two orders of magnitude and observations over the full MIR/FIR range with sophisticated imaging, spectroscopic and coronagraphic instruments. Canada contributes a concept study for instrument design of the different detector technologies.

SPIDER – In development

Spider is a mission concept using high-altitude balloon-borne instrument to study the sky in the far infra-red and measure the polarization of the cosmic microwave background which is the signature of the Big Bang.

STEP – Under review

The Stratosphere-Troposphere Exchange Processes (STEP) mission is a CSA concept study composed of three limb-viewing instruments on a small satellite focusing on the retrieval of relevant information about the photochemistry, dynamics and radiative properties associated with the upper troposphere and lower stratosphere.

SWIFT – Under review

SWIFT, Stratosphere Wind Interferometer For Transport studies, is a Canadian instrument that 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.

SWOT – Under review

The Surface Water Ocean Topography (SWOT) mission is a proposed NASA mission to make the first global survey of Earth's surface water. The mission involves a partnership between the Canadian Space Agency, NASA and the French Space Agency (CNES). Developed by an international group of hydrologists and oceanographers to provide a better understanding of the world's oceans and its terrestrial surface waters, SWOT will give scientists their first comprehensive view of Earth's freshwater bodies from space and much more detailed measurements of the ocean surface than ever before. The mission addresses topics of importance to Government of Canada, especially from Environment Canada and Fisheries and Oceans Canada, and Canadian scientists performing Climate Research and Monitoring.

THEMIS – In operation

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.

TICFIRE – Under review

The Thin Ice Clouds in Far IR Experiment (TICFIRE) mission is a CSA concept study composed of one nadir-viewing instrument on a micro satellite that aims to fill a global observational gap in the far IR for the detection and the measurements of radiation anomalies induced by thin ice clouds and light precipitation from cold regimes in polar regions and in the upper troposphere.

TRACTEUR – Under review

The Terrainable Reconfigurable Autonomy-Capable Tool-using Exploration and Utility Rover (TRACTEUR) is a CSA concept of a large, modular “work-horse” rover that could lead to a critical and central Canadian contribution to the Global Exploration Strategy (GES). The concept is primarily targeted at manned exploration of the Moon but has a technology development path that could lead through a robotic precursor mission.

TriDAR DTO – Completed/In development

The TriDAR is a vision system built to support rendezvous and docking operations. It permits to track spacecraft from a distance of 1 km down to 0 meter. The TriDAR flew on the STS-128 and STS-131 flights as a Detailed Test Objective (DTO) under a collaboration between NASA and CSA. The TriDAR was used to provide images of the International Space Station (ISS) and to track it while the Space Shuttle was approaching the ISS. Similar operations were performed during undocking.

UVAMC – Under review

UVAMC means Ultra Violet Auroral Monitoring Camera. It is a technology in phase 0 that the University of Calgary is developing to photograph the aurora borealis from space. Some candidate missions are KuaFu (China) and PCW. Current studies aim to determine the sensitivity required to obtain scientific validated images.

UVIT-ASTROSAT – In development

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 – In operation

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 – Under review

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.

VSE – under review

The Vision Systems for Exploration (VSE) is a CSA concept study to examine the potential technology to fulfill requirements for autonomous rendezvous and docking mission, and for planetary surface operations such as inspection and navigation. The study would identify technology roadmaps for both near-term and long-term applications as early as 2 years, and as far as 12 years from now.

WaMI – Under review

Advanced study for an instrument to observe upper atmosphere dynamics through waves Michelson interferometer (WaMI).