CANADIAN SPACE AGENCY
2007-2008 DEPARTMENTAL PERFORMANCE REPORT

ANNEXES

3.3.1) Sources of Respendable and Non-Respendable Revenue

Non-Respendable Revenue

($ in millions)	Actual Revenue 2005-2006	Actual Revenue 2006-2007	2007-2008			
			Main Estimates	Planned Revenue	Total Authorities	Actual Revenue
Space Based Earth Observation						
Royalty Revenues	3.1	3.3	N/A	4.1	N/A	4.0
Miscellaneous revenues	0.0	4.0	N/A	-	N/A	-
Generic Space Activities in support of EO, SE & SC						
Testing Facilities and Services of the David Florida Laboratory	1.7	0.9	N/A	0.7	N/A	3.2
Satellite Communications						
Royalties from intellectual property	0.0	0.0	N/A	0.1	N/A	0.1
Total Non-Respendable Revenue	**4.9**	**8.2**	**N/A**	**4.9**	**N/A**	**7.3**

Notes:

- Due to rounding, figures may not add up to totals shown.
- Miscellaneous revenues are deferred revenue write-off from RARADSAT-1.

3.3.2) User Fee Reporting – User Fees Act

A. User Fee	Fee Type	Fee Setting Authority	Date Last Modified	2007-2008					Planning Years		
				Forecast Revenue ($000)	Actual Revenue ($000)	Full Cost ($000)	Performance Standard	Performance Results	Fiscal Year	Forecast Revenue ($000)	Estimated Full Cost ($000)
Fees charged for the processing of access requests filed under the *Access to Information Act* (ATIA)	Other products and services (O)	*Access to Information Act*	1992	$0.1	$0.1	$55 (incl. Salary of the ATIA Coordinator and O&M)	Response provided within 30 days following receipt of request; the response time may be extended pursuant to section 9 of the ATIA. Notice of extension to be sent within 30 days after receipt of request. The Access to Information Act provides fuller details.	CSA responded to 17 access to information requests; 15 consultations from other government departments. CSA routinely waives fees in accordance with TBS guidelines. The response time was within time limits in 88% of the requests.	2008-2009 2009-2010 2010-2011	$0.1 $0.1 $0.1	$55 $55 $55
			Total	**$0.1**	**$0.1**	**$55**			**Total**	**$0.3**	**$165**

B. Date Last Modified

N/A

C. Other Information

The Canadian Space Agency (CSA) collects user fees for information requests in accordance to the *Access to Information Act.* The total user fees collected in 2007-2008 are for application fees. There was no need to charge for preparation and search fees.

3.3.3) Policy on Service Standards for External Fees

A. External Fee	Service Standard	Performance Result	Stakeholder Consultation
Fees charged for the processing of access requests filed under the *Access to Information Act* (ATIA).	Response provided within 30 days following receipt of request; the response time may be extended pursuant to section 9 of the ATIA. Notice of extension to be sent within 30 days after receipt of request. The Access to Information Act provides fuller details.	The most common performance measurement is the percentage of "on-time" responses as stipulated by the performance standard. For this reporting period the figures were 85% for the *Access to Information Act* and 100% for the *Privacy Act*.	The Access to Information Act and the Access to Information Regulations establish the service standard. Consultations were undertaken by the Department of Justice and the Treasury Board Secretariat for amendments made in 1986 and 1992.

B. Other Information

In November 2004, Treasury Board ministers approved the *Policy on Service Standards for External Fees.* The Policy requires departments to report on the establishment of service standards for all external fees charged on a non-contractual basis. In CSA's context, this policy applies to the ATI Program, for fees charged for the processing of access requests filed under the *Access to Information Act* (ATIA).

3.3.4) Details on Project Spending

($ in millions)	Current Estimated Total Cost	Actual 2005-2006	Actual 2006-2007	2007-2008			
				Main Estimates	Planned Spending	Total Authorities	Actual
Space Based Earth Observation							
(Q) RADARSAT-1 (MCP)	723.1	8.1	8.2	11.2	8.8	11.4	7.5
(BC-Q) RADARSAT-2 (MCP)	418.6	17.0	10.6	18.5	12.3	17.3	12.9
(O-Q) SWIFT - CHINOOK (PPA)[1]	93.1	1.5	0.9	16.8	18.3	10.0	0.8
(BC-M-O-Q) SAR CONSTELLATION (PPA)	143.2	4.7	8.2	33.8	32.2	33.7	2.6
Space Science and Exploration							
(BC) APXS (EPA)	8.7	-	4.0	5.2	1.4	4.1	3.1
(O) JWST (MCP)	134.7	8.3	22.2	34.1	23.3	32.1	30.3
(O) MARS PHOENIX (EPA)	27.8	11.9	6.7	1.7	0.5	1.5	0.8
(O) NEOSSAT (EPA)	5.4	-	0.1	4.5	2.1	5.5	2.1
(O) UVIT (EPA)	5.7	1.3	1.5	2.8	2.7	3.0	1.0
Satellite Communications							
(O) M3MSAT (PPA)	5.4	-	0.0	-	-	0.1	0.1
TOTAL	1565.9	52.8	62.4	128.6	101.5	118.7	61.1

Notes:
- Due to rounding, figures may not add to totals shown.
- Difference between Total Authorities and Actual Spending is mainly due to re-profiling of funds from 2007-2008 to 2008-2009, 2009-2010 and 2010-2011 associated with the management of Capital Projects.

Provinces where the capital project will be carried out:
O = Ontario
Q = Quebec
BC = British Columbia
M = Manitoba

Class of Project:
MCP = Major Crown Project
EPA = Effective Project Approval
PPA = Preliminary Project Approval

[1] SWIFT – CHINOOK (PPA): Project under redefinition.

3.3.5) Status Report on Major Crown Projects

RADARSAT-1

Description

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 to consistently supply timely and high-quality data to RADARSAT International (RSI), now a wholly owned subsidiary of MacDonald, Dettwiler and Associates (MDA), and other partners (federal and provincial government departments, NASA and the U.S. National Oceanic and Atmospheric Administration). RADARSAT-1 has continued to supply SAR data to clients in its extended mission, now in the 13th year of operation.

RADARSAT-1 operations continued with the same level of high performance for satellite reliability and image production last year. Since RADARSAT-2 has now been commissioned and declared operational, the CSA has notified NASA and NOAA that the RADARSAT-1 CSA-NASA-NOAA IMOU is terminated. In other words, no new RADARSAT-1 data would be available to NASA and NOAA after May 2, 2008 under this IMOU. RADARSAT-1 operations are to continue for 2008-2009 and the CSA has started deliberations on the future of RADARSAT-1 operations through consultations with main users.

RADARSAT-1 acquires high quality images of the Earth, covering most of Canada every 72 hours and the Arctic every 24 hours. It has proven itself in gathering the data needed for more efficient resource management (e.g. support to fishing, shipping, oil and gas exploration, offshore drilling, mapping) as well as ice, ocean and environmental monitoring, disaster management, and Arctic and offshore surveillance.

Leading and Participating Departments and Agencies

Sponsoring Agency:	Canadian Space Agency
Contracting Authority:	Public Works and Government Services Canada
Participating Departments:	Environment Canada
	Natural Resources Canada (Canada Centre for Remote Sensing)

Prime and Major Sub-Contractors

Prime Contractor: - EMS Technologies (now MacDonald, Dettwiler and Associates)	 - Ste.-Anne-de-Bellevue, Quebec
Major Sub-Contractors: - MacDonald, Dettwiler and Associates - SED Systems - EMS Technologies - COM DEV - Lockheed Martin	 - Richmond, British Columbia - Saskatoon, Saskatchewan - Ottawa, Ontario - Cambridge, Ontario - Longueuil, Quebec
Other Contractors: - Ball Aerospace - RADARSAT International (RSI) (now MacDonald, Dettwiler and Associates)	 - Boulder, Colorado - Richmond, British Columbia

Major Milestones

Major milestones of the RADARSAT-1 Major Crown Project are now complete.

Major Milestones	**Date**
- Preliminary studies	Complete
- Feasibility and concept definition	Complete
- Systems requirement and preliminary design	Complete
- Development and testing up to qualification test review	Complete
- Manufacture of the prototype flight sub-systems up to acceptance testing of the sub-systems	Complete
- Assembly and integration of the sub-systems up to flight readiness review, plus post-launch and commissioning activities up to system acceptance	Complete
- First Antarctica mission - Second Antarctica mission - Original Mission Life of five years	Complete Complete Complete
- Satellite operations	April 1996 to April 2008 and beyond

Progress Report and Explanation of Variances

Effective Program Approval was obtained for RADARSAT-1 in March 1991, with launch in November 1995 and beginning of operations in April 1996. The initial system included receiving stations for Synthetic Aperture Radar (SAR) data in Prince Albert (Saskatchewan), Gatineau (Quebec), Fairbanks (Alaska) and McMurdo (Antarctica). The CSA and RADARSAT International (now MDA) have since signed agreements with another 31 network stations distributed around the world: Argentina, Australia, Brazil, China, Japan, Kasakhstan, South Korea, Malaysia, Norway, Puerto-Rico, Russia, Saudi Arabia, Singapore, Taiwan, Thailand, Turkey, the United Kingdom and the United-States. Presently, a second station in Norway is undergoing the certification process. This list includes the agreements that have been also signed with transportable stations for the direct reception of RADARSAT-1 data: one in Italy, five in the U.S., one in Taiwan and one in France. Even more stations are expected to join the RADARSAT network in 2008.

Following a commissioning period, routine operations of RADARSAT-1 commenced in April 1996. The average system performance is being maintained at 95.8%. The worldwide client base includes more than 600 commercial and government users from over 60 countries.

Several system upgrades were completed over the past few years to enhance performance, reliability, and maintainability of RADARSAT-1. Highlights include: June 2005 – addition of a new Order Desk server for Joint Contingency Operation with ESA; November 2005 – completion of scheduled MMO/DBM database server and controller system upgrades (SunFire V240/Solaris 9 equipment); January 2006 – completion of a scheduled upgrade of all five planning stations in the MMO (SunBlade 100/Solaris 8 equipment); November 2006 – completion of a scheduled Order Desk dual redundant configuration system upgrade (SunFire V210/Solaris 10 equipment) and an improved algorithm and tool for computing shared SAR usage statistics was developed, validated and made operational.

Since October 2000, the CSA is a signatory, along with ESA and the Centre National d'Études Spatiales (CNES) in France, to the 'International Charter on Space and Major Disasters'. The emphasis of the Charter is on multi-satellite support for disaster response and mitigation efforts around the world utilising RADARSAT-1 and satellites of other Charter member agencies. Since its official launch, the Indian Space Research Organisation (ISRO), the National Oceanic and Atmospheric Administration (NOAA), Argentina's Comisión Nacional de Actividades Espaciales (CONAE), the Japanese Aerospace Exploration Agency (JAXA), the United States Geological Survey (USGS) and the Disaster Monitoring Constellation (DMC) have also joined the Charter and participate fully in its operations.

As of March 31st 2008, there have been 170 activations of the Charter for events such as: floods in Afghanistan, New York state, Uruguay, UK, Pakistan, China, India, Vietnam, North Korea, West Africa, Slovenia, Dominican Republic, Mexico, Bangladesh, Fiji, South Africa, Bolivia, Ecuador, Namibia and Illinois; Tsunami in the Solomon Islands; Earthquakes in Afghanistan, Chili, Peru and, Rwanda; Volcanic eruptions in Colombia and Ecuador; oil spills off the coasts of Chili an Norway; forest fires in the Canari Islands, Paraguay, Greece, California and Chili and, wind storms (hurricanes and tornadoes) in Mexico, Nicaragua and USA. The Charter also covered one activation in Canada in April 2007 when hundred of fishing vessels were caught in ice on the east cost of Newfoundland and Labrador. The three most recent devastating disasters, namely the Hurricane Dean in Mexico, the Greece forest fires and the floods in Namibia-Angola were covered with the assistance of Canada's RADARSAT-1.

The RADARSAT-1 system has been improved to provide on average a less than 2.5-hour turnaround in the electronic delivery of images to the Canadian Ice Service (CIS) for the production of ice charts and bulletins for the Canadian Coast Guard and other marine clients. The CIS continues to be one of the leading users of RADARSAT-1 data since the first operational data began to flow in February 1996. Recently, the CIS has been collaborating with Noetix Research, the CSA, and RSI (now MDA) on an ESA-sponsored Global Monitoring for Environment and Security (GMES) Project - The Northern View - to provide regular RADARSAT-1 images in support of a Floe Edge Service for two communities in the Canadian Arctic.

The RADARSAT-1 Background Mission has archived one of the largest microwave remote sensing data collections in the world. In fact, it is the first multi-mode uniformly collected database of its kind ever created. The data archive is the result of several Background Mission global coverage campaigns undertaken in the past seven years. These include a complete coverage of the world's continents, continental shelves and polar ice caps, as well as complete coverage of nearly the Earth's entire landmass with two RADARSAT-1 imaging beams for the first ever beam-pair stereo data collection. This is the world's largest radargrammetric dataset currently available. Some of the continents, including North America, were covered more than once to generate seasonal snapshots in the form of wide-area SAR mosaics. High-resolution RADARSAT-1 image mosaics of Canada, the U.S., Australia and Africa were produced with the Background Mission data. Several time- and site-specific coverage types have also been done, such as that of the remote oceanic island localities, the world's major cities and capitals. A seasonal coverage of the tropical deltas is also underway, as is also a four-season continuous coverage of the Arctic. The latter coverage, which now has uninterrupted data records over the Arctic since the summer of 2003, supports the growing interest in the Arctic and climate change captured within the International Polar Year (IPY) activities. These baseline coverage campaigns of RADARSAT-1 have established benchmarks for the follow-on Canadian SAR missions to build upon.

MacDonald, Dettwiller and Associates (MDA) Geospatial Services Inc. (GSI) continues to provide Earth-Observation data, derived information products, and leading-edge services to global clients. The broad range of MDA/GSI products includes geo-corrected imagery, digital elevation models, and application-specific products such as flood and ocean oil-seep vectors to meet the demands for new markets. Products are delivered to clients via Internet in near-real time for time-critical operations such as disaster management and ship navigation. Other services include training, monitoring and emergency response services, and custom product generation, as well as Geographic Information Systems (GIS) project implementation.

Industrial Benefits

The Canadian Space Agency undertook a study to determine the achievements of RADARSAT data in support of ice mapping and related activities in Canada. To date, the Canadian Ice Services (CIS) is the only Canadian Government operational user of RADARSAT-1 data. RADARSAT-1 provides observations over a wider geographical area, at much lower cost and risk, and in much less time than with an aircraft. As a result, CIS has been able to improve its operational efficiency. Over five years (1995 to 2000), the net average annual savings to CIS operations have been about $7.7 million per year ($38.5 million over 5 years). The same annual benefits have continued for the past eight years.

The Canadian Coast Guard (CCG), the largest customer of CIS products, has felt these benefits most significantly. The CCG Ice Operation Centres can provide improved routing information to commercial shipping, which allows for faster transit times. The shipping industry has benefited from the accuracy of RADARSAT information to produce ice charts. The shipping companies believe that as a result of RADARSAT-based ice charts, there have been savings in transit time through ice-infested waters. These commercial shipping savings are estimated to be $18 million a year. Other benefits included less damage to ships and a reduction in the need for CCG escorts. As for the CCG, an estimated dollar savings in both operating costs and transit time to be between $3.6 million and $7 million a year, depending on the severity of ice conditions.

In the past, the prime contractor SPAR and its Canadian sub-contractors created over 2,000 person-years of high technology employment during the construction phase of RADARSAT-1. Ongoing mission operations employ 75 people at the CSA's headquarters in St-Hubert (Quebec), 7 in Saskatoon (Saskatchewan), 15 at ground stations in Prince Albert (Saskatchewan) and Gatineau (Quebec), as well as more than 80 at RSI (now MDA) in Richmond (British Columbia). In the highly competitive marketplace for space-based information, MDA continues to capture roughly 15% of the world’s space borne remote sensing market. MDA has continued to process scenes and integrate RADARSAT data into information products for delivery to nearly 600 clients in 60 countries, and furthermore, MDA has signed up 80 international distributions, 18 RADARSAT-1 Network Stations and 11 Resources Centres. The market development for data archives is likely to be significant and an area in which new benefits may develop.

RADARSAT-2

Description

RADASART-2, is a Canadian satellite from the next generation with its synthetic aperture radar (SAR) technology and the most advanced satellite of its kind in the world. RADARSAT-2 provides all-weather, day-and-night coverage of the entire globe to support fishing, shipping, oil and gas exploration, offshore drilling, mapping and ocean research. Equipped with a C-band radar system, it is the first fully commercial SAR satellite to offer multi-polarization, an important aid in identifying a wide variety of surface features and targets. It also has the capability to image both the right and left with a resolution down to three metres and to access an area of 800 kilometres on either side. This translates into a new range of products and services, which contributes valuable new information on natural resources and the global environment.

The RADARSAT-2 Major Crown Project, in partnership with MacDonald, Dettwiler and Associates (MDA), carried out the design, development, testing, deployment and operations of a space-borne SAR satellite to provide global coverage of terrestrial phenomena as a follow-up to RADARSAT-1. The current estimated total cost from CSA's budget is $418.6 million.

RADARSAT-2's design and construction improves upon RADARSAT-1, with new capabilities to ensure Canada's continued leadership in the satellite remote sensing global marketplace and to create a commercial industrial satellite remote sensing industry in Canada.

Leading and Participating Departments and Agencies

Sponsoring Agency:	Canadian Space Agency
Contracting Authority for the CSA/MDA Master Agreement:	Canadian Space Agency
Participating Departments:	Natural Resources Canada (Canada Centre for Remote Sensing) Environment Canada Industry Canada Fisheries and Oceans National Defence Foreign Affairs International Trade Agriculture Canada

Prime and Major Sub-Contractors

Prime Contractor: - MacDonald Dettwiler, and Associates (MDA)	 - Richmond, British Columbia
Major Sub-Contractors: - EMS Technologies (now MacDonald Dettwiler, and Associates) - Alenia Aerospazio - AEC Able Engineering Co. - RADARSAT international (RSI) (now MacDonald Dettwiler, and Associates) - STARSEM	 - Ste.-Anne-de-Bellevue, Quebec - Rome, Italy - Goletta, California - Richmond, British Columbia - Baikonur, Kazakhstan

Major Milestones

The major milestones on Major Crown Projects, by phase, are the following:

Phase	Major Milestones	Date
A and B	Requirement Definition	June 1999
C	System Design	May 2002
D	Sub-system Construction Integration and Testing Pre-launch Preparations Launch/System Commissioning	September 2005 January 2007 July 2007 December 2007 April 2008
E	Operations	2008 to 2015

Progress Report and Explanation of Variances

In June 1994, the government directed the CSA to develop an arrangement with the private sector for the development and operation of a RADARSAT follow-on program to maintain continuity of data following RADARSAT-1. In February 1998, following a formal Request for Proposal, MDA was selected to construct and operate RADARSAT-2.

The CSA and MDA signed a Master Agreement in December 1998 for the RADARSAT-2 mission, under a firm price agreement in which the government contribution was $225 million, in exchange for data. MDA was to invest $80 million. The Master Agreement between the CSA and MDA was updated in January 2000 to reflect changes in the schedule and the latest cost estimates. The company (MDA) is responsible for spacecraft operations and business development, while the CSA is responsible for arranging the launch and maintaining the long-term national archive of RADARSAT-2 data. The CSA will also provide an additional "in-kind" contribution of certain assets, plus the services of its David Florida Laboratory and the NRC Institute of Aerospace Research Laboratory for spacecraft integration and testing.

In November 1998, Treasury Board approved the RADARSAT-2 Major Crown Project with a funding envelope of $242.2 million. In March 2000, Treasury Board approved an increase of $47.1 million to cover the cost of changing bus suppliers, required by U.S. - government restrictions imposed on the U.S. bus supplier at that time, and an increase of $12.3 million for upgrades to existing satellite ground station infrastructures. In June 2000, Treasury Board approved an increase of $108 million to cover the cost of procuring a commercial launch as a result of NASA withdrawing from the agreement to provide launch for RADARSAT-2 in exchange for data, as it did for RADARSAT-1. In June 2001, Treasury Board approved an increase of $6 million to cover the cost of critical modifications to be made to the RADARSAT-2 spacecraft in order to accommodate a potential future tandem mission with RADARSAT-3.

The development of the RADARSAT-2 satellite was completed at a slower pace than planned. Delays encountered by the main contractor and sub-contractors in the production of some of the satellite components have resulted in a significant delay in the assembly, integration and testing of the spacecraft. The Extendible Support Structure (ESS), one of the primary spacecraft sub-systems, was delivered to the Assembly, Integration and Test (AI&T) site at the David Florida Laboratory (DFL) in October 2003. The Solar Arrays and the Bus were delivered to DFL in April and May 2004, respectively. The SAR antenna was delivered in September 2005. The assembly, integration and test of the RADARSAT-2 spacecraft at the David Florida Laboratory, along with the operations-preparations activities at the CSA in St-Hubert were successfully completed in September 2007. RADARSAT-2 was launched on December 14, 2007 and associated commissioning activities were completed by the end of April 2008.

The additional costs to complete the construction and launch of RADARSAT-2 were at the main contractor's expense. However, these additional delays required that the CSA RADARSAT-2 project office remained operational to cover the remaining activities until project close-out, now expected by the end of 2008-2009. The necessary funding to cover all additional expenditures for the CSA is from within the project risk funding envelope and associated project authorities.

Industrial Benefits

Significant industrial benefits in the space and Earth observation sectors are expected from this next-generation satellite system. The RADARSAT-2 program will generate employment growth in the Canadian knowledge-based economy, mostly from export sales, and spur the growth of small- and medium-sized businesses as the Canadian infrastructure and services industry continues to grow.

A major objective of this project is the transition of the Earth Observation industry from the public sector to the private sector. The intention is to build on the SAR data and value-added markets established with RADARSAT-1 to strengthen the Canadian industry's position as a supplier of SAR-related technology, systems and value-added products and services. Specifically, manufacturing potential and competitiveness will be encouraged in Canadian industry in the areas of phased array antenna design/manufacture, high performance receiver/transmitter design and manufacture, and enhanced structure design. Moreover, opportunities will be created for the export of ground station systems. The new capabilities also make new applications possible, creating new and expanded markets for data sales and value-added products.

As of March 31, 2008, the CSA has funded $384.7 million worth of work to Canadian industry directly attributable to the RADARSAT-2 Major Crown Project (MCP). Direct industrial benefits from the construction of RADARSAT-2 will benefit all regions of Canada. The regional distribution of direct industrial benefits is shown in the following table.

Regional Distribution of RADARSAT-2 Contracts
(as of March 2008)

PROGRAM	British Columbia	Prairie Provinces	Ontario	Quebec	Atlantic	Total Canada
RADARSAT-2	59.1%	0.3%	10.2%	29.9%	0.4%	100%

Note: Due to rounding, decimals may not add up to totals shown.

Summary of Non-Recurring Expenditures ($ in millions)
(as of March 2008)

PROGRAM	Current Estimated Total Expenditure	Forecast to March 31, 2008	Planned Spending 2008-2009	Future Years
RADARSAT-2	418.6	416.9	1.7	0

James Webb Space Telescope

Description

The James Webb Space Telescope (JWST) is a joint mission of NASA, ESA, and the Canadian Space Agency. The mission concept is for a large filled-aperture telescope located 1.5 million km from Earth. Like Hubble, the JWST will be used by the astronomy community 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 science mission is centered on the quest to understand our origins, and specifically aimed at:

- Observing the very first generation of stars to illuminate the dark universe when it was less than a billion years old.
- Understanding the physical processes that have controlled the evolution of galaxies over cosmic time, and, in particular, identifying the processes that led to the assembly of galaxies within the first 4 billion years after the Big Bang.
- Understanding the physical processes that control the formation and early evolution of stars in our own and other nearby galaxies.
- Studying the formation and early evolution of proto-planetary disks, and characterizing the atmospheres of isolated planetary mass objects.

The JWST is scheduled for launch in 2013. JWST instruments will be designed to work primarily in the infrared range of the electromagnetic spectrum, with some capability in the visible range. JWST will have a large mirror, 6.5 meters in diameter and a sunshield the size of a tennis court that will both fold up and open once in outer space.

Canada is providing hardware for JWST: the Fine Guidance Sensor (FGS) and Tuneable Filter Imager (TFI). The FGS is integral to the attitude control system of JWST, and consists of two fully redundant cameras that will report precise pointing information of JWST. Canadian expertise in this area has been established with the successful fine error sensors for the FUSE mission.

Packaged with the FGS but functionally independent, the Tuneable Filter Imager is a unique, narrow-band camera with imaging capability. For example, it will allow astronomers to search for extrasolar planets through a technique called *coronography*, which means that the light from a star will be blocked out so that astronomers can see what is in the star's neighbourhood.

The JWST-FGS Major Crown Project, in partnership with COM DEV, consists of the design, development, integration and testing and integration into the spacecraft, launch and commissioning of the Fine Guidance Sensor and Tunable Filter Imager.

By participating in this leading-edge international space exploration mission, the Canadian Space Agency is actively promoting Canadian scientific expertise and innovative, advanced space technologies. The National Research Council's Herzberg Institute of Astrophysics is a key Government of Canada partner for activities related to the development of science instruments and distribution of telescope data.

In return for its overall investment in the JWST, Canada will obtain a minimum of 5% of the time on this unique space telescope. Already, the news of Canada's involvement in this international space exploration mission is inspiring youth, educators and amateur astronomers, and rallying members of Canada's world-renowned astrophysics community.

Leading and Participating Departments and Agencies

Sponsoring Agency:	Canadian Space Agency
Contracting Authority:	Public Works and Government Services Canada for the Canadian Space Agency
Participating Departments:	NRC's Herzberg Institute of Astrophysics Industry Canada

Prime and Major Sub-Contractors

Prime Contractor: - COM DEV Canada	 - Ottawa, Ontario
Major Sub-Contractors: - Teledyne - Corning Netoptix - ABB Bomem - MDA - CDA - ESTL	 - U.S. - U.S. - Canada - Canada - U.S. - Europe

Major Milestones

The major milestones, by phase, are the following:

Phase	Major Milestones	Date
A	Requirement Definition	2003-2004
B	Preliminary Design	August 2004 to May 2005
C	Detailed Design	July 2005 to September 2008
D	Manufacturing/Assembly; Integration/Testing; Pre-launch preparations, Launch/System Commissioning	May 2007 to November 2013
E	Operations	2013-2014 to 2018-2019

Note: The Major Crown Project terminates with the completion of Phase D.

Progress Report and Explanation of Variances

In March 2004, Treasury Board gave Preliminary Project Approval for Phases B, C and D at an indicative cost of $67.2 million. In December 2006, before the completion of the detailed design of the FGS, the CSA requested increased expenditure authority to complete the project. Treasury Board granted Effective Project Approval for a substantive total cost estimate of $98.4 million in February 2007 with the condition "that the Canadian Space Agency provide reports to Treasury Board at the completion of Phases C and D of the JWST project which include up-to-date information on the project scope, costs, schedule and risks". The project was also designated at that time as a Major Crown Project.

Overall, the Fine Guidance Sensor with the Tunable Filter Instrument contribution is technically very challenging and proved to be more complex than envisioned by the CSA and the prime contractor at the time the substantive estimates were generated. Extremely tight tolerances on the optics combined with the need for reliable and precise mechanisms that must operate in a harsh cryogenic temperature environment required more design and testing effort than was originally envisaged. The full complexities of the FGS became evident during the Phase C, after the first of the two-planned Critical Design Reviews (CDR). The first CDR, held in March 2007, for the guider function of the FGS, did reveal some technical issues, which required additional effort to resolve. This Review took place after the Effective Project Approval (EPA) received in February 2007. After this first CDR, with the focus now turning toward the preparation of the system level CDR, new issues became apparent requiring additional analysis. Testing of the Tunable Filter Imager prototype also revealed technical issues that needed to be addressed.

During this transition between the completion of the detailed design phase (Phase C) and the initiation of the manufacturing phase (Phase D) the project was facing the prospect of a significant cost growth requiring the CSA to return to Treasury Board to amend its Effective Project Approval (EPA) for the JWST Major Crown Project. The current estimated total cost for the Definition and Implementation phases is now $134.7 million. On December 2007, Treasury Board granted a revised Effective Project Approval.

Industrial Benefits

As of March 31, 2008, the CSA has funded $50.6 million worth of work to Canadian industry directly attributable to the JWST-FGS Major Crown Project (MCP). Direct industrial benefits from the construction of the JWST-FGS and TFI system will benefit central regions of Canada. Although there is no regional distribution requirement for this project, the following table provides an approximate distribution:

Regional Distribution of JWST Contracts
(as of March 2008)

PROGRAM	Ontario	Quebec	Total Canada	Foreign
JWST-FGS and TFI	78%	5%	83%	17%

Summary of Non-Recurring Expenditures ($ in millions)
(as of March 2008)

PROGRAM	Current Estimated Total Expenditure	Forecast to March 31, 2008	Planned Spending 2008-2009	Future Years
JWST-FGS and TFI	134.7	64.3	31.8	38.6

3.3.6) Details on Transfer Payments Programs (TPPs)

Contribution to European Space Agency (ESA)	
Start Date: January 1, 2000	**End Date:** December 31, 2009
Description: Through key international partnerships, enhance the Canadian industry's technological base and provide access to European market for value-added products and services in the field of EO.	
Strategic Outcome: Canada's presence in space meets the needs of Canadians for scientific knowledge, space technology and information. **Expected Results (Program Activity Level)** **Space Based Earth Observation:** Delivery, directly or in partnership, of Space Based EO data, products and services in response to operational and scientific user requirements in the fields of Environment, Resource and Land Use Management, and Security and Foreign Policy, supported by access capacity development. **Space Science and Exploration:** Increased participation in Canadian and international opportunities in order to expand the scientific knowledge base made available to Canadian academia and R&D communities in astronomy, space exploration and solar-terrestrial relations, as well as physical and life sciences. **Satellite Communications:** 1) Increased access for Canadians to state-of-the-art space communications systems and services to meet their social and economic needs. 2) Better use of space communications, search and rescue, and global navigation satellite systems and applications to improve the efficiency and effectiveness of other government departments in delivering services to Canadians. **Generic Space Activities in support of EO, SE and SC:** Innovative space technologies, techniques, and design and test methodologies in response to advanced developments required for future space missions and activities.	

Expected Accomplishments:

Successful development and demonstration of advanced technologies, systems, components, and studies provided for in the contracts awarded by ESA to Canadian firms under the following ESA EO programs: EOEP, GMES (Global Monitoring for Environment and Security) Service Element and GMES Space Component.

Continue do develop the Space Exploration programs ELIPS and Aurora.

Successful development and demonstration of advanced technologies, systems, components, or studies provided for in the contracts awarded by ESA to Canadian firms under the following ESA Telecommunications and Navigation programs: ARTES 1,3,4,5,8 and GalileoSat.

Growing utilization of data obtained from ESA on markets and Earth observation / Telecommunications technologies as strategic information for government departments, agencies and industries in Canada.

Because of our participation in Europe's telecommunication, Earth observation and exploration programs, more demonstration of space-qualified technologies and products developed by Canadian firms for the space markets take place.

Development of new alliances and/or strengthening of established alliances between Canadian and European companies, to diversify Canada's international space partnerships and complement its long-standing relationship with the U.S.

Actual Accomplishments:

Several technologies and skills have been developed and improved through the participation of Canadian companies in ESA programs. Some businesses have integrated these technologies into products, allowing them to sell these products in other than European markets. In addition to generating revenues, the development and improvement of space technologies also created or maintained specialized jobs. In addition, specialized skills were created in the areas of space hardware, ground segment, and space technology applications.

The program served to boost the visibility of Canada in European markets. Canadian contractors see the ESA Contribution program as a means of cultivating business relationships. The program also fosters regional development and access to other markets by virtue of the successes of companies in Europe. Furthermore, Canada expanded its knowledge and technology in fields such as weather and ice movement forecasting, Earth Observation data, satellite communications technologies, environmental monitoring and security.

($ in millions)	Actual Spending 2005-2006	Actual Spending 2006-2007	Planned Spending 2007-2008	Total Authorities 2007-2008	Actual Spending 2007-2008	Variance between Planned vs. Actual
Space Based Earth Observation	17.1	9.9	10.1	12.6	7.3	2.9
Space Science and Exploration	3.7	5.8	8.3	6.9	6.9	1.4

Satellite Communications	9.1	11.0	12.2	13.7	13.7	(1.5)
Generic Space Activities in support of EO, SE & SC		8.7	8.6	7.4	7.3	1.3
Total Contributions	29.9	35.5	39.2	40.6	35.2	4.0
Total Program Activities	**29.9**	**35.5**	**39.2**	**40.6**	**35.2**	**4.0**

Notes:

- Due to rounding, figures may not add up to totals shown.
- This table details contribution programs with funding in excess of $5 million per annum.

Comments on Variances:

Several factors explain the year-to year fluctuations in spending under Canada/European Space Agency (ESA) programs: the cash flow requirements of ESA programs which Canada is participating in (the budget requirements vary with the project's delivery phase), the slippage in the disbursements for Canada/ESA programs (the programs and associated contracts to industry are delivered by ESA; hence, the CSA has no direct control on actual project implementation), and the exchange rate fluctuations between Euros and Canadian dollars.

The positive variance of $4.0 million in 2007-2008 is due to: Surplus of $1.4 million related to surplus in the Risk Reserve associated to a lower exchange rates than anticipated between Euros and Canadian dollars during 2007-2008. The balance of $2.6 million is due to an amount reprofiled to future years following delays encountered to start three new optional programs (e.g. Earth Observation – 3, ELIPS – 2 and Aurora Exploration), in which Canada announced its participation at the December 2005 ESA Council. This involves a slippage in the disbursements for those programs to future years.

This variance is in accordance with the objectives and terms and conditions of the 2000-2009 Canada/ESA Cooperation Agreement. The Canadian industry (like that of other member states) is awarded contracts for the implementation of ESA optional programs in direct proportion to Canada's financial contributions to ESA.

Significant Audit and Evaluation Findings and URL (s) to the Last Audit and/or Evaluation:

Canada is well thought of by Europeans, as the 28 years of cooperation between ESA and Canada clearly demonstrates. Canadian companies have made a significant contribution to the many technologies developed in the areas of Earth Observation and Satellite Communications.

Several businesses have developed business relationships with Europe thanks to the Agreement, and all stakeholders in the program agree that these relationships could continue, provided that Canada maintains its financial contribution to ESA. Canadian businesses have cultivated alliances with each other to benefit from or facilitate access to European markets through ESA programs under the Agreement.

The program helps diversify and open markets and aids in the achievement of objectives under the Canadian Space Strategy respecting Earth Observation and Satellite Communications. However, it does not lead to the transfer of technologies as much as to the exchange of information on technologies.

Small- and medium-sized companies have difficulty taking part in ESA programs and require greater support, not only to access these markets, but also to develop expertise so that they can continue doing business in these markets after their initial participation in ESA programs.

Source: Evaluation of the Canada/ESA Cooperation Agreement
http://www.asc-csa.gc.ca/asc/eng/resources/publications/er-0405-0202.asp

CASSIOPE Mission	
Start Date: November 1, 2003	**End Date:** March 31, 2011

Description:

Support the integration of two payloads on a single generic Canadian small satellite bus the CASCADE telecommunications Ka-Band component and the enhanced Polar Outflow Probe (ePOP) scientific instrument.

Strategic Outcome:

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

Expected Results (Program Activity Level)

Space Science and Exploration:

Increased participation in Canadian and international opportunities in order to expand the scientific knowledge base made available to Canadian academia and R&D communities in astronomy, space exploration and solar-terrestrial relations, as well as physical and life sciences.

Satellite Communications:

1) Increased access for Canadians to state-of-the-art space communications systems and services to meet their social and economic needs.

2) Better use of space communications, search and rescue, and global navigation satellite systems and applications to improve the efficiency and effectiveness of other government departments in delivering services to Canadians.

Generic Space Activities in support of EO, SE and SC:

Innovative space technologies, techniques, and design and test methodologies in response to advanced developments required for future space missions and activities.

Expected Accomplishments:

Development and demonstration of the CASCADE Ka-Band telecommunications payload designed and built by Canadian companies. CASCADE is the precursor of communication satellite constellations that will help position the Canadian industry on the international market as a supplier of advanced components and a service provider.

Development of a small Canadian scientific satellite, the enhanced Polar Outflow Probe (ePOP), which will probe the upper atmosphere and ionosphere region where solar variability influences global change in various time scales.

Development of a generic Canadian small satellite bus that could also be used for future Canadian missions.

Actual Accomplishments:

Continued manufacture of the Cascade payload and preparation for assembly, integration and test in the spacecraft. Continued manufacture of ePOP instruments, data handling units and booms. Planned payload assembly and test and integration into the spacecraft. Continued manufacture, test and integration of the generic small satellite bus.

($ in millions)	Actual Spending 2005-2006	Actual Spending 2006-2007	Planned Spending 2007-2008	Total Authorities 2007-2008	Actual Spending 2007-2008	Variance between Planned vs. Actual
Space Science and Exploration	3.2	2.3	1.2	1.7	1.7	(0.5)
Satellite Communications	14.5	16.2	9.1	8.5	7.0	2.1
Total Contributions	17.7	18.5	10.3	10.2	8.7	1.6
Total Program Activities	**17.7**	**18.5**	**10.3**	**10.2**	**8.7**	**1.6**

Notes:

- Due to rounding, figures may not add up to totals shown.
- This table details contribution programs with funding in excess of $5 million per annum.

Comments on Variances:

CASSIOPE: Program delays due to problems with the development of critical components (DSU, C&DH) and the move of the launch date from November 2008 to June 2009 due to delays in the development of the Falcon launch vehicle. After detailed reviews of all the mission components, the schedule and milestones were modified to fit the new program schedule and launch date and the cash flow projections were adjusted accordingly.

ePOP: The additional funding for ePOP was necessitated by the extension of the CASSIOPE schedule and slippage of the launch date, which are beyond the control of the University of Calgary. The schedule extension will require the University of Calgary to stretch instrument development, assembly and test to fit the extended CASSIOPE schedule and maintain the project development teams at the universities and in industry for a longer period. The integration of ePOP with the CASSIOPE spacecraft is MacDonald, Dettwiller and Associates's responsibility, and will be performed at Bristol in Winnipeg and at the David Florida Lab in Ottawa. Synchronization of all program elements and activities, including the ePOP payload development, integration and test, is critical for success.

Significant Audit and Evaluation Findings and URL (s) to the Last Audit and/or Evaluation:

Management has adopted systems and procedures that make for appropriate monitoring of the CASSIOPE Contribution Program, particularly with regards to its technical aspect. The various specialists involved in Program monitoring, scrupulously review the monthly reports received from recipients. Moreover, presentations are made to senior management regularly to acquaint them with the advancement of the Program, both in terms of its execution and costs or scheduling. Management has also implemented a Risk-Based Audit Framework (RBAF) as well as a Results-based Management and Accountability Framework (RMAF).

Source: http://www.asc-csa.gc.ca/asc/pdf/ar-0607-0102.pdf

3.3.7) Response to Parliamentary Committees and External Audits for Fiscal-Year 2007-2008

Response to Parliamentary Committees
No recommendation was received during the period covered by this report.
Response to the Auditor General
No recommendation was received during the period covered by this report. However, a Status Update for 2006-2007 on the 2002 recommendations was produced. To learn more about the Status Update, go to: http://www.asc-csa.gc.ca/asc/eng/resources/publications/pr-2005_response.asp
External Audits
The Public Service Commission tabled an Audit Report for Calendar Year 2007. To learn more about the Audit Report, go to: http://www.psc-cfp.gc.ca/abt-aps/inta-veri/2008/riac-rcvi/index-eng.htm

3.3.8) Internal Audits (current reporting period)

1. Name of Internal Audit	2. Audit Type	3. Status	4. Completion Date	5. Electronic Link to Report
Project Management Processes and Practices	Management Framework	Completed	2008-01-21	http://www.asc-csa.gc.ca/asc/pdf/rv-0607-0103_e.pdf
Management Framework of the Space Operations Branch	Management Framework	Completed	2007-10-10	http://www.asc-csa.gc.ca/asc/pdf/ar-0506-0103.pdf
Audit of Contract Management by the Sectors	Financial Management	Completed	2007-09-07	http://www.asc-csa.gc.ca/asc/pdf/ar-0506-0102.pdf
Audit of the Contracting Process	Financial Management	Completed	2007-09-07	http://www.asc-csa.gc.ca/asc/pdf/ar-0506-0101.pdf
CASSIOPE Contribution Program Audit	Transfer Payments	Completed	2007-08-29	http://www.asc-csa.gc.ca/asc/pdf/ar-0607-0102.pdf

Evaluations

1. Name of Evaluation	2. Program Activity	3. Evaluation Type	4. Status	5. Completion Date	6. Electronic Link to Report
No evaluations completed	-	-	-	-	-

3.3.9) Travel Policies

Comparison to the TBS Special Travel Authorities

Travel Policy of the Canadian Space Agency: The Canadian Space Agency follows the TBS Special Travel Authorities.
Authority: N/A
Coverage: N/A
Principal difference(s) in policy provisions: N/A
Principal financial implications of the difference(s): N/A

Comparison to the TBS Travel Directive, Rates and Allowances

Travel Policy of the Canadian Space Agency: The Canadian Space Agency follows the TBS Travel Directive, Rates and Allowances.
Authority: N/A
Coverage: N/A
Principal difference(s) in policy provisions: N/A
Principal financial implications of the difference(s): N/A