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EVALUATION OF THE EARTH OBSERVATION DATA AND IMAGERY UTILIZATION PROGRAM

For the period from April 1, 2005 to March 31, 2010

Project # 10/11 02 - 01

Prepared by the Audit and Evaluation Directorate

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Table of contents

Appendices

List of tables and figures

Executive Summary

The aims of the Earth Observation Data and Imagery Utilization Program (the program) are to promote the use of satellite data by other government departments (OGDs), support the Canadian value-added industry and maximize the potential offered by the missions supported by the Canadian Space Agency (CSA). In so doing, it aims to close the gap between the potential offered by the development of this technology and the capacity to use it.

The purpose of this evaluation, which covered the period from April 1, 2005 to March 31, 2010, was to examine program relevance and performance. A document review and consultation of administrative data dealing with the 174 projects funded during this period were carried out and 39 interviews were conducted with representatives of government departments, industry and CSA personnel. During the interview process, 80% of the businesses and 71% of the OGDs that participated in the program were contacted and information was collected on 45% of the projects completed during the evaluation period.

Based on the collected information, the program is effective and relevant, but improvements could be made to maximize the use of resources to achieve the expected outcomes.

On one hand, several applications developed under the program are now operational, which has helped departments increase their ability to use satellite data and achieve their objectives more easily. Program expenditures have also helped to boost the competitiveness of Canadian businesses in the Earth observation market, especially in world markets. The collected data also indicate that the program encourages the use of data generated by CSA-supported missions.

Despite these outcomes, access and data sharing continue to be major obstacles to greater use of satellite data, while the price of data is the main impediment to the commercialization of products and services developed by the industry.

We also noted that other federal government departments (OGDs) too rarely enter into partnerships with industry to develop the products and services they need, especially when one considers the role that the industry should play based on the Science and Technology Strategy.

Finally, half of the respondents in OGDs and the industry would like to see greater participation by the university community. A lack of expertise was also cited a number of times in the interviews. It was identified by OGDs as the main obstacle to using Earth observation data.

On the other hand, awareness and knowledge transfer activities have helped to increase the knowledge and capacities of departments and the industry. The respondents said that it was easy to find information on data utilization. However, it was mentioned several times in the interviews that senior managers of departments were unaware of the potential benefits of using satellite data.

With regard to program relevance, the program's objectives and its implementation are clearly aligned with federal government and CSA priorities and responsibilities. A number of strategic policy documents indicate that focusing on science and technology and supporting the industry have been core strategies of the Government of Canada and the CSA for a long time. Moreover, the Government of Canada uses Earth observation data in several priority sectors, particularly in the North.

Despite the progress achieved, several applications must still be developed if we wish to develop the full potential of Earth observation activities. These applications would require the use of a full range of satellite data, including data from foreign satellites. In addition, potential applications identified by the industry do not correspond in every respect with those identified by OGDs, particularly in the raw materials sector (mines, oil and gas).

In regard to program implementation, CSA respondents were unable to identify official methods used to obtain a clear understanding of the requirements of the program's target clientele. When asked about ways to increase the program's efficiency, two thirds of respondents emphasized the lack of planning and the need to concentrate resources in areas where they can achieve the best results. They feel that a more strategic approach is required that would help identify clusters of applications that several players could develop.

Consequently, we recommend that the following be considered:

- Giving industry a greater role in the development of applications in response to the needs of federal departments and agencies;

- Implementing mechanisms to financially support the participation of academia in the development of applications;

- Determining the proportion of resources that will be allocated to the development of applications that rely exclusively on foreign data;

- Developing the Radarsat Constellation data policy in a manner that facilitates data access and sharing;

- Allocating a greater share of program resources to awareness-raising and knowledge transfer activities;

- Identifying ways of increasing the funding available to industry so that it can develop products and services that will help it improve its competitiveness on the market;

- Introducing mechanisms to help identify development clusters and better coordinate the partners' contributions, with the goal of attaining the objectives;

- Developing a performance measurement strategy in order to clearly identify the program objectives, set targets and agree on the indicators that will serve as a basis for fact-based decision making.

Introduction

During the 2010-2011 and 2011-2012 fiscal years, the Audit and Evaluation Directorate of the Canadian Space Agency (CSA) conducted an evaluation of the Earth Observation Data and Imagery Utilization Program. This evaluation project was chosen because of this program's strategic importance in attaining the CSA's priorities. The evaluation covers the period from April 1, 2005 to March 31, 2010.

This report presents the findings and recommendations resulting from this evaluation. A description of the program, including the implementation context, the resources allocated to the program, as well as information on the projects carried out, is presented in section 1. The purpose of the evaluation, the evaluation approach and methodology, as well as the limitations of the evaluation process are presented in section 2. Section 3 constitutes the core of the report and includes the findings relating to program effectiveness, followed by an analysis of program relevance and lastly the results pertaining to efficiency and economy. The report then concludes with a presentation of the conclusions and recommendations, as well as an action plan.

1 Program description

1.1 Context and objectives

Space-based Earth observation (EO) is finding increasingly varied applications in many areas. In fields as diverse as natural resources management, the environment or security, space-based Earth observation is a tool that can provide detailed information about large geographic areas and over long periods of time, particularly in remote and inaccessible regions.

Launching a satellite is only the first step toward obtaining this information. The signal received must first be processed in order to extract information from it, and the information obtained must then be integrated with other sources of information. Consequently, the development of an application that uses satellite data can take years.

Although this technology offers tremendous potential and a number of applications are already operational, the Earth observation sector is still in its infancy, particularly in terms of radar technology, an advanced technology that offers the capability to observe the Earth both day and night, regardless of weather conditions, and in which Canada has established itself as a leader. In addition, since governments are still the main users of this technology, the value-added industry must be supported so that it can develop in this growing market.

The purpose of the Earth Observation Data and Imagery Utilization Program (the program) is to ensure that federal government departments and the Canadian value-added industry can take full advantage of the potential offered by space-based Earth observation. The program comprises two main components: the Government Related Initiatives Program (GRIP) and the Earth Observation Application Development Program (EOADP). Awareness-raising and knowledge transfer activities complete the program activities.

The GRIP is an initiative that aims to establish partnerships with other government departments and agencies. It provides financial and technical support to other government departments (OGDs) in order to support the development of applications that use Earth observation satellite data. These applications will increase the value of the services provided by the federal government so that their continued use can be funded from the OGDs' operating budgets. In so doing, the GRIP helps ensure that users are able to take full advantage of Canadian and international investments in Earth observation activities.

The use of space services by government departments and agencies is in keeping with the vision outlined in the Canadian Space Strategy, namely to "*integrate space fully in Government of Canada departments and agencies as an invaluable tool to help fulfill their mandates and reach our Government's goals for Canadians.*" Space-based Earth observation thus contributes to the attainment of the federal government's priorities, particularly in the North, where the area to be covered is vast and access limited.

The EOADP, on the other hand, targets the Canadian value-added industry, which is encouraged to establish partnerships with potential users, including OGDs and other national or international jurisdictions, universities, research centres and non-profit organizations. This program aims to maximize the potential of Canadian Space Agency-supported missions. By soliciting the contribution of the value-added industry and promoting partnerships with the research community, this program contributes to the attainment of the target results of the Science and Technology Strategy.[1]

1.2 Structure and governance

GRIP projects are implemented under interdepartmental memoranda of agreement (MOA). These MOAs establish the parameters of collaboration between the CSA and OGDs for project implementation. The projects are of limited duration, are usually proposed by the OGDs in the context of an annual cycle and are supported by senior management of the OGDs. These projects require financial support from the OGDs.

The CSA provides less than 50% of the funding required for the projects accepted; the exact proportion varies depending, among other factors, on the importance of the issue involved. Insofar as possible, GRIP projects use Earth observation data obtained from Canadian satellites or CSA-supported missions, as well as the services of the Canadian value-added industry. However, the Earth observation technologies are chosen based on the information requirements. In the context of supported projects, GRIP supports the development of private-sector Canadian expertise in Earth observation through industry contracts and encourages the development of specialists and university expertise through their involvement in OGD projects, particularly at the R&D stage.

The EOADP component relies on contracting out. Projects are chosen through a competitive or negotiated procurement process, usually Requests for Proposals (RFPs) (directed procurement and unsolicited proposals have been used on an exceptional basis). The EOADP focuses exclusively on Earth observation data obtained from missions in which the CSA participates, with the possibility of supplementing these data with data from foreign sources.

In order to maximize the benefits for Canadians of Canada's investments in space, the EOADP relies on collaboration with other federal government departments and provincial government departments when specific needs can be met with data from missions in which the CSA participates. In order to create international business opportunities for Canadian industry, prior to 2005, the EOADP also relied on partnerships with foreign organizations to jointly issue thematic RFPs inviting Canadian businesses and foreign businesses with complementary expertise to work together in areas identified as priorities. Although this approach was successful in carrying out technology transfers, demonstrating Canadian

[1] For more details on the content of this strategy, visit Industry Canada's website at: http://www.ic.gc.ca/eic/site/ic1.nsf/eng/h_00856.html

capabilities and forging business alliances capable of meeting the challenges of international markets, this practice was discontinued after 2005, to refocus on the needs of OGDs.

Both program components fund projects aimed at various stages of development:

- Research and development (R&D): projects aimed at establishing a preliminary correlation between satellite data and the terrain;
- Demonstration: projects aimed at determining the reliability of measurements and demonstrating the possibility of integrating Earth observation data in the routine operations of OGDs or in the development of commercial products and services;
- Operational use: projects aimed at integrating the use of applications in the routine operations of OGDs or in the production of commercial products and services.

The Director General, *Space Utilization* and the Director, *Mission Engineering and Applications* are responsible for this program. The specific roles and responsibilities of the management team assigned to program delivery are presented in Table 1.

Table 1: Roles and responsibilities within the program

Role	Responsibilities
Head, Earth Observation Applications and Utilizations	➢ Promote the development and exploitation of applications, products or services resulting from Canadian and foreign investments in space o Establish and implement policies and procedures for managing activities relating to Earth observation applications and the commercialization of Earth observation applications; o Develop a work plan, implementation plans and submissions for major new initiatives; o Develop an information strategy; o Establish the thrusts of program policy and its implementation; o Interface with other CSA sectors, federal government departments and provincial governments, industry, the scientific community and the international community for all program strategic issues and directions; o Approve program performance objectives.
Manager, Earth Observation Applications and Utilizations	➢ General program management and implementation o Serve as program spokesperson by liaising with other CSA sectors, other federal and provincial agencies, industry and researchers; o Serve as the main program contact; o Approve the proposal evaluation report and authorize the initiation of negotiations with businesses; o Oversee the development of general and thematic Requests for Proposals; o Manage funds, human resources and contracts; o Supervise project officers.

Role	Responsibilities
Project Officer, Earth Observation Applications and Utilizations	➢ Prepare documents relating to general and thematic Requests for Proposals o Coordinate funding mechanisms to respond to Announcements of Opportunities; o Coordinate projects and contracts, ensuring that funds are used properly and that contractor deliverables meet the requirements set out in the contracts; o Implement the program management process, including development and control of the elements of results-based management, and coordinate and support the activities of the project team in order to ensure that meetings and reviews are held in accordance with contract requirements and to ensure regular production of progress reports; o Evaluate, select, implement and complete projects in accordance with program practices; o Organize and/or participate in events that promote program activities and results, e.g. industry days, information days, workshops, symposia, conferences and trade missions.

Source: Internal documentation

1.3 Program theory

The logic model presented on the following page (Figure 1) illustrates the process whereby the resources allocated to the program attain the expected outcomes.

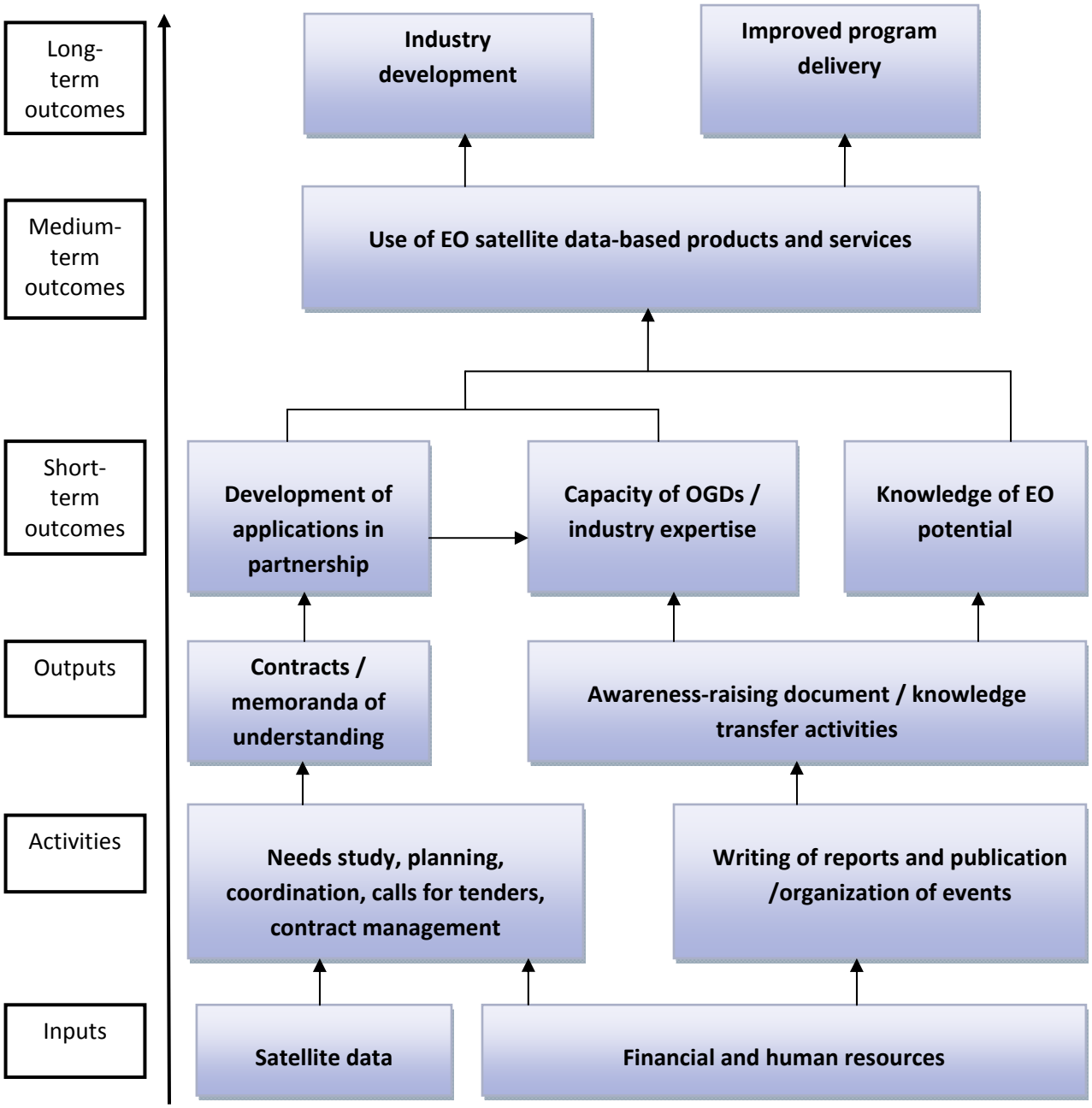
First, the allocated resources provide the necessary support to enter into agreements with OGDs and industry in order to support the development of applications in areas deemed promising. These activities, carried out in partnership, promote the exchange of knowledge between partners and increase OGDs' capacity to use satellite data as well as industry expertise, expertise that can be applied to the development of new applications, without program support.

Second, the resources allocated to the program are used to carry out various awareness-raising activities in order to increase knowledge about the potential of space-based Earth observation and spark interest in new technologies as well as promoting knowledge transfer between the various partners, which increases their expertise and capacity.

Combined with the development of applications, expertise and capacity to use satellite data, having a better understanding of the potential offered by Earth observation and of the level of interest in this technology are helpful in promoting the use of satellite data-based products and services by OGDs as well as by public and private agencies in Canada and abroad.

Finally, use of these products and services contributes to enhancing the scope, quality and efficiency of government programs and fosters the development of a value-added industry in Canada.

Figure 1: Program logic model



1.4 Allocation of resources

As Table 2 shows, the resources allocated to the program were relatively stable over the evaluation period. It should be noted that, owing to the long-term nature of the projects supported by the program, the expenditures made during a particular fiscal year may have been paid under agreements signed in preceding fiscal years.

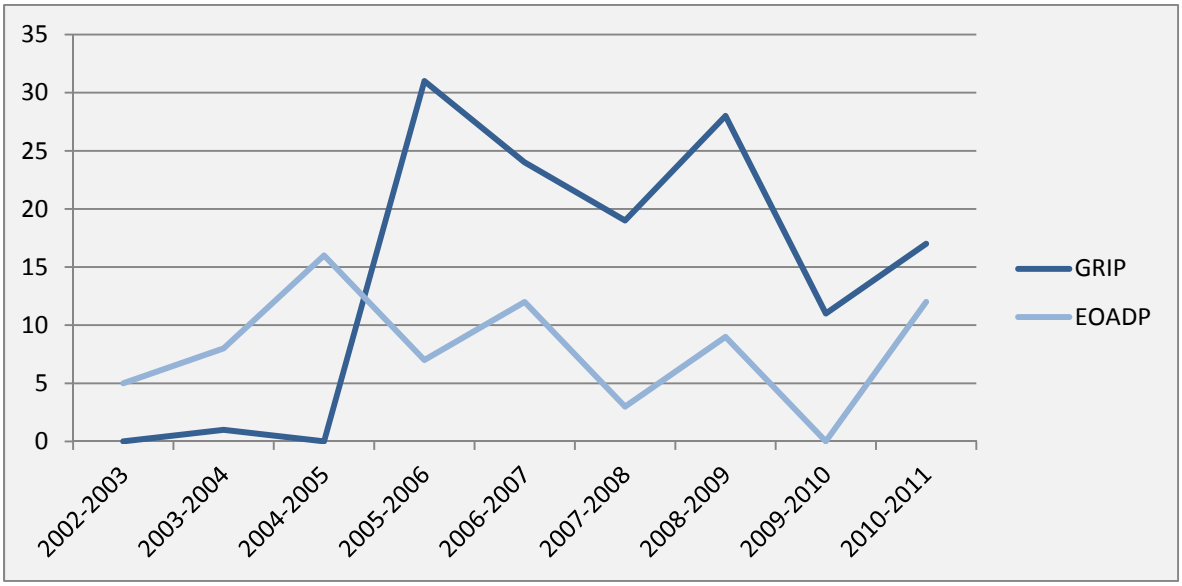
Table 2: Resources allocated to the program

	2005-06	2006-07	2007-08	2008-09	2009-10
Forecast budget*	13.9	13.6	13.6	14.6	12.7
Actual budget*	12.1	15.6	11.9	13.5	13.5
Planned FTEs**	9.0	9.7	11.3	9.0	11.8
Actual FTEs**	8.7	9.8	9.7	8.3	8.6

Source: Departmental performance reports *In millions of dollars **FTEs: full-time equivalents

Although the resources allocated to the program were relatively stable, the number of agreements and contracts signed has varied over the years. In fact, the data presented in Graph 1 show a gradual decrease in the number of projects funded under the EOADP component during the evaluation period. These variations reflect the new direction taken by this program component.

Graph 1: Number of agreements (GRIP) and contracts (EOADP) by year in which they were signed



Source: ORIS database

As Table 3 shows, several RFPs relating to agreements signed with other levels of government were issued prior to 2005 and several contracts were awarded to industry following these RFPs in 2004-2005.

This approach, which aimed to create international business opportunities, was subsequently discontinued. In addition, in 2007, it was decided that contracts with industry had to be used strictly to meet needs expressed by OGDs. The impact of this change in policy concerning this program component therefore extended over the entire evaluation period, which explains the gradual decrease in the number of contracts awarded, before the major increase that occurred in 2010-2011.

In total, 174 application development projects were supported during the evaluation period: 114 for the GRIP component and 60 for the EOADP. The average project value was $342,000 for the GRIP and $288,000 for the EOADP.

Table 3: Requests for Proposals to industry and Announcements of Opportunities to OGDs

Requests for Proposals prior to April 1, 2005	Requests for Proposals after April 1, 2005	Announcements of Opportunities
General call Radarsat call General-operational call Canada-Quebec Agreement Canada-Finland Agreement TIGER Initiative (Africa)	Preparation for RADARSAT-2 Infrastructure monitoring Disasters Environment and climate change Geology Glaciation and iceberg ice Land cover and land use Coasts and oceans	2003-2004 to 2007-2008: Environment Resource management Security 2008-2009 and 2009-2010: • *(Emphasis on Radarsat-2)* The Arctic and the North Security and sovereignty Climate change

Sources: ORIS database and internal documentation

In keeping with the Canadian Space Strategy, the projects supported by the program were aimed at the development of applications in three main activity areas: the environment, resource and land use management, and security and foreign policy. Under the EOADP component, a few projects more general in scope focusing on innovation and technology were also initiated. In total, 24 organizations from the private sector and various sectors within seven government departments participated in the program during the evaluation period. A list of the organizations and departments that participated in the program is provided in Appendix E.

In addition to the projects intended to support application development, resources were allocated to support awareness-raising activities or to produce reports and purchase satellite images in support of the program. In the majority of cases, these were contracts awarded to the private sector, regardless of the program component to which these activities contributed. A breakdown of all the funds disbursed for all contracts and memoranda of agreement, by type of activity and by activity area, is provided in Table 4.

Table 4*: Funds disbursed for contracts and memoranda of agreement in effect, by type of activity and by program component, 2005-2006 to 2009-2010

	GRIP	EOADP	Total	GRIP	EOADP	Total
Application development		**$ Value**			**%**	
Innovation and technologies	-	2,653,614	2,653,614	-	4%	4%
Resource management	13,035,624	5,997,709	19,033,333	19%	9%	28%
Environment	18,851,343	4,625,725	23,477,068	28%	7%	35%
Security	3,629,833	2,264,457	5,894,290	5%	3%	9%
Data missing	3,566,183	1,724,285	5,290,468	5%	3%	8%
Total	**39,082,983**	**17,265,790**	**56,348,773**	**58%**	**26%**	**84%**
Awareness-raising activities						
Demonstration	70,752	547,970	618,722	0%	1%	1%
Workshops/conferences	389,973	135,268	525,241	1%	0%	1%
Advertising and promotion	45,924	298,749	344,673	0%	0%	1%
Other	91,558	1,232,466	1,324,024	0%	2%	2%
Total	**598,207**	**2,214,453**	**2,812,660**	**1%**	**3%**	**4%**
Program support						
Planning and reporting	712,327	3,415,472	4,127,799	1%	5%	6%
Purchase of images	565,720	3,283,254	3,848,974	1%	5%	6%
Total	**1,278,047**	**6,698,726**	**7,976,773**	**2%**	**10%**	**12%**
Total	**40,959,237**	**26,178,969**	**67,138,206**	**61%**	**39%**	**100%**

Source: ORIS database

* The values indicated represent the total of the funds disbursed for the agreements in effect during the evaluation period. They therefore include amounts that were disbursed for projects that began prior to the evaluation period.

Finally, it is important to note that, in order to encourage sustainable industrial regional development and maximize benefits to all Canadians, the CSA uses regional distribution objectives as guidelines for investments in space. Every effort must be made to attain these targets insofar as possible. Table 5 presents the value of the contracts awarded under the program for each region, as well as the targets.

Table 5: Regional distribution of contracts awarded to industry

	$ Value	%	Target
British Columbia	9,817,250	29%	10%
Prairies	128,240	0%	10%
Ontario	11,886,161	35%	35%
Quebec	10,243,612	30%	35%
Atlantic	2,303,819	6%	10%

Source: ORIS database

2 Methodology

2.1 Evaluation approach, purpose and scope

The approach used in this evaluation is two-fold. First, in accordance with the TBS (2009) Policy on Evaluation, this summative evaluation deals with program relevance and performance. It is therefore consistent with a results-based approach. Second, it aims to ensure that the evaluation results can be used to support decision making. It is therefore also consistent with a utilization-focused approach, the goal of which is to meet decision makers' information needs.

The questions that this evaluation will attempt to answer were therefore developed taking into consideration the expected outcomes presented in the logic model and managers' information needs. These questions were grouped according to the five basic questions presented in Annex A of the TBS Directive on the Evaluation Function:

1) Does the program address a demonstrable need?
   - What are the needs of other government departments and of the Canadian space industry?
   - For what types of sensors should the program support application development?
   - What is the level of preparation for the radar technology?

2) Does the program support federal government priorities and the CSA's strategic outcome?
   - Is the program effectively aligned with the new program architecture?

3) Is the program aligned with the roles and responsibilities of the federal government and of the CSA?

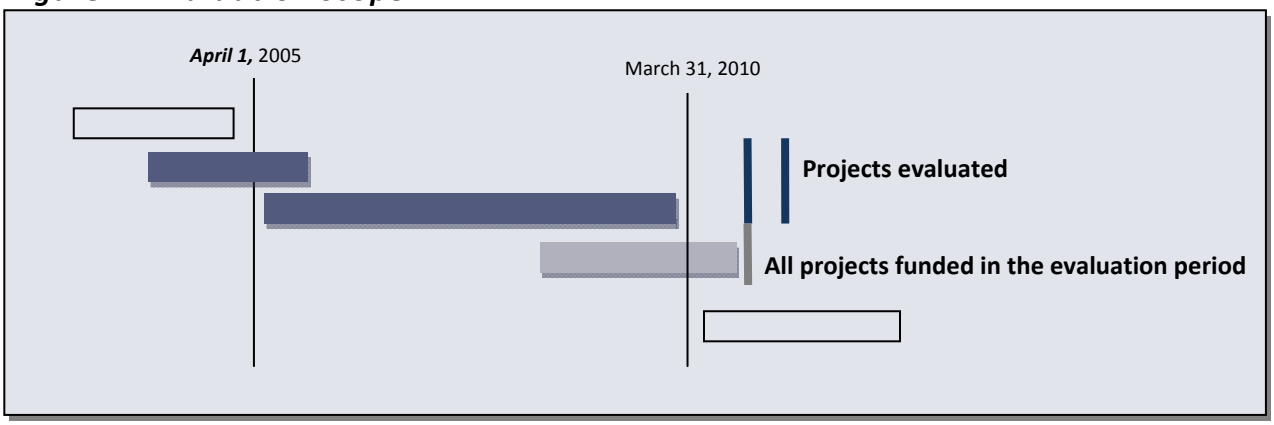
4) What progress has been made in attaining the expected outcomes?
   - To what extent has the program helped facilitate partnered R&D?
   - What percentage of projects has achieved an operational level?
   - Has the program helped increase the capacity of industry and of the departments?
   - Has the program developed knowledge of the potential of satellite Earth observation?
   - Does the program promote the use of Earth observation satellite data?
   - What are the benefits for the other departments?
   - Has the program been effective in supporting industry development?
   - What benefits have international projects generated?

5) Is resource utilization optimal in relation to attainment of the expected outcomes?
   - Is the program target population satisfied with the implementation process?
   - Do we have good knowledge of users' needs?
   - Are there alternatives to the current program delivery method?

The evaluation deals with the activities carried out and the results obtained during the 2005-2006 to 2009-2010 period. As mentioned in the preceding section, because of the long-term nature of the projects supported by the program, some of the projects that were completed during the evaluation period had received funding prior to the evaluation period. Similarly, certain projects that were funded during this period had not yet been completed at the time of the evaluation (Figure 2). In total, 174 projects were funded during the period covered by the evaluation, while 139 were completed. As Figure 2 shows, only projects completed during this period were included in the program evaluation.

The evaluation design and level of effort were determined based on program risks and characteristics, as well as on the quality of the available performance data.

Figure 2: Evaluation scope



2.2 Evaluation design

In the context of a results-based approach, the use of an experimental design would obviously be appropriate. However, given the program implementation process and the intrinsic nature of programs of this kind, a randomized control study could not be used to assess program effectiveness. This type of study requires the random establishment of two groups (participants and controls) and pre- and post-program measurements in order to determine the effect of the program on participants. In the absence of such a design, it is more difficult to determine the actual contribution of the program to the results observed, and what the outcome would have been in the absence of the program.

In order to overcome this problem, the evaluation of program effectiveness was based on a mixed design incorporating two types of design: the implicit and quasi-experimental designs. The implicit design consists of attributing the results achieved to the program by assuming that they are the logical result of the program. Descriptive analyses of the projects as well as an opinion survey on the program's contribution to the attainment of the results were therefore conducted.

In quasi-experimental designs, an attempt is made to artificially and purposefully reproduce a control group. Various methods were therefore used to compare the results obtained during the program to the

progress that would have been made without the help of the program. First, inspired by the "*regression discontinuity*"[2] design, follow-up was conducted on the industry proposals that had not been accepted. Since the scores assigned to the projects that were not accepted were similar to the scores obtained by certain projects that were accepted, according to this design, it can be concluded that the differences observed were due to the program.[3] Second, a study on the main uses of satellite data was carried out in order to determine whether the applications involving use of these data were developed with or without program support. Finally, the respondents were also asked to provide information on the progress made without the support of the program.

The design chosen as well as the various methods used made it possible to gather multiple sources of evidence. A number of program stakeholders had an opportunity to comment on each of the aspects evaluated and several questions on each of these aspects enabled us to consider these aspects from several angles. In the absence of a randomized control study, using a mixed design that is supported by several sources of evidence offers a means of triangulating the data.

Program relevance was evaluated taking into account the stated program objectives, the needs of the target population as well as the priorities, roles and responsibilities of the federal government and of the CSA. A document review was carried out and a survey of participants was conducted to inquire about their needs. Administrative data on program implementation were also compiled in order to support the analysis.

Finally, the evaluation of program efficiency and economy was based on the views expressed by the program participants and CSA personnel. Information on the type of support needed as well as on how to increase the benefits generated by the program was therefore collected. The data collection strategy also served to identify obstacles to the commercialization and use of satellite data, since these obstacles constitute the main risks associated with attainment of the expected outcomes.

2.3 Data collection

Data collection relied on primary and secondary data sources. Three data sources were used to compile the information provided in this report:

- Document review
- Administrative data
- Interviews with program stakeholders

[2] The attractiveness of the regression discontinuity design is its close similarity with an experimental design (Erich Battistin and Enrico Rettore, 2002). According to this design, the assignment of units is based solely on observable variables before the observation period (in this case, the score assigned to the project), and the probability of participation varies discontinuously as a function of these variables.

[3] It should be noted that the score assigned to certain projects that were not accepted was higher than the passing score. These projects were excluded since the funds allocated to the program were not sufficient to fund all the projects.

The documents reviewed included Speeches from the Throne, Budget Speeches, Government of Canada and CSA strategic policy statements, as well as various documents dealing with developments in satellite Earth observation and the potential offered by this technology. Various guidance documents that were used for program implementation were also consulted. A list of the documents examined is provided in Appendix A.

The administrative data were obtained mainly from the ORIS (Organized Research Information System) database, which is used throughout the CSA to store project management data. Data retrieval was carried out in August 2010 and yielded information on various characteristics of the projects funded (beneficiaries, project description, partners, satellite data used, activity area, etc.). The information retrieved from the ORIS database was used as the sampling frame for the evaluation of completed projects. The integrity of the ORIS database was verified by comparing it to the SAP database, used for financial management at the CSA. Sampling confirmed that all the projects for which expenditure was entered in the SAP database were indeed entered in the ORIS database. A few documents used for routine program management were also consulted.

The interviews with program stakeholders were the main source of the information collected in order to assess program effectiveness. Particular attention was therefore paid to the development of the questionnaires as well as to sampling. An in-house advisory group, established at the beginning of the evaluation process, was tasked to validate the work (information needs, relevance of the questions, representativeness of the sample, etc.). The list of projects completed during the evaluation period was used as the sampling frame. This approach has certain advantages in that it makes it possible to collect up-to-date information on the status of applications that were developed with the support of the program.

A stratified purposeful sample was used to determine the list of projects to be evaluated and persons to be interviewed. Given the limited number of interviews that could be conducted, owing to the resources allocated to the evaluation and the number of strata to be covered (various private organizations, departments and directorates, various calls for tenders), a purposeful sample was deemed the most effective and most efficient way to ensure good sample representativeness. The projects were first grouped by stratum and then selected blindly in each stratum, taking into consideration the number of projects in each of these strata. This approach enabled us to ensure accurate representation of the projects carried out by each department and directorate, as well as by each private organization, during the various calls for tenders.

Interviews with OGDs and industry representatives were conducted in person or by telephone. In addition to the information obtained on the results of the completed projects, these interviews enabled us to obtain the respondents' opinions on various aspects of the program. Interviews were also conducted in various CSA directorates. The questionnaires used for these interviews are provided in Appendix B. The interviews were conducted between March and April 2011, except for the interviews with CSA personnel, which were conducted in June 2011.

In total, 31 interviews with OGDs and industry representatives were conducted, which enabled us to obtain information on 60 of the 139 projects completed during the evaluation period, or 43% of the total number of completed projects and 45% of the value of completed projects. Eight interviews were conducted at the CSA. The coverage of the interviews conducted with OGDs and industry representatives is presented in Tables 6 and 7.

Table 6: Number and percentage of projects covered during the interviews

	Number of interviews	Number of projects		% of projects covered	
		Completed	Covered	Number of projects	Value of projects
Industry	**12**	**56**	**19**	**34%**	**37%**
Agriculture Canada	3	9	5	56%	79%
Environment Canada	7	21	15	71%	63%
Fisheries and Oceans Canada	0	10	0	0%	0%
Natural Resources Canada	7	38	18	47%	44%
Other*	2	5	3	60%	77%
Total OGDs	**19**	**83**	**41**	**49%**	**49%**
Total	**31**	**139**	**60**	**43%**	**45%**

Source: ORIS database

* Department of National Defence, Parks Canada and Public Health Agency of Canada

Table 7: Number and percentage of organizations contacted during the interviews

	Funded	Contacted	Coverage
Industry	15*	12	80%
OGD	7	5	71%

Source: ORIS database

* Organizations still active

2.4 Presentation of results

As explained in the preceding section, the evaluation strategy is based on two analysis units: projects and respondents. The administrative data and the interview data dealing with projects were merged using SPSS software. Excel was used to produce the tables and graphs.

Quantitative and qualitative data were collected from the respondents during the interviews. Throughout this report, quantitative data are presented as percentages (%). Data from qualitative

sources that were categorized and subjected to a frequency analysis are presented in descriptive terms (a few, one-third, half, nearly all, etc.). It should be noted that interpretation of the results obtained varies depending on whether they are from qualitative or quantitative sources. Results from qualitative sources on which a frequency analysis was performed frequently underestimated the actual value of the result presented. For example, when we asked respondents to provide the sources of information that they used to keep informed about recent developments in the use of satellite data, eight indicated that they read EO Express. However, when we specifically asked the respondents whether they read EO Express, 16 answered "yes."

Finally, unless indicated otherwise, all quotes in this report are from the respondents. They are presented in italics and in quotation marks.

2.5 Limitations

Despite the efforts made to ensure a representative sample and the resources allocated to conduct the interviews, no representative of the Department of Fisheries and Oceans was able to participate in the interviews (Table 6), which limits the representativeness of the results obtained.

Certain data are missing from the ORIS database, which limits the representativeness of the results presented. In order to accurately reflect this situation, all the tables that present data from this database indicate the number of valid cases.

A considerable proportion of the evidence compiled during this evaluation comes from program stakeholders, which constitutes a potential source of bias. The information collected during the preparatory interviews conducted for the purpose of developing the evaluation strategy demonstrated that the definition of the application development stages varies depending on the context and the stakeholders' point of view. Caution should therefore be exercised when interpreting the results relating to the application development stage.

In addition, owing to the use of sampling and the missing data in the administrative databases, certain analyses are based on a limited number of projects, which affects the ability to generalize the results from a sample of projects.

The lack of data on program performance has had the effect of limiting the scope of the evaluation. Hence, it was not possible to conduct an analysis of the management costs associated with the various program delivery processes (industry, OGDs) owing to a lack of detailed information on the resources allocated to these various processes. In addition, the limited data available on the population reached by awareness-raising activities and the results obtained restricted our ability to evaluate the effectiveness of this aspect of the program. These deficiencies constitute a significant limitation to the evaluation of resource utilization in relation to the production of outputs and the attainment of expected outcomes. The recommendations concerning alternatives to the current program delivery

methods are therefore based on an analysis of the program theory as well as on the viewpoints expressed by the stakeholders.

2.6 Conclusion

In conclusion, although it is appropriate to note the inherent limitations of each evaluation method used, the use of a mixed design that relies on several sources of evidence made it possible to mitigate these limitations by triangulating the data. In the absence of the conditions required to conduct a randomized control study, the validity of the findings is based on the degree of convergence of the results obtained.

3 Results

3.1 Program effectiveness

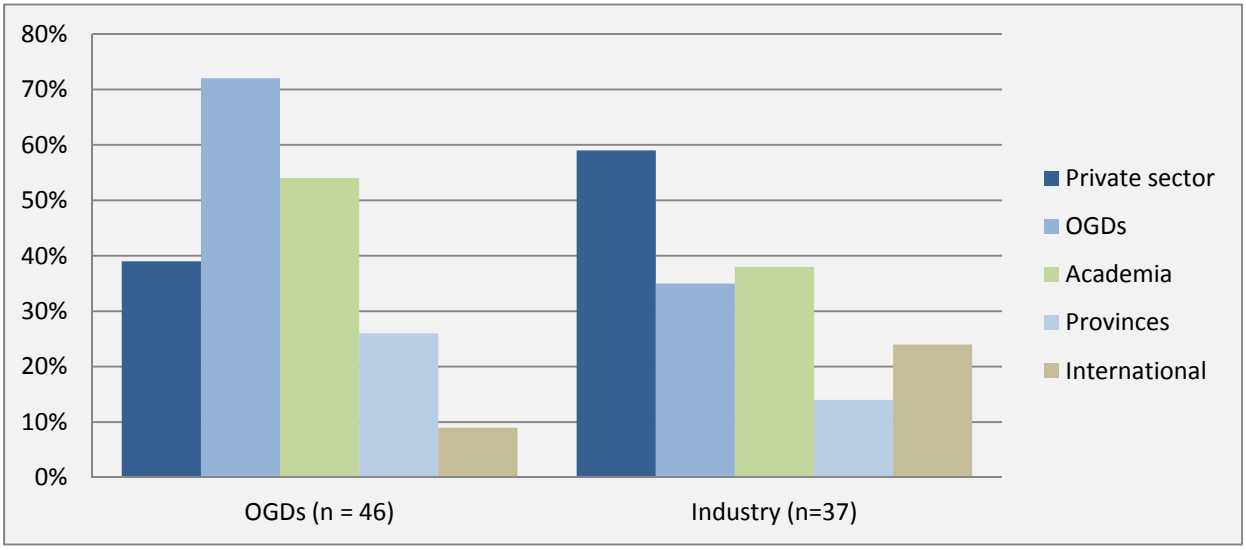
In this first section, we present the results dealing with the progress made in attaining the expected outcomes. These results were grouped by the expected outcomes presented in the program logic model (section 2.4).

1) To what extent has the program helped facilitate partnered R&D?
2) What percentage of projects have achieved an operational level?
3) Has the program helped improve industry expertise and the departments' capacity to use EO satellite data?
4) Has the program sufficiently developed knowledge of the potential of satellite Earth observation?
5) To what extent does the program promote the use of EO satellite data?
6) What are the benefits for the other departments?
7) Has the program been effective in supporting development of the industry?

3.1.1 Partnered research

One of the immediate expected outcomes following the signing of agreements with program participants is the development of applications in partnership. Partnership activities promote the exchange of knowledge between partners and increase OGDs' capacity to use EO satellite data and industry expertise, expertise that can be applied to the development of new products and services. Graph 2 presents the percentage of projects by type of project partner.

Graph 2: Percentage of projects by type of partner



Source: ORIS database

The results indicate that the departments' main partners are other departments (72%), whereas industry's main partners come from the private sector (59%). By comparison, just fewer than 40% of the projects gave rise to OGD/industry partnerships.

According to the information collected during the interviews, 75% of the OGD respondents were satisfied with the partnerships established between departments, industry and universities, compared to 50% for the industry respondents.

Industry's lower level of satisfaction can be explained in part by the fact that, although there is separate funding for each program component, industry is now required to develop applications in response to the needs expressed by the departments, whereas the departments are not required to use the services of industry. Consequently, when the industry respondents were asked what could improve the partnerships, one-third mentioned access to the projects carried out by OGDs, while half of the CSA respondents felt that involving industry in the development of applications for departments would help increase synergy between program components.

The respondents from the departments seemed to be more concerned about the difficulty in drawing on the expertise of academia, a finding mentioned by nearly half of the OGD respondents: "*Industry contacts work very well, but it continues to be a challenge to get universities involved, whether it is sharing of knowledge or joint projects. There is no straightforward mechanism; we always have to resort to RFPs and it is very difficult for universities to compete with industries under this type of setting.*" It should be noted that half of the industry respondents also indicated that they would like to see mechanisms that would promote greater university involvement in projects.[4]

The contribution of universities thus seems to be an important issue for the respondents. Despite the difficulties mentioned, the data indicate that nearly 50% of the departments' projects are carried out in partnership with academia, compared to 40% of the projects carried out by industry. In addition, 95% of the OGD respondents agreed (63%) or totally agreed (32%) that their department made regular use of the knowledge developed in universities or research centres. However, a few respondents mentioned the lack of expertise and the lack of funding mechanisms for remote sensing research.

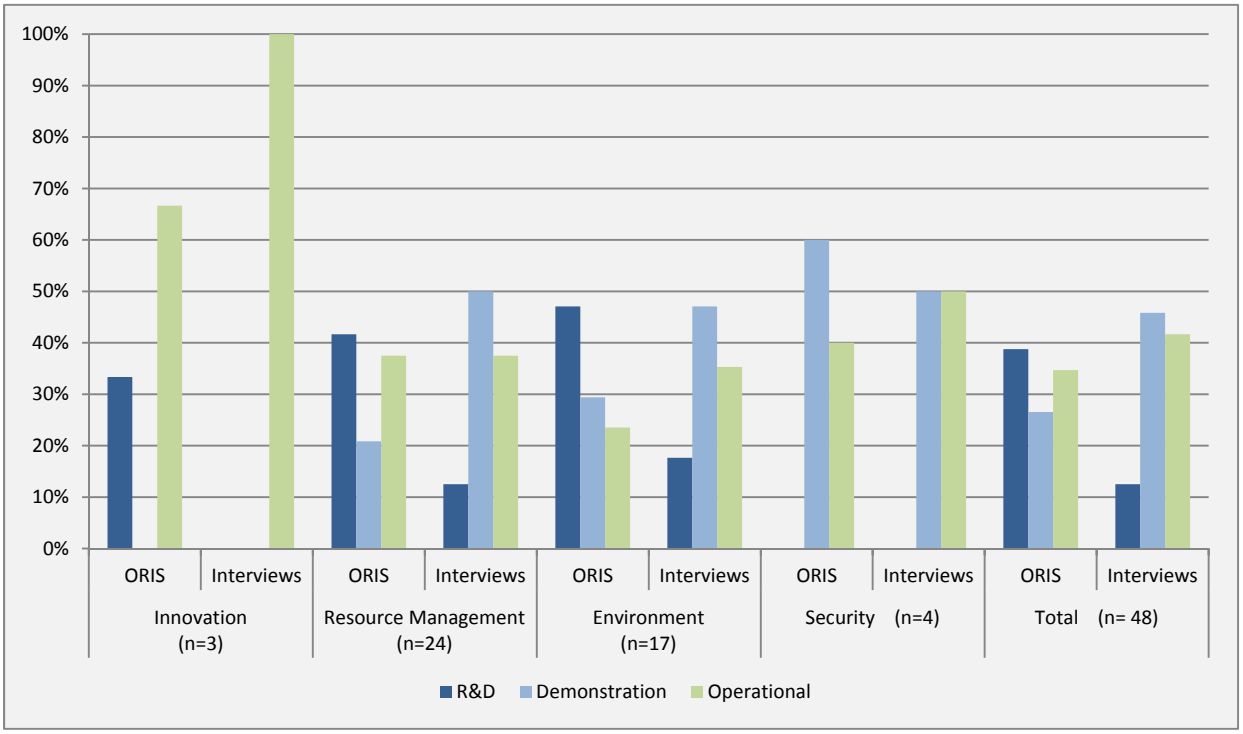
Finally, aside from funding mechanisms or financial incentives to encourage industry, OGDs and universities to work on theme areas or joint projects, there are factors that would have a positive impact on the development of partnerships. These factors are to improve access to data and more frequent theme workshops (industry days, Radarsat-2 symposia) - an opinion shared by a number of respondents from each category of program stakeholders.

[4] In order to promote research in academia, the SOAR program provides, via a loan mechanism, a loan of circumscribed amounts of RADARSAT-2 data to selected research projects. For more details, visit the CSA website: http://www.asc-csa.gc.ca/eng/observation/applications.asp

3.1.2 Application development

In comparing the development level targeted by projects carried out under the program (ORIS database) and the level attained at the time of the evaluation (interviews), we note a clear progression (Graph 3), which indicates that the projects exceeded the program development goals or that the parties involved continued development of these applications after the projects ended. The results indicate that 64% of the projects carried out by OGDs are currently at more advanced stages than anticipated at the onset of the project or are operational. This is also the case for 59% of the projects carried out by industry. For all the projects evaluated, nearly 40% were not expected to move beyond the R&D stage under the program, whereas less than 15% of the projects were still at this stage at the time of the evaluation.

Graph 3: Percentage of projects by sector by development level



Sources: ORIS database and interview data

According to the respondents, in total, 41% of the applications developed are now operational. Innovation and security are the activity areas with the highest proportion of projects that have reached this level, while the environment is the area with the lowest proportion.

The interview data presented in Table 8 indicate that a higher proportion of the projects carried out by industry are operational (56%), which reflects the development level targeted by the projects carried out under the program. In fact, 53% of the projects carried out by industry initially aimed to reach the operational stage, compared with only 27% for OGDs.

Table 8: Percentage of projects by development level achieved

	Industry (n=18)	Departments (n=41)	Total (n=59)
R&D	11%	15%	14%
Demonstration	33%	51%	46%
Operational	56%	34%	41%

Source: Interview data

The interview data also indicate that development work is continuing for applications that are not yet operational. The OGD respondents reported that, in 85% of the projects, their department plans to fund continued development of the applications that are not yet operational. In half of the cases, the respondents pointed out that they could benefit from program support. The reasons given by those that were not planning to continue development were lack of human and financial resources, as well as lack of commitment from senior management.

The industry respondents, on the other hand, plan to continue the development of the applications that are not operational in 62% of the projects. Lack of market interest was cited as the reason for not continuing development.

Hence, program expenditures allocated to the development of applications have borne fruit: many applications are at more advanced stages than initially planned or contemplated by the projects or are operational, and, in the majority of cases, the participants plan to fund continued development work on applications that are not yet operational.

Industry respondents were also asked follow-up questions about what happened to six proposals that were not accepted under the program. Five of the six projects not accepted were shelved, while the sixth project was carried out, four years later, following a contract awarded under the program.

Despite this finding, it cannot be concluded that there would have been no development of applications in the absence of the program because 92% of the industry respondents indicated that they have developed applications without the support of the program. However, only 42% indicated that these applications used data generated by CSA-supported missions. By comparison, all the applications developed by industry under the program use data from CSA-supported missions, which is a requirement for submitting a proposal. Hence, in the absence of the program, the applications developed by industry would have relied much less on data generated by CSA-supported missions.

Of the CSA-supported missions, particular attention was paid to the development of applications using Radarsat-2 (R-2) data. The results presented in Table 9 indicate that 18% of the projects using R-2 data achieved the operational level compared to 41% for all projects. These results can be explained by the fact that R-2 was launched in 2008 and that 64% of the projects aimed at the development of applications for this sensor were initially at the R&D stage, compared to 39% for all projects.

Nevertheless, it may be noted that a significant proportion of the projects using R-2 data (56%) achieved the demonstration level.

Table 9: Percentage of projects by development level and type of data used

	R-2		All sources	
	Project stage goal (n=11)	Achieved (n=11)	Project stage goal (n=59)	Achieved (n=59)
R&D	64%	27%	39%	14%
Demonstration	18%	56%	27%	46%
Operational	18%	18%	35%	41%

Sources: ORIS for the project stage goal; interview data for the stage achieved

3.1.3 Expertise and capacity to use satellite data

The results presented in Graph 4 can be used to estimate the program's contribution to the increase in industry expertise and in the OGDs' capacity. In the case of the departments, 95% of the respondents agreed that the program helped increase their department's capacity to use satellite data.

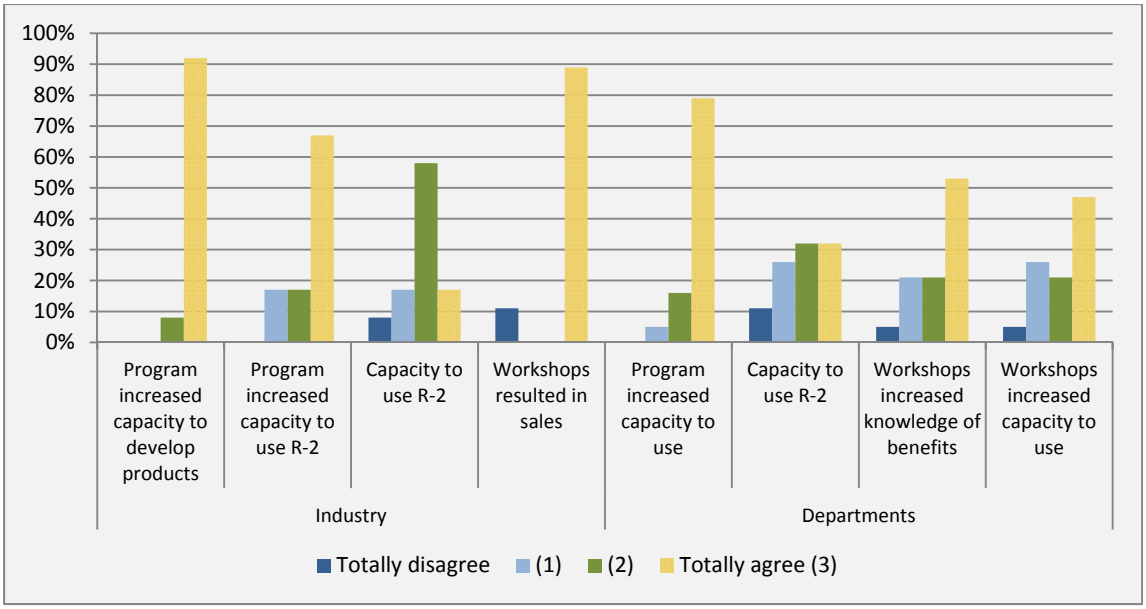
When asked about the specific contribution of presentations or workshops organized by the CSA, 74% of the respondents agreed that these events had helped increase their knowledge of the potential benefits of Earth observation, while 68% indicated that these events increased their capacity to use satellite data.

All the industry respondents agreed that the program had helped increase their organization's capacity to develop products: "*EOADP is the major funding source for this activity.*"

The program's contribution to increasing the capacity to use R-2 data is also clear; 83% of the industry respondents agreed that they would not use R-2 data as much if the program did not exist.

However, although a substantial majority of the respondents acknowledged the significant contribution of the program to improving their capacity to use satellite data, opinions concerning their organization's ability to take full advantage of the potential offered by R-2 were divided, as can be seen from the results presented in Graph 4.

Graph 4: Percentage of respondents by degree of agreement with the program's contribution and their capacity to use R-2 data



Source: Interview data

These results partially reflect the data presented earlier concerning the degree of maturity achieved by the projects using R-2 data and the fact that a number of the projects are still under way: "*Not "full" advantage. We are using RADARSAT-2 data in research projects and some in piloting and pre-operational activities. We use more of it every year, but we could use more than we do now.*" For instance, 46% of the R-2 data used by OGDs in 2009-2010 was used for R&D purposes.[5] The lack of resources and the fact that R-2 data are not suited to the planned uses were also factors mentioned by OGD respondents, whereas, for industry, the price of data and data access were the main constraints mentioned.

In conclusion, a substantial majority of respondents acknowledged the program's contribution to increasing expertise and capacity. However, according to the respondents, work remains to be done in order to take full advantage of the potential of R-2.

3.1.4 Knowledge of the potential of EO

Awareness-raising activities constitute the second category of activities on which the program relies in order to promote the use of Earth observation satellite data. To this end, two types of vehicles are used: conferences and workshops, and the EO Express newsletter.[6]

[5] Earth Observation Radarsat-2 Reporting; Monthly Credit Consumption Report, March 2010.
[6] For more details on this newsletter, visit the CSA's Web site at:

Table 10 presents the main sources of information that respondents said they use to keep informed of recent developments in the use of satellite data. As the table shows, journals,[7] conferences and workshops were the main sources mentioned. The methods used by the CSA to disseminate information on the potential benefits of Earth observation therefore correspond to the main channels mentioned by the respondents.

Table 10: Sources of information on the use of satellite data

Sources	Percentage of respondents
Journals	****
Conferences and/or workshops	***
EO Express	** (84% if asked the question explicitly)
Contacts at the CSA	*
Informal networks	*
Web sites	*

Source: Interview data

**** More than three-quarters of respondents
*** Half of respondents
** Just over one-third of respondents
* Less than one-quarter of respondents

Unfortunately, little data is available on the impact of conferences and workshops. However, as reported above (Graph 4), respondents say that these workshops help increase their knowledge and capacity. In addition, as described in section 4.1.1. respondents would like to see more events of this kind, which would suggest that they are appreciated.

Concerning EO Express, the data indicate a significant increase in readership. Between 2006 and 2010, the number of subscribers increased from 400 to 2,200. The newsletter reaches a wide range of potential users, both nationally and internationally. In 2010, departments accounted for 40% of subscribers and Canadian industry accounted for 17%. Readers from Canadian academia and international actors (governments, space agencies, research centres) complete the list of newsletter subscribers.

Among the information sources mentioned by the respondents from the departments, EO Express is fairly high on the list, in that it was mentioned by more than a third. It should be noted that, when explicitly asked, several additional respondents indicated that they read EO Express: 84% of the respondents from the departments indicated that they read the newsletter.

http://www.asc-csa.gc.ca/eng/newsletters/eo_express/editions.asp

[7] The main journals mentioned were: Canadian Journal of Remote Sensing (42%), International Journal of Remote Sensing (32%) and IEEE Journals (32%).

Generally, 70% of the OGD respondents agreed that it is easy to find information on the potential uses and benefits of data, and all indicated that the program helped their department obtain a better understanding of the potential benefits of EO.

From another perspective, 90% of the departments indicated that the program helped improve Canada's image as a major player in the use of satellite data "a fair amount" or "a lot." Several also mentioned that Canada is perceived as a leader in the use of satellite data (land use, monitoring of carbon emissions during forest fires).

All the industry respondents indicated that the program helped extend their organization's reach internationally: "*This program has helped, as 80% of our business is in exports. It is very important for Canadian companies to showcase Canadian technologies nationally and internationally."*

While the majority of the respondents agreed on the effectiveness of the program in increasing knowledge about the potential benefits of Earth observation as well as improving Canada's image and the reach of Canadian industry internationally, a few OGD respondents pointed out that the information disseminated does not always get through to decision makers:

"*Information is not always in the format that is desired for senior managers or to support policy."*

"People whose jobs are policy/programs probably don't appreciate all the different satellite technologies and how to benefit from them. There is still a lot education required."

"Yes, but CSA could do a better job at communicating uses and benefits (e.g., the way ESA outreach and community building is done)."

3.1.5 Data use

According to the program theory, knowledge of the potential offered by Earth observation, combined with the development of applications and the increase in expertise and capacity, promote the use of satellite data-based products and services. Although the respondents acknowledged the program's fundamental contribution to achieving this objective, several obstacles to using and commercializing data must still be overcome.

The data collected indicate that 84% of the respondents believed that, without the help of the program, there would be less use of satellite data in their department. Interview responses also indicate that the contribution of the program varies depending on the department. For instance, 25% of the respondents indicated that all the applications used by their department were developed with the help of the program. *"Without the program, there would be no use of satellite data. It would be inexistent."* The other respondents estimated that, on average, 50% of the applications used were developed with the support of the program:

"*We've always used satellite data, but now, with GRIP, we use it a lot more. There is not more than 25% that is not GRIP-supported."*

"The program allows the use of data to develop applications which demonstrate value, a value that may have not been perceived by our department prior to the GRIP program."

The program has an impact on other aspects besides just the quantity of data, as one of the respondents pointed out: "*But we would not use satellite data as efficiently and effectively. The quality of products would be affected without the help of the program.*"

The results also indicate that the program contributes to the use of data generated by CSA-supported missions. For instance, in an internal document[8] illustrating success stories in the use of data generated by CSA missions, 14 of the 17 success stories presented use applications developed with the support of the program.

Despite the program's obvious contribution to the use of satellite data, certain obstacles remain. Table 11 provides an overview of the various obstacles mentioned by the OGD respondents, as well as their relative importance on a scale of 0 (non-existent obstacle) to 10 (major obstacle). Lack of expertise and lack of funding for development as well as access to and sharing of data were the main obstacles mentioned.

Nearly all the CSA respondents mentioned access to data (acquisition costs and conflicts) and lack of awareness of the potential benefits of Earth observation. Half of these respondents also mentioned lack of expertise.

The OGD and CSA respondents identified access to data and lack of expertise as obstacles. However, the OGDs also stressed lack of funding, whereas CSA personnel tended to mention lack of awareness of the potential benefits.

Table 11: Relative importance of the various obstacles to data use by departments

	Relative importance (0-10)	Respondents' comments
Other obstacles mentioned by the respondents	8.7	More than one-third of the respondents mentioned lack of expertise. A few mentioned lack of high-level coordination.
Funding	7	Little money spent for R-2 compared to R-1 and compared to what the ESA invests in application development.

[8] Illustrations of Space Applications Linked to Government Priorities and Departments, 2011.

Complexity for user	6.1	Requires specialized personnel
Integration with existing systems	5.3	Requires specialized personnel
Price	4.5	This depends on the satellite (high-resolution and ERS are expensive). High cost of processing.
Uncertainty as to availability	4.5	Mainly conflicts between users for acquisition.
Lack of interest on the department's part	4.2	Lack of interest is not an obstacle, but rather funding. There was more money before the Agency was established.
Data policy	3.7	For the majority of the respondents, the policy on access to data is not a major obstacle. However, a few respondents mentioned the restrictions on sharing data with partners (provinces, USA) or universities. Three of the respondents considered this to be the greatest obstacle.
Data acquisition	3.7	Mainly conflicts between users for acquisition.

Source: Interview data

The industry respondents unanimously indicated that users respond very favourably to information products and services that make use of satellite-based Earth observation data. The results presented in Table 12 show that the more mature the applications developed by industry, the more potential users they found in the departments. For instance, an increase in the percentage of projects with OGDs as users is observed during the timeframe between commencement of the project (ORIS) and the interview stage, and this percentage increases for applications that are at the operational stage. The percentage of potential users in international organizations and the provinces is also higher for applications that are operational.

Table 12: Percentage of projects carried out by industry by type of potential user

	ORIS All applications (n=35)	**Interview** *All applications (n=19)*	Operational applications (n=10)
Departments	45%	58%	70%
International organizations/ provinces	54%	53%	60%
Private sector	28%	47%	40%

Sources: ORIS database, interview data

However, the situation is different in the case of the private sector. In fact, although the percentage of projects with potential users was higher by the interview stage than at the beginning of the project, this percentage declined for applications that were at the operational stage, which suggests that the forecasts for the private sector are not attained when the applications reach the operational stage, particularly because of the price of the data.

As the data presented in Table 13 show, the price of data constitutes the main obstacle to the commercialization of the products and services developed by industry. Access to data and data sharing (provinces, territories, international markets) also represent major obstacles, according to the respondents.

Table 13: Relative importance of the various obstacles to the commercialization of the products and services developed by industry

	Relative importance (0-10)	Respondents' comments
Price	9	
Data policy	7.8	The provinces and territories do not have access to the data.
Complexity	7.1	
Acquisition	6.4	The time required to obtain the data.
Uncertainty as to availability	5.8	Conflicts with other users for acquisition.
Access to international markets	4.8	Export restrictions (DFAIT)

Source: Interview data

The CSA respondents shared this opinion. All mentioned that the cost of data and data policy constitute obstacles to the commercialization of the products and services developed by industry. On this point, half of these respondents mentioned the quasi-monopoly of MDA (owner of R-2) on R-2 data. Finally, a few respondents mentioned the scope of eligible projects and the lack of knowledge about how to use the data.

In conclusion, despite the results which confirm the program's significant impact on the use of Earth observation data, a number of obstacles must still be overcome in order to take full advantage of the potential offered by satellite data.

3.1.6 Contribution to the activities of other federal government departments

Earth observation data is finding increasingly varied applications in many areas. In fields as diverse as natural resources management, the environment or security, the results indicate that space-based Earth observation can be used to obtain information that helps improve the delivery of the services provided by OGDs.

For instance, 89% of the respondents from the departments agreed that the program has helped increase their department's capacity to meet its objectives. The respondents who did not share this opinion indicated that there was insufficient capacity within their department or that senior management must still be convinced of the benefits of using satellite data. These same points have been mentioned several times in the preceding sections.

The benefits of using Earth observation data are evident at three stages in the process. Of the respondents whose projects reached the operational stage, 29% mentioned increased knowledge, 14% reporting and decision-making assistance, and 57% improved or expanded services (weather forecasting, on-line data, quality of mapping products, ocean dumping surveillance, etc.).

Several of these benefits are related to the use of data generated by Agency-supported missions. As described earlier in this report, 14 of the 17 success stories mentioned in the internal document aimed at documenting the benefits of these missions are related to applications developed with the support of the program. These applications resulted in advances in various fields:

- *Support for flood monitoring and response;*
- *Detection of illegal oil dumping in Canadian costal waters;*
- *Monitoring and reporting on forest fire activity at the national scale;*
- *Evaluation and mitigation of active geohazard sites;*
- *Monitoring of changes in the cryosphere and response to climate risks;*
- *Enhancement of maritime surveillance and ship detection;*
- *Collection of data on the quantity and quality of groundwater reserves;*
- *Use of ocean colour in ecosystem-based management;*
- *Maintaining the safety and efficiency of marine operations in ice-covered waters;*
- *Monitoring harmful algae in Canadian waters;*
- *Marine wind data collection and prediction in Canada's coastal zones;*
- *Implementation of beneficial soil and water management practices in order to improve the sustainability and profitability of agriculture;*
- *Monitoring the ecological integrity of national parks in the Arctic;*
- *Improving wildlife management and surveillance of Canadian territory.*

These applications enable Canada to remain at the leading edge in the field of remote sensing: "*We are the first nation in the world to have a wall-to-wall carbon accounting system using remote sensing and for the issues of parliament related to forest fires.*"

In addition, according to the OGD respondents, satellite data are also used to meet Canada's international commitments. Table 14 presents the list of commitments mentioned by the respondents.

Table 14: Use of Earth observation data and Canada's international commitments

	Canada–US bilateral agreements	UN biodiversity	UN climate change	UNESCO heritage sites	FAO resources assessment	Kyoto	Other
Agriculture and Agri-Food Canada						X	X
Department of National Defence	X						X
Environment Canada	X	X	X		X	X	X
Natural Resources Canada	X	X	X		X	X	X
Parks Canada	X			X			

Source: Interview data

The bilateral agreements with the United States deal with such issues as water quality, common borders in national parks and ice monitoring. There are also various reporting commitments relating to the international conventions on climate change and biodiversity. Finally, more specific uses, such as supporting the operations of coalition troops in Afghanistan and reconstruction in Haiti were also mentioned. By promoting the development of applications used by OGDs in the context of their international commitments, the program helps improve Canada's image as a leader in the use of satellite data, an opinion shared by 90% of the respondents from the departments.

Despite the obstacles identified in the preceding section, the results indicate that the program's contribution to the development of applications and to the use of satellite data has already enabled several government departments to increase their capacity to meet their objectives and to enhance Canada's international image.

3.1.7 Industry development

Program expenditures also contribute to improving the competitiveness of Canadian businesses in the Earth observation market, a finding with which all the industry respondents strongly agreed. According to the respondents, 60% of the projects resulted in sales opportunities totalling $5.6 million, which represents 1.1 times the amounts invested in these projects under the program.[9] The awareness-raising

[9] In addition, 3.4 jobs, on average, were assigned to the funded projects or to related activities.

activities supported by the CSA also have an impact on development of the industry; 88% of the respondents from the organizations who attended events supported by the Agency indicated that these events resulted in sales opportunities.

It should be noted that the half of the projects that translated into sales opportunities are projects that have not yet reached the operational level, which would suggest that the capacities developed during these projects gave rise to the development of related products and services. On the other hand, not all operational applications resulted in sales opportunities, which tends to illustrate the effect of the obstacles to commercialization mentioned above.

Although the applications developed under the program are now aimed at meeting the needs expressed by the OGDs, it should be recalled that a large proportion of the funding was allocated to projects aimed at developing international business opportunities. This was the case for 11 of the 60 projects funded by the EOADP component during the evaluation period, or 18% of the projects. The value of these projects was $5,106,574, or 30% of the $17,265,790 invested in this component. These are projects that therefore received a higher than average amount of funding for projects under this component.

The spinoffs of international projects of the EOADP component enabled Canadian industry to develop its capacity by working with partners from Asia, Africa, the Middle East, South America and Europe in such varied fields as forest mapping, water and resource management, biodiversity conservation and management of pollutants that pose a health risk. When questioned on this point, all the respondents indicated that the program helped to extend their organization's international reach. *"If it wasn't for EOADP, we would not be able to enter in a number of new markets like South East Asia and Africa where our organization has offices set up. We would not be able to be nearly as successful without the program.*" Articles that appeared in the EO Express newsletter enabled us to document international spinoffs, sometimes multiple, for seven of these 11 projects. Details on these achievements are provided in Appendix C:

- *Forest modelling and mapping from satellite images in Finland;*
- *Maps derived from RADARSAT-1 images on the magnitude and chronological progression of flood events in the Lower Mekong basin;*
- *Management of the health risks attributable to persistent organic pollutants (POP) in southeast Asia;*
- *Provision of training services in environmental monitoring for a mining project in Laos;*
- *Integrated decision aid system for water resource management for the Sous-Massa basin in Morocco. This system can be used to identify areas suitable for drilling (groundwater reserves), to monitor land use and its impact on the use of water resources, to identify overexploited areas, to prepare a profile of erosion at the basin scale and to manage dams;*
- *Topographic and thematic products for extracting information in 3D, including products for temporal monitoring of water variations in small reservoirs used for agricultural purposes, as*

well as detailed visualization tools for visualizing managed riparian buffer areas to control erosion in Africa;

- *Production of topographic, thematic and cadastral data in Peru;*
- *Remote sensing products for surface water management in Finland, including retrieval of fraction of snow-covered area and snow water equivalence, detection of lake and river ice, as well as water quality and quantity monitoring;*
- *Nile River environment awareness kit, an interactive multimedia learning tool for increasing knowledge about the resources and environmental management practices of the Nile Basin;*
- *Traditional ecological mapping and biodiversity conservation in Vietnam. Earth observation-derived information was incorporated in the planning and management of biodiversity conservation in Vietnam.*

3.2 Program relevance

The results presented in this section enable us to evaluate the extent to which the program is still relevant. More specifically, as mentioned in section 3.1:

1) Does the program address a demonstrable need?
   What are the needs of other government departments and of the Canadian space industry?
   For what types of sensors should the program support application development?
   What is the level of preparation for the radar technology?

2) Does the program support federal government priorities and the CSA's strategic outcome?
   To what extent is the program effectively aligned with the new program architecture?

3) Is the program aligned with the roles and responsibilities of the federal government and of the CSA?

3.2.1 Continuing need for the program

Despite the progress that has been made, to date only a fraction of the potential offered by the use of Earth observation satellite data has been realized. As reported earlier in this report, a number of respondents indicated that they were not taking full advantage of the potential offered by R-2. In addition, the CSA is planning to launch within a couple of years a constellation of three satellites (Radarsat Constellation) that will enable Canada to consolidate its position as a leader in remote sensing. Finally, the partnerships established with foreign space agencies will continue to provide access to an extended range of satellite data. The program's expected outcomes are aimed at filling the gap between the potential offered by this technology and the capacity to realize this potential: "*Without users, satellites serve no purpose. There must be incentives for the departments to use them. Otherwise, they will invest elsewhere. The ESA has clearly understood this. The best way to support the manufacturing sector is to develop the market.*"

The R-1 and R-2 satellites, as well as the future Radarsat Constellation, account for a large share of the CSA's investments in Earth observation. Like the industry and OGD representatives, the CSA respondents were divided in their opinions when asked to rate the extent to which R-2's potential is fully utilized. Although several of these respondents acknowledged an increase in use to varying degrees, all pointed out that price, data policy and acquisition conflicts are obstacles that must still be overcome. It should be noted that, once the Radarsat Constellation has been placed in orbit, this should mitigate these obstacles. Half of the respondents mentioned that the revisit time will increase significantly, which will reduce acquisition conflicts and facilitate the development of more operational applications, including interferometry. In addition, a new data policy should accompany the Constellation program.

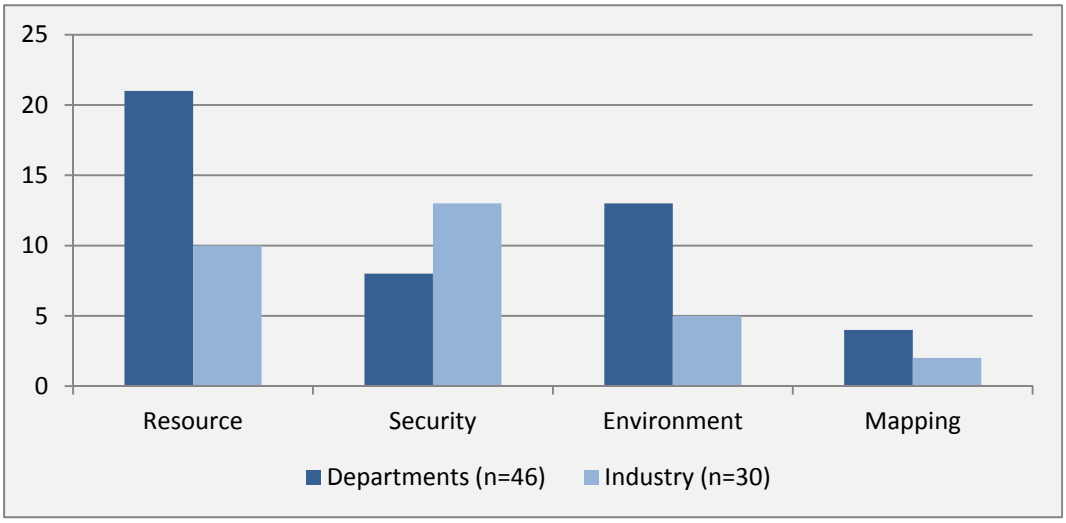
In order to realize this potential, half of the respondents believed that additional efforts should be made in the development of applications and infrastructure necessary to manage the quantity of data that will be generated by the increased revisit time.

Nevertheless, numerous potential applications were mentioned by the CSA respondents. Nearly all identified potential marine applications (ice, surface wind, surveillance). Disaster management (floods, landslides), environmental monitoring (erosion, biomass, spring thaw) as well as interferometry for infrastructure monitoring were also mentioned.

When the CSA representatives were asked to consider all the satellite data available, whether from CSA-supported missions or not, half of the respondents mentioned forestry and agriculture applications. However, almost all indicated that other types of data (optical/multispectral/hyperspectral) would be necessary for these types of applications.

The OGD respondents also mentioned a number of activity areas where Earth observation satellite data could be used. Graph 5 presents the number of potential applications by activity area. In total, 46 applications were mentioned.

Graph 5: Number of potential applications by application sector



Source: Interview data

Nearly half of these applications (21) concern the resource management sector. For instance, 13 applications were mentioned in agriculture (land use, crop condition and yields, soil moisture and traceability of fertilizers, ecosystem modelling) and eight in forestry (forest, biomass and biodiversity inventories, detection of insects or invasive species). There are also numerous potential applications in the environment sector, with the respondents indicating 13 potential applications (monitoring of the ecological conditions of national parks, carbon cycle balance, air and water quality, characteristics of oceans and climatology). Eight applications in the security sector (iceberg detection, maritime surveillance, forest fire prevention and control, monitoring of ground shifts) were also mentioned. Finally, applications in mapping, including mapping of the North, were also among the applications mentioned by the respondents from the departments.

In the case of the industry respondents, potential security applications (13) were the category most frequently mentioned (iceberg and sea ice monitoring, disaster prevention and response [flooding, ground movement], maritime surveillance), followed by potential resource management applications, including six in agriculture and forestry (crop mapping and monitoring) and four in raw materials exploitation (mining, oil and gas). Finally, five potential environmental applications (glacier and permafrost monitoring, measurement of carbon sequestration and water purification and weather) and two mapping applications complete the list of potential applications mentioned by the respondents. These results indicate that industry's perception of potential applications is not concentrated in the same sectors as those mentioned by the OGDs and that the needs identified by industry are also somewhat different from those identified by the OGDs.

Table 15: Proportion of potential applications by type of data required

	Departments (n=31)	Industry (n=21)
R-1	3%	0%
R-2	45%	57%
RCM	13%	10%
Other CSA	19%	14%
Total CSA missions	**61%**	**62%**
Foreign satellites	**71%**	**76%**

Source: Interview data

In most cases, the respondents from the departments and from industry also identified the type of data that would be used to develop these applications. The results indicate that a high proportion of these applications would use foreign data (Table 15). For instance, nearly 60% of the applications mentioned by the respondents would make use of data from CSA-generated missions, while more than 70% of the applications would use data from foreign satellites. It should be noted that, for a significant proportion of applications, both types of data (CSA, foreign) would be used, particularly in the agriculture and

forestry sectors. The type of data required for each application mentioned by the respondents is presented in Appendix C.

Hence, the program objectives continue to meet a need. The potential offered by radar technology has not been fully exploited and numerous applications still remain to be developed, particularly given the planned launch of the Radarsat Constellation. "*If you are going to spend $800M on a mission to get things in space, you have to invest in ways to know how to use the data on the ground.*"

These applications would allow OGDs to use more Earth observation data, which would contribute to the attainment of their objectives. As reported above, the respondents expressed numerous needs. Finally, there are various benefits in having a Canadian value-added industry. For instance, all the CSA respondents mentioned that the support provided to this industry promotes innovation and generates economic activity, particularly by facilitating positioning in international markets.

> *Canada needs a strong private-sector commitment to S&T. Firms large and small are bringing innovations into our lives, […] create high-quality, knowledge-intensive jobs with high wages. They make our economy more competitive and productive, giving us the means to achieve an even higher standard of living and better quality of life. The private sector in Canada needs to do more of what it alone can do, which is to turn knowledge into the products, services, and production technologies that will improve our wealth, wellness, and well-being.*
> Mobilizing Science and Technology to Canada's Advantage

However, the results indicate that it can be difficult to reconcile greater use of satellite data by the departments, maximization of the potential of Agency-supported missions and the support provided to industry.

A large proportion of the potential applications mentioned by the respondents require the use of foreign data, particularly in forestry and agriculture. To date, the program has shown some flexibility on this point with the departments because 17% of the projects carried out by the departments did not use data generated by CSA-supported missions (Table 16).

Table 16: Percentage of projects by type of data used

	OGD	Industry	Total
R-1	49%	73%	53%
R-2	40%	27%	38%
Other CSA	52%	47%	51%
Total CSA	**83%**	**100%**	85%
Foreign	78%	33%	71%

Source: ORIS database (n=96)

On the industry side, the results indicate some degree of mismatch between the needs expressed and the conditions for participating in the program. As was demonstrated earlier, the industry respondents also see a potential outside the needs expressed by the departments, particularly concerning the exploitation of natural resources. In addition, a high proportion of potential applications would require use of foreign data. Currently, in order to be eligible, projects must demonstrate that they use data generated by CSA-supported missions and that they meet a need expressed by the departments.

In conclusion, the program objectives continue to meet a need. However, these needs are varied. Under these conditions, it can be difficult to reconcile the various objectives when it comes time to accept or reject a project.

3.2.2 Alignment with federal government and CSA priorities

The program objectives are clearly linked to federal government priorities. Firstly, promoting science and technology and supporting industry are long-standing strategies on which the Government of Canada relies in order to succeed in today's global economy and ensure the well-being of Canadians.

Published in 2006, the economic plan "*Advantage Canada - Building a Strong Economy for Canadians*" presents five competitive advantages on which the Government of Canada plans to rely. The program objectives contribute to the attainment of two of these advantages: the knowledge advantage and the entrepreneurial advantage.

In order to achieve these objectives, in 2007, the Government of Canada published the strategic plan "*Mobilizing Science and Technology to Canada's Advantage,*" which aims to make Canada "*a world leader in science and technology and a key source of entrepreneurial innovation and creativity.*"

Since the release of these documents, the Government of Canada has repeatedly reiterated that the commitment to science and technology and industry support is one of its priorities:

> *Our Government understands that advances in science and technology are essential to strengthen the competitiveness of Canada's economy. Our Government will start at home, working with industry to apply the best Canadian scientific and technological know-how to create innovative business solutions.*
> Speech from the Throne, 2008

> *To fuel the ingenuity of Canada's best and brightest and bring innovative products to market, our Government will build on the unprecedented investments in Canada's Economic Action Plan by bolstering its Science and Technology Strategy.*
> Speech from the Throne, 2010

Secondly, and more specifically, Earth observation data are used to support several priority areas for the Government of Canada:

> *While contributing to the economic well-being of the country, Canada's space program supports key policy areas such as security and sovereignty, the environment and sustainable development.*
> National Aerospace and Defence Strategic Framework, 2005

> *The federal government supports security and the environment […] by co-funding the Earth observation RADARSAT II satellite, which will have agricultural, marine and pollution monitoring roles as well as extensive mapping capabilities.*
> National Aerospace and Defence Strategic Framework, 2005

> *Polar Epsilon, National Defence's space-based wide area surveillance and support program, will use RADARSAT II to provide the Canadian Forces with greater capacity to monitor Canada and its Maritime Boundary.*
> Canada's Northern Strategy: Our North, Our Heritage, Our Future, 2009

Finally, we have already seen that 89% of the respondents from the departments agreed that the program helps increase their department's capacity to meet its objectives, a finding supported by the current Minister of Industry:

> *The critical images of these satellites support the operational needs of many government departments and agencies, especially in the Arctic region.*
> The Honourable Christian Paradis, Minister of Industry and Minister of State (Agriculture)
> CSA 2011-2012 Report on Plans and Priorities

The program objectives are also linked to the CSA's strategic outcome, which is to ensure that "*Canada's exploration of space, provision of space services and development of its space capacity meet the nation's needs for scientific knowledge, innovation and information.*"

The program objectives thus contribute to the attainment of four of the five objectives presented in the CSA's Report on Plans and Priorities for 2011-2012:

> *In order to give full force to this strategic direction, the Agency has reformulated its Program Activity Architecture and reorganized its business lines to achieve the following objectives:*
>
> - *Align the Canadian Space Agency's programs and activities to support the key priorities of the Government and the Science and Technology Strategy.*
> - *Increase service and expand the use of space data and information by government departments and agencies to respond to the needs of Canadians.*
> - *Expand Canadian space expertise and enhance synergy between government, academia and industry partners.*
> - *Foster operational excellence and effectiveness by promoting a consistent vision and direction on programs and projects throughout their life cycle.*
> - *Strengthen the Canadian Space Agency to position Canada as a key player in future space exploration missions*.
>
> Steve MacLean, President of the Canadian Space Agency, 2011-2012 Report on Plans and Priorities.

The program objectives are therefore clearly aligned with federal government priorities and with the CSA's strategic outcome. However, the CSA's various objectives can make it difficult to prioritize the various program objectives.

On the one hand, enhancing synergy among partners and implementing the Science and Technology Strategy requires placing the emphasis on two aspects:

- Greater participation of industry in the development of products and services that meet the needs of OGDs;
- Continue efforts made so that industry can develop applications aimed at the international market.

The following passages, excerpted from an analysis of the strategic context in which the CSA operates, illustrate this fact:

> *Canada's space infrastructure must not only meet national strategic needs, but must also play a tangible role in responding to issues of interest to the international community. […] In particular, emerging space-faring countries in Asia and South America may offer great potential for future cooperation. […] It is of paramount importance that the Canadian Space Agency continues to work with its stakeholders to ensure the competitiveness of our research and business communities in world markets. […]*
>
> *The Canadian Space Agency recognizes that the best means of turning scientific and technological advancements into innovative products and services is through partnerships with Canadian universities and businesses. […] Given that the national market is relatively small, it is critical that the Canadian space industry be able to leverage foreign investments and generate export sales. Capitalizing on export revenue depends on the industry's ability to commercialize highly competitive products and services, and establish local and international partnerships.*
>
> 2011-2012 Report on Plans and Priorities; Strategic Context of the Canadian Space Agency

On the other hand, increasing services to the departments and using space data to meet Canadian needs requires that particular attention be paid to the needs of OGDs, particularly for applications that use foreign data.

Finally, development of the radar technology has required major investments. Consequently, the launch of the Radarsat Constellation is one of the CSA's priority projects and it is therefore important to ensure that the potential offered by these investments is fully realized.

Under these conditions, it is difficult to prioritize the program objectives. Seven out of eight CSA respondents agreed that that the use of data by the departments is the program's priority objective. However, 50% of these respondents feel that supporting the industry is more important than maximizing the potential of CSA-supported missions, while 25% hold the opposite view and 25% did not

answer the question. Finally, 63% of the CSA respondents added that there should be greater reliance on industry to develop applications for the departments.

3.2.3 Roles and responsibilities of the federal government

According to the Science and Technology Strategy, the role of the federal government is to:

> *[…] ensure a free and competitive marketplace, and foster an investment climate that encourages the private sector to compete against the world on the basis of their innovative products, services, and technologies. The government also has a role in supporting research and development (R&D).*

The government also plays a role:

> […] *facilitating domestic and international partnerships among researchers, industries, and others to improve the speed with which advanced knowledge can be generated, tapped, and applied to solve problems and create opportunities*.

On the other hand, the private sector:

> […] *needs to do more of what it alone can do, which is to turn knowledge into the products, services, and production technologies that will improve our wealth, wellness, and well-being*.

Concerning the CSA, the *Canadian Space Agency Act* stipulates that:

> *The objects of the Agency are to promote the peaceful use and development of space, to advance the knowledge of space through science and to ensure that space science and technology provide social and economic benefits for Canadians.*

Among other functions, the Agency shall:

> *[…] assist the Minister to coordinate the space policies and programs of the Government of Canada; […] plan, direct, manage and implement programs and projects relating to scientific or industrial space research and development […]; [and] encourage commercial exploitation of space capabilities (functions).*

In addition, the Agency may:

> *[…] assist departments, boards and agencies of the Government of Canada to use and to market space technology; [and] make grants and contributions in support of programs or projects relating to scientific or industrial space research and development and the application of space technology […] with a view to determining the commercial potential of that science and technology, but not including any programs or projects relating solely to the commercial exploitation of space science or technology (idem).*

Hence, implementation of the program is part of the roles and responsibilities of the federal government and of the CSA.

However, the role accorded to industry in the implementation of the program does not appear to reflect the emphasis placed on industry in the Science and Technology Strategy. For instance, $39 million of the $56 million (70%) allocated to application development was allocated to projects carried out by OGDs and only 40% of these projects gave rise to partnerships with industry. Although no specific targets were set in this regard, the following passages suggest that little has been accomplished to date in meeting these goals.

> *[…] the best means of turning scientific and technological advances into innovative products and services is through industry. Industry is also the best vehicle for providing a broad range of services to diverse groups of users–from individuals to public and private organizations.*
> The Canadian Space Strategy, 2005

> *The Canadian Space Agency recognizes that the best means of turning scientific and technological advancements into innovative products and services is through partnerships with Canadian universities and businesses.*
> CSA Performance Report, 2009-2010

3.3 Efficiency and economy

The results presented in this section aim to answer the following question: Is resource utilization in relation to attainment of expected outcomes optimal? More specifically:

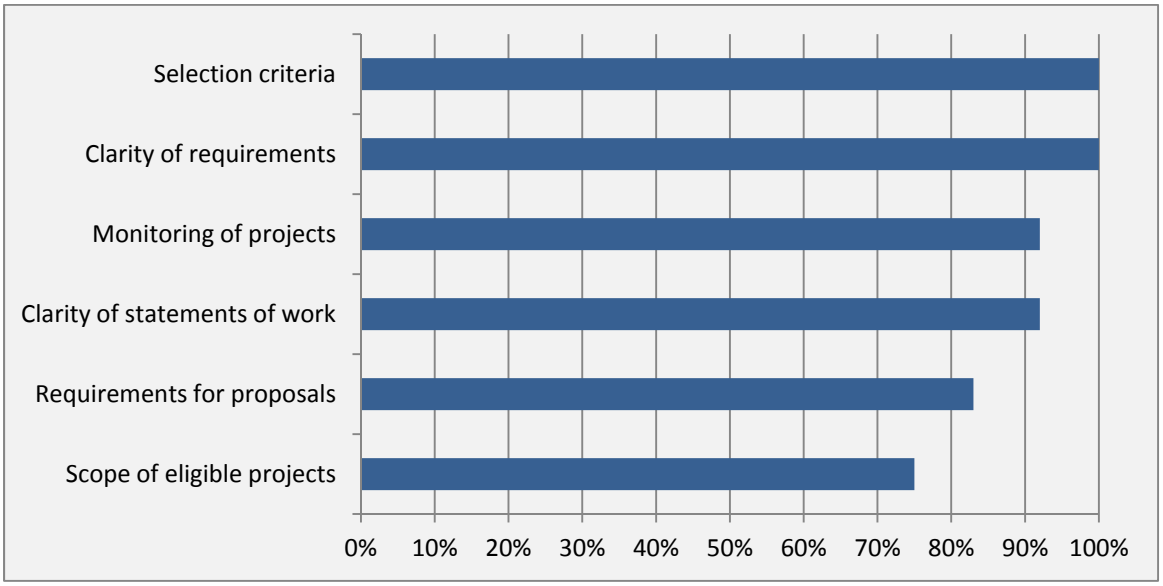
1) Is the target program population satisfied with the implementation process?
2) Do we have good knowledge of users' needs?
3) Are there alternatives to the current program delivery method?

3.3.1 Program implementation

The interview results indicate that users consider the program implementation process appropriate. All the OGD respondents agreed that the program is well-suited to the needs of their department. In addition, 84% of these respondents feel that the current delivery method, which consists of allocating funding for each project, is the most effective method of ensuring greater use of satellite data by their department. Finally, 84% were also satisfied with the project selection criteria. However, a few respondents mentioned delays in concluding an agreement.

The industry respondents were also satisfied with the program implementation process (Graph 6), although they were somewhat less satisfied with the scope of eligible projects and the requirements for submitting proposals, an opinion that was repeatedly reiterated during the interviews.

Graph 6: Percentage of respondents satisfied with implementation of the EOADP



Source: Interview data

3.3.2 Knowledge of users' needs

Although CSA personnel are aware of the participants' needs concerning potential applications (see section 4.2.1), there do not appear to be any formal mechanisms to obtain accurate information about participants' needs. When questioned on this point, none of the CSA respondents could list any consultation mechanisms other than "users and sciences teams," a consultation mechanism used to determine users' needs in the context of specific missions. In addition, a few respondents mentioned that this frequently involves processes aimed at promoting missions rather than mechanisms for determining the real needs of users, particularly decision makers. Establishing an interdepartmental committee with this mandate was mentioned. Otherwise, it appears that the information is collected informally, through daily contacts for program implementation.

These deficiencies appear to have repercussions on strategic planning. For instance, when asked about program efficiency, two-thirds of the CSA respondents pointed out the lack of planning and the need to concentrate resources where it counts. In addition, although the current implementation model appears to function adequately, two-thirds of the respondents felt that a more strategic approach was required, in order to develop themes on which several stakeholders could work together.

Finally, when asked about ways of improving synergy between the two program components, nearly all the respondents agreed that a common vision should be developed that would allow the two components to work on the same themes, with half of the respondents adding that efforts must be made to ensure that industry is involved in the development of applications for the departments.

3.3.3 Opportunities for improving program implementation

Despite the high level of satisfaction reported with the program implementation process, many suggestions were made concerning the support required for the development of applications and use of data, as well as for improving the benefits generated by the program. Other than increasing funding, which was mentioned by a number of industry and OGD respondents, these suggestions can be grouped into four categories (Table 17).

Table 17: Support required and improving benefits: themes mentioned by respondents

	Access to data	Expertise of academia	Awareness-raising	Coordination/ collaboration
OGD	*	* *	* *	*
Industry	* * *	*		* * * *
CSA		* *	* * *	* * * *
Total	*	* *	* *	* * *

Source: Interview data

* One-quarter of respondents
** One-third of respondents
*** Half of respondents
**** Three-quarters of respondents or more

Access to data was a theme mentioned mainly by industry respondents. Access to the Radarsat and foreign satellite databases, as well as the price of acquisition, were major concerns of industry, as has been noted several times in this report. The OGD respondents would like to have access to a wider range of foreign data.

Lack of the expertise necessary to take full advantage of the potential offered by satellite data was also a subject of concern. Several OGD and CSA respondents suggested implementing measures that would allow the program to establish more working partnerships with academia. Using grants and contributions to fund university research was mentioned several times.

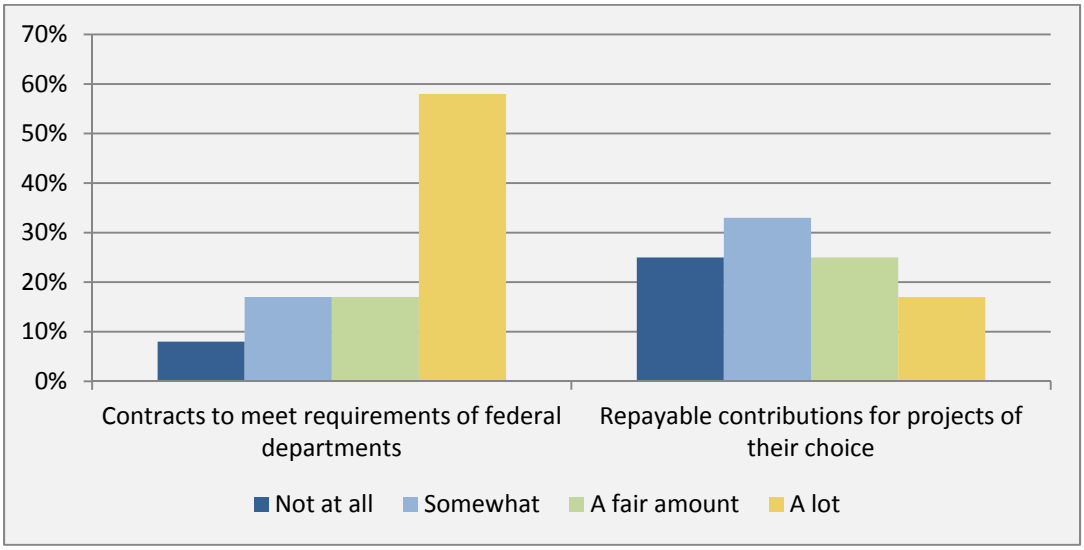
Several CSA and OGD respondents also mentioned that greater awareness of the benefits generated by the use of satellite data, especially on the part of senior management of OGDs, would promote greater use of satellite data.

Finally, coordination and opportunities for collaboration constituted the main concerns of the CSA and industry respondents. Nearly all the CSA respondents mentioned that better coordination would

increase the benefits generated by the program. The respondents pointed out that a more strategic vision of needs was required, which would allow investments to be made by project portfolios. In their opinion, a thematic approach would make it possible to carry out broad-based projects that would promote collaboration among the various actors.

The industry respondents would like to see greater coordination and more opportunities for collaboration in order to ensure better funding of their activities. For instance, the possibility of participating in international initiatives was mentioned by a few respondents. Others pointed out that they would like to see better integration of the various federal government programs and objectives, which would help ensure continuity of available funding sources, especially at the commercialization stage.

Graph 7: Potential contribution of contracts and contributions to business competitiveness



Source: Interview data

The recent introduction of a new grants and contributions (G&C) program at the CSA could provide an additional source of funding for industry and expand the scope of eligible projects. However, only 42% of the industry respondents felt that repayable contributions (for the purpose of developing applications of their choice) would help increase their organization's competitiveness "*a fair amount*" or "*a lot*" (Graph 7). However, a full 75% felt that contracts to meet the needs of the departments would help increase their competitiveness.

When asked about other available sources of funding, the respondents mentioned nearly 20 different funding sources. The various programs of the ESA (8), GeoConnection (2), IRAP (2) and ISTP (2) were mentioned more than once.

It should be noted that all those who mentioned three or more funding sources had received funding from all the sources they named, whereas this was the case for only half of those who mentioned two sources or less. In addition, only one respondent was able to name more than five sources of funding. These results suggest that greater awareness of the various funding sources would help increase the funding available for the development of applications.

Conclusion

The aims of the Earth Observation Data and Imagery Utilization Program (the program) are to support the Canadian value-added industry, promote the use of satellite data by other government departments (OGDs) and maximize the potential offered by the missions supported by the Canadian Space Agency (CSA). In so doing, it aims to close the gap between the potential offered by the development of this technology and the capacity to use it.

The purpose of this evaluation, which covered the period from April 1, 2005 to March 31, 2010, was to examine program relevance and performance. A document review and consultation of administrative data dealing with the 174 projects funded during this period were carried out and 39 interviews were conducted with representatives of government departments, industry and CSA personnel. During the interview process, 80% of the businesses and 71% of the OGDs that participated in the program were contacted and information was collected on 45% of the projects completed during the evaluation period.

The information collected indicates that the program is effective and relevant, but that improvements could be made in order to maximize resource utilization relative to the attainment of expected outcomes.

We found that the program expenditures invested in the development of applications have borne fruit: several applications are at more advanced stages than initially anticipated by the projects or are operational. Nearly 40% of the applications developed are at the operational stage and, in the majority of cases, the participants indicated that their organization will continue the development of the applications that are not yet operational.

The reasons mentioned by those who did not plan to continue the development of an application were lack of human resources and commitment by senior management (for OGDs), as well as lack of market interest, mainly because of the cost of the data (for industry).

We also noted that the departments' main partners are other departments (72%), whereas industry's main partners are from the private sector (59%). By comparison, just fewer than 40% of the projects gave rise to OGD/industry partnerships, which is rather inadequate considering the emphasis placed on the participation of industry by the Science and Technology Strategy, particularly since 70% of the expenditures made for the development of applications were allocated to OGDs. These results indicate that it would be desirable to **ensure greater industry participation in the development of applications in response to the needs of federal departments and agencies** in the coming years**.** A major step in this direction seems to have been taken with the awarding, in 2010-2011, of 12 contracts intended to meet the needs expressed by the departments.

Finally, we saw that half of the OGD and industry respondents indicated that they would like to see greater participation of academia. Lack of expertise was also mentioned a number of times during the interviews. This was the main obstacle to the use of data identified by the OGDs and was also mentioned by half of the CSA respondents. These results indicate that it would be desirable to **introduce mechanisms to financially support the participation of academia in the development of applications**. The CSA's grants and contributions program could be used for this purpose and thus supplement the support provided under the SOAR program. Partnerships with other granting agencies could also be considered.

From the information collected, it can also be concluded that the program contributes to the attainment of its stated objectives in the medium and long term. For instance, nearly all the OGD respondents indicated that the program helped increase their department's capacity to use satellite data (95%) and that, without the help of the program, their department would make less use of satellite data (84%). Almost all of these respondents also agreed that the program helped increase their department's capacity to meet its objectives (89%).

The respondents who did not share this opinion mentioned that there was insufficient expertise within their department or that senior management still had to be convinced of the benefits of using satellite data.

In addition, in an internal document illustrating success stories in the use of data generated by CSA missions, we saw that 14 of the 17 success stories presented used applications developed with the support of the program, which tends to demonstrate the significant contribution of the program to the use of data generated by these missions.

Program expenditures also help to increase the competitiveness of Canadian businesses in the Earth observation market, particularly in international markets. All the industry respondents agreed that the program helped increase their organization's competitiveness and extend its reach internationally. According to these respondents, 60% of the applications developed under the program resulted in sales opportunities, particularly on the international market. The articles published in the EO Express newsletter documented the spinoffs on the international market for seven of the 11 international projects.

When industry respondents were asked a follow-up question about what happened to proposals that were not accepted under the program, they indicated that five of the six projects not accepted were shelved, while the sixth project was carried out, four years later, following a contract awarded under the program. Since industry proposals must use data generated by CSA missions, it can be concluded that, without the program, use of these data by industry would be lower.

For instance, only 42% of the respondents indicated that they used data generated by CSA-supported missions to develop applications without the support of the program. In addition, 83% of the industry respondents agreed that they would not use R-2 data as much if the program did not exist.

Paradoxically, while the program aims to increase the use of satellite data, data access and data sharing were obstacles frequently mentioned during the interviews. The price of data was the main obstacle identified by industry. The data policy, which restricts data access and sharing for potential users (provinces, territories, international markets), also represents a major obstacle. In addition, some OGD respondents also mentioned that sharing data with potential partners as well as conflicts for the acquisition of images were additional, although more minor, obstacles.

Hence, although several CSA respondents indicated that the use of satellite data had increased to varying degrees, all pointed out that price, data policy and acquisition conflicts were obstacles still to be overcome. It should be noted that once the Radarsat Constellation has been placed in orbit, these obstacles will be mitigated, particularly because of the increase in revisit time. It is therefore recommended that steps be taken to **ensure that the data policy accompanying the Radarsat Constellation be designed to facilitate data access and sharing**.

Concerning awareness-raising and knowledge transfer activities, little data is available on the impact of conferences and workshops. Nevertheless, 74% of the respondents from the departments agreed that these events helped them obtain a better understanding of the potential benefits of Earth observation, while 68% of these respondents indicated that these events had helped increase their capacity to use satellite data. In addition, 88% of the industry respondents who attended Agency-supported events indicated that these events had resulted in sales opportunities. Several respondents indicated that they would like to see these types of events held more frequently.

Seventy percent of the OGD respondents agreed that it is easy to find information on the potential uses and benefits of using data, and all indicated that the program had enabled their department to gain a better understanding of the potential benefits of EO. However, a few of these respondents pointed out that the information disseminated does not adequately reach decision makers.

The awareness of senior management was one of the themes mentioned a number of times during the interviews. One-third of the OGD respondents and nearly all the CSA respondents also felt that greater awareness by senior management of the advantages of using satellite data would help increase the benefits generated by the program.

These results indicate that it would be desirable to **allocate a larger share of program resources to awareness-raising and knowledge transfer activities**, which would help publicize and share the results achieved by the program, particularly to decision makers in the OGDs. It is appropriate to point out here that little data was available on the human resources devoted to this program component.

Nevertheless, the administrative data indicate that less than 5% of the financial resources were allocated to this component.

We also saw that the program objectives as well as program implementation are clearly linked to federal government and CSA priorities, roles and responsibilities. Several strategic guidance documents (Advantage Canada, S&T Strategy, Canadian Space Strategy, Speech from the Throne, Report on Plans and Priorities, etc.) indicate that promoting science and technology and supporting industry are long-standing strategies on which the Government of Canada and the CSA rely. In addition, as we have seen, Earth observation data are used in several priority areas for the Government of Canada, particularly in the North.

The interview results also indicate that the needs are varied. The OGD and industry respondents identified a number of potential applications. These applications would require using a wide range of satellite data and many (39%) would use exclusively data from foreign satellites. During the evaluation period, the program has shown some flexibility on this point with the departments, since 17% of the projects funded used only foreign data. In a context of limited resources and where it is important to maximize the potential of CSA-supported missions, it would be advisable to **determine the proportion of resources allocated to the development of applications that use exclusively foreign data** but that would help support OGD program delivery.

Similarly, the needs identified by industry were somewhat different from the needs identified by the OGDs, particularly for applications in the raw materials sector (mining, oil and gas). We also saw that a number of the projects supported helped position the Canadian industry internationally. Once again, in a context of limited resources and given the fact that industry's perception of potential applications is somewhat different from the needs expressed by the OGDs, it would be advisable to **identify ways of increasing the funding available to industry so that it can develop products and services to help improve its competitiveness on the market**. Greater awareness of the various sources of funding available as well as use of the CSA grants and contributions program would make it possible to increase the funding available for the development of applications in these areas.

Concerning program implementation, although little data is available on resource utilization in relation to the production of outputs or outcomes, the results indicate that users consider the program implementation process appropriate.

All the OGD respondents agreed that the program is well-suited to the needs of their department. In addition, 84% of these respondents considered the current delivery method to be the most effective in ensuring greater use of data by their department. Finally, 84% were also satisfied with the project selection criteria.

The industry respondents were also satisfied with the program implementation process, although they were somewhat less satisfied with the requirements for submitting proposals and the scope of eligible projects, an opinion repeatedly reiterated during the interviews.

The CSA respondents were not able to identify any formal mechanisms for obtaining accurate information about participants' needs. When asked about program efficiency, two-thirds of the respondents mentioned the lack of planning and the need to concentrate resources where it counts. Hence, although the current implementation model seems to function adequately, two-thirds of the respondents felt that a more strategic approach was required, which would make it possible to identify clusters of applications on which several stakeholders would work together**.** It is therefore advisable to **implement mechanisms for identifying development clusters and for better coordinating the partners' contributions, with a view to attaining the objectives**. It would then be possible to develop a more strategic approach, focus efforts and better coordinate the partners' contributions, with a view to attaining the program objectives. To this end, it would be desirable to **develop a performance measurement strategy in order to clearly identify the program objectives, set targets and agree on indicators that will serve as a basis for fact-based decision making**.

It should be noted that this evaluation has several limitations, some implicit in the design of the evaluation, others attributable to missing data in the administrative databases. The conclusions and recommendations presented in this report are therefore largely based on the information provided by the respondents during the interviews. In addition, certain analyses are based on a limited number of projects, which reduces representativeness. Nevertheless, the sample selected is representative of the various program stakeholders and the results presented are consistent across the various themes addressed and among the various categories of respondents. In conclusion, while certain results should be interpreted with caution, particularly those dealing with the level of maturity achieved by the projects, the results concerning the contribution of the program, the obstacles and the opportunities for improvement are representative of the various program stakeholders.

Recommendations

Based on the information collected during this evaluation and considering the limitations noted, we recommend that consideration be given to:

- Giving industry a greater role in the development of applications in response to the needs of federal departments and agencies;

- Implementing mechanisms to financially support the participation of academia in the development of applications;

- Determining the proportion of resources that will be allocated to the development of applications that rely exclusively on foreign data;

- Developing the Radarsat Constellation data policy in a manner that facilitates data access and sharing;

- Allocating a greater share of program resources to awareness-raising and knowledge transfer activities;

- Identifying ways of increasing the funding available to industry so that it can develop products and services that will help it improve its competitiveness on the market;

- Introducing mechanisms to help identify development clusters and better coordinate the partners' contributions, with the goal of attaining the objectives;

- Developing a performance measurement strategy in order to clearly identify the program objectives, set targets and agree on the indicators that will serve as a basis for fact-based decision making.

Management response and action plan

	RESPONSABILITY ORGANISATION / FUNCTION	MANAGEMENT RESPONSE	DETAILS OF ACTION PLAN	SCHEDULE
RECOMMENDATION # 1				
Giving industry a greater role in the development of applications in response to the needs of federal departments and agencies.	*Head EOAU*	Agree	One of the objectives of the new partnership to be established with departments will be to foster the use of industry in the development and implementation of applications developed by departments and agencies.	2011-2012: start of negotiations to establish the new partnership. 2012-2013: information and consultation sessions with departments and agencies. 2012-2013: development of a new IMOU.
RECOMMENDATION # 2				
Implementing mechanisms to financially support the participation of academia in the development of applications.	*Head EOAU*	*Agree*	EOAU participated in the development of the terms and conditions of the CSA's Class G&C Program to Support Research, Awareness and Learning in Space Science and Technology to make sure they can be used to support the development of EO applications. The SOAR program also uses the terms and conditions of the Class G&C Program to financially support the development of the EO expertise. A pilot project is going through the approval process. It is also planned to use Announcements of Opportunities and to have an unsolicited proposals section. Finally, communications and awareness activities in relation with this new mechanism will be put in place to reach the targeted audience.	2012-2013: implementation of pilot project. Required adjustments to the program. 2013-2014 : Grants and Contributions section of EOAU is operational

RECOMMENDATION # 3				
Determining the proportion of resources that will be allocated to the development of applications that rely exclusively on foreign data.	*Space Utilization DG with the support of GLO and GPP*	*Partially agree*	The specific objectives of the EO data and image usage program, including the proportion of resources allocated to the use of foreign data, will be clarified and the proportion of resources to be allocated to the development of applications that rely exclusively on foreign data will be submitted for decision.	2012-2013 : implementation of the governance mechanism allowing to record the user's needs. 2013-2014: development of the first strategic plan addressing the expressed needs. This plan will establish the proportion of data from foreign sources.
RECOMMENDATION # 4				
Developing the Radarsat Constellation data policy in a manner that facilitates data access and sharing.	*Space Utilization DG with the support of the Head, Policy and Regulatory affairs*	*Agree*	The development of the RCM data and use policy is done in conjunction with the users' departments. The policy shall meet many requirements, either commercial, industrial and for defense. It will also be developed in conformance with the data strategy being prepared by the GLO.	Launch of RCM's 1st satellite currently planned for 2016.
RECOMMENDATION # 5				
Allocating a greater share of program resources to awareness-raising and knowledge transfer activities.	*Head EOAU with the support of CSA Communication s section*	*Agree*	A communication and awareness plan will be developed. The plan will define activities, products, resources and an implementation schedule and will be developed to respond to the targeted audience. A particular attention will be devoted to decision makers to increase their awareness of the potential of EO to support them in fulfilling their mandate. However, further from reporting on our partners'	2012-2013: ratification of collaborative agreements with departments. The agreements will include the preparation of a communications plan as a deliverable.

			accomplishments, the CSA supports private and governmental organizations capacity building in using satellite data by gathering experts and users from the targeted field to foster the accomplishment of the project's objectives	2012-2013: Preparation of the communication and awareness plan, in consultation with CSA's communications section.
RECOMMENDATION # 6				
Identifying ways of increasing the funding available to industry so that it can develop products and services that will help it improve its competitiveness on the market.	*Head, EOAU*	*Agree*	To better diversify innovation and development of new value-added EO products, other financing mechanisms are required, for example grants programs. This measure requires the implementation of a Grants and Contributions program within EOAU. This program will be in pilot phase in 2012-2013. We plan on supporting a project with the industry to validate the terms and conditions, clarify our eligibility criteria, and better define our implementation process for this new mechanism and to train our internal resources. We plan to call upon industry annually and to have an unsolicited proposals section, to better respond to business opportunities (in a context of R&D projects). Finally, communications and awareness activities in relation with this new mechanism will be put in place to reach the targeted audience. We will also look at collaboration/partnership possibilities with existing industry support programs to better complement our existing programs and to increase the leverage effect for the benefit of industry. We work in collaboration with the Grants and Contributions Center of Expertise to implement this new mechanism.	2012-2013: implementation of a pilot project, consultation with industry and adjustments to the definition of this new mechanism if required. 2013-2014: Grants and Contributions section of EOAU is operational. However, the actual implementation date will be set according to the availability of EOAU's financial resources.
RECOMMENDATION # 7				
Introducing mechanisms to help identify development clusters and better	*Space Utilization DG with the support of the GLO and*	*Agree*	Supporting the governance framework that CSA is currently implementing, particularly the interdepartmental committee on needs, priorities and commitments, the new partnership agreements to be established with government departments and agencies will include a mechanism allowing CSA and	2012-2013: implementation of the governance mechanism allowing to record the users'

coordinate the partners' contributions, with the goal of attaining the objectives.	*GPP*		departments to consult and identify priorities. This consultation framework will be based on CSA's commitments and on the orientations/priorities of departments and agencies.	needs. 2013-2014 : development of the first strategic plan addressing the expressed needs.
RECOMMENDATION # 8				
Developing a performance measurement strategy in order to clearly identify the program objectives, set targets and agree on the indicators that will serve as a basis for fact-based decision making.	*Director, MEA*	*Agree*	The performance measurement strategy covering PAA activities 1111 et 1131 will be developed.	AF11/12: strategy developed AF12/13 : implementation of data collection mechanisms

Appendices

Appendix A: Bibliography

CSA, Canadian Space Strategy, 2005.

CSA, Departmental Performance Report, 2005-2006 à 2010-2011.

CSA, Estimates, Report on Plans and Priorities, 2011-2012.

CSA, EO EXPRESS, 2005, 2006, 2007, 2008, 2009, 2010.

CSA, Government Related Initiatives Program Management Framework, 2007.

CSA, Earth Observation Application Development Program (EOADP), Management Framework, 2007.

CSA, Government Related Initiatives Program (GRIP): Standard Operating Procedures Manual, 2007

CSA, Earth Observation Applications Development Program (EOADP): Standard Operating Procedures Manual, 2007

CSA, EOAU management framework, 2010.

CSA, Results-based Management and Accountability Framework for RADARSAT-2 Mission (Phase E2), March 2010.

CSA, Earth Observation Radarsat-2 reporting; Monthly Credit Consumption Report, March 2010.

CSA, Illustrations of Space Applications Linked to Government Priorities and Departments, 2011.

Erich Battistin, Enrico Rettore, Nouveau regard sur le plan expérimental de discontinuité de la régression, Recueil du Symposium 2002 de Statistique Canada; Modélisation des données d'enquête pour la recherche sociale et économique, 2002.

Government of Canada, Budget Speech, 2006, 2007, 2008, 2009, 2010.

Government of Canada, Speech from the Throne, 2006, 2007, 2008, 2009, 2010.

Government of Canada, Advantage Canada; Building a Strong Economy for Canadians, 2006.

Government of Canada, Mobilizing Science and Technology to Canada's Advantage, 2007.

Government of Canada, Canada's Northern Strategy, Our North, Our Heritage, Our Future, 2009.

Industry Canada, The National Aerospace and Defence Strategic Framework, 2005.

Department of Justice, Canadian Space Agency Act, 1990, Act current to 2011 February 9.

Appendix B: Questionnaire

Interview Guide – Federal Departments

The Canadian Space Agency (CSA) is currently evaluating the Government-Related Initiatives Program (GRIP) to determine the extent to which implemented activities have contributed to achieving program objectives efficiently and economically, and ensure that they still fulfil a need.

As part of this evaluation, the CSA evaluation team is conducting interviews with key stakeholders at the CSA and in other federal departments.

Although your participation in this interview is voluntary, we are counting on your co-operation to ensure that the various program partners are fairly represented. The following questions will serve as guide for the interview. Throughout the interview, we ask that you provide us with any other information that you consider relevant.

The information gathered during this interview will remain confidential and is protected pursuant to the Access to Information and Privacy Acts. Only evaluation team members will have access to it and the results will be released solely in the form of compiled data. The interview will last between 30 and 45 minutes.

Do you agree to participate in this interview?

Yes [ ] No [ ]

To be able to make maximum use of your comments, we would like to request your permission to record this interview. The recording will be destroyed once the evaluation has been completed.

Do you agree to beginning the recording of this interview?

Yes [ ] No [ ]

The GRIP objectives are to promote the use of satellite data by federal departments and the development of satellite-based Earth observation applications, products, and services. The program builds on Canada's position as a leader in radar technologies and the processing of radar remote sensing data, made possible partly by RADARSAT 1 and 2 and by Earth imaging systems using synthetic aperture radar (SAR).

Interview No: _____

The objective of this first series of questions is to obtain your impressions of the Program's contribution to your activities.
On a scale of 0 to 3, where 0 represents "totally disagree" and 3 represents "totally agree", please indicate the extent to which you agree with the following statements.

	Totally Disagree			Totally Agree
1- Generally speaking, the support provided by the program, financial or otherwise, is well-suited to the needs of my department (16.1, 17.2) Comments: _____	0	1	2	3
2- The program has helped my department obtain a better understanding of the potential benefits of using satellite data. (10.7) Comments: _____	0	1	2	3
3- The program has helped to increase my department's capacity (knowledge, expertise, skills, etc.) to use satellite data. (11.3) Comments: _____	0	1	2	3
4- The program has helped to increase my department's capacity to meet its objectives. (14.1, 10.8) Comments: _____	0	1	2	3
5- Without the help of the program, the degree to which my department uses satellite data would be less. (13.2) Comments: _____	0	1	2	3
6- The information on the potential uses and benefits of satellite data is easily accessible. (10.4) Comments: _____	0	1	2	3
7- My department makes regular use of the knowledge developed in universities and research centres to develop its applications. (6.3) Comments: _____	0	1	2	3
8- My department is satisfied with the various means for drawing up memoranda of agreement (MOAs) (16.4, 18.6) Comments: _____	0	1	2	3
9- My department takes full advantage of the potential offered by RADARSAT-2. (11.1) Comments: _____	0	1	2	3

According to our records, your department concluded one or more memoranda of agreement (MOAs) with the CSA. The following questions seek to obtain a better understanding of the spinoffs of this project.

Project 1: (*Describe the project(s) before sending the interview guide*.)

10- What is the level of maturity achieved with this application? (7.2, 7.3, 12.3)
1- [ ] Preliminary correlation between observation data and the terrain (R&D completed)
2- [ ] Determination of the reliability of measurements (pre-operational demonstration carried out)
3- [ ] The application is operational.

11- If the application is operational, what benefits were obtained through use of the application? (For example, increased knowledge or products and services, decision-making assistance, generated revenue, or any other changes pertaining to program delivery that have resulted from use of this application) (12.2)

_____

12- If the application is not operational, does your department plan to invest in the development of this application? (12.2, 12.5)
[ ] Yes [ ] No (If no, give reason)

_____

13- Did the private sector participate in the development of this application? (6.2) [ ] Yes [ ] No

14- Did this project make use of knowledge developed in universities or research centres? (6.2)
[ ] Yes [ ] No

The following few questions will give us a better understanding of the opportunities and challenges associated with this program.

15- What are the activity areas where satellite data would be most useful for increasing your department's ability to meet its objectives? For each of these activity areas, specify the sensor and/or satellite that would be most useful for developing these products and services. (1.1, 1.4, 10.8)

[ ] No activity area

15a. Activity Area 1: _____ 20aa. Sensor/satellite _____

15b. Activity Area 2: _____ 20bb. Sensor/satellite _____

15c. Activity Area 3: _____ 20cc. Sensor/satellite _____

16- On a scale of 0 to 10, where 0 represents a non-existent obstacle and 10 represents a major obstacle, indicate the degree to which the following factors constitute an obstacle preventing your department from using satellite data. (12.7, 18.7)

	Not an obstacle										Major obstacle
a) Price of satellite information compared with that of other sources of information	0	1	2	3	4	5	6	7	8	9	10
b) Procedures for acquiring data/accessibility	0	1	2	3	4	5	6	7	8	9	10
c) The policy on access to data	0	1	2	3	4	5	6	7	8	9	10
d) Uncertainty as to availability of data	0	1	2	3	4	5	6	7	8	9	10
e) Degree of complexity in generating information	0	1	2	3	4	5	6	7	8	9	10
f) Difficulty of integration with existing systems	0	1	2	3	4	5	6	7	8	9	10
g) Lack of funds for new initiatives	0	1	2	3	4	5	6	7	8	9	10
h) Lack of interest on the Department's part	0	1	2	3	4	5	6	7	8	9	10
Other (please specify):											
i) _____	0	1	2	3	4	5	6	7	8	9	10
j) _____	0	1	2	3	4	5	6	7	8	9	10

These final questions seek your opinion on improvements that could be made to the program.

17- Does your department use satellite data to meet its international commitments? (10.10)

[ ] No [ ] Yes (If yes, which commitments?)

_____

18- In your opinion, to what extent does the program help improve Canada's image as a major player in the use of satellite data? (10.12)

0- [ ] Not at all 1- [ ] Somewhat 2- [ ] A fair amount 3- [ ] A lot

Comments: _____

19- Does your department use applications that use satellite data developed without the support of the program? (13.1)

[ ] No [ ] Yes (What is the percentage?) _____

20- If yes, were some of these applications developed in-house? (8.2)

[ ] Yes [ ] No

21- What source(s) of information do you consult in order to be informed of recent developments in the use of satellite data? Please indicate the source titles. (10.13)

_____

22- *If the respondent does not mention EO Express, ask the following question:*
Is EO Express one of these sources? [ ] Yes [ ] No *(10.13)*

23- Have you participated in a workshop or attended a presentation on the use of satellite data funded by the CSA in the past five years? (10.6) [ ] No [ ] Yes

24- If yes, to what extent did participation in this workshop or presentation help you to:

a) Increase your knowledge of the potential benefits associated with the use of satellite data? (10.7)
0- [ ] Not at all 1- [ ] Somewhat 2- [ ] A fair amount 3- [ ] A lot

b) Increase your capacity (knowledge, expertise, skills, etc.) to use satellite data? (11.4)
c) [ ] Not at all 1- [ ] Somewhat 2- [ ] A fair amount 3- [ ] A lot

25- In your opinion, is the current program delivery method, which consists of allocating funding for each project, the most effective method for ensuring greater use of satellite data by your department? (16.6)
0- [ ] Not at all 1- [ ] Somewhat effective 2- [ ] Fairly effective 3- [ ] Completely effective

26- What other types of support or mechanisms might promote greater use of satellite data by your department? (16.11) _____
_____

27- To what extent are you satisfied with established partnerships and/or opportunities for the sharing of knowledge in this field between universities, the industry, and federal departments? (16.15)
0- [ ] Not at all satisfied 1- [ ] Somewhat unsatisfied 2- [ ] Somewhat satisfied 3- [ ] Very satisfied

28- In your opinion, what can be done to improve partnerships and/or the sharing of knowledge between universities, the industry and federal departments? (16.9) _____
_____

29- In your opinion, what can be done to increase the benefits generated by the program? (17.2)
_____

30- Is there anything else you would like to add in regard to the program? (18.8)
_____

The CSA would like to thank you for your participation.

Interview Guide – Industry

The Canadian Space Agency (CSA) is currently evaluating the Earth Observation Application Development Program (EOADP) to determine the extent to which implemented activities have contributed to achieving program objectives efficiently and economically, and ensure that they still fulfil a need.

As part of this evaluation, the CSA evaluation team is conducting interviews with key stakeholders at the CSA as well as representatives of organizations that have received program contracts.

Although your participation in this interview is voluntary, we are counting on your co-operation to ensure that the various program partners are fairly represented.

The following questions will serve as a guide for the interview. Throughout the interview, we ask that you provide us with any other information that you consider relevant.

The information gathered during this interview will remain confidential and is protected pursuant to the Access to Information and Privacy Acts. Only evaluation team members will have access to it and the results will be released solely in the form of compiled data. The interview will last between 30 and 45 minutes.

Do you agree to participate in this interview?

Yes [ ] No [ ]

To be able to make maximum use of your comments, we would like to request your permission to record this interview. The recording will be destroyed once the evaluation has been completed.

Do you agree to beginning the recording of this interview?

Yes [ ] No [ ]

The EOADP objective is to develop an internationally competitive Canadian space industry that is able to develop applications, products, and services using Earth observation satellite data that meet private- and public-sector requirements. The program builds on Canada's position as a leader in radar technologies and the processing of radar remote sensing data, made possible partly by RADARSAT 1

and 2 and by Earth imaging systems using synthetic aperture radar (SAR).

Interview No: _____

The objective of this first series of questions is to determine your impressions of the program's contribution to your activities.

On a scale of 0 to 3, where 0 represents "totally disagree" and 3 represents "totally agree", please indicate the extent to which you agree with the following statements.

	Totally Disagree			Totally Agree
1- Without the help of the program, my organization would not use RADARSAT-2 data as much to develop information products and services. (7.6)	0	1	2	3
Comments: _____				
2- The program has helped to increase my organization's capacity (knowledge, expertise, skills, etc.) to develop products and services in the satellite-based Earth observation field. (9.1, 9.2)	0	1	2	3
Comments: _____				
3- The program has helped to increase my organization's competitiveness in the satellite-based Earth observation market. (15.1)	0	1	2	3
Comments: _____				
4- My organization is able to take full advantage of RADARSAT-2 capabilities. (9.3)	0	1	2	3
Comments: _____				
5- The program has helped to extend my organization's reach internationally in the satellite-based Earth observation field. (10.12)	0	1	2	3
Comments: _____				
6- My organization is satisfied with the following participation procedures relative to requests for proposals (RFPs): (18.6, 16.1)				
Scope of eligible projects	0	1	2	3
Clarity of statements of work	0	1	2	3
Clarity of requirements to be met by tenderers	0	1	2	3
Requirements for proposals	0	1	2	3
Selection criteria	0	1	2	3
Monitoring of projects	0	1	2	3
Comments: _____				

7- Are there other sources of funding, either from the Government of Canada or other sources, to help you develop and/or commercialize applications using satellite data? (1.5)

No [ ] Yes [ ] Please specify:

7a. Name of source: _____ Gov't of Canada [ ] Other [ ] Funding received: Yes [ ] No [ ]

7b. Name of source: _____ Gov't of Canada [ ] Other [ ] Funding received: Yes [ ] No [ ]

8- In your opinion, would it be possible to ensure greater continuity between these various sources of funding? (16.14)

No [ ] Yes [ ] Explain how:

_____

9- In the past five years, have you presented your products or services that use Earth observation data at conferences, conventions, or in trade magazines supported by the CSA? (10.11)

No [ ] Yes [ ] Please provide names of conferences, conventions and/or trade magazines: _____

10- Were these presentations and/or publications followed by sales opportunities? (14.7, 15.3)

No [ ] Yes [ ]

According to our records, you received funding from the CSA to develop an application for the purpose of (*Describe the project before sending the interview guide*). **The following questions seek a better understanding of the spinoffs of this (these) project(s).**

11- Who were the potential users of this application? (12.1, 12.3)

_____

12- What is the level of maturity achieved with this application? (7.2, 7.3, 12.3)

a) [ ] Preliminary correlation between observation data and the terrain (R&D completed)
b) [ ] Determination of the reliability of measurements (pre-operational demonstration carried out)

If you checked off a) or b), are you continuing to develop this project? Yes [ ] No [ ]

If No, please explain: _____

c) [ ] The application is operational.

13- Did the project or related activities result in sales opportunities? (15.2, 15.3)

No [ ] Yes [ ] What is the estimated value of these sales? (15.4) _____

14- How many jobs have been assigned to this project and related activities? (15.5) _____

15- According to our records, you also submitted a proposal for a project, the objective of which was to **(*Describe the project before sending the interview guide*).** The CSA did not accept this proposal. Can you tell us what happened to this project? (8.1)

_____

16- Has your organization carried out activities involving the development of applications using satellite data without CSA support in the past five years? (8.2)

No [ ]

Yes [ ] Which satellite(s) provided the data that were used? _____

These final questions seek a better understanding of opportunities and problems you have, as well as your opinion on improvements that could be made to the program.

17- Would your organization like to develop other information products and services using satellite data? If it would, specify for each of these products and services the sensor and/or satellite that would be most useful for developing these products and services. (1.4)

[ ] No information product or service

17a. Activity Area 1: _____ 17aa. Sensor/satellite: _____

17b. Activity Area 2: _____ 17bb. Sensor/satellite: _____

17c. Activity Area 3: _____ 17cc. Sensor/satellite: _____

18- On a scale of 0 to 10, where 0 represents a non-existent obstacle and 10 represents a major obstacle, indicate the degree to which the following factors constitute an obstacle preventing your organization from commercializing its products and services using satellite data. (15.6, 18.7)

	Not an obstacle										Major obstacle
Price of Earth observation data compared with that of other sources of information	0	1	2	3	4	5	6	7	8	9	10
Procedures for acquiring data/accessibility	0	1	2	3	4	5	6	7	8	9	10
The policy on access to data	0	1	2	3	4	5	6	7	8	9	10
Uncertainty as to availability of data	0	1	2	3	4	5	6	7	8	9	10
Degree of complexity for end user	0	1	2	3	4	5	6	7	8	9	10
Limited access to international markets	0	1	2	3	4	5	6	7	8	9	10
Other (please specify):											
_____	0	1	2	3	4	5	6	7	8	9	10
_____	0	1	2	3	4	5	6	7	8	9	10

19- In general, how do potential users respond to your information products and services that make use of satellite-based Earth observation data? (12.2)

_____

20- To what extent would the obtaining of contracts to meet the requirements of federal departments for information products and services using satellite data help to increase your organization's competitiveness in the Earth observation market? (16.11)
0- [ ] Not at all 1- [ ] Somewhat 2- [ ] A fair amount 3- [ ] A lot

Comments: _____

21- To what extent would the receipt of repayable contributions for the purpose of developing products and services of your choice help to increase your organization's competitiveness in the satellite-based Earth observation market? (16.11)
0- [ ] Not at all 1- [ ] Somewhat 2- [ ] A fair amount 3- [ ] A lot

Comments: _____

22- What other types of support, either from the Canadian government or from other players, does your organization need in order to undertake innovative projects using satellite-based Earth observation data? (16.11)

_____

23- To what extent are you satisfied with established partnerships and/or opportunities for the sharing of knowledge in this field between universities, the industry, and federal departments? (16.9, 16.15)
1- [ ] Not at all satisfied 1- [ ] Somewhat unsatisfied 2- [ ] Somewhat satisfied 3- [ ] Very satisfied

24- In your opinion, what can be done to improve partnerships and/or the sharing of knowledge in this field between universities, the industry, and federal departments? (16.9, 16.15)

_____

25- In your opinion, what can be done to increase the benefits generated by the program? (17.2)

_____

26- Is there anything else you would like to add in regard to the program? (18.8)

_____

The CSA would like to thank you for your participation.

Interview Guide – Canadian Space Agency Employees

The Evaluation team at the Canadian Space Agency (CSA) is currently evaluating the Earth Observation Data and Imagery Utilization Program (EODIUP). This evaluation is designed to examine the extent to which the implemented activities have efficiently and effectively met the program objectives and to ensure that that the Program still meets a need.

As part of this evaluation, the CSA evaluation team is conducting interviews with key stakeholders at the CSA, other federal organizations and organizations that have received contracts under the Program.

Your participation in this interview is voluntary. Nevertheless, we are counting on your cooperation to ensure fair representation of the various Program partners. The following questions will serve as a guide for the interview. You are therefore encouraged, throughout the interview, to share with us any other information that you consider relevant.

The information gathered during this interview will remain confidential, as it is protected under the *Access to Information Act* and the *Privacy Act*. Only evaluation team members will have access to it, and the results will be released solely in the form of compiled data. The interview will last approximately 60 minutes.

Do you agree to take part in this interview?

[ ] Yes [ ] No

To be able to make full use of your comments, we would like to request your permission to record this interview. These recordings will be destroyed upon completing the evaluation.

Do you agree to have this interview recorded?

[ ] Yes [ ] No

Interview number: _____

The objective of this first series of questions is to obtain your impressions of the Program's contribution to your activities.

1- In your opinion, how does the program contribute to the CSA's strategic outcome? (3.3)

_____

2- Does the program tie in well with the objectives of the new program activity architecture? (3.3)
[ ] Yes [ ] No

Please explain: _____

3- Currently, the program's three main objectives are to support the industry, maximize the potential of Agency-supported missions, and ensure a greater use of satellite and Earth observation data by federal departments. In your opinion, which of these objectives is the most important? (2.2)

[ ] to support the industry

[ ] to maximize the potential of Agency-supported missions

[ ] to ensure a greater use of satellite and Earth observation data by federal departments

Comments: _____

4- In your opinion, are there any benefits to having a Canadian industry that is able to develop applications using Earth observation and satellite data? (1.2)

[ ] No [ ] Yes: What are they?_____

5- Does the CSA use Earth observation satellite data to meet its international commitments? (10.10 and 14.5)

[ ] No [ ] Yes: Which ones?_____

6- Can you think of any situations in which Earth observation products and services have been used in an international context, outside our international commitments? (14.6)

_____

7- What benefits does Canada receive from this participation? (14.7) _____

_____

8- How would you rate the use of Radarsat-2's potential? (7.5)_____

_____

9- What are the most promising applications for ensuring greater use of RADARSAT-2's data? (9.3)
_____

_____

10- How would you rate the level of preparation for the RADARSAT Constellation Mission (RCM)? (1.3 and 1.4)
_____

11- What new applications will be made possible by the RCM? (1.4) _____
_____

The purpose of the following questions is to gather information on improvements that could be made to the Program.

12- When you consider all the data available, whether they come from CSA-supported missions or not, what are the business lines and types of data in which satellite Earth observation would be the most useful in improving the program delivery of the departments? (1.1, 1.4)

11a. Activity Area 1: _____ 11aa. Sensor/satellite _____

11b. Activity Area 2: _____ 11bb. Sensor/satellite _____

11c. Activity Area 3: _____ 11cc. Sensor/satellite _____

13- What mechanisms exist that allow the CSA to get a full understanding of its partners' needs? (16.5)
_____
_____

14- Is the support for application development coordinated so that an application may be used in more than one area of activity? (6.7)

[ ] No [ ] Yes: What are these mechanisms? _____
_____

15- Are there other programs, from the Government of Canada or other sources, that support the development and/or commercialization of applications using Earth observation data? (1.5)

[ ] No [ ] Yes: Please specify

14 a. Name of source:_____ Gov't of Canada [ ] other [ ]

14 b. Name of source:_____ Gov't of Canada [ ] other [ ]

14 c. Name of source:_____ Gov't of Canada [ ] other [ ]

16- Are there other mechanisms in place to ensure continuity between these different programs? (16.13)
[ ] No [ ] Yes: What are they? _____
_____

17- Would it be possible for the CSA to ensure a better continuity among the various programs? (16.14)
[ ] No [ ] Yes How?: _____

_____

18- What mechanisms exist to ensure partnerships and/or knowledge sharing between universities, industry and departments? (16.15) _____

19- In your opinion, what can be done to improve partnerships and/or knowledge sharing between universities, industry and federal departments? (16.15) _____
_____

20- Is there any overlap between the GRIP and EOADP programs? (18.5)

[ ] No [ ] Yes: What are they?
_____

_____

21- How could we improve the synergy between these two programs? (18.5)

_____
_____

22- In your opinion, what are the greatest obstacles preventing the use of Earth observation data by federal departments? (12.7 and 18.7) _____

_____

23- In your opinion, what are the greatest obstacles preventing improved commercialization of Earth observation data by Canadian industry? (12.7, 18.7)

_____

_____

24- In your opinion, is the current program delivery method, which consists of allocating funding for each project, the most effective method for ensuring greater use of satellite data? (16.6)

0- [ ] Not at all 1- [ ] Somewhat 2- [ ] Fairly 3- [ ] Completely

25- What other types of support or mechanisms might promote greater use of satellite data? (16.11)

_____

_____

26- In your opinion, what could the Agency do to improve the participation of federal departments in the program, in particular those that have never taken part? (10.9)

_____

_____

27- In your opinion, does the program operate efficiently in the implementation of these processes and procedures? (18.6) _____

_____

28- What could be done to increase the benefits generated by the program, while maintaining the current level of resources? (17.2) _____

_____

29- Is there anything else you would like to add regarding the program? (18.8)

_____

The Evaluation Team would like to thank you for your participation.

Appendix C: Industry breakthroughs in the international market

"Environmental protection is not just about protecting nature. It's about the health of Canadians. An information session recently held at the Great Lakes Forestry Centre (GLFC) in Sault Ste. Marie, Ont., highlighted forestry in Finland, forest modeling and maps created from satellite imagery. The diverse subject matter was the result of a joint Finland – Canada initiative supported by the Canadian Space Agency (CSA) and the National Technology Agency of Finland (TEKES)."
EO Express 27.12, project # 9F028-04-4902-02

"With the support of the CSA and Hatfield Consultants, the Mekong River Commission (MRC) Regional Flood Management and Mitigation Centre in Cambodia is now providing flood extent and flood change maps of the Lower Mekong Basin derived from RADARSAT-1 images. Under the Lower Mekong Basin Flood Mapping Service, a set of flood products are available in near real time every 5 to 7 days on the MRC website."
EO Express 21.9, project # 9F028-03-9514

"Hatfield Consultants (Vancouver, BC) has recently been awarded a contract from World Bank for the Regional Capacity Building Program for Health Risk Management of Persistent Organic Pollutants (POPs) in South East Asia. Project funding to the World Bank and Hatfield is through the Canadian International Development Agency (CIDA) POPs Fund. In March 2008, Hatfield was contracted by Phu Bia Mining Limited to provide environmental monitoring training services to their new copper-gold mining development in Lao PDR. Both of these contracts were awarded based on Hatfield's extensive experience working in South East Asia, and were directly related to marketing efforts undertaken through the CSA Earth Observation Applications Development Program (EOADP) in the Mekong Region (Lao PDR, Cambodia, Thailand and Viet Nam)."
EO Express 27.1, project # 9F028-03-9514

"A progress meeting was held in Morocco from July 17 to 24 concerning the TIGER project on the use of satellite data for an integrated decision support system for managing the water resources of the Souss-Massa basin in Morocco. At this meeting, the project partners (IES, UQAM, CRTS) discussed this system, which will be used to target zones favourable for drilling (groundwater reserves); track land use and associated impacts on water resources; target underexploited zones; prepare a portrait of basin-scale erosion; and manage dams."
EO Express 21.7, project # 7001486

"Developed under CSA's Earth Observation Application Development Program (EOADP), ViaSat GeoTechnologies' StereoSat Africa project led to the development of a set of geospatial solutions for use by African agencies concerned with water resource management. These solutions consist of topographic and thematic products obtained chiefly from stereoscopic pairs of radar and/or optical satellites, to extract 3D information–in particular, products were developed to track water in the small reservoirs used for agricultural purposes or to meet household needs, as well as tools to generate detailed views of riparian management areas for purposes of erosion control."
EO Express 24.12, project # 9F028-04-5010-02

"Developed by VIASAT GeoTechnologies, a member of GéoQuébec, as part of the CSA's Earth Observation Application Development Program (EOADP), the StereoSAT project in Peru has enabled various Peruvian organizations to seize the advantages in using RADARSAT-1 data to produce topographical, thematic and cadastral data. More than 80 top executives took part in a workshop on this project in Lima, in June."
EO Express 29.12, project #9F028-04-5010-02

"Developed with support from the CSA's Earth Observation Application Development Program (EOADP), under the Canada-Finland MoU, Noetix Research recently completed the project entitled "Water Resource Development Project". The objective was the development and demonstration of Remote Sensing based products for surface water management; 1) Retrieval of fraction of snow covered area and snow water equivalence; 2) Detection of lake and river ice; 3) Water quality and quantity monitoring. Water Quality maps are available online at www.noetix.ca/WaterQuality/."
EO Express 18.5, project # 9F028-04-4902-03

"The final version of the Nile River Awareness Kit is now available on the Nile Transboundary Environmental Action Project (NTEAP) website both in French and English. This multimedia and interactive learning tool encourages knowledge and awareness regarding the environmental resources and management of the Nile Basin. The NRAK have been produced by Hatfield Consultants Ltd. and funded by the Earth Observation Application Development Program (EOADP) under the TIGER initiative."
EO Express 17.5, project # 9F028-04-5010-01

"Hatfield Consultants has completed a project, developed under CSA's Earth Observation Application Development Program (EOADP), entitled Earth Observation Support for Traditional Ecological Mapping and Biodiversity Conservation in Viet Nam (EO-STEM). EO-derived information was incorporated into the planning and management of biodiversity conservation in Vietnam by the World Wide Fund for Nature (WWF) and the Forest Protection Department of Thua Thien-Hue province (Vietnam)."
EO Express 19.9, project # 9F028-04-5007-01

Appendix D: Potential applications and type of data required

Potential applications as per industry.

Potential application	Type of data required
Agriculture (farmers and agr retail)	Optical Med/high resolution
Agriculture (humidité)	Radar
Environmental Monitoring (Agriculture, geology, forestry)	--
monitoring crop growth (agriculture / forestry	Fusion of Spot SAR, TerraSAR X, RADARSAT 2, Other EO and SAR including Airborne
Forestry	Tandem X
Cartographie forestière	Optique, LandSat, Rapid Eye
feature extraction	SPOT5 and WorldView2
Geotechnical Engineering	Advanced SAR
Mine and UXO Clearance	For road status: TerraSarX. For land cover RadipEye
Water, mining, oil, gas	Optical
Cartographie et Topographie	Interférométrie R-2 et RCM
Wide Area mosaicking	all optical and radar sensors
(Carbon Sequestration, Water Purification, Avoided reservoir sedimentation, Habitat Quality (biodiversity)	RapidEye, Sentinel-2
Environment/weather	weather satellites (GOGS, METESAT, INSAT, HRPT, METOP,MODIS
Oceans and lakes	Optical and Thermal
Permafrost Monitoring	TerraSar Tandem
Weather web display	high resolution optical imaging (SPOT) & radar satellites for elevation/topology
Change detection	Radar and optical sensors
Defence and Security	Radarsat
Disaster monitoring	RADARSAT 2, ASAR, TerraSAR X
Flood Mapping	Radarsat-2, RCM, Sentinel-1
Glacier Monitoring	Radarsat-2
Iceberg Monitoring	TerraSarX, Radarsat-2
Marine	Optical (Meris and Modus) and High resolution optical data for bisymmetry.
Maritime Surveillance (Ship detection, Oil, Ice)	Radar (Radarsat)
Multi-Frequency SAR for Ice navigation	ALOS Palsar and Radarsat-2
Multi-Polarization data for Ice navigation	Radarsat-2
port-surveillance/maritime	Fusion of Spot SAR, TerraSAR X, RADARSAT 2, Other EO and SAR including Airborne
Sea Ice Monitoring	TerraSarX, Radarsat-2, Envisat
Topographie pour les feux	Radar

Potential applications as per OGDs

Potential application	Type of data required
Water Clarity & Quality	Modis, Meris
Climate monitoring	Optical – Modis, VIIRS
Inventory and carbon accounting	Landsat, Spot, MODIS
Qualité de l'air	Tous les senseurs pouvant améliorer la prévision numérique du temps
Ocean surface current measurement	RADARSAT-2 and an application called Doppler centroid anomaly map
Humid environments	-2 & high resolution satellites like (Worldview and Econos for hot spots)
Change in Ecological Conditions of National Parks - ecosystem integrity	LandSat, Spot-4, Spot-5, Ikonos, Modis, Radarsat-2, AVHRS.
Algal Blooms	Modis, Meris and occasionally Landsat
Ecosystem Productivity (Carbon, water, energy)	Modis, VIIRS, PCW, Radarsat-2
water quality	MERIS or MODIS
Bilan du cycle du carbone	Tous les senseurs pouvant améliorer la prévision numérique du temps
Ocean features (sea surface temperature and acoustic sensor operation	Infrared, Radarsat-2, RCM
National Glacier Monitorin	Radasart-2, RCM
Construction des climatologies de couvertures/densité de neige, glace de mer	Tous les senseurs pouvant améliorer la prévision numérique du temps
Forest Dynamics (Fire, Defoliation, Deforestation)	Moderate resolution sensors both optical and radar, AVHRR.
Forest Inventory (where & type of forests)	Radarsat-2, Sentinel-2, LandSat 8, ENMAP, ALOS (pelsar)
Forest health assessment (fire, insect)	Landsat, MODIS, MERIS, AWiFS (worthy of investigation)
Biomass	Radarsat-2, Sentinel-2, LandSat 8, ENMAP, ALOS (pelsar)
Biodiversity	Modis, LandSat, QuickBird
Forest Assessment (inventory and biomass/living matter)	High resolution Optical, LandSat, GeoEye, QuickBird
Forest Biomass	Landsat, MODIS, Radarsat II, ICESat
Forest health (insects, invasive species	Enmap, Prisma
land use/occupation (e.g., environmental indicators)_	optic and radar data
crop and land-cover monitoring	multi-frequency radar (x-band, c-band, and l-band)
culture production in agriculture	Sentinel 2 and RADARSAT-2_
Monitoring crop condition	optical & radar
soil moisture	l-band radar and passive microwave

Inputs for agro-ecosystem model	optical & radar
crop condition and crop productivity	hyper-spectral of at least super-spectral
traceability of nitric fertilizers, heat stress	hyper-spectral
Agri-environment assessment	optical & radar
land use mapping	LANDSAT, SPOT multispectral and panchromatic
tracking land use change	MODIS
soil occupation	optical
Groundwater	SAR
Vegetation Cover (fuel mapping in the fire)	LandSat, Modus, Spot VDT
Measuring hot spots with thermal imagery – measuring the fire radiated energy	Modis, NIRST
Monitoring drought in Canadian forests	Radarsat-2
Sea Ice Detection	SAR: Radarsat-1, Radarsat-2, RCM
Ship Surveillance	Radarsat-2, RCM
Sea ice monitoring	SAR (though also optical, infrared, and passive microwave)
Geohazards (earthquake monitoring, landslides, volcanos,)	Radarsat, SAR, InSAR.
Iceberg detection	SAR
acquisition of planimetric data (e.g., lake cartography, roads)	LANDSAT and SPOT5
cartographic revision	LANDSAT and SPOT5
acquisition of altimetric data	ERS
Northern Arctic Mapping	SAR

Appendix E: List of organizations that participated in the program

Other Government Departments

Environnment Canada

- Sciences de l'atmosphère
- Service canadien des glaces
- Application de la loi
- Émissions canadienne de gaz à effet de serre
- Institut national de recherche sur les eaux
- Centre St-Laurent.

Natural Ressources Canada

- Centre canadien de télédétection
- Service canadien des forets
- Centre d'information topographique
- Commission géologique du Canada.

Pêches et océans Canada

- Régions du Pacifique
- Région de l'Atlantique
- Service des eaux côtières et des eaux intérieures.

Agriculture Canada
Ministère de la défense nationale
Agence de la santé publique du Canada
Parcs Canada

Private Sector

A.U.G. Signals Ltd.
AECOM Tecsult Inc.
C-CORE
Dendron Resource Surveys Inc.
DVP-GS Inc.
Enfotec Technical Services
Geomat International Inc.
GlobVision Inc.
Golder Associates
Hatfield Consultants Ltd.
Info-Electronics Systems Inc.
Geographic Resources & Integrated Data Solutions Ltd
IUCN The World Conservation Union
MDA
MIR Télédétection inc.
Noetix Research Inc.
PCI Geomatics
Radarsat International (RSI)
SoftMap Technologies Inc.
Synetix Inc.
Telesat Canada
Vantage Point International Inc.
Vexcel Canada
VIASAT GeoTechnologies Inc.