

2002



Report of the  
**Auditor General  
of Canada**  
to the House of Commons

DECEMBER

Chapter 7  
Canadian Space Agency—  
Implementing the Canadian Space Program



Office of the Auditor General of Canada

*The December 2002 Report of the Auditor General of Canada comprises 11 chapters, Matters of Special Importance—2002, a Foreword, Main Points, and Appendices. The main table of contents is found at the end of this publication.*

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Cat. No. FA1-2002/2-15E  
ISBN 0-662-33113-3



Chapter

# 7

Canadian Space Agency  
Implementing the  
Canadian Space Program

*The audit work reported in this chapter was conducted in accordance with the legislative mandate, policies, and practices of the Office of the Auditor General of Canada. These policies and practices embrace the standards recommended by the Canadian Institute of Chartered Accountants.*

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# Canadian Space Agency

## Implementing the Canadian Space Program

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### Main Points

7.1 The Canadian Space Agency needs to develop a new strategic plan that can help it balance the activities required of it under the Canadian Space Program and its annual funding level. Currently, it is unable to meet the expectations for the Space Program fully because of financial obligations that the government incurred in the past and that extend into the future; to some extent the Agency's own process of setting priorities is also responsible. The current imbalance between activities required under the Canadian Space Program and the Agency's financial capacity is likely to worsen in the next five years.

7.2 The Agency has only partially assessed the shortfall in its capacity to deliver the Canadian Space Program, and it needs to inform the government of the gaps in its ability to meet the Program's objectives.

### Background and other observations

7.3 The Space Program Management Framework is lacking some key elements that are required under the Canadian Space Program, including stakeholder participation in setting priorities, strategies, and plans for the Agency's five key service lines. As a result, the Agency is making strategic decisions that affect the funding of the service lines without the benefit of input from the advisory structure approved by the government, although it has held informal consultations with key stakeholders.

7.4 The Agency's project and risk management practices are generally sound in projects over which it has prime responsibility and control. However, in two major Crown projects it has been unable to escape the negative effects of program slippage, cost escalation, and unilateral decisions by international partners. For example, the three-year delay of the launch of Canada's third component for the International Space Station (ISS) will cost the Agency about \$13 million to maintain that component's full operational capability; and the withdrawal of the National Aeronautics and Space Administration (NASA) from the launch arrangement resulted in a delay of more than two years and additional costs of \$167 million for the Agency's RADARSAT-2 project. In addition, a projected cost overrun of US\$5 billion in the ISS program by NASA caused the United States Congress to impose a temporary budget cap of US\$25 billion while NASA corrects its program management practices. If this cap is maintained, it threatens to severely limit Canada's ability to conduct the research for which it has invested in the program.

7.5 The Agency enjoys a strong reputation for excellence. Although it is not a large organization, its programs are highly visible nationally and internationally. They are a source of national pride for most Canadians and have earned Canada worldwide recognition in the space industry.

7.6 There is an urgent need for the Agency to develop a strategic human resources plan. Although senior managers are aware of their short-term needs, a human resources committee has yet to be established and made responsible for developing a comprehensive human resources plan that links the needs of directorates to operational plans and strategic objectives. The Agency is currently increasing its indeterminate workforce significantly while reducing its reliance on term employees and contract workers. However, it has not aligned its present competencies with the projects it has planned for the short and the long terms to identify clearly the additional resources it needs.

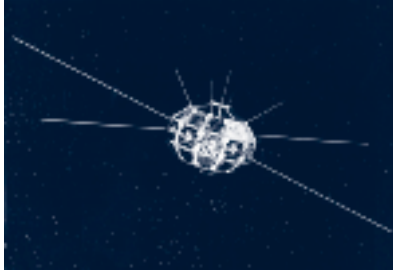
7.7 The Agency does not have all the necessary processes to report on its performance. It has developed few performance indicators by which to measure its progress toward desired strategic outcomes. Currently, in reporting to Parliament, the Agency arbitrarily matches the strategic outcomes with consolidated information from the reports of its directorates.

**The Agency has responded.** The Canadian Space Agency has generally agreed with our recommendations. Actions it has under way or planned are set out in its response to each recommendation in the chapter.



## Introduction

### The Canadian Space Program



Alouette 1 research satellite, launched 29 September 1962 to study the ionosphere. Canada was the third country in the world, after Russia and the United States, to design and build its own satellite.

**7.8** Canada has had a space program since Canadians first studied the upper atmosphere with the assistance of balloons and rockets, followed by the launch of the Alouette 1 satellite in 1962. Early activities were scattered among several government departments and agencies and co-ordinated by the Interdepartmental Committee on Space. However, the Committee was not in a position to set priorities and reallocate funds among those departments and agencies. The space program remained fragmented, the government's support for the Canadian industry was inconsistent, and the management structure was confusing to Canada's international partners.

**7.9** Several studies over the years concluded that a distinct Canadian space agency was needed to focus Canada's space efforts. A separate agency that emphasized the contracting out of research and development could ensure the active involvement of the private sector and universities and augment the social and economic benefits of Canada's space program.

**7.10** The Canadian Space Agency was established by order-in-council in March 1989. Several activities and programs were transferred to the new Agency from what were then the Department of Energy, Mines and Resources, the Department of Communications, and the Ministry of State for Science and Technology. However, a number of space-related activities remained in other departments and agencies, and they continue there today. The two largest programs transferred to the Agency governed Canada's participation in the International Space Station and the RADARSAT remote-sensing satellite.

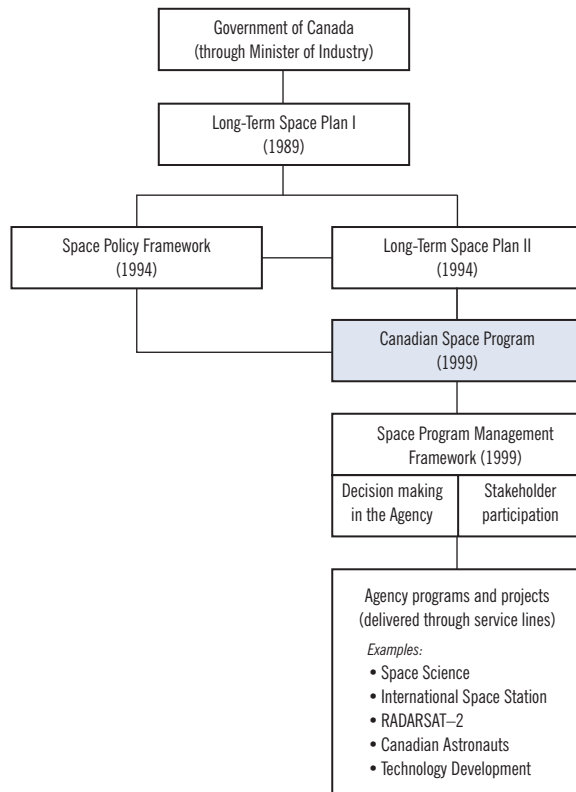
**7.11** In 1999, responding to the changing international space sector and the increasing demand for space technologies, the government announced the new Canadian Space Program to be managed by the Agency. Exhibit 7.1 shows the main elements of the Program, whose main objectives are

- to develop and apply space science and technology to meet Canadian needs, and
- to develop an internationally competitive space industry.

**7.12** The Canadian Space Program is guided by the 1994 Space Policy Framework. The Framework states that space is strategically important in Canada's transition to a knowledge-based economy and to the social, scientific, sovereignty, security, and foreign policy objectives of the federal government. Under the Framework, the Agency co-ordinates the federal government's efforts in civil space-related research, science and technology, industrial development, and international co-operation.

**7.13** The Space Program Management Framework describes the Agency's decision-making structure and the means by which various stakeholder committees participate in defining, implementing, and developing the Canadian Space Program.

**Exhibit 7.1 Structure of the Canadian Space Program**



7.14 To deliver the Program, the Agency has organized its activities under a single business line—Space Knowledge, Applications and Industry Development—with seven service lines (Exhibit 7.2).



RADARSAT-1 at the Agency's David Florida Laboratory in Ottawa during testing and assembly.

7.15 The Canadian Space Program is heavily oriented toward domestic and international partnerships and close collaboration with key federal, provincial, and academic stakeholders (Exhibit 7.3).

7.16 The Agency's mandate under the *Canadian Space Agency Act* is to

- promote the peaceful use and development of space,
- advance the knowledge of space through science, and
- ensure that space science and technology provide social and economic benefits for Canadians.

7.17 The Agency reports to Parliament through the Minister of Industry. In March 2002, the Agency employed about 500 people and had some 400 contract workers. Most of its staff work at the head office, the John H. Chapman Space Centre in Saint-Hubert, Quebec. Some staff and the spacecraft testing facility are in Ottawa, and a small number work in Washington, D.C.; Houston, Texas; and Paris, France.

## Exhibit 7.2 Canadian Space Agency's service lines

### Key service lines assigned priority under the Canadian Space Program

- **Space Science**—Advancing scientific knowledge in areas of strategic importance to Canada by giving Canadian scientists access to the unique environment of space (for example, space life science, microgravity science, space astronomy, and space exploration).
- **Earth and Environment**—Using space technologies to understand, monitor, and protect the Earth and its environment (for example, RADARSAT-1 and RADARSAT-2).
- **Human Presence in Space**—Providing a meaningful and visible contribution to international efforts to establish a human presence in and beyond low Earth orbit, and ensuring that this contribution will bring tangible benefits to Canada (examples are the Canadian Astronaut Program and Canada's contribution to the International Space Station).
- **Satellite Communications**—Ensuring that all Canadians have access to new communications technologies and services and positioning Canadian industry to participate significantly in the new global communications business.
- **Generic Space Technologies**—Developing innovative and emerging technologies to ensure the growth and competitiveness of the Canadian space industry to meet future needs of the Canadian Space Program and maximize commercialization of space technologies in both space and non-space applications.

### Other service lines

- **Space Qualification Services**—Providing an environmental test facility capable of meeting the current and emerging needs of Canada's space community and space-related objectives (the David Florida Laboratory).
- **Comptrollership and Awareness**—Ensuring that the Agency performs its role as the national leader of the Canadian Space Program.

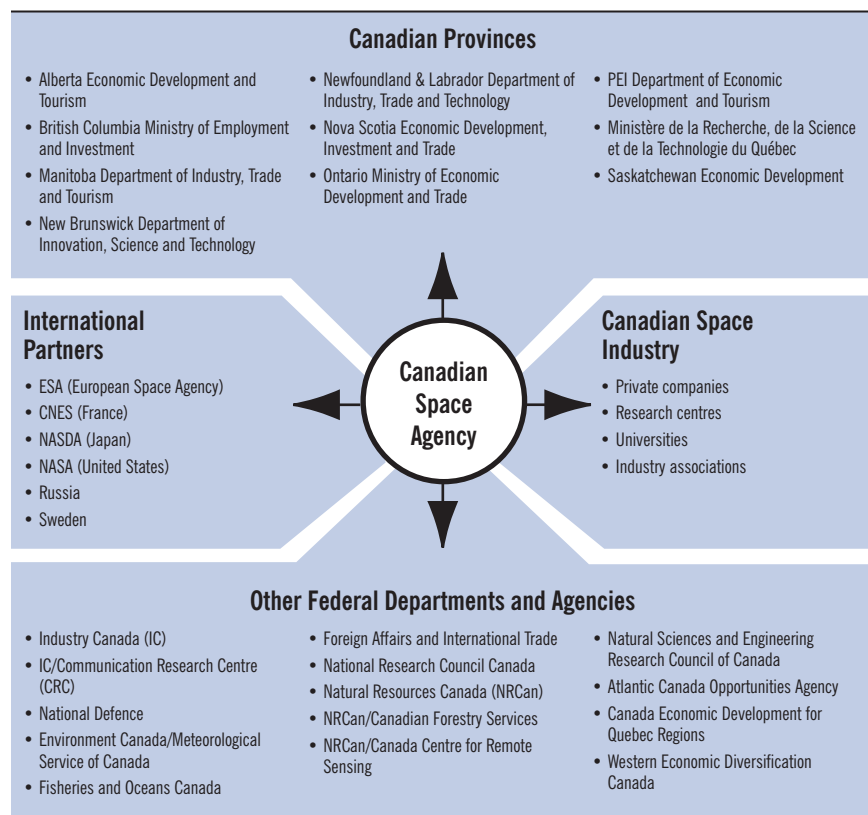
Source: Canadian Space Agency

**7.18** Until 1999 the Agency lacked stable ongoing funding; it was funded under long-term space plans approved by Cabinet and consisting mainly of major Crown projects. The Agency had to seek Cabinet approval for any supplementary funding required for projects. The 1999 federal Budget provided \$430 million in additional funding over the three years that followed and, beginning in 2002–03, a stable envelope of \$300 million to deliver the Canadian Space Program.

### Focus of the audit

**7.19** This was our first value-for-money audit of the Canadian Space Agency. Our objective was to assess whether the Agency is implementing the Canadian Space Program with due regard to economy, efficiency, and effectiveness. We looked at how the Agency selects programs or projects for funding and how it monitors and evaluates those it funds. We looked at how the Agency ensures that it has the staff it needs at the right time. Finally, we assessed how it reports on its performance.

**7.20** More information on our audit objectives, scope, approach, and criteria can be found at the end of the chapter in About the Audit.

**Exhibit 7.3** The Canadian Space Agency's main partners and stakeholders

Source: Canadian Space Agency

## Observations and Recommendations

### Strategic planning

#### A new strategy is needed to resolve an imbalance between obligations and funding

**7.21** The Canadian Space Agency is an organization in transition. For most of the 1990s, its programs and projects needed Cabinet's explicit approval and were largely major Crown projects under a Long-Term Space Plan. The Agency's priorities were clear, and it had a small number of very large projects to manage; its strategic and operational management practices reflected that environment.

**7.22** The new Canadian Space Program in 1999 and the approval of stable ongoing funding for the Agency meant that it would need to make some fundamental changes in the way it operated. It now had to decide its own priorities and manage them within its \$300 million annual budget. It also had to change its approach to human resources management—from an extensive use of term employees and contract workers on each new project to a greater use of indeterminate employees to meet long-term needs.

**7.23** The Agency receives many requests for funding. New initiatives reflect the evolving nature of the space business in Canada and internationally. Past decisions to fund major Crown projects represent ongoing and long-term

financial commitments. With a fixed budget, the Agency must make critical choices: Where, why, and how will it intervene with the maximum impact?

**7.24** We expected that to fulfil its mandate and obligations under the Canadian Space Program, the Agency would have clear objectives and strategies that would take into account its capacity, the demands of its operating environment, and the needs and priorities of its stakeholders. The Program also requires that in defining its future strategic direction the Agency consult closely with science-based federal departments, provincial governments, academia, and the space industry.

#### **A legacy of funding obligations hampers the Agency's flexibility for new initiatives**

**7.25** The government decided in 1975 to launch its program of remote sensing radars, and in 1984 to participate in the International Space Station (ISS) program. Both decisions were made before the Canadian Space Agency was created. However, both of these major Crown projects are now and will continue to be the Agency's responsibility for the next decade or longer.

**7.26** The risks associated with these two major commitments, each involving international partners, have caused delays and significant cost increases for the Agency. For example, the launch of Canada's third component for the International Space Station was delayed for three years, adding about \$13 million to the Agency's costs. Furthermore, NASA's withdrawal from the launch arrangement resulted in a launch delay of more than two years and additional costs of \$167 million for the Agency's RADARSAT-2 program. And NASA's projected cost overrun of US\$5 billion on the International Space Station has resulted in a temporary budget cap of US\$25 billion, imposed on the program by the U.S. Congress while NASA corrects its program management practices. If maintained, this cap will reduce the science capacity of the space station and could limit Canada's ability to conduct the research for which it has already invested in the program.

**7.27** The current and future financial obligations imposed by these two major Crown projects seriously limit the Agency's flexibility to fund new program initiatives and pursue the full range of scientific developments currently envisaged under the Canadian Space Program. They have meant the cancellation or postponement of approved activities. They also limit the Agency's ability to provide new opportunities to Canada's research and development community, to maintain a position of excellence worldwide in the exploration and use of space, and to optimize the benefits of participating in international space activities. Overall, they have created an imbalance between the Agency's obligations and its financial capacity, a situation that is likely to worsen in the next five years.

#### **The Agency needs to reassess its capacity to deliver its work program**

**7.28** Prior commitments, cost overruns in some projects, and the desire to fund some emerging new initiatives left the Agency facing a funding shortfall for fiscal year 2002-03, which it estimated at about \$58 million. To address the situation, the Agency completed a priority review exercise in early 2002

to determine which planned programs and projects it would fund for the current year. This exercise, the first in an annual process, consisted of a review and ranking of all the Agency's programs and projects and a number of proposals not yet funded. The criteria used to rank programs and projects were defined broadly and in line with the Agency's strategic outcomes (set out in paragraph 7.89). The review resulted in the elimination of the \$58 million shortfall and the reallocation of about \$12.5 million to fund new initiatives for the current fiscal year.

**7.29** However, a corporate-wide ranking of programs by merit is difficult because senior managers lack detailed knowledge of programs outside their own core function directorates. Furthermore, we are concerned about the short-term focus of the priority review exercise. While the Agency has addressed the funding shortfall for the current fiscal year, we are concerned that it has analyzed neither the future financial implications of some current proposals nor the prospects for their continued funding.

**7.30** **Some current proposals and emerging initiatives.** Canada has had co-operation agreements with the European Space Agency (ESA) since 1979 and is the only country outside Europe that participates in the ESA's programs. In the past, Canada's annual contributions to ESA programs have ranged from \$20 million to \$30 million; its contribution for 2001–02 amounted to \$21.8 million. The ESA's industrial policy guarantees member states a financial return on their contributions as well as technology development contracts. Its contracts with the Canadian space industry reflect the size of the Canadian Space Agency's contribution—mainly to Earth observation and satellite communications.

**7.31** As part of its priority review exercise, the Agency assessed the benefits of continuing the Canada-ESA co-operation. It concluded that Canada's agreement with the European Space Agency is a valuable strategic framework for international space co-operation, and it decided to support continued co-operation, including a few new ESA programs.

**7.32** The Agency hopes to participate in the development and validation phase of the Galileo project, Europe's global navigation satellite system that is expected to complement the U.S. Global Positioning System but with enhanced technology. If the ESA accepts its bid to participate, the Agency will have to make a five-year commitment of funds and persuade other federal government departments to make unanticipated contributions in order to make Canada's contribution meaningful.

**7.33** In our opinion, the new Agency initiatives in ESA programs represent only a preliminary involvement by Canada, while its future participation in the programs is far from certain given the Agency's budget limitations. We believe this shows the importance of better integrating its planning system with its strategic direction before the Agency contemplates any significant new investments.

**7.34** The Agency has made a commitment to preserve its in-house expertise in space technologies, satellite operations, program management, life-cycle

support of the ISS, and hardware testing. The President of the Agency has stated his desire that the Agency also maintain a minimum research and development capacity. In addition, the Agency currently faces other challenges that include increasing its indeterminate workforce, adjusting to changes such as the government's modern comptrollership initiative, and funding other new initiatives.

**7.35** The Agency recently decided to participate in the international Mars Exploration program led by the United States. Ongoing participation in this program is conditional on the Agency's obtaining the required funding. This is a long-term program that requires a high level of funding. It is clear that while the Agency is motivated to pursue leading-edge space programs and projects that could benefit Canada and the Canadian space industry, it must make choices among competing proposals to remain within its budget.

**7.36 Recommendation.** The Canadian Space Agency should develop a new strategic plan with clear objectives and strategies that reflect its current and long-term funding obligations and proposed new initiatives and that take account of its financial capacity. The Agency should then advise the government of any significant gaps in its ability to deliver its obligations under the Canadian Space Program and the consequences of not being able to undertake specific initiatives.

**Agency's response.** This action is currently under way. In the past, the Canadian Space Agency has developed several strategic plans, which were submitted for approval to the government. The Agency will take into account the points raised by the Auditor General in the development of a new strategic plan to be completed during 2003. The Agency will continue to advise the government on its ability to deliver its obligations under the Canadian Space Program.

#### **The Space Program Management Framework is still not operating as intended**

**7.37** The Space Program Management Framework of 1999 formalizes the structure and processes by which the Agency conducts its business and interacts with its stakeholders. One of the Framework's guiding principles is that stakeholders must have visible input into resource allocation decisions for the Canadian Space Program. We expected that the key components of the Framework would be in place and roles and responsibilities well understood by stakeholders and by Agency staff.

**7.38** The Framework calls for the creation of the Canadian Space Agency Advisory Council and service line advisory groups. The Advisory Council is to advise the President on corporate strategic direction; the service line advisory groups are to advise the Agency on priorities, strategies, and plans for each of the five key service lines. The service line priorities and strategies together are to represent the core of the Agency's strategic plan.

**7.39** The Advisory Council was not formed until late 2001, due in part to senior management changes at Industry Canada and at the Agency. On the Agency's recommendation the Minister of Industry appointed the members of the Advisory Council, who include representatives of the Government of

Canada, industry, academia, and other groups. The Council has yet to fulfil its central role of advising the Agency on priorities during the strategic planning process, as approved by the government in 1999. For example, it had no input into preparing the Agency's 2002–03 *Report on Plans and Priorities*; it was able to review the document only after it had been finalized and submitted.

**7.40** A corporate Strategic Development Directorate was created in 1999 to separate strategic planning from program management. Programs are managed by senior managers in each core function directorate, while a separate group of senior managers, the service line co-ordinators, are to co-ordinate program development. However, the Strategic Development Directorate has not been fully active, partly due to staffing delays.

**7.41** At the time of our audit, the Earth and Environment Service Line Advisory Group was the only one formed. Management has since advised us that due to delays in staffing the service line co-ordinator positions, the Agency only recently established advisory groups for the Human Presence in Space and the Space Science service lines. Advisory groups for the Generic Space Technologies and the Satellite Communications service lines are expected to be formed before the end of 2002.

**7.42** At the time of our audit, the Agency was preparing a revised Government of Canada Strategy on Space to present to Cabinet in the fall of 2002. This document was expected to form part of service line strategies targeted for December 2002 and an agency-wide strategic plan targeted for June 2003.

**7.43** We believe the Agency should have an effective planning function by now and should be consulting with stakeholders on revising the long-term strategic plan. In our opinion, the Agency does not yet have the key components of the Space Program Management Framework. Some components are operating but are not fully integrated within the Framework. As a result, the Agency is making important decisions that affect funding to the service lines without the benefit of input from the advisory structure approved by the government, although informal consultations have been held with key stakeholders.

**7.44 Recommendation.** The Agency should ensure that all remaining components of the Space Program Management Framework are put in place as soon as possible.

**Agency's response.** This action is under way. The Agency agrees with the recommendation and will ensure that all components of the Space Program Management Framework are in place before the end of 2002.

**7.45 Recommendation.** The Agency should continue to consult with all key stakeholders in its formulation of long-term strategies for the Canadian Space Program and should ensure that the strategic advice of the Advisory Council is considered in the Government of Canada Strategy on Space.



**Agency's response.** The Agency values the input of its stakeholders and will continue to consult its key stakeholders in the formulation of long-term strategies for the Canadian Space Program, including the Government of Canada Strategy on Space.

## Project management

### Managing projects is at the core of the Agency's business

**7.46** Contracts for projects involving industry, universities, and specialized research institutes represent about 75 percent to 80 percent of the Agency's budget; project management, internal research and development, and support functions account for the rest. In early 2002, the Agency's priority review exercise included 134 programs or projects and 20 additional proposals not yet funded.

**7.47** We reviewed the Agency's project management practices in two major Crown projects—the Canadian Space Station program and the RADARSAT program—and in seven other capital projects under its full responsibility and control. We expected that the Agency would monitor, evaluate, and report to decision-makers both the costs, potential risks, and benefits associated with the two major projects and their impact on programs of other service lines. We also looked for generally accepted principles of project management in projects contracted to Canadian industry and projects carried out with international partners. Our audit did not examine the Agency's contracting practices or compliance with government contracting regulations.

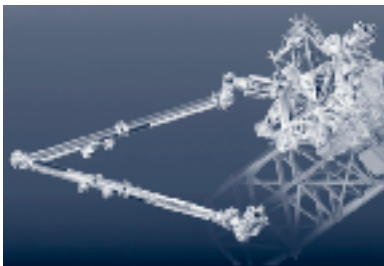
**7.48** We found that although generally sound, the Agency's project management and risk management practices are applied inconsistently in projects over which it has prime responsibility and control. Project documentation, cost projections, and risk assessments do not always meet the criteria set out in the Agency's Project Approval and Management Framework.

**7.49** In consultation with the Treasury Board Secretariat, the Agency established its Risk Assessment and Commitment Control Plan, a five-year plan to ensure that resources are set aside to mitigate risks to approved programs. In some cases, this means that some planned programs are put on hold until identified risks to approved programs have been removed. However, managers are often reluctant to assign risk levels that could push the costs of proposed projects above approval thresholds. Further, in programs involving international partners the risks are difficult to anticipate.

### Delays, cost overruns, and decisions by international partners in major Crown projects prove costly to the Agency

**7.50** We found that the Agency has followed generally accepted project management principles in the Canadian Space Station and RADARSAT-1 programs. In its two major Crown projects with international partners, however, it has been unable to escape the negative effects of program slippage and cost escalation. Project delays, cost overruns, and decisions by its international partners have increased the costs of Canada's contributions to the International Space Station program, could reduce the opportunities for Canadian astronauts to participate, and could delay scientific experiments.

**The Mobile Servicing System**—This includes the Space Station Remote Manipulator System, the Mobile Base System, and the Special Purpose Dexterous Manipulator; their related ground equipment and operations; and support facilities located on the space station and on the ground.



Space Station Remote Manipulator System (Canadarm2) and Mobile Base System, two of the three components of the Mobile Servicing System, Canada's contribution to the International Space Station.



Artist's rendition of the Special Purpose Dexterous Manipulator (SPDM) attached to the Canadarm2 of the Mobile Servicing System.

Furthermore, NASA's decision not to launch the RADARSAT-2 satellite for Canada has added considerably to the Agency's costs. We are concerned that Canada's agreements with the Agency's international partners involve a level of moral commitment that could lead to significant downstream costs and limit the Agency's budget flexibility.

**7.51 The Canadian Space Station program.** Appendix A provides a brief history of the Canadian Space Station program, Canada's participation in the International Space Station (ISS). Canada's main contribution to the ISS is the \$1.4 billion **Mobile Servicing System**; that amount includes the cost of a major Crown project to construct the Mobile Servicing System and the cost of operating it for the life of the space station.

**7.52** Canada is a partner in the management, operation, and use of the ISS over its entire lifetime. Until 2015–16 Canada is also responsible for the costs of the Mobile Servicing System's ongoing operational support, logistics and sustaining engineering, repair and overhaul, astronaut training, and the related ground facilities (estimated at \$45 million a year). When Canada increased its contribution to the space station to include the Special Purpose Dexterous Manipulator (SPDM) and Canadarm2 support, NASA agreed that Canada could have a specified use of the space station without paying its annual share of the common system operating costs. Around 2008, Canada will start paying a 2.3 percent share of the common system operating costs (a share currently estimated at \$50 million a year and likely to increase). Other financial obligations associated with this program have not yet been estimated. These include the costs of development, launch, and retrieval of payloads as well as the future decommissioning costs. Having signed a cross-waiver of liability with the international partners, Canada is also exposed to the cost of repairing or replacing the **Mobile Servicing System** if it is damaged on orbit and the cost of replacing the Special Purpose Dexterous Manipulator if it is lost due to a launch failure.

**7.53** In 2002, NASA projected a cost overrun on the program of US\$5 billion, which led the U.S. Congress to impose a temporary budget cap of US\$25 billion. That decision has a major impact on Canada's future use of the ISS, since it could delay indefinitely the completion of three of the planned components and could reduce the capacity of the ISS from seven astronauts to three. Since the time of 2.5 astronauts will be taken up in operating and maintaining the space station, there would be little opportunity to carry out the science for which it is being constructed.

**7.54** Another consequence of the temporary budget cap and the resulting redesign of the ISS is a delay in the launch of Canada's third and final component for the space station, the Special Purpose Dexterous Manipulator (SPDM). The launch was originally scheduled for 2002 but has now been delayed until 2005. The contractor is scheduled to deliver the SPDM in 2002. It will cost about \$13 million to keep it in operating condition during its storage period.

**7.55** We are concerned about a July 2002 report of the U.S. General Accounting Office, which noted that NASA's financial management system

had proved inadequate for tracking ISS costs; new studies were to include a reassessment of long-term operating costs. Since 2.3 percent of those costs will eventually be Canada's responsibility, the reassessment could increase the costs to the Agency and cause an additional drain on the resources it has available for other projects.

**7.56** In our opinion, the key risks associated with Canada's involvement in the NASA-led ISS program could prove to be beyond the Agency's ability to manage. A major objective of the International Space Station was to serve as a platform for scientific experiments. However, it will be only partially available for scientific use by Canada until NASA's cost control problems are resolved and the crew increases beyond three, which is not expected before 2008. If the crew size is not increased, there is also a risk that the space station may never be available for its intended purpose. Furthermore, the costs of the long-term maintenance and operations of the ISS and the Mobile Servicing System will eventually absorb about a third of the Agency's current annual budget of \$300 million.



RADARSAT-1 Earth observation satellite, launched in November 1995, uses a powerful microwave Synthetic Aperture Radar (SAR) system to collect imagery of the Earth day or night and in all weather conditions.

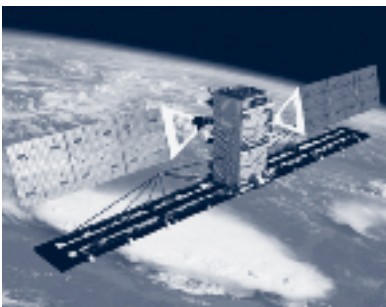
**7.57 The RADARSAT program.** Appendix B provides a brief history of the RADARSAT Program. RADARSAT-1 is a \$678 million Canadian-led project involving the private sector, nine provinces, and the United States. The federal government was responsible for developing the satellite, and it continues to manage its operations; the private sector is responsible for marketing, data processing, and data distribution. NASA provided the satellite launch in return for access to the data.

**7.58** The RADARSAT-2 project followed, to maintain the continuity of data from RADARSAT-1 and move toward privatization; the government's long-term objective is to create a commercial satellite remote sensing business in Canada. The operations phase of RADARSAT-2 is expected to last seven years. A prime contractor was selected through a competitive process in 1998 to construct and operate this satellite.

**7.59** A decision by NASA, however, had serious consequences for the costs of RADARSAT-2. In May 1994, the Canadian Space Agency and NASA signed "Arrangements for Enhanced Cooperation in Space" to provide for the launch of RADARSAT-2 "involving essentially the same terms as RADARSAT-1." In December 1998, NASA informed the Agency that it would not conclude a formal agreement as envisaged in the 1994 arrangement. There are conflicting explanations for this change in NASA's position.

**7.60** That decision resulted in a launch delay of more than two years and additional project costs of about \$178 million. The Agency's share of the additional cost was \$167 million, with the balance borne by the prime contractor. To cover the cost increase, the Agency reallocated \$167 million from its budget over the four years starting at 2001-02. This has had a significant impact on the Agency's ability to implement some of the new application development programs under the Canadian Space Program.

**7.61** Major Crown projects such as the International Space Station and the RADARSAT program, often referred to as Big Science, involve a level of risk



The launch of RADARSAT-2 satellite was delayed more than two years to 2004, resulting in additional project costs of about \$178 million.

and complexity that presents special challenges for those asked to approve them. In our opinion, Big Science proposals submitted for Cabinet approval need to be as complete and as accurate as possible, with information for decision makers on the following:

- The unique scientific nature of the project that can push the boundaries of knowledge.
- The many uncertainties and risks associated with the project and a thorough assessment of whether they are internal (technological or scientific) or external (inflation, partners' withdrawal).
- The costs of all project cycles—from construction to implementation, ongoing operation and maintenance, research and development, and decommissioning.
- The financial involvement of all federal organizations and an indication of whether the funding needs government approval.
- The expected scientific benefits based on adequate analysis, including valid peer review.
- The expected economic benefits based on adequate analysis, recognizing that commercial potential may be modest.
- Procedures for evaluating a project's results and benefits using measures that reflect an appropriate mix of outcomes and perspectives (for example, scientific accomplishments and economic benefits).

**7.62 Recommendation.** In proposing future projects for Cabinet's approval, the Agency should consider carefully its ability to sustain funding commitments for projects that involve high risk, international partners, and leading-edge technology, and should fully disclose to decision makers all known and potential risks and costs.

**Agency's response.** The Agency agrees with the recommendation and will continue to identify and disclose potential risks and costs. It should be noted, however, that the Canadian Space Agency leverages international partnerships to extend the reach of many of its projects, and thus cannot fully control all programming issues associated with those projects.

#### **The Project Approval and Management Framework is not fully implemented**

**7.63** In the 1990s, before the Agency had stable ongoing funding, the discipline imposed on it by government requirements for major capital projects made the setting and balancing of priorities relatively simple. However, the Agency's environment is changing, with a trend expected toward more and smaller projects. Management currently has two challenges: to determine relative priorities among competing project proposals and to monitor several projects under way at the same time. These challenges call for uniform project planning and management processes.

**7.64** The Agency has developed a formal Project Approval and Management Framework for all projects. The Treasury Board approved the new project framework in March 2000 as a condition of increasing the Agency's delegated authority for project approval from \$1 million to \$5 million. The Agency's original target of March 2001 to complete the

necessary documentation and fully implement the project framework was delayed a year because the Agency had underestimated the magnitude of the task; it is now being implemented in progressive phases. However, we noted that some project managers are resisting the framework because they believe the approval process is too onerous for smaller projects. The Agency advised us that it is reviewing the project framework in light of these concerns.

**7.65** In our opinion, the project framework has the potential to improve the selection and management of projects. In the past it appeared that projects were selected on a basis other than their relative priority and contribution to corporate objectives. The Agency participates formally in many international meetings with NASA and the ESA, and its individual scientists attend various conferences. We noted that what were initiated as “in-house” investigations through such activities have led to participation in projects without adequate analysis of their downstream financial implications. Once initiated, these projects could become costly and difficult to abandon or downgrade.

**7.66 Recommendation.** The Agency should continue to refine its Project Approval and Management Framework to meet the needs of large and small projects and should ensure its full acceptance and use.

**Agency’s response.** The Agency is reviewing and refining its Project Approval and Management Framework to better meet the needs of Agency project managers in their management of a wide range of projects. The Agency will implement the revised Project Approval and Management Framework by the end of 2003.

## Human resources management

### There is an urgent need to develop a strategic plan for human resources

**7.67** The Agency’s most valuable asset is its workforce. As a knowledge-based organization, it relies on the quality of its workforce to reach its objectives. The Agency’s success thus depends in large part on its ability to attract, retain, and motivate the highly educated and specialized workforce it needs to carry out its activities. We therefore expected the Agency to have a means of ensuring that it has the right number of people with the right knowledge, skills, and abilities in the right place and at the right time.

**7.68** The Agency has considered increasing the number of indeterminate employees since it obtained its stable ongoing funding in 1999. As already noted, funding in the past was based on major capital projects with a lifespan of about 15 years. The Agency made extensive use of term employees and contract workers for space-related activities in the design, development, implementation, and operation of its projects. In December 2001, more than 50 percent of entry-level staff in engineering and computer science positions were term employees. Today, the Agency believes that its new initiatives and projects, together with stable ongoing funding, can allow it to increase its indeterminate workforce.

**7.69** Effective human resources planning should give the Agency’s senior managers a clear picture of human resources needs in both the short and the long terms. Analysis of current resources and future needs would allow for

optimal and timely decisions by management to ensure that it has the staff it needs at the right time.

**7.70** The Agency approved a human resources management framework in December 1999 that recognizes as one criterion for success its awareness of present and future human resources requirements and its ability to address the gap between the human resources it has and those it needs. It also identified the planning of human resources management as a performance indicator and an important element of its business plan that must be integrated into the Agency's planning process.

**7.71** The Human Resources Directorate developed human resources guidelines and provided managers with several notable tools, all of which are located on the Agency's intranet site. The planning guideline indicates that senior managers should submit their objectives and their human resources plans annually and report their results to the President. The President establishes annual corporate priorities. One of the President's priorities for 2000–01 called for all senior managers to prepare human resources plans, succession plans, and career and training plans. The plans were to describe current staff shortages and future staff needs. The planning guideline also suggests that once a year a committee of senior managers review the human resources plans and establish objectives for human resources management over the following fiscal year. This committee will also develop guidelines on how to prepare human resources plans.

#### **The Agency has neither a demographic profile of its workforce nor a comprehensive human resources plan**

**7.72** Given the success criteria outlined in the human resources management framework, we expected the Agency to have a comprehensive human resources plan based on a demographic analysis and integrated with its strategic and operational plans.

**7.73** However, we found that the Agency has never produced a demographic profile of its current workforce that would allow it to project its emerging requirements for workforce renewal on a short-term and long-term basis. A demographic profile usually shows the workforce by age, gender, type of employment, occupational group and level, annual salary, years of service for pension eligibility, organizational unit, and region of work. One objective of a demographic profile is to illustrate an organization's demographic risks and prepare the organization to make better decisions in human resources planning. Producing a demographic profile would help the Agency to better analyze its needs.

**7.74** We also found that the human resources information system, to which managers do not have access, is not integrated with other information systems. Furthermore, the Agency has not prepared guidelines, tools, or reference documents for managers on how to perform demographic analyses, trend analyses, and forecasts for short-term and long-term planning. Nor has it given managers the data to make such forecasts. Without systems and practices to quickly identify current resources and competencies, the Agency

may hire staff it does not need or may fail to meet immediate needs, or it may simply evaluate its present capacity incorrectly.

**7.75** At the same time, most senior managers we met with had a fairly comprehensive system of tracking their immediate and short-term staffing needs and related staffing actions, which are monitored closely. The Agency's human resources planning guideline states that a comprehensive plan should be submitted to the Executive Committee, or to a human resources committee composed of senior managers and human resources advisors, for discussion and approval of needs. In approving the Human Resources Management framework, the Executive Committee requested that key human resources priorities be identified for 2000–01. Despite the Executive Committee's request and the President's stated priority, we found no comprehensive human resources plan at either the directorate or the corporate level that identified the Agency's needs for 2000–01 or 2001–02. We also noted that the recommended human resources committee has not yet been established.

**7.76** As a consequence of having no comprehensive human resources plan, managers can identify staff shortages or surpluses only when specific project activities are assigned. This means that senior managers do not have the information they need, for example, to develop a recruitment strategy and find sources of funding. At present, the Agency does not have a clear picture of its future needs; essentially, it fills vacancies as they arise. Most managers told us it is much faster and easier to cover shortages with contract workers. However, employees and union representatives complained that they are losing opportunities for professional development to contract workers.

#### **A substantial workforce increase is under way despite the absence of a strategic plan**

**7.77** The Agency decided to normalize its workforce profile in February 2002 and announced that by December 2002, functions performed over time by contract workers and term employees would be converted to indeterminate positions. This conversion exercise involves 240 positions, about half of which are now filled by term employees. About 100 positions will be staffed through competitions. In February 2002, the Human Resources Directorate presented its recruitment strategy to the Executive Committee, including the number of positions identified by senior managers as critical to their operations.

**7.78** Despite the absence of a comprehensive human resources plan, we expected to find an analysis of future needs as part of this special exercise to increase the indeterminate workforce. However, we found no such analysis, and only one directorate out of 14 has analyzed the effect on its budget envelope of converting its contract workers to employees. That directorate's analysis revealed that converting 46 contract workers (representing five occupational groups) could save between \$1.2 million and \$1.9 million. This single analysis cannot be extrapolated, however, because the directorate is not representative of the Agency's 20 occupational groups affected by the exercise. Nevertheless, it does indicate that the conversion of contract workers to employees should result in substantial savings.

**7.79** However, the proposed conversion is not merely a question of cost savings. Before proceeding further with this conversion exercise, the Agency needs to align the projects planned for the short and the long terms with its present competencies and identify clearly the additional resources it needs. The absence of a strategic and comprehensive human resources plan seriously hinders its ability to do that.

**7.80** We are concerned about the lack of succession planning in the Agency. Many senior managers were able to identify someone in their groups who could replace them. However, we found no written plan—one of the President's priorities. Senior managers tended to consider only those on their own teams as possible successors. Planning for succession means correctly assessing and strengthening the capacity to build and maintain a pool of employees who have the competencies essential to the Agency's programs. Vacancies in key positions must first be foreseen and then filled to meet future strategic needs.

**7.81** We are also concerned about performance management in the Agency and the lack of career and training plans. Senior management explained that it is easier to replace contract workers than permanent employees if their professional competencies are not satisfactory. In the future, when permanent employees are covered by a collective agreement that gives them certain rights, it will not be as easy for the Agency to remove them. Therefore, before it hires employees the Agency needs to ensure that they have the professional and managerial competencies to perform their current functions. Then it needs to provide them with a career development program that will allow them to grow within the organization. The Agency is currently improving its performance management system and has created skills inventories to deal better with its conversion exercise. However, it has not yet adopted competency profiles that are linked with career and training plans.

**7.82** There are other challenges that could affect the timetable for acquiring these new employees by December 2002. The Agency's recruitment strategy identifies employment equity goals but does not identify the potential shortfalls in the labour force and the labour market. Moreover, managers recognize that the recruitment process can take as long as nine months before they can make an offer of employment.

**7.83 Recommendation.** The Agency should produce a demographic profile of its workforce, develop a comprehensive and strategic human resources plan integrated with its operational plans and strategic objectives, and finish implementing its human resources management framework.

**Agency's response.** The Canadian Space Agency is both a young organization and one in transition. The Agency is committed to developing and implementing an integrated approach to human resources management that will ensure its continued ability to recruit, retain, and develop the professional expertise it requires to deliver its objectives through the Canadian Space Program. The less-than-full implementation of an integrated human resources management system in the past has not compromised the Agency in attaining excellence while meeting its objectives.



**7.84 Recommendation.** The Agency should consider delaying its staff conversion exercise until it has developed its strategic human resources plan.

**Agency's response.** A Canadian Space Agency human resources plan will be developed by late 2003. In parallel with the development of this plan, the conversion of term and contract staff to a stable workforce will reduce costs, while immeasurably contributing to strengthening the Public Service through the recruitment, development, and retention of a highly professional and capable workforce.

## Performance measurement

### The performance measurement process requires improvement

**7.85** The Agency enjoys a strong reputation for excellence. Although it is not a large organization, its programs are highly visible nationally and internationally. They are a source of pride for most Canadians and have earned Canada worldwide recognition in the space industry. Public opinion surveys commissioned by the Agency demonstrate that Canadians consider it important to have a Canadian space agency and that the Agency's work is important to Canada.

**7.86** The Agency maintains strong relationships with its international partners. In spite of its limited budget, it is well respected for its contributions in partnership with other space agencies. Our discussions with senior officials in other space agencies confirmed that the Agency enjoys an excellent international reputation. It has also been commended by its partners for its technical competence, the professionalism of its staff, and the importance of its technological contributions to their space programs.

**7.87** The Agency has experienced little difficulty in reporting to Parliament on its many highly visible achievements. However, we are concerned that its current reporting practices do not provide Parliament with a complete overview of how its performance measures up to the strategic outcomes expected of it.

### Reporting of performance is incomplete and not linked to strategic outcomes

**7.88** The Agency faces difficult choices in selecting which programs and projects to fund. Having good information on past results can be useful for making these choices and for deciding to terminate some activities or reallocate resources. Solid information on performance is also needed to hold managers accountable for results and to communicate to Parliament and to stakeholders how well the Agency is managing its resources and meeting its corporate objectives.

**7.89** The Treasury Board approved seven desired strategic outcomes developed by the Agency, and the Agency is accountable to report to Parliament on its performance against them. They are

- economic benefits,
- understanding of the environment and contribution to sustainable development,
- technological development and diffusion,

- contribution to the quality of life,
- world-class space research,
- social and educational benefits for Canadians, and
- promotion and awareness of the Canadian Space Program.

**7.90** We expected that the Agency would have a process for measuring the performance of its activities and their contribution to achieving the strategic outcomes. We found that the existing frameworks and documents do not provide information that adequately reflects the Agency's performance. Furthermore, the Agency has few performance indicators to measure the extent to which project activities contribute to its strategic objectives.

**7.91** The Agency's primary tool for monitoring activities is its system of work plans, developed by directorates and approved by the Executive Committee; the plans are updated twice a year.

**7.92** Work plans comprise an operational plan, linked to financial and non-financial information on activities and projects by service line; a description of the directorate's commitments, linked to corporate priorities; and multi-year financial information, showing the distribution of parliamentary appropriations by service line. In general, each directorate links all three of these work plan elements by project and service line in reporting to the Executive Committee.

**7.93** Managers said they find work plans a useful basis for monitoring project activities. The twice-yearly updates also allow management to measure progress by project and by service line and to take quick corrective action as needed. However, we noted that work plans do not allow the Agency to identify clearly what a project contributes toward the seven strategic outcomes.

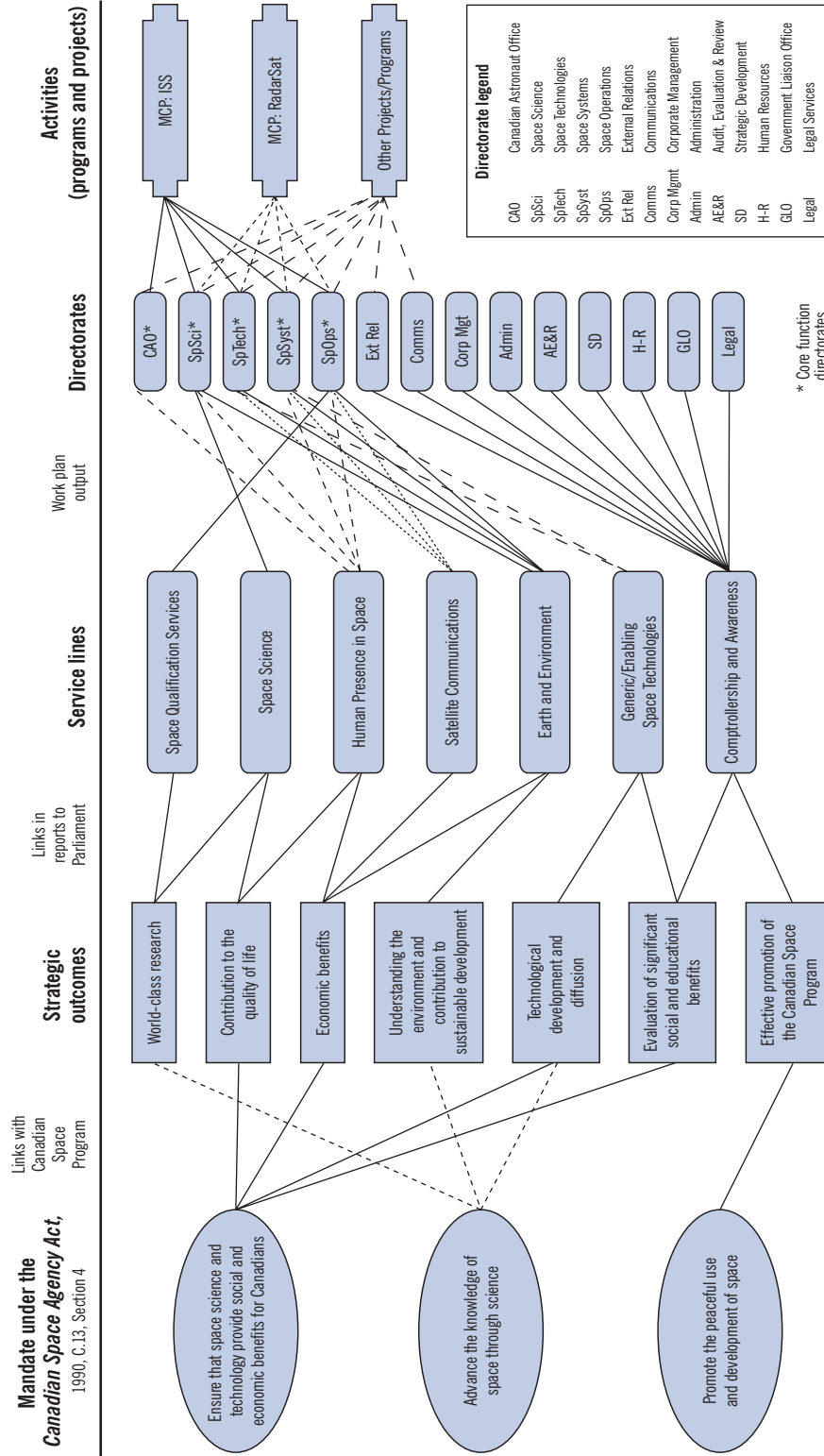
**7.94** Appropriate indicators of performance are fundamental to good management of performance information. We expected the Agency to have performance indicators against which it could report on results.

**7.95** Directorates do have performance indicators for project delivery, budgets, and milestones. However, they do not match projects with any of the seven strategic outcomes and have developed few performance indicators to measure progress toward them. In reporting to Parliament, the Agency arbitrarily matches the strategic outcomes with consolidated information from directorate reports.

**7.96** The Agency recognizes the importance of reporting performance against the strategic outcomes and it has created a schematic illustration (Exhibit 7.4) of the links among its mandate, strategic outcomes, service lines, directorates, and activities (programs and projects).

**7.97** The Agency's illustration shows how projects contribute to each service line. However, its complexity makes it difficult to see how projects contribute to the Agency's mandate. Also, we are concerned that the arbitrary matching could leave gaps in the Agency's performance story and make it difficult for Parliament to assess whether the Agency is fulfilling its mandate.

**Exhibit 7.4 How the Canadian Space Agency links its mandate, strategic outcomes, service lines, directorates, and activities (programs and projects)**



Source: Canadian Space Agency

**7.98** In our opinion, by better integrating the strategic outcomes into the existing performance measurement process, the Agency could develop appropriate performance indicators, measure the progress of projects toward strategic outcomes, and move closer to the results-based management approach it has adopted.

**7.99 Recommendation.** The Agency should improve its performance measurement process to ensure that its reporting to Parliament on performance is more comprehensive and linked to its strategic outcomes.

**Agency's response.** The Agency is committed to implementing the modern comptrollership initiative and will ensure more comprehensive reporting on its performance to Parliament. Actions are under way to enhance the performance measurement process, including the linking of performance with strategic outcomes.

## Conclusion

**7.100** We found that the Canadian Space Agency has been unable to meet the expectations for the Canadian Space Program fully, because its budget is limited by funding obligations that predate its creation. The Agency's project management and risk management practices are inconsistent, although generally sound, in projects over which it has prime responsibility and control. However, in its major Crown projects involving international partners it has been unable to escape the negative effects of program slippage and cost escalation.

**7.101** The direct impact of the Agency's current budget shortfalls is that space science and technology activities proposed for the Canadian Space Program must be cancelled or deferred to keep the Agency operating within its budget. The current imbalance between its budget and its obligations under the Program could become even more serious in the near term, when the Agency begins paying its share of the costs of operating the International Space Station. Those costs could consume about a third of the Agency's current annual budget. It is clear that the Agency needs to resolve this imbalance by seeking an increase in its funding level or a reduction in the activities currently required under the Canadian Space Program.

**7.102** The approval of a stable ongoing funding base in 1999 changed the Agency's operating environment to one that requires new management processes and practices. These include seeking appropriate involvement of stakeholders in developing a new strategic plan and assessing its long-term human resources needs; improving its measurement and reporting of performance; and conducting its annual priority review exercise from a longer-term corporate perspective. The Agency also needs to consult with stakeholders when a change in strategic direction is warranted.

**7.103** The Agency's senior management understands the need for these changes and has indicated to us its intention to act on that need. Several change initiatives are under way now, but it will take time and sustained management support if the Agency is to make the required transition in its corporate culture and practices.

## About the Audit

### Objectives

The objectives of the audit were to assess the Canadian Space Agency's capacity to deliver the Canadian Space Program with due regard to economy, efficiency, and effectiveness; to provide the government and Parliament with an assessment of the Agency's response to its new funding environment; and to identify opportunities for improvement in the early stages of designing and implementing policies and procedures.

### Scope and approach

The audit focussed on how the Agency manages its activities, programs, and human resources to support the delivery of the Canadian Space Program and the results the Program is expected to achieve. We reviewed the Agency's activities at its headquarters in Saint-Hubert and at its Ottawa facilities, and included discussions with its liaison staff in Washington and Paris.

We held discussions with senior officials of other space agencies both to gain perspective on the Agency's performance in the global space industry and its international partnership arrangements and to obtain information on best practices. These agencies included the U.S. National Aeronautics and Space Administration (NASA), the European Space Agency (ESA), the Centre National d'Études Spatiales (CNES), and the German Aerospace Center (DLR). We also met with officials of the European Commission and the U.S. General Accounting Office.

The audit included an extensive review of Agency documentation, including project briefs and approval documents from central agencies. We conducted many interviews with the Agency's senior management and with key external stakeholders. In reviewing the Agency's human resources management and performance measurement practices, we also conducted a number of focus groups with staff at middle and senior management levels. We observed several meetings of the Agency's internal management committees and external advisory committees. The management committees included the Executive Committee, the Enlarged Executive Committee, the Program Review Advisory Board, and the Core Function Coordinating Panel. The external advisory committees included the Canadian Space Agency Advisory Council and the Interdepartmental Committee on Space. We also attended briefings provided to Canadian industry representatives by senior officials of the European Space Agency.

### Criteria

Our audit was based on the following criteria:

- The key components of the Space Program Management Framework should all be in place and operating as intended. Roles and responsibilities should be well understood by stakeholders and by Agency staff at all levels.
- The Agency should know who its key constituencies are, understand their needs, assess those needs against the goals of the Canadian Space Program, and set appropriate priorities and budgets.
- Management's strategic vision for the Agency should be consistent with the Canadian Space Program and should be communicated clearly to staff and stakeholders and understood by them. Decisions at all levels should be consistent with and supportive of the strategic vision.
- The Agency's submissions for approval of major capital projects should be based on objective business cases. It should monitor, evaluate, and report to decision makers on the costs, potential risks, and benefits of the major capital projects and their impact on other service line programs. The Agency should follow generally accepted principles of project management, as supported by the Project Management Institute, in overseeing projects contracted to Canadian industry and international partners.

- The Agency should have the financial and human resources capacity to implement its programs. It should have strategies for ensuring that it has the necessary human resources competencies where and when they are needed. It should also have strategies for allocating appropriate resources to enable programs to achieve expected results.
- The Agency's performance reporting should clearly indicate organizational strategies, performance expectations, and key results against the objectives and expected results identified in the Canadian Space Program.

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## Appendix A Canadian Space Station program—A brief history

In January 1984, the President of the United States directed the National Aeronautics and Space Administration (NASA) to develop and place in orbit within a decade a permanently manned space station, and invited friends and allies, including Canada, to participate in its development and use. By April 1986, Canada had confirmed to NASA its intention to participate in the International Space Station (ISS) program and had decided what its contribution would be.

In May 1988, Canada signed a formal agreement with the United States, member states of the European Space Agency, and Japan to participate in the ISS program. Each partner is required to build, operate, and maintain the equipment it contributes to the space station, and to pay a share of the common system operating costs. Canada committed to contributing the design, construction, and operation of a Mobile Servicing System.

In February 1990, the Treasury Board approved the funding of a major Crown project that included all activities to discharge Canada's obligations under its intergovernmental agreement. The initial project cost approved was \$1.114 billion with a completion target of 2000, which was to include completion of the on-orbit assembly of the Mobile Servicing System and one year of initial operational verification. Canada would have ongoing operating and maintenance costs beyond the major Crown project for the 10-year planned life of the space station.

In 1994, the Russian Federation joined the ISS program. Also in 1994, domestic fiscal pressures led Canada to renegotiate its contributions to the ISS. However, this decision was revisited; in 1998 Canada signed an agreement to bring its commitment to \$1.22 billion and extend the completion date of the Mobile Servicing System to 2001–02. In return, Canada has the right to use up to 2.3 percent of the space station's capabilities to conduct scientific and technological research.

The first two elements of the ISS were launched in November 1998 (Russian Zarya) and December 1998 (U.S. Unity). Slippage in the ISS assembly schedule in 1998 and 1999 meant further adjustments to the schedule and added to the costs of Canada's contribution. In February 2000, the Treasury Board approved a revised budget of \$1.25 billion for the project and set a new target for completion in 2004–05.

In April 2001, Canada's first contribution to the ISS, the Canadarm2 (or Space Station Remote Manipulator System) was launched successfully. In June 2002, Canada's second contribution, the Mobile Base System, was also launched.

In 1984 the total cost of the ISS was estimated at about US\$11 billion. By 2002 the cost had grown to about US\$30 billion, with US\$13 billion of that increase and a four-year slippage in schedules since 1995. Canada's contribution to the ISS is currently estimated to cost CAN\$1.4 billion.

## Appendix B RADARSAT program—A brief history

The concept of a space-borne Synthetic Aperture Radar (SAR) has been the main focus of Canada's Earth Observation Remote Sensing Program since a 1975 report to Cabinet, *Satellite and Sovereignty*. In 1980, following early trials using data from NASA, the Department of Energy, Mines and Resources (EMR) initiated preliminary technical and feasibility studies for the RADARSAT satellite, which would carry a remote sensing SAR.

The Synthetic Aperture Radar is a powerful microwave instrument that is able to transmit and receive signals through clouds, fog, smoke, and darkness and obtain high-quality images of the Earth in all weather.

In 1985, EMR submitted a proposal to Cabinet for a \$770 million program that would include the United Kingdom and the United States as partners. Cabinet directed the Minister of Energy, Mines and Resources and the Minister of State for Science and Technology to seek ways of reducing the cost to the federal government through financial commitments from the provinces, the private sector, and international partners. In March 1988, the United Kingdom decided to withdraw from the program. The project was reconfigured and the costs reduced to \$541 million between 1987 and 2000.

In March 1989, responsibility for the RADARSAT program was transferred by order-in-council to the new Canadian Space Agency. In June 1989, the Minister of State for Science and Technology was authorized to sign a memorandum of understanding with the United States partner agencies; Energy, Mines and Resources; Canadian provinces; and a private sector marketing and distribution organization.

In June 1994, Cabinet approved the Long-Term Space Plan II, which established Earth observation as a major thrust of the Canadian Space Program. The RADARSAT program brought Canada into the Earth observation business by providing operational and commercial services to users worldwide. The Space Plan directed the Agency to ensure the continuity of this service and to encourage increasing financial involvement by the private sector until the business is completely privatized.

Besides the commercial benefits, the government has a vital interest in the public-good aspects of RADARSAT for resource management, environmental monitoring, support for Canadian sovereignty in the Arctic, and support to foreign and defence policy around the world.

RADARSAT-1 was launched successfully in November 1995 and began its commercial operations in April 1996. It had an operational life expectancy of 5 years, later extended by 2.5 years to September 2003. However, the launch of RADARSAT-2 is now not expected before early 2004. In 2001, the estimated cost of the RADARSAT-1 project was \$678 million; revenues from the sale of data were estimated at \$87.5 million.