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English only

Committee on the Peaceful Uses of Outer Space
Scientific and Technical Subcommittee
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Vienna, 19–30 April 2021

International cooperation in the peaceful uses of outer space: activities of Member States

Note by the Secretariat

I. Introduction

1. At its fifty-seventh session, in 2020, the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space recommended that the Secretariat continue to invite Member States to submit annual reports on their space activities (A/AC.105/1224, para. 34).

2. In a note verbale dated 16 October 2020, the Office for Outer Space Affairs of the Secretariat invited Member States to submit their reports by 13 November 2020. The present conference room paper was prepared by the Secretariat on the basis of a reply received in response to that invitation.

II. Reply received from a Member State

Canada

[Original: English]
[23 March 2021]

Summary:

Canada engaged in a diverse range of space activities in 2020, highlights include: Canadarm2's contributions to the International Space Station (ISS) operations; contributing to the high-resolution measurements of the atmosphere and advancing global research in greenhouse gases; modernizing and renewing its funding mechanism related to Earth observation applications development through the smartEarth initiative; and awarding more than 35 grants to Canadian universities through the Science, Technology and Expertise Development in Academia (STEDiA) program, $18.8M CAD to support the advancement of 55 commercially promising technologies in various space domains through the Space Technology Development Program (STDP), and $4.4M CAD to over 25 space-related research projects in

Canadian post-secondary institutions through the Flights and Fieldwork for the Advancement of Science and Technology (FAST) funding initiative.

Canada continues to use satellite imagery and collaborative work with national and international partners to support the global data challenge for the Sustainable Development Goals and has been working closely with international partners as part of disaster relief programs, making our Earth observation data available in times of crisis, helping to assess impact and mitigate risk for natural disasters.

Canada also joined the Artemis Accords, along with Australia, Italy, Japan, Luxembourg, the United Arab Emirates, the United Kingdom and the United States, as a practical first step towards ensuring safe and sustainable space operations.

Finally, Canada and the United States of America have signed a Memorandum of Understanding to cooperate on the civil Lunar Gateway – an outpost orbiting the Moon.

The International Space Station (ISS)

Canada's contribution to the ISS, the Mobile Servicing System (MSS – comprised of Canadarm2, Dextre and the Mobile Base System), demonstrated its importance as the critical robotics system by performing resupply, maintenance, and service tasks essential to ISS operations.

Canadarm2 was used to capture, manoeuvre, unload, and release various cargo vehicles including two (2) SpaceX's Dragon, three (3) Northrop Grumman's Cygnus and one (1) Japan's H-II Transfer Vehicle. The Space Station Remote Manipulator System (Canadarm2) also performed a survey of the thermal protection system during the SpaceX Crew Demo 1 mission.

Dextre and Canadarm2 remain critical to the maintenance of the ISS as well as maintenance and deployment of its externally deployed payloads, providing valuable flexibility to ISS planners for rapid recovery from anomalies while reducing the number of time-consuming spacewalks. As an example in July a critical power equipment was successfully removed and replaced using Special Purpose Dexterous Manipulator (Dextre).

Space Exploration

The Canadian Alpha Particle X-Ray Spectrometer mounted on NASA's Curiosity rover is continuing to perform well. Curiosity entered its third extended mission phase last year. It has been used routinely over the last eight years to measure the amounts and types of chemical elements that are present in Martian rocks.

Canada provided the OSIRIS-REx Laser Altimeter (OLA) on NASA's asteroid-sampling mission OSIRIS-REx, which arrived at asteroid Bennu in December 2018. OLA is a sophisticated laser-based mapping system; it was the source of data that has made Bennu the most precisely mapped body in the entire solar system, including the Earth. OLA was played a critical role in determining the sampling site from which OSIRIS-REx acquired samples in December 2020. OSIRIS-REx is now getting ready for returning to Earth in 2023 with its precious cargo.

Lunar Initiatives

Countries from around the world are getting ready to send humans farther into our solar system, beyond the International Space Station (ISS). Nearly 400,000 km away from our planet, the Moon represents a crucial stepping stone in humanity's quest to travel onwards to Mars. Moving beyond the ISS, partners have begun the design of a space platform in a lunar orbit – called the Gateway – that will extend human presence and further demonstrate and prove technologies and operations at a larger distance from Earth. Canada is currently looking to develop an autonomous, AI-enabled robotics system for the Lunar Gateway.

Canada is in the planning phase for the development of the Canadarm3 and, in the meantime, the Gateway External Robotic Interfaces (GERI) project has been initiated. The GERI project is currently in the Detailed Project Requirements Setting Sub-phase (Phase A). The aim of the GERI project is to deliver two types of interfaces to International Partners, setting the stage for the Canadarm3 system. These GERI will be the standardized connection points between the Canadian external robotics and the Gateway: larger "basepoints" on the various modules and visiting vehicles allowing the Canadarm3 to walk to different locations on the Gateway, along with smaller interfaces to support handling both scientific payloads and the replacement units for maintenance and repair of the Gateway. Interfaces and system requirements will be developed to undertake concept and technology development activities necessary to provide the Gateway module and element developers with information to support the integration of the external robotics and its interfaces.

Coupled with Gateway, a new Lunar Exploration Accelerator Program (LEAP) that was announced in 2019's *Exploration, Imagination, Innovation: A New Space Strategy for Canada*, with an investment of $150M CAD over five years. LEAP will support space technology development and in-space demonstrations, as well as science missions. Its aim is to expand and prepare Canada's space sector for future exploration missions by offering technology development, science and mission opportunities in lunar orbit, on the Moon's surface, or further into deep space.

LEAP will be delivered under two parallel streams: 1) a digital healthcare stream that will focus on developing innovative astronaut healthcare technologies and assessing how to leverage them to help improve healthcare delivery in Canada, particularly in remote and Northern regions; and 2) a science and technology stream that will focus on the development and demonstration of cutting edge science instruments and AI-enabled robotics. Both streams will support key Canadian industrial capabilities in niche technology areas that are likely to be sought after for future international missions. This will ultimately lead to the flight of one or more Canadian scientific or technology demonstration payloads to the Moon and Mars in the next five years that will advance our scientific knowledge in priorities areas defined by the Canadian space exploration community, and position Canada well for international missions that take place beyond the initial five year LEAP window.

Health Science

Human health science remains the Canadian priority for the utilization of the ISS. Canada is developing new multipurpose medical and research platforms to address risks associated with human space flight, such as the Life Science Research System (LSRS), which was deployed on the ISS in 2019. The LSRS is designed to support the identification, characterization and mitigation of the risks associated with the space environment for astronauts. Canada also initiated the development of a novel and breakthrough biological sample preparation technology for the ISS, MicroPrep and pursued seven scientific studies related to health on the ISS: T-Bone, At Home in Space, Vascular Echo, Vascular Aging Wayfinding, Vection, and Radi-N2.

Space Atmospheric Sciences

Canada's SCISAT satellite, measuring ozone and ozone depleting substances, continues to operate nominally. It remains the only satellite to measure hydrofluorocarbons (HFCs) from space and is well positioned to support monitoring efforts of the Kigali Amendment to the Montreal Protocol. It is also the only satellite able to measure all major greenhouse gases, including high quality atmospheric profiles of carbon dioxide down to 5km, which supports monitoring efforts of the United Nations Paris Climate Agreement. This year, SCISAT data was used to study the chemical elements that make up stratospheric aerosols in plumes arising from extreme forest fires. The research team reported on multiple possible chemical signatures and point to oxygen- and hydrogen-containing organic aerosols that may represent a characteristic by-product of biomass burning in situations where the fire is intense enough to generate smoke plume tops well into the stratosphere. SCISAT's

greenhouse gas and air quality data was also used to further Canada's contribution to Arctic research by publishing data in the United Nations/World Climate Research Program water vapour assessment. This contributes to Canada's leadership in high-resolution measurements of the atmosphere and advancing global research in greenhouse gases.

The CSA continues to support Canada's Optical Spectrograph and InfraRed Imaging System (OSIRIS) instrument onboard the Swedish Odin satellite, measuring atmospheric composition. The ozone dataset from OSIRIS has been merged with other instruments to study long-term trends and analysis of ozone recovery. This year, the OSIRIS instrument team contributed to the discovery of the highest amount of aerosol injection into the stratosphere ever recorded due to the 2020 Australian bushfires. The amounts were found to be three times higher than those previously recorded from wildfires, measured from the 2017 fires in Western Canada.

Finally, 20 years of Canada's Measurement of Pollution in the Troposphere (MOPITT) instrument onboard the NASA Terra satellite was highlighted at a national workshop on atmospheric sciences from space. The instrument continues to scan the Earth's atmosphere and collects profile measurements of carbon monoxide to support air quality and climate studies. Its data contributed to a scientific discovery on the reduction of air pollution over China due to implemented COVID-19 restrictions. As a result, an important reduction in hospital admission rates was estimated. MOPITT is the longest-running pollution monitor in space today and the longest continuously-operating space mission in Canadian history.

Space-Based Astronomy

Canada continues to support the James Webb Telescope project, a partnership between NASA, ESA and the CSA. The partners are working toward an October 2021 launch date. Canada has provided two instruments: the Fine Guidance Sensor (FGS), a critical element of the mission used for the extremely precise pointing of the telescope; and the Near-Infrared Imager and Slitless Spectrograph (NIRISS) which is sensitive to infrared wavelengths and will capture the light emitted by objects and gather information about the spectra from exo-planets to distant galaxies. The CSA has contributed to the integration and testing of the instruments on the telescope. This partnership will offer Canadian astronomers a share of the observation time on the most complex and powerful space telescope ever built.

Canada is operating its own space telescope, the Near-Earth Object Surveillance Satellite, NEOSSat (launched in 2013), a dual mission in space astronomy and space situational awareness. Offering imaging even at very low solar elongations, the NEOSSat space telescope is a unique platform for Canadian astronomers and their international collaborators. Through the Canadian Space Agency's NEOSSat Guest Observer program, Canadian astronomers publish near-Earth asteroid and comet observation data to the International Astronomical Union (IAU) Minor Planet Center (MPC), participate in international observation campaigns under International Asteroid Warning Network (IAWN), and support the photometric follow-up of exoplanet candidates from NASA's Kepler and Transiting Exoplanet Survey Satellite (TESS), and other missions. NEOSSat data is published on CSA's Open Data portal and National Research Council of Canada's Canadian Astronomy Data Centre consistent with Canada's Open Government policy.

The CSA continues its collaboration with the Indian Space Research Organisation (ISRO) on ASTROSAT. Canadian astronomers are eligible to observe with ASTROSAT thanks to the provision of a Canadian detector system for the Ultra-Violet Imaging Telescope instruments, the twin UV and visible imaging telescopes, as well as on-going support to data reduction.

Canada has been a partner in the BRITE Constellation with Austria (University of Vienna and Graz University of Technology) and Poland (Copernicus Astronomical Center) since 2013. This constellation is dedicated to long duration observations of

many of the most luminous stars. BRITE is a Canadian innovation, designed and built by University of Toronto Space Flight Lab.

Canada joined the science team for JAXA's X-Ray Imaging and Spectroscopy Mission (XRISM) mission through a partnership with NASA which collaborates to the mission. The CSA contributes along with NASA to the testing and calibration of one of XRISM's instruments at the Canadian Light Source in Saskatchewan. This collaboration offers eligibility to compete for observation time to XRISM which is planned for launch in early 2022.

Space Weather

Space weather science requires world-wide ground and space-based observations to develop models that will ultimately contribute to the detection and mitigation of risks. Given Canada's northern location, it is highly impacted by the effects of space weather, but also has a front row seat to observe the near-Earth space environment (geospace) where space weather impacts Canadians and the world.

Canada's Geospace Observatory initiative observes geospace using arrays of ground-based instruments deployed across Canada. Seven projects have been selected for funding until March 2023, and will make their data openly available to scientists worldwide.

Canada also continues to operate ground imagers and magnetometers across Canada, through the support of the University of Calgary and the University of Alberta, to contribute to the NASA THEMIS mission through ground-based observations of the aurora borealis.

Canada will be providing an Ultraviolet Imager to the ESA-China (the National Space Science Center of the Chinese Academy of Sciences) Solar-Wind Magnetosphere Ionosphere Link Explorer (SMILE) mission, whose goal is to simultaneously observe the impact of the incoming solar wind on the magnetopause and its effect on the aurora borealis, even during daytime, to better understand the role of the magnetosphere in shielding the Earth from incoming solar radiation. The instrument is based on heritage UV telescope design that have flown on several past missions with international partners.

Canada is a partner in the European Space Agency's (ESA) Swarm mission (launched in 2013), designed to measure the magnetic fields generated by the Earth. ESA procured a Canadian Electric Field Instruments (EFI) for each of Swarm's three identical satellites, and the Canadian satellite CASSIOPE has joined the Swarm constellation in March 2018, contributing its observations to the success of the mission. The University of Calgary, supported by the CSA, uses measurements from the EFIs to learn about the influence of space weather on the space environment.

Finally, Canada continues to lead the Committee on the Peaceful Uses of Outer Space Expert Group on space weather which supports the 21 Guidelines of the of the Long-term Sustainability of Outer Space Activities and the work of the Space2030 agenda.

Space Situational Awareness (SSA)

Canada's Department of National Defense (DND) continues to operate Sapphire, an operational space-based SSA sensor. Sapphire currently contributes up to 3000 metric observations/day on deep-space objects to the larger US-led Space Surveillance Network (SSN) helping to maintain the safety of space objects in Earth orbit. Planning for the Surveillance of Space 2 project, the operational follow-on to Sapphire, is progressing well. This capability will continue to provide advanced space-based and ground-based tracking data to the SSN.

In addition, Canada continues to operate the NEOSSat space telescope, launched in 2013, in support of advanced space situational awareness R&D. NEOSSat's Sun-synchronous orbit and near-Sun observation capabilities allow it to maintain near continuous tracking of man-made objects in geostationary orbit. NEOSSat has also

pioneered unique LEO-to-LEO (Low Earth Orbit) tracking, an innovative new capability allowing NEOSSat to collect tracking data on space objects making close approaches (conjunctions), including objects conjuncting with NEOSSat itself. It also enables NEOSSat to make observations of recently launched objects, such as the RADARSAT Constellation Mission (RCM), and manoeuvring objects in any orbit regime, such as tracking the approach of the first on-orbit servicing Mission Extension Vehicle (MEV-1) to its client satellite in geostationary orbit. Canada has also begun space-based observations of new orbital mega-constellation infrastructures to help better understand their unique on-orbit phenomenology. NEOSSat SSA observations are led by Defence Research & Development Canada (DRDC) and allow Canada to contribute valuable data to international SSA campaigns, such as Phantom Echoes (Technical Cooperation Program), Sprint Advanced Concept Training (SACT) and the Inter-Agency Space Debris Coordination Committee (IADC).

Based on the success of NEOSSat, Canada is planning the development of a new SSA microsatellite, the Multi-purpose Space Surveillance Satellite (MSS-Sat), intends to continue advanced SSA research, development and capability demonstration in LEO.

Within the CSA's Satellite Operations Centre, Conjunction Risk Assessment and Mitigation System (CRAMS) continues to provide its users with invaluable analysis of conjunction data delivered by the United States 18th Space Control Squadron. The CRAMS reports are used by satellite operators and the Canadian Space Operations Centre (CANSpOC) to facilitate good decision-making and ensure the protection of space assets against space debris. Following additional requests from Canadian industry, academia and international partners, CRAMS now supports a total of 78 space assets both from LEO and Geostationary Orbit (GEO) missions and remains an essential space situational awareness asset in Canada.

Finally, several Canadian universities are collaborating with international colleagues in an "all-sky camera networks", collecting observations on incoming debris/meteorites for logging and recovery purposes.

Earth Observation

The RADARSAT Constellation Mission (RCM), comprised of three satellites, represents an evolution of the RADARSAT Program and ensures C-Band SAR data continuity. Canada continues to support the free and open access to its satellite data and has released a first set of RADARSAT-1 data records, while supporting free access to RCM data. RCM supports the Government of Canada in its mandate to monitor the impacts of climate change, protect our environment and foster sustainable development, manage natural resources, and support disaster relief.

Most of the RCM image products are freely and openly available to users outside the Government of Canada, subject to security, privacy and confidentiality exceptions. The user profile (i.e. public or vetted user) defines the level of access to RCM image products. Users can also view the RCM Standard coverage maps, which are provided every three months. The maps are technical and show the RCM image products that are available for the previous three-month period. RCM data has been acquired and made available for all Charter activations requested since June 2, 2020. A script was finalized for the automatic push of RCM data to COS-2 (The Charter Operational System) and has been tested on a training platform. Value-added products were created for seven activations. Here is an example of the November 16, 2020 flood in the Philippines: https://disasterscharter.org/image/journal/article.jpg?img_id=8212111&t=1605776015031

The CSA supported a large number of R&D activities with industry, government and academia using RADARSAT-2 data, both nationally and internationally, until mid-July, 2020. Since then, RADARSAT-2 data is available commercially and is still being used by the Government of Canada to complement RCM data.

Following a thorough environmental scan and extensive consultations conducted in 2018 and 2019 with stakeholders from the government, industry and academia, the

Canadian Space Agency modernized and renewed its funding mechanism related to Earth observation applications development. The smartEarth initiative fosters a smart use of satellite data to develop solutions to key challenges on Earth and in our everyday lives. smartEarth replaces the former CSA's Earth Observation Application Development Program (EOADP), Government Related Initiatives Program (GRIP), and Science and Operational Applications Research (SOAR) Program.

EO activities are undergoing enormous paradigm shifts concerning broad-scale operational utilization and application. By the same token, web-based education solutions have emerged as a significant eLearning component. The Canadian SAR Mini-MOOC (Massive Open Online Course) was conceptualized as a contribution to the EO College (www.eo-college.org) learning platform of education materials and online teaching modules. The cooperation with European EO College partners complements existing radar remote sensing eLearning tools and strengthens transatlantic EO education activities with a view of engaging the broader public online. The course introduces learners to Canadian radar remote sensing applications, ongoing research and development, and operational use by government departments and agencies. The Canadian SAR Mini-MOOC is entitled “Winter, Water, Warming”. Production is presently in the final stage, with a planned release in early 2021.

STEM Outreach

As part of Canada’s participation in the Lunar Gateway, the CSA launched the Junior Astronauts campaign in 2019 to engage young Canadians from kindergarten to Grade 12, and get them excited about Science, Technology, Engineering and Mathematics (STEM) and future careers in the space field, and help them understand how they can play a role in Canada’s mission to the Moon. Online content and learning games were made available to all young Canadians. Structured activities in science and technology, fitness and nutrition, and teamwork and communications were also developed. By completing some of these activities, educators could apply to win the visit of an astronaut to their school or organization. Qualified young participants from across Canada can apply to a contest to take part in a camp, during which they will meet astronauts, scientists and engineers. Given the continued impact of the global COVID-19 pandemic, both the astronaut visits and the camp will be done virtually by summer 2021. The CSA is also working on developing a series of initiatives for youth related to Lunar STEM.

The CSA also continued the Canadian CubeSat Project (CCP), where over 450 post-secondary students, from across Canada, are taking part in a real space mission, by designing, building, launching, and operating their own CubeSat over a three-year period. A one-week hands-on workshop was organized and offered to more than 45 students from 15 teams across Canada. The main objective of the CCP is to provide professors in post-secondary institutions with an opportunity to engage their students with real space missions. Once tested and ready for space, the CubeSats will be launched to and deployed from the ISS. The teams will then operate their satellites and conduct science according to their mission objectives, which could last up to 12 months.

Also, through the Science, Technology and Expertise Development in Academia (STEDiA) program, more than 35 grants were awarded to Canadian universities involving 285 students and young professionals.

Finally, the CSA remains engaged in Women in STEM activities and initiatives, both internally and externally, and has recently signed the Dimension’s Charter, endorsed by the National Research Council; a federal government engagement to foster equality, diversity and inclusion in the workplace.

National Capacity Building

The CSA continued to support initiatives and activities related to space science and technology development to attract, sustain and enhance a critical mass of Canadian space specialists; reduce technological unknowns; foster space innovation

and know-how; preserve Canada's space-related capabilities; and increase commercial potential.

In particular, the CSA invested through the Space Technology Development Program (STDP), the CSA also invested an amount of $18.8M to support the advancement of 55 commercially promising technologies in various space domains, such as a hazard avoidance navigation system for landers, and 45 activities to reduce the technological uncertainties of potential future missions.

In addition, through the Flights and Fieldwork for the Advancement of Science and Technology (FAST) funding initiative, over 25 space-related research projects in Canadian post-secondary institutions were funded for $4.4M CAD. The CSA also carried out pre-mission research and technology activities and supported various pre-space capability demonstration opportunities to raise the space readiness of Canadian science and technology, while training post-secondary students in the field of space science and technology.

Canada confirmed new investments totalling approximately $90M in a series of ESA programs that support key Government priorities, as well as the space industry and the scientific community. Investments cover several domains, namely Earth observation, satellite communications, space exploration and technology development.

The Canadian Space Agency (CSA) has issued an Announcement of Opportunity through its newly announced **smartEarth** initiative, and will be supporting up to seventeen (17) projects. The objective is to ensure that the Canadian downstream space sector capitalizes on the data revolution so that it can develop the necessary capabilities, through R&D activities and projects, to better adapt to the current transformations in the digital marketplace and to open new opportunities that will:

- Make the most of the growing volume of available open data;
- Make the most of accessibility to a wider variety of data types (EO, Non-EO, Internet of Things, etc.);
- Infuse new numerical approaches such as AI, Machine Learning (ML) and Deep Learning (DL) in areas and markets where there exist Big Data challenges, and where EO data can contribute;
- Identify innovative ways through further research and testing with actual imagery to maximize the use satellite data and other environmental data sources; and
- Create partnerships with AI experts in the private sector and academia.

Support to Global Challenges

The CSA and the Public Health Agency of Canada (PHAC) continue to apply Earth observation satellite data and derived geospatial information to advance research efforts and risk assessments within the Canadian public health domain. Efforts have been focused on mosquitos-borne diseases, Lyme disease and vulnerable human population.

With its large landmass, Canada counts on its longstanding use of satellite imagery and collaborative work with national and international partners to support the global data challenge for the Sustainable Development Goals. Canada participated in the review and development of two initiatives under the Group on Earth Observations (GEO) and the Committee on Earth Observation Systems (CEOS) promoting the use of Earth observations and geospatial information to support progress on the Sustainable Development Goals.

A number of the world's whale populations are in crisis and in need of protection if they are to survive. The Government of Canada has demonstrated its commitment to the protection and recovery of right whales through several investments in recent years to help protect and recover endangered whale species in Canada. In June 2020,

CSA under the smartEarth initiative, in partnership with the Department of Fisheries and Oceans (DFO) and Transport Canada (TC), released a Request for Proposal (RFP) to explore and develop ways in which space-based solutions can be used in conjunction with other information sources to contribute to the protection and environmental management of *North Atlantic Right Whale* (NARW) in Canadian waters. This initiative will (1) improve the accuracy of detection and monitoring of NARW and (2) increase the effectiveness of prediction and modelling methods for locating and tracking the movements and activities of NARW and their habitat characteristics.

It is widely recognized that an important aspect in dealing with the dynamics of climate change is the establishment and development of effective monitoring and evaluation systems that are capable of providing continuous, wide-area, up-to-date information of the ever changing climate and its impact on the nation's environment, its infrastructure and its communities. Innovations in the use of space based Earth Observation (EO) data, along with other complementary technologies, can form a strong basis from which to build and maintain the kind of monitoring systems required to create a robust capacity to deal with changing climate conditions. As part of its response to the growing crisis of climate change, the Canadian Space Agency (CSA), in close partnership with Federal Departments, the Canadian EO Industry and Academia, funded the development of 25 projects within the theme of the "Climate Change Impacts and Ecosystem Resilience" (CCIER).

The CCIER projects will (1) ensure an increasing use of Canadian satellite Earth Observation (EO) missions in key policy areas of terrestrial monitoring activities supporting climate change impacts and ecosystem resilience; (2) support the development of innovative solutions and applications that address the CCIER needs in a Canadian context; (3) develop new advancements in the technologies and applications of EO data that will provide tangible solutions to evolving climate change challenges in Canada in response to emerging downstream end users and their needs; and (4) contribute to a growing and knowledge-based Canadian economy.

The CSA has been working closely with international partners as part of disaster relief programs, making our Earth observation data available in times of crisis, helping to assess impact and mitigate risk for natural disasters. Canada continues to actively support the International Charter Space & Major Disasters, a collaboration founded by ESA, CNES and CSA that has now grown to seventeen (17) members with the provision of RCM data since June 2, 2020. From January to November 2020, there were 50 activations of the Charter.

Space Policy

A non-legally-binding Artemis Accords commitment was signed by CSA President Lisa Campbell on October 13, 2020, during a virtual ceremony at the International Astronautical Congress (IAC). The CSA President was joined by representatives from Australia, Italy, Japan, Luxembourg, the United Arab Emirates, the United Kingdom, and the United States.

The Artemis Accords are a common set of principles designed to guide the exploration and use of outer space in a safe and sustainable manner and in accordance with international treaty obligations. The Artemis Accords are a commitment to safe and sustainable space exploration activities, but more work will have to be done, within the United Nations structure, to ensure space exploration and use continues to be for the benefit and in the interest of all humankind.

Furthermore, Canada and the United States of America have signed a Memorandum of Understanding to cooperate on the civil Lunar Gateway – an outpost orbiting the Moon. Canada is contributing a smart robotic system – Canadarm3. This highly autonomous robotic system will be designed to handle many tasks, including to maintain and repair the Gateway; provide support for spacewalks; as well as facilitate and enable science in deep space.

Finally, the Canadian Space Agency is undertaking an internal assessment of Canada's compliance to the *21 Guidelines for the Long-term Sustainability of Outer Space Activities* in order to identify gaps and areas for review in an effort to further strengthen our commitment to the safety and sustainability of outer space.

State of the Canadian Space Sector Report 2019

The State of the Canadian Space Sector Report provides factual information about the Canadian space sector. The annual report is based on a questionnaire sent to companies, not-for-profit organizations, research centres and universities with space-related activities in Canada. *The 2019 report includes data from 2018* on organizations composition, sectors of activity, the Canadian space workforce, research and development (R&D), and innovation.

Link to report: https://www.asc-csa.gc.ca/pdf/eng/publications/2019-state-canadian-space-sector-v2.pdf

Key Takeaways:

- In 2018, total revenues in the Canadian space sector reached $5.7B.
- While Ontario and Quebec had the highest space revenues, the Prairies experienced the highest revenue growth in 2018.
- The Canadian space workforce declined by 4% in 2018, and totalled 9,567 direct space-related jobs.
- In 2018, the space sector supported a total of 20,891 jobs in Canada.
- Quebec and Ontario accounted for 77% of space sector jobs.
- STEM workforce experienced a 3% growth in 2018, totalling 5,795 FTEs and accounting for 61% of the Canadian space workforce.
- With 6,152 FTEs, HQP (employees with at least a bachelor's degree) accounted for 64% of the workforce.
- Canadian space companies hired 741 employees, of whom 26% (196) were women and 74% (545) were men.
- Business Expenditures on R&D (BERD) totalled $356M in 2018.
- R&D intensity for space manufacturing was 11 times higher than the average for manufacturing in Canada.
- Canadian space companies derived $282M in revenues through the commercialization of externally funded R&D projects.
- Space sector organizations reported a total of 170 inventions and 53 registered patents.