

**CANADIAN SPACE AGENCY**

**2013-14 DEPARTMENTAL PERFORMANCE REPORT  
SUB-PROGRAM PLANNING HIGHLIGHTS**

## **1.1. Program: Space Data, Information and Services**

**Description:** This Program 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 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, defense, 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 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.

### **1.1.1 Sub-Program: Earth Orbit Satellite Missions and Technology**

- The plans for integration and testing of the three satellites were prepared and will be finalized in 2014-15. Work on the design of the RCM ground segment equipment also continued and is expected to be completed in 2015-16. As per current planning, the equipment will then be delivered and installed at the CSA headquarters in 2016-17. A potential issue with the three-satellite launch configuration has been identified by the launch service provider. The prime contractor is evaluating alternate launch options, should this become necessary. The launch currently remains scheduled for 2018-19.
- The CSA continued to explore synergies between the RCM and ESA's Sentinel-1 radar satellite from the Copernicus Programme launched in April 2014. This is part of the whole-of-government approach to ensure timely and sustained access to radar data for the government's organizations.
- The CSA managed and optimized the RADARSAT-2 data allocation to ensure that the needs for Synthetic Aperture Radar (SAR) data by operational Government users were met in a sustainable way. Out of the \$445 million worth of prepaid RADARSAT-2 data, the Canadian government has consumed \$202 million by March 2014.
- The CSA continued to develop promising mission concepts for space-based services for operational, technology demonstration and scientific purposes. These mission concepts include Canadian instruments on foreign as well as Canadian spacecrafts. Implementation approaches to meet users' needs have been studied, notably the use of micro and small satellite platforms. In order to meet user needs in the most cost-efficient way, the CSA has initiated the development of a business case for the implementation of a Microsat Program.

- The CSA continued to develop the CASS (Chemical and Aerosol Sounding Satellite) mission concept which is a follow-on to CSA's successful SCISAT-1 mission, which is now in its 11<sup>th</sup> year of operation and to OSIRIS on Odin, now in its 13<sup>th</sup> year of operation. CSA signed a memorandum of understanding (MOU) with the Swedish National Space Board to undertake a concept study for a scientific atmospheric limb sounding mission. The study began in December 2013 and will conclude in summer 2015. Each collaborating nation would contribute an innovative instrument. This mission, now referred to as ALISS (Atmospheric Limb Sounding Satellite), responds to the national and international need for the continuation and enhancement of measurements to meet rapidly evolving requirements for atmospheric sciences and services, to support monitoring of the efficacy of regulatory protocols and policies, and to answer key science questions on the processes that link atmospheric composition and climate. Its goal is to improve the delivery of atmospheric sciences and services of interest to the Canadian public such as air pollution monitoring, Air Quality Health Index Forecasting and UV forecast applications.
- The CSA continued to develop Canadian participation in the Surface Water and Ocean Topography (SWOT) mission being prepared by NASA/JPL and CNES for launch in 2020. SWOT will allow global measurement of lake level and ocean circulation features. SWOT data 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. Sophisticated Canadian technology will be at the heart of the interferometric radar instrument on this ground-breaking wide-swath ocean altimeter mission.
- The CSA continued to support the ESA Swarm mission by enabling the University of Calgary's participation in the calibration, verification and validation of the Canadian Electric Field Instrument on Swarm. The Swarm mission, which launched on 22 November 2013, has already measured the Earth's magnetic field with a precision that took earlier missions 10 years to achieve, allowing scientists to decompose the total field into its many sources, and understand their evolution in time. Canadian scientists will use the EFI data obtained from the three Swarm spacecraft in conjunction with data from the ePOP payload (on CASSIOPE) and from Geospace Observatory Canada ground-based instrument arrays to help understand ionospheric plasma processes that contribute to space weather and their impact on Canadian infrastructure and services.
- The CSA continued 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 space borne atmospheric CO<sub>2</sub> observations and a transport model to infer surface fluxes. The system will also be useful for assessment of future space-borne greenhouse gas observation requirements.
- The CSA continued collaborating with Environment Canada (EC) and with Agriculture and Agri-Food Canada (AAFC) 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 are participating 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 finalized the manufacturing, integration and testing of the Maritime Monitoring and Messaging Microsatellite (M3MSat), developed jointly by the Canadian Space Agency and Defence Research Development Canada to meet complementary objectives. This joint CSA-DND micro-satellite project will demonstrate and further develop a multi-mission micro-satellite bus capability, it will allow optimization of the Automatic Identification System (AIS) payload in maritime traffic identification and provide significant opportunities to advance Canadian industry business development strategies in a global market context. M3MSat is designed to extend the coverage of current AIS of ships, covering 200 nautical miles zone, to the middle and outer maritime zones. With this additional coverage, Canadian maritime authorities will be able to identify and monitor shipping further away from Canada's shores. The M3MSat mission will demonstrate the effectiveness of a space-based AIS receiver in areas of the world where there is a high level of shipping activity.
- Through an Implementing Agreement between NASA and CSA "for cooperation on the IceBridge Mission and Sounding Rocket Research" signed in 2012, Canadian scientists were provided with 24 science flight hours over their site. These flights provide a multi-instrument look at the behavior of the rapidly changing features of polar ice. Data collection started in March 2014 during the Operation IceBridge 2014 Arctic Campaign.
- CASSIOPE was successfully launched on 29 September 2013. The commissioning was successfully completed in February 2014 and demonstrated both the small satellite bus and the space-based digital courier system CASCADE capabilities as well as preliminary scientific outcomes from the suite of eight instruments designed to help understand particle exchange and energy coupling processes between the Earth's atmosphere and space environment that contribute to space weather.

### **1.1.2 Sub-Program: Ground Infrastructure**

- Following the demise of RADARSAT-1 on March 29, 2013, the CSA kept providing the satellite imagery data from the archives to user communities. RADARSAT-1 data keeps being instrumental in ensuring data complementarities with the successor RADARSAT-2 Mission.
- The CSA continued funding of the operation of the 16 Canadian ground-based observatories for the THEMIS mission, complementing the observations from four Alaskan observatories and three 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 our proximity to the magnetic North Pole and our large landmass under the auroral oval.
- The CSA continued to safeguard CSA satellites in orbit against space debris by taking operational actions as required. Also, the CSA operationally collaborated with the Department of National Defence and foreign agencies to ensure latest tools and information are available to protect satellites from the impact of debris in space. The CSA continued to participate in international fora concerned with space debris and to offer its operational expertise in avoiding space debris to Canadian operators of satellites.
- The CSA continued to operate SCISAT and to support data production, validation and analysis. The tenth anniversary of successful on-orbit operations was celebrated in October 2013 in Toronto. SCISAT makes climate quality, vertical profile, measurements of atmospheric composition (over 35 gas species) that help scientists to monitor the atmosphere as it responds to natural and anthropogenic changes, and to improve climate and weather models. A strategic review of SCISAT activities was initiated with partners and stakeholders to decide whether to continue satellite operations and data analysis. The results of the review are expected next year.
- The CSA participated actively in the Federal Global Navigation Satellite Systems Coordination Board (FGCB) to support the Government of Canada's effort on global navigation satellite systems (GNSS) activities.

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

- 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 CSA continued satellite data applications development and Earth Observation (EO) utilization activities, to support the growth of EO needs or capabilities within Government of Canada and the service industry. Among the 25 ongoing projects supporting the industry there were 10 new applications initiated to further optimize the utilization of RADARSAT data with the development of new technological

advancements in support of the Canadian Government priorities in its various roles nationally and in the international community. The industry had also the opportunity to bid on other applications development opportunities to provide high-value solutions to the Government of Canada while increasing its capability and competitiveness. The CSA continued its collaboration and support to other government departments in the development of new applications using EO data focusing on Government of Canada mandate and priorities for the Canadian ecosystems, water management and the North. In this regard, 17 projects were initiated in partnership with the Government of Canada various departments.

- The CSA continued to leverage international efforts by playing a tangible role and being a reliable partner in international organizations.
  - The CSA continued to participate actively in the International Charter *Space and Major Disasters*, to use Earth Observation (EO) satellites in response to disasters. The CSA continued to regularly provide RADARSAT-1 and 2 data and strategic EO-derived information products upon Charter activation, thus contributing to help mitigate the effects of disasters on human life and property. Data from the RADARSAT satellites for generating the information products were provided for 46 Charter activations around the world.
  - In 2013, the CSA was Chair of the Committee on Earth Observation Satellites (CEOS). This was an opportunity for Canada to guide this international body aiming at ensuring international coordination of civil space-based Earth observation programs and promoting exchange of data to optimize societal benefit and inform decision making for securing a prosperous and sustainable future for humankind. The CSA was pleased to host the 2013 CEOS plenary in Montreal where the organization's governance was renewed and global topics such as forestry, climate, agriculture and oceans were discussed. During its chairmanship, the CSA has put sustained emphasis on improving disaster risk management through closely coordinated actions and on the impact of climate change on the polar region. In fact, the CSA contributed to the international effort aiming at providing global satellite mapping of the polar ice sheet to ensure historical data continuity. The CSA also continued to hold leadership positions in key working groups such as Calibration and Validation and Disasters Management.
  - The CSA also continued to support the implementation of key international initiatives led by the Group on Earth Observation, such as Joint Experiment for Crop Assessment and Monitoring (JECAM) for space-based monitoring of agriculture, and Space Data Coordination Group (SDCG) in support to the Forest Carbon Tracking and Global Forest Observation Initiative (GFOI) and the third phase of the Caribbean Flood Pilot Project aiming at improving the capacity for mitigation, management and coordinated response to natural hazards.

- The CSA continued to support MOPITT and OSIRIS. These two major Canadian science instruments are currently orbiting Earth and collecting atmospheric composition 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 and aerosols in the stratosphere, providing important data for monitoring trends of these essential climate variables, for assessing the status of the ozone layer and for improving climate models.
- The CSA continued collaborating with the Canadian Forest Service in developing and testing an Active Fire Product to be derived from radiance measurements from the US-Argentina SAC-D/Aquarius satellite (launched in 2011) and ESA's Sentinel-3 (to be launched in 2015). The CSA contributed unique uncooled microbolometers detectors that should improve the estimation of biomass fire emissions through the measurement of Fire Radiative Power.

To learn more about satellites, go to:

<http://www.asc-csa.gc.ca/eng/satellites/default.asp>

## 1.2. Program : Space Exploration

**Description:** This Program provides valuable Canadian science, signature technologies and qualified astronauts to international space exploration endeavors. This Program 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 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. This Program 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.

### **1.2.1 Sub-Program: International Space Station (ISS)**

- The CSA continued the utilization of the ISS through the development and support of scientific research, technology demonstrations and educational activities such as:
  - Science teams at NRCan, York University, University of Guelph, Simon Fraser University, University of Waterloo, and University of New Brunswick continued to analyze data obtained from experiments on the ISS (APEX-CSA2, APEX-Cambium, BCAT-5, Hypersole, Bodies in Space Environment (BISE), Cardiovascular and Cerebral Control on ISS (CCISS). New scientific publications appeared for CCISS and APEX-CSA2.
  - The CSA successfully began implementation on ISS of an experiment to test the risk of fainting on return to Earth after long-duration space flights (BP Reg), led by the CSA and the University of Waterloo. Data were collected in-flight from four of the required eight subjects. This experiment comprises collaboration with ESA and NASA to determine the validity of a new approach to measuring cardiac output in space, and will also test the effectiveness of a new method for the identification of crew-members who are most susceptible to fainting upon return to Earth. This latter method also has potential application to the identification of fall-susceptibility in vulnerable populations on Earth such as the elderly.
  - 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. BCAT-5 revealed aspects of the physics of phase separation that were previously unknown; BCAT C1 will further illuminate the physics of this three phase separation process, which is conceptually similar to many industrial processes. BCAT-C1 operations continued successfully in 2013-2014 and will operate on the ISS until Fall 2014.
  - The technology demonstration of the Microflow1 Instrument was completed by Canadian Astronaut Chris Hadfield during the second Canadian long duration mission to the ISS. This successful demonstration of the robust and portable



Microflow1 on the space station could become the first step into providing future capacity to perform affordable real-time bio-diagnostics and bio-analysis for medical care as well as for research in physiology and biology in space and in medically isolated communities on Earth.

- The CSA continued 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, nine data collection sessions took place during this reporting period.
- The CSA initiated the development of four life science studies for the ISS. These studies were selected during the 2009 International Life Sciences Research Announcement to increase understanding of the risks of human space-flight, and will lead to new strategies for countermeasure development. Implementation of these experiments will begin in Fall 2014.
- Through the International Space Life Sciences Working Group (ISLSWG), the CSA continued to work 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. Participation in this international working group generates efficiencies through collective peer review, and space hardware and data sharing. A new international Announcement of Opportunity (the International Life Sciences Research Announcement 2014) was launched in February 2014 for selection of new ISS experiments.
- The CSA honored its collaborative agreement with the Canadian Institute of Health Research (CIHR) to jointly fund research related to nanotechnology-based diagnostic and treatment systems for health on Earth and in space. The CSA also worked with the CIHR Institute of Aging to develop a strategy for collaborative research.

### **1.2.2 Sub-Program: Exploration Missions and Technology**

- The CSA continued 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 but the flight has been delayed by India. The subsystem suffered a failure with an ISRO supplied component. The subsystem was reshipped to ISRO for continued integration after having been repaired in Canada. The launch is scheduled no earlier than 2015. The CSA's participation will guarantee 5% of the observing time for Canadian scientists and access to ASTROSAT's astronomic data.
- The CSA continued to support the science team involved in the analysis of data produced by the ESA's Herschel and Plank space telescope's instruments, successfully launched in May 2009 to study how galaxies were formed in the early universe and how stars have been created throughout the history of time.

- The CSA continued 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 thousands of targets during 10 years of operations. The CSA has conducted a mission extension review and concluded that it will terminate the MOST mission during the FY 2014-15.
- The CSA completed the design of the OSIRIS-Rex Laser Altimeter (OLA), an advanced scanning LIDAR (Light Detection and Ranging) 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. The mission is part of the NASA New Frontiers program and will launch in 2016. It will be the first U.S. mission to return samples from an asteroid and will constitute a first for Canada.
- The CSA continued to support the operations of the Alpha Particle X-ray Spectrometer (APXS) for Curiosity and the Mars Science Laboratory (MSL) that was launched on 26 November 2011 and landed on Mars in August 2012. The Canadian contribution helps scientists to determine the chemical composition of various soil, dust and rock samples on Mars.
- The CSA initiated the evaluation of potential contributions to international Space Astronomy and Planetary Exploration missions aligned with the Canadian Space Exploration Plan by initiating phase 0 studies for the Mars 2020 mission and the joint JAXA/ESA SPICA space astronomy mission.
- In line with the Canadian Space Exploration Plan the CSA's Exploration Core Program aims at preparing Canadian industry and research organizations for future exploration missions by advancing the readiness of various technologies as well as scientific, medical and operational procedures. The CSA continued the development of concepts for planetary, space astronomy and space robotic servicing missions. The CSA deployed terrestrial rover prototypes in its planetary analogue terrain and to external locations in the vicinity of the CSA and in Ontario. The next generation Canadarm testbed that were delivered as part of Canada's Economic Action Plan was also used by industry. Through the Advanced Astronaut Medical Support project, the CSA continued to explore the development of medical concepts of operations as well as medical technologies and procedures for human space flight; the Advanced Crew Medical System concept study was delivered and testing on the AstroSkin prototype was initiated. The CSA also initiated new prototyping activities and supported multiple analogue mission deployments, working in collaboration with many industrial and academic partners such as the NSERC Canadian Field Robotics Network and international partners.
- The CSA continued to participate actively to the International Space Exploration Coordination Group (ISECG) as Chair. This group was created in 2007 to promote coordination of Moon and Mars exploration between 14 space agencies around the world. In 2013, the ISECG focused on issuing the second version of the Global

Exploration Roadmap for robotics and human exploration of the Moon, Mars and asteroids released in August 2013. The ISECG also developed a first version of an international framework to discuss benefits stemming from space exploration that was released in September 2013. The CSA will continue chairing ISECG until the next Head of the space exploration programs of the ISECG participating agencies meeting in October 2014.

### **1.2.3 Sub-Program: Human Space Missions and Support**

- The CSA continued to maintain its human space flight expertise in order to meet the requirements of the exploration program.
- 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 provides an interesting model for aging. Since there are important similarities between the effects of space on humans and the process of aging, multiple teleconferences were held with international stakeholders in order to foster the establishment of partnerships between space, aging and health research sectors.
- The CSA continued to collaborate with the European Space Agency on planning the next program of bed-rest campaigns: an Announcement of Opportunity on Bedrest and Isolation as part of the ELIPS program was published on 1 October 2013. Peer review and selection of meritorious proposals was completed on 1 May 2014. Investigators at the University of Ottawa, University of Waterloo and York University are expected to publish reports on the mechanisms of bedrest-induced muscle atrophy, cardiovascular dysfunction and anaemia. The results of these studies will be applied to analysis of the risks of human spaceflight, and are also applicable to rehabilitation therapy and other medically important fields.

To learn more about space science and exploration, go to:

<http://www.asc-csa.gc.ca/eng/activities.asp>

### 1.3 Program: Future Canadian Space Capacity

**Description:** This Program 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 secures the nation's strategic and ongoing 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 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.

#### **1.3.1 Sub-Program: Space Expertise and Proficiency**

- The CSA completed the construction of a new stratospheric balloon launch base in Timmins, Ontario. Moreover, the first two (2) maiden flights were successfully launched, thereby qualifying the new base and marking the beginning of affordable frequent flight opportunities to Canadian space experts and professionals. Furthermore, two (2) Canadian instruments (SSCEPC & Xiphos Q6) were mounted onboard these maiden flights with the aim of conducting research and development in space technologies' priority areas. These generic technologies advance science and technology solutions for future Canadian space initiatives, thereby limiting the overall risk to these potential missions, while maintaining our pool of space experts at the forefront of their field. The investment in this new base will continue to provide access to frequent flight opportunities on stratospheric balloons to be launched not only from Canada but also from bases located worldwide, thanks to the collaborative agreement signed between the CSA and the French Space Agency (the '*Centre national d'études spatiales*' or CNES). Such 'low cost' flight opportunities, in turn, provide a unique platform to perform atmospheric and space sciences as well as for the qualification of new space technologies and for the training of Canada's next generation of scientists and engineers. The first scientific campaign is planned to start as soon as August / September 2014, also out of the Timmins Balloon Base.
- Ten universities and their research and industrial collaborators funded through the CSA Flight for the Advancement of Science and Technology initiative (FAST) have started the development of space-related technologies to test or validate satellite instruments, generate scientific data during suborbital flights but importantly to train the next generation of scientists and engineers. Skills to be acquired as well as scientific and/technical knowledge to be developed are a direct response of industry needs. Technologies developed by graduate students will fly on nanosatellites (cubesats), sounding-rockets, aircrafts or stratospheric balloons.

- In order to facilitate a regular and low-cost access to different suborbital platforms, the CSA initiated several bilateral discussions with national and foreign suborbital flight operators. Results of these discussions will be presented to the Canadian academic community and industry and integrated into the up-coming grant and contribution announcements of opportunities.
- Following a NASA decision to postpone the 2014 balloon flight campaign from Antarctica, the flight of the two Canadian SPIDER balloon-borne telescope instruments has been rescheduled for December 2014.
- The flight of two BRITE-Canada nanosatellites has been rescheduled for June 2014 joining three other nanosatellites already in orbit. Several Canadian scientists and graduate students funded through the Flight for Advancement of Science and Technologies initiative will conduct investigations using scientific data generated by the BRITE nanosatellites constellation instruments.
- The CSA provided support to scientists and engineers through continued support to 10 CLUSTER grants funding research and HQP development at 22 Canadian universities, 3 representatives of Canadian space industry, 2 NGOs, 4 federal and provincial government departments and 2 international universities.
- A pilot program will be established to provide academic training programs access to the CSA ground installations and laboratories. The intention of the program is to ensure that unique space-related ground assets are incorporated into undergraduate and graduate training in research and development to encourage the acquisition of mission-relevant knowledge, skill sets and experience.
- The CSA developed and provided in-kind support for research and design training programs that are integral to Faculty of Science and Engineering curricula. In particular, the Agency collaborated with 2 Canadian post-secondary institutions to establish mission specific 4<sup>th</sup> year Engineering capstone projects. Twenty-one students were trained through these initiatives. At least one was offered a prestigious scholarship to continue his studies at the master level abroad and several are undertaking graduate studies in Canada.
- Consultations continued with Canadian academic institutions that include Space as a strategic thrust, in the aim of aligning investments in areas of common strategic interest.
- The CSA contributed to the development of HQP through funded and in-kind support for mission-focused training programs and activities at Canadian universities. Two students are doing a master degree in space related fields through that initiative. One got offered a position in the space industry in Canada and the other won a scholarship for doctoral studies.
- The 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.

### **1.3.2 Sub-Program: Space Innovation and Market Access**

- Through Canada's participation in European Space Agency (ESA) Earth Observation programs, more specifically the Earth Observation Envelope Program and GMES Space Component, the CSA continued 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. Examples of accomplishments in 2013-14 are:
  - The successful launch of the SWARM satellite on 22 November 2013 carrying the Canadian Electric Field Instrument (EFI), built by COMDEV with support from University of Calgary. EFI data have been successfully received, calibrated and verified.
  - The Sentinel-1 satellite has been successfully launched on 3 April 2014 carrying a C-band Synthetic Aperture Radar (SAR). Canadian company C-CORE of Newfoundland, designed and built the SAR active calibration transponders which have been deployed and are providing high quality calibration data during current satellite commissioning phase and MDA of Richmond BC developed the SAR data processor.
  - Several Canadian remote sensing companies were successful in obtaining contracts to support on- and –off shore oil and gas industries, and providing tool boxes for exploitation of Sentinel data.
  - The intergovernmental ad-hoc committee, Sentinel Tiger Team (STT), met regularly and generated a comprehensive Canadian plan to develop the ground infrastructure for reception of the Sentinel data over Canada in near real time.
  - Canada played an active role in promoting the “open and free” data policy, which has been adopted by ESA and the European Union.
- The CSA supported the development and demonstration of innovative space technologies through its participation to ESA's General Space Technology Program (GSTP). Under that program, the Proba-V satellite was successfully launched on 7 May 2013. A Canadian company from Sherbrooke, NGC, provided the intelligent software for navigation, guidance and control to ensure the correct positioning and orientation of the satellite so its cameras point to the terrestrial targets with the accuracy and stability that maximize the quality of the images.
- Through its partnership with the European Space Agency (ESA), the CSA continued to position the Canadian industry and scientists in future scientific and technological developments relating to the European Aurora planetary exploration programs and the European Life and Physical Science Program (ELIPS). More specifically, several Canadian companies have been awarded contracts to deliver key components of the Exomars missions scheduled to be launched in 2016 and 2018. Also, Canada's contribution the ELIPS Program has provided opportunities to Canadians in Europe

and on European assets such as bed rest facilities, sounding rockets and even ISS allocation to advance the Space Life Science mandate.

- Canada's participation in the European Advanced Research in Telecommunications Systems (ARTES) continued to allow our industry to access forward-looking studies on new telecommunications services, and to develop new satellite, technologies, equipments and applications focussing in the area of satellite-based Automatic Identification Systems (AIS) for improved maritime domain awareness in partnership with the European industry. More specifically, the ESA Alphasat Satellite was launched on 25 July 2014 with two Canadian provided components/technologies:
  - An advanced antenna feed in L-Band , provided by the Satellite division of MDA, in Ste Anne de Bellevue, Quebec; and
  - An advanced Pilot Tone Injection Unit (PTIU) and L-Band Test Interface Unit (LTIU) for Next Generation Processed Payloads on Geo-Mobile Communications Satellites provided by COMDEV International Products in Cambridge, Ontario.
- Through a newly implemented prioritization process using mission and technology roadmaps as input, the CSA identified 11 technology priorities in order to reduce uncertainties of future missions of Canadian interest as well as 12 promising generic technologies that could enhance Canada's capabilities. The CSA's Space Technology Development Program (STDP) conducted two separate Requests for Proposals (RFP's) and awarded 2 R&D contracts to various Canadian companies and research organizations. Examples of technology development activities in 2013-14 included:
  - Improvements of the vertical resolution of instrument recording spectral signature of the earth atmosphere using solar occultation technique;
  - Requirements for a follow-up system to RCM have been studied with DND and OGDs. Users have expressed a need for 1-meter resolution at C-band and 0.5 m at X-band. The proposed development is to design, build and test the key units that would need to be upgraded to support the 1-meter resolution at C-band. The proposed developments are to support a 300 MHz bandwidth at higher output levels compared to RCM for the following SAR payload sub-systems: antenna sub-array, distribution network and TRM;
  - Development of a suite of integrated technologies that will help monitor the state of health of the crew during missions. The system developed will help establish the diagnosis of sick or injured astronauts and will allow the crew and ground personnel prescribe treatment protocols as soon as possible. The system will also allow the simulation of medical situations for the purpose of remotely training and certifying crew members for the execution of medical procedures techniques;
  - Development of critical technologies to enable the development of tools required to robotically capture, repair, assemble, replace space hardware, e.g., future space servicing missions (satellite, orbital debris removal); and,
  - Development of large arrays of bolometric detectors in order to reach the mapping speed required for the next generation of mm/sub-mm space-based observatories.

- Through a space technology development program (STDP) aimed at supporting Industrial Capacity Building, the CSA managed 8 non-refundable agreements (all less than \$100K) to companies to support industry responsiveness to future market demands and their maintenance of global competitiveness in the Area of Spacecraft Platforms. The work covered by these agreements could range from developing novel concepts, products to improving industrial processes related to spacecraft platforms.
- The CSA continued some modifications and risk reduction work on the CSA generic microsatellite bus. One mission option has been analyzed to try to take advantage of the flight opportunity offered by this platform, and work remains to confirm its feasibility and target performance.
- The CSA continued 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 the growing threat from man-made and natural debris in space. The CSA access to the latest space debris research activities will minimize potential threats to Canadian satellites and other space assets.
- The CSA continued, on a best effort basis, the development of the Concurrent Design Facility (CDF) which is currently in its phase B of development. This facility is meant to improve the definition of mission requirements by simultaneously involving all specialists and could also support feasibility analysis.
- The CSA reviewed its entire portfolio of space technologies, and conducted activities promoting their transfers to industry such as commercial studies and brokering activities to find potential industrial receptors to enhance benefits to Canadians. Those activities gave rise to 5 new patent applications and 8 new licenses agreement with industry.

### **1.3.3 Sub-Program: Qualifying and Testing Services**

- The David Florida Laboratory continued 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.
  - o CSA Internal Programs supported:
    - Space Exploration – JWST, UVIT, CAMS ASTRO-H, OSTEO
    - Space Utilization – RCM, M3MSAT spacecraft
  - o Commercial Programs supported:
    - Neptec Design Group – Cygnus TRIDAR
    - True North Avionics – router, wi-fi handset and cradle, data link unit
    - Communications and Power Industries – EarthCare



- MDA Montréal – ABS-2 spacecraft
- Thales Alenia – SICRAL 2
- CCARI – base station antenna
- Woolna – L-Band Antenna
- WL Gore – Spacecraft cables
- Targa/L-3 Communications – Targa V22
- COMDEV Ltd. - SICRAL 2, mini actuator switch
- EMS – AMT-1800 Inmarsat
- ABB Bomem – SOFIA

To learn more about enabling technology development, go to:

<http://www.asc-csa.gc.ca/eng/programs/default.asp>

To learn more about qualifying and testing services go to:

<http://www.asc-csa.gc.ca/eng/dfi/>

## 1.4 Program: Internal Services

**Description:** Internal Services are groups of related activities and resources that are administered to support the needs of programs and other corporate obligations of an organization. These groups are: Management and Oversight Services; Communications Services; Legal Services; Human Resources Management Services; Financial Management Services; Information Management Services; Information Technology Services; Real Property Services; Materiel Services; Acquisition Services; and Travel and Other Administrative Services. Internal Services include only those activities and resources that apply across an organization and not to those provided specifically to a program.

In order for the CSA to have its management practices meet the standards set by the Government wide policies and based on lessons learned from the Management Accountability Framework assessments, the results of the Public Service Employee Survey, and Internal Audit recommendations, the following actions will be undertaken in 2013-14:

- A new project management framework was approved in February 2014, and was implemented early in the 2014-15 fiscal year. The Investment Governance and Monitoring Framework (IGMF) supports integrated project management, governance, and monitoring across the Agency, through the consistent application of gating processes appropriate for the risk and complexity of investments. The framework will strengthen informed investment decision-making and monitoring, to maximize investment outcomes stemming from projects and non-projects initiatives.
- The CSA completed the development of its first Investment Plan (IP) in 2013-14. The Plan was approved by Treasury Board in June 2014.
- The Corporate Risk Profile was also updated in March 2014 and reflects the level of risks the Agency manages in order to meet its strategic objectives and expected results. This profile is updated annually and used in support of investment decisions and monitoring.
- The CSA's Departmental Security Plan was implemented as required in the Policy on Government Security.
- The CSA's Strategic Emergency Management Plan was developed and implemented as required by the *Emergency Management Act*.
- The ongoing implementation of a five-year Evaluation Plan applicable to the CSA's 2013-14 Program Alignment Architecture (PAA) as well as the development of Performance Measurement Strategies for all programs.
- The ongoing implementation of the three-year (2013-16) Risk-Based Audit Plan.