



Canadian Space Agency  
Agence spatiale  
canadienne

*Canadian Space Sector Characterisation*

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# THE STATE OF THE CANADIAN SPACE SECTOR

## 1997



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*Canadian Space Agency - External Relations Directorate*

Canada



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## INTRODUCTION

This report marks the Canadian Space Agency's second annual study on the state of the space sector in Canada. The company-specific information used to compile this report remains strictly confidential and will not be released in a manner other than in an aggregate form.

The primary purpose of this report is to provide a reference tool to Canadian space sector organizations quantifying the state of the sector within Canada, and to provide a point of comparison with the rest of the world. The report should assist Canadian space sector constituents, government and private sector organizations alike, in making strategic long-term decisions on future space business priorities.

## BACKGROUND

The global space industry is in the midst of a period of tremendous growth and transformation. Worldwide revenues in 1997 were \$US 79.1 billion and are forecast to exceed \$US 117 billion by the year 2001, thus constituting a total growth of almost 48 percent over this period. Last year, the space industry employed over 960,000 people worldwide.<sup>1</sup>

The world's space industry is undergoing rapid globalization. The effects of globalization can be seen by industry concentration and restructuring of the world's space industry around a few larger companies which can produce complete turn-key satellite systems and associated systems, from design through launch and operation. It also creates greater international competition and interdependency amongst trading partners.

Globalization has now reached the Canadian space sector and since many of these systems are designed to provide worldwide coverage, it creates significant challenges for Canada's space industry, particularly in satellite communications where our industry has traditionally built its capability to respond to our domestic market. International cooperation and specialization are likely the two best approaches Canadian space companies should follow to ensure continued success and growth.

The space sector in Canada is undergoing significant growth. This report quantifies the rate of growth experienced by the space sector in Canada, with specific sectoral analysis across the following categories: Space Segment, Ground Segment, Applications and Other Services, and Space Research.

The landscape of the Canadian space sector has historically been characterized by a few large space manufacturing companies. The year 1997 saw the continuation of the emergence of some new entrants to the space sector mainly involved with the development of value-added products and in the provision of services derived from the use of space systems. Similarly, corporate repositioning within the industry in late 1998 saw the purchase of a significant portion of Spar Aerospace's space operations by Electromagnetic Sciences (EMS), the U.S. parent corporation of perennial Canadian space player CAL, which led to the creation of a new space entity, EMS Technologies Canada. More recently, the acquisition of Spar's Brampton robotics division by

<sup>1</sup> State of the Space Industry 1998, Space Publications and A.T. Kearney Management Consultants

MacDonald Dettwiler and Associates, a wholly-owned subsidiary of Orbital Sciences Corporation of the U.S., further changes the landscape of the Canadian space sector. The effects of these changes will not be measured for at least another year.

## METHODOLOGY AND DEFINITION

The CSA sent a questionnaire to 351 private sector and research organizations in Canada who have a defined interest in space. The rate of response received from our survey was over 62 percent. The results presented in this report were weighted in order to account for non-respondents and obtain an accurate profile of the sector. The method used for weighing the results is explained in Appendix 1.

The definition of the space sector that was used as a guideline for the survey is the one developed last year in collaboration with federal departments and agencies involved in the development of the Canadian space sector, and also with our provincial and industrial partners.

*The Canadian space sector consists of organizations (public, private and academic) whose activities rely on the development and the use of space assets and/or space data.<sup>2</sup>*

## PRESENTATION OF SURVEY RESULTS

### OVERALL RESULTS

**In 1997 the Canadian space industry generated revenues of over \$1.25 billion and employed over 5300 people.** This represents an increase of over **30 percent** in total sector-wide revenues and an increase of close to **11 percent** in total employment from the previous year.

Perhaps of equal significance to the overall increase in total sector size is the considerable improvement in revenue related to exports. In 1996, exports accounted for 31 percent of total revenues or \$301.2 million. In 1997, while total revenues increased by 30 percent, export revenue increased by over 88 percent, to \$566.4 million. This represents 45 percent of total revenue, a figure unmatched by any other country in the world.

### OVERALL RESULTS

Category	Total Revenues		Domestic Revenues		Exports Revenues		R & D Expenditures	Number of Employees	Organi-zations
	(\$)	(%)	(\$)	(%)	(\$)	(%)	(\$)	(n)	(n)
Space Segment	466,178,615	100	231,069,593	50	235,109,022	50	21,354,857	2278	72
Ground Segment	210,902,827	100	124,375,819	59	86,527,008	41	17,083,800	1154	66
Apps & other Services	557,843,514	100	314,123,774	56	243,719,740	44	16,901,146	1659	179
Space Research	21,437,136	100	20,437,136	95	1,000,000	5	6,400,000	245	34
<b>Total :</b>	<b>1,256,362,092</b>	<b>100</b>	<b>690,006,322</b>	<b>55</b>	<b>566,355,770</b>	<b>45</b>	<b>61,739,803</b>	<b>5336</b>	<b>351</b>

<sup>2</sup> See Appendix 2 for more details on the definition

All categories are showing an increase in total revenues for 1997 compared to the previous year.

**Space Segment: increase of 36 percent to \$466.2 million.** This category consists of R&D, manufacturing, testing, integration and launch of platforms (satellites, spacecraft and robotic systems), complete systems, subsystems and components.

**Ground Segment: increase of 166 percent to \$210.9 million.** This category consists of R&D, manufacturing, testing and integration of facilities on earth for controlling space-based systems and satellites, for linking satellites to operational terrestrial networks and for processing satellite-derived data.

**Applications and Other Services: increase of 4.9 percent to \$557.8 million.** This category is the largest of the four groupings in terms of total revenues and is defined by the development and/or provision of services and value-added products and technologies that are derived from the use of space systems and/or data, and the provision of consulting and engineering services.

**Space Research: increase of 31.2 percent to \$21.4 million.** This category Research relates to non-commercial space activities. Included in Space Research is revenue and funding received by scientific research organizations such as universities, hospitals, and government research institutes. This category, however, does not capture monies spent by organizations on in-house R&D activities.

Note to the Reader: The key change in 1997 was the inclusion of an additional 90 new organizations in the survey, increasing the total number of organizations surveyed to 351. All are organizations that have at least some portion of their business-line relating to space, as defined in this report. Some are new entrants into the space marketplace, while others are organizations that we identified during the past year as having space-related revenues.

In either case, the addition of these 90 new organizations in the survey had little statistical impact.<sup>3</sup> They did not account for any of the significant statistical differences between the 1997 and 1996 surveys because most of the major statistics are accounted for by the top 30 companies, which remained virtually the same over both survey periods.

#### REVENUES OF TOP 30 ORGANIZATIONS

Year	Total Revenues (\$)	Revenue - Top 30 Companies (\$)	Percentage – Top 30/Total Revenues
1996	968,849,042	830,202,660	86 %
1997	1,256,362,092	1,175,178,592	94 %

These figures demonstrate that the sector is still heavily concentrated into relatively few major companies. In fact, industrial concentration has increased somewhat from 1996 to 1997, despite the corresponding increase in the number of organizations. However, the

<sup>3</sup> The only exception to this statement is the growth in Atlantic Canada space-related revenues.

number of organizations exceeding \$1 million in revenues grew from 34 in 1996 to 42 in 1997.

### **DOMESTIC REVENUES**

Of the space activity which is not export-related (\$690 million), it is interesting to note that direct sales to government account for only \$208 million or 30 percent, a decrease of 6% compare to the previous year, whereas non-government or commercial sales account for \$482 million or 70 percent. In this respect, Canada compares favourably to the rest of the world in this regard, as the percentage of world-wide space industry revenues relating to commercial activity is 57 percent.<sup>4</sup>

#### **DISTRIBUTION OF DOMESTIC REVENUES**

Category	Government		Others		Total	
	(\$)	(%)	(\$)	(%)	(\$)	(%)
Space Segment	99,343,053	43	131,726,540	57	231,069,593	100
Ground Segment	37,845,683	30	86,530,136	70	124,375,819	100
Apps & other Services	53,390,940	17	260,732,834	83	314,123,774	100
Space Research	17,437,136	85	3,000,000	15	20,437,136	100
<b>Total :</b>	<b>208,016,812</b>	<b>30</b>	<b>481,989,510</b>	<b>70</b>	<b>690,006,322</b>	<b>100</b>

### **EXPORT REVENUES**

The total volume of Canadian space exports increased sharply in 1997, up 88 percent from \$301.2 million in 1996 to almost \$566.4 million. Some of this increase in exports can be explained by a decline in the value of the Canadian dollar relative to other major world currencies, and by aggressive and strategic marketing efforts on the part of Canadian space organizations.

The United States accounts for \$363.7 million or 64 percent of Canada's space exports, an increase of 102 percent from 1996. The United States continues to represent by far the largest space sector export destination, up from 59.7 percent the previous year. This situation will likely continue. Exports to Europe grew by 41 percent to \$99.8 million, some of which stem from Canadian participation in programmes of the European Space Agency (ESA), of which Canada is a Cooperating State. Exports to Asia grew by 186 percent to over \$72.7 million. However, taking into account the negative economic events which unfolded in Asia in late 1997 and 1998, this figure may decline in the subsequent reporting period.

<sup>4</sup> State of the Space Industry 1997, Space Publications and A.T. Kearney Management Consultants

## DISTRIBUTION OF EXPORT REVENUES

Category	United States		Europe		Asia		Other		Total	
	(\$)	(%)	(\$)	(%)	(\$)	(%)	(\$)	(%)	(\$)	(%)
<b>Space Segment</b>	173,330,680	74	37,452,450	16	19,975,750	8	4,350,142	2	235,109,022	100
<b>Ground Segment</b>	31,037,890	36	17,888,973	21	22,052,108	25	15,548,036	18	86,527,008	100
<b>Apps &amp; Other Services</b>	159,087,364	65	43,671,028	18	30,639,764	13	10,321,585	4	243,719,740	100
<b>Space Research</b>	200,000	20	800,000	80	0	0	0	0	1,000,000	100
<b>Total :</b>	<b>363,655,934</b>	<b>64</b>	<b>99,812,451</b>	<b>18</b>	<b>72,667,622</b>	<b>13</b>	<b>30,219,763</b>	<b>5</b>	<b>566,355,770</b>	<b>100</b>

**SPACE REVENUES BY SECTOR OF ACTIVITY**

In terms of revenues, **telecommunications** constitutes by far the largest space-sector activity in Canada. Satellite telecommunications accounts for 69 percent (\$861 million) of total space activity. Globally, the satellite telecommunications industry is evolving rapidly, as more satellites are launched and technologies become more powerful and less expensive. In 1997, global satellite telecommunications revenues were \$US 23 billion. World-wide satellite telecommunications activity is forecast to grow by 21.3 percent per year over the next 5 years.<sup>5</sup> Canada is home to several companies involved in the manufacturing of space and ground-based telecommunication hardware, the provision of satellite-based long distance services, and satellite operations. Future growth in this market sector shows much promise for Canadian companies.

**Earth Observation** makes up the second-largest space-sector activity, with sectoral revenues comprising 14 percent of total space revenues (\$177 million). This represents an increase of 65.5 percent from the previous year. Canada has demonstrated world leadership in this area, with the launch of Radarsat-1 in 1995 and the planned launch of Radarsat-2 in 2002. The value-added industry which uses remotely sensed data from Radarsat and other earth observation satellites has been a point of strength within the Canadian space sector. Future growth appears promising. Remote sensing, like satellite telecommunications, has the potential to fundamentally alter the way many economic sectors operate, and its integration into the commercial market has likely only just begun. With the advancement of computer hardware capabilities, automated software analysis and high-resolution data systems, remotely sensed information will significantly impact commercial activities such as Geographical Information Systems (GIS) and mapping, Global Positioning Satellite Services (GPS), environmental monitoring and natural disaster management, civil planning, and forestry, geology, and natural resource management.

**Robotics**, which makes up 10 percent of total revenues (\$126 million), has seen a decline from the year previous level of \$184.4 million. Much of this decline is due to the maturation of the Mobile Servicing System (MSS) project, Canada's contribution to the International Space Station. Canada has long been recognised as one of the world leaders in space robotics. The public sector is currently the only customer of space robotics and infrastructure servicing. However, as in the communications and Earth observation

<sup>5</sup> C.E. Unterberg, Towbin, The Satellite Book, First Quarter 1999

sectors, public funding will likely be replaced gradually by jointly funded activities with the private sector to eventually result in the commercial use of space robotics. Given that the Canadian space robotics market is limited, future growth of revenues for Canadian companies will most likely occur via exports through strategic international alliances. 1997 robotics revenues related to Ground Segment (\$7.3 million), and Applications & Other Services (\$7.1 million) were significantly lower than those related to the Space segment (\$110.7 million). This could, however, change in the near future since terrestrial applications and utilization of space robotics have been observed and documented in several fields of activities including: hazardous environments, food inspection, automobile refuelling, and medical radiology.

**Space Sciences** accounts from 4 percent of total revenues (\$45.1 million), which represents a decline of 20.5 percent the year earlier. Included within Space Sciences is planetary exploration and the new era soon to be opened by the International Space Station (ISS), providing opportunities for Canadian scientists for years to come. Also included within Space Sciences is microgravity experimentation, which targets near-term market industries such as pharmaceutical and drug development, medical research, electronic semiconductor and advanced materials development. The near-term market viability of microgravity science in Canada depends greatly on the ability of Canadian researchers to access the vast research budgets of the pharmaceutical, biotechnology, medical-device and advanced electronics industries. With the creation of the ISS and the continued advancement in scientific areas such as microgravity research, Canada is well positioned to maintain a position of excellence in the world-wide exploration and utilization of space.

#### DISTRIBUTION OF SPACE REVENUES BY SECTOR OF ACTIVITY

Sector of activity	Space Based		Ground Segment		Applications & Other Services		Space Research		Total	
	(\$)	(%)	(\$)	(%)	(\$)	(%)	(\$)	(%)	(\$)	(%)
<b>Telecommunications</b>	310,938,928	67	136,924,334	65	413,136,989	74	200,000	1	861,200,251	69
<b>Robotics</b>	110,665,114	24	7,260,778	3	7,084,403	1	971,880	5	125,982,175	10
<b>Earth Observation</b>	15,325,927	3	58,409,753	28	100,824,866	18	2,567,522	12	177,128,068	14
<b>Space Sciences</b>	25,576,737	5	144,081	0	7,191,652	1	12,247,734	57	45,160,204	4
<b>Other</b>	3,671,909	1	8,163,881	4	29,605,604	5	5,450,000	25	46,891,394	4
<b>Total :</b>	<b>466,178,615</b>	<b>100</b>	<b>210,902,827</b>	<b>100</b>	<b>557,843,514</b>	<b>100</b>	<b>21,437,136</b>	<b>100</b>	<b>1,256,362,092</b>	<b>100</b>



### **SPACE ACTIVITIES BY REGIONS**

**British Columbia** witnessed an increase of 89 percent in revenue and a 26 percent increase in employment levels. The majority of this increase is due to one B.C.-based company which plays an increasing role in the space industry. We expect this trend to continue in the coming years.

The **Prairies** saw an increase in revenues of 65 percent and in employment of 55 percent. Alberta showed continuing strength in the Global Positioning Systems (GPS) industry, and has long been recognized as a centre of excellence for this technology. Saskatchewan continues to show strength in Ground Systems Control. Manitoba is quite active in space science-related project, as well as having a proven aerospace presence.

The **Atlantic provinces** experienced an increase in revenues of 562 percent and in employment of 108 percent, adding 174 jobs. Much of this increase can be attributed to the introduction of a new satellite telecommunications company.

**Quebec** witnessed an increase in revenues of 42 percent and in employment of 31 percent. Satellite telecommunications accounted for much of this gain.

Finally, **Ontario** saw a modest increase of 1.5 percent in revenues and a decline of 15 percent in space sector employment, losing 355 jobs. Ontario continues to have the broadest industrial base within the sector.

Together, Ontario and Quebec account for nearly \$1 billion of the Canada-wide total of \$1.25 billion of total space revenues and 3649 of the 5336 jobs across the country.

### **DISTRIBUTION OF SPACE ACTIVITIES BY REGION**

Region	Total Revenues		Domestic Revenues		Export Revenues		Number of Employees	
	(\$)	(%)	(\$)	(%)	(\$)	(%)	(n)	(%)
<b>British Columbia</b>	139,036,720	100	77,571,676	56	61,465,044	44	905	17
<b>Prairies</b>	66,925,332	100	24,330,781	36	42,594,551	64	447	8
<b>Québec</b>	467,193,971	100	267,064,214	57	200,129,757	43	1534	29
<b>Ontario</b>	525,497,905	100	307,335,485	58	218,162,420	42	2115	40
<b>Atlantic</b>	57,708,164	100	13,704,166	24	44,003,998	76	335	6
<b>Total :</b>	<b>1,256,362,092</b>	<b>100</b>	<b>690,006,322</b>	<b>55</b>	<b>566,355,770</b>	<b>45</b>	<b>5336</b>	<b>100</b>

**EMPLOYMENT**

The space industry employed 5336 people in 1997, compared with 4812 people in 1996. It is without question that the Canadian Space Sector is a knowledge-intensive, high-technology sector employing a remarkably high proportion of engineers, scientists and information professionals.

**DISTRIBUTION OF EMPLOYEES BY GROUP**

Category	Management/ Administration		Engineers/ Scientists		Technicians		Others		Total	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Space Segment	430	19	959	42	475	21	414	18	2278	100
Ground Segment	274	24	610	53	129	11	141	12	1154	100
Apps & other Services	370	22	757	46	289	17	243	15	1659	100
Space Research	19	8	185	76	23	9	18	7	245	100
<b>Total :</b>	<b>1093</b>	<b>20</b>	<b>2511</b>	<b>47</b>	<b>916</b>	<b>17</b>	<b>816</b>	<b>15</b>	<b>5336</b>	<b>100</b>

**CONCLUSION**

1997 was a successful year for the Canadian space sector. Both revenues and employment levels increased significantly. Several new companies entered the scene. Figures on the distribution of space activities by region show a more balanced sector across the country, with sharp growth in both the Eastern and Western regions.

Coinciding with this domestic growth, the global industry has expanded at a furious pace. Canadian companies have shown their ability to keep pace with this growth and to compete internationally, as demonstrated by the very significant increase in Canadian space exports. Canadian space organizations have developed world-renowned expertise in Satellite Telecommunications and in niche markets such as Earth Observation, Space Robotics and Space Science. The CSA is committed to helping Canadian organizations to maintain and expand these results.

## APPENDIX 1

### Calculation of the Weighted Index

#### 1) Background

The Canadian Space Sector, as defined, is comprised of 351 organizations.

Given the relatively small size of the sector, it was decided that we undertake a census, rather than a sampling, and that a weighted index be developed to take into account the non-respondents.

The questionnaire was sent to all 351 organizations and 215 questionnaires were returned for a response rate of just over 62 percent. The results presented in this report have been weighted and represent an estimation for all 351 organizations which comprised the survey population.

#### 2) The Weighting

The objective of the weighting is to allow for accurate inferences of the results obtained for the whole surveyed population. By using a weighted index, we can attribute to a non-respondent a weight that reflects its importance in the population. This method is frequently used by Statistics Canada.

To ensure that the weight given to a non-respondent is representative of its importance in the population, a weighted index was defined for each category. Furthermore, for a given category, the weighted index applies only to results of organizations with profiles similar to the one of the non-respondent. For example, a non-respondent SME in the Earth Observation sector is only weighted according to organizations in the same sector and of the same approximate size.

#### 3) The Calculation

For each category, the weighted index (W) is calculated by dividing the number of organizations (N) by the number of respondents (r):  $W=N/r$

#### CALCULATION OF THE WEIGHTED INDEX

Category	Organizations ( N )	Respondents ( r )	Non Respondents ( N - r )	Response rate ( r / N )	Indice ( N / r )
Space Based	72	52	20	72.22%	1.39
Ground Segment	66	47	19	71.21%	1.40
App & other Services	179	99	80	55.31%	1.81
Space Research	34	17	17	50.00%	2.00
<b>Total :</b>	<b>351</b>	<b>215</b>	<b>136</b>	<b>62.19%</b>	<b>1.65</b>

**APPENDIX 2****Definition of the Canadian Space Sector**

The Canadian Space sector consists of organizations (private, public and academic) whose activities rely on the development and the use of space assets and/or space data.

In accordance with this definition, the Canadian space sector encompasses the following activities:

**Space-based**

R&D, manufacturing, testing, integration and launch of platforms (satellites, spacecraft and robotic systems), complete systems, subsystems, and components.

**Ground Segment**

R&D, manufacturing, testing, and integration of facilities on Earth for controlling space-based systems and satellites, for linking satellites to operational terrestrial networks and for processing satellite-derived data.

**Applications and Other Services**

The development and/or provision of services and value-added products and technologies that are derived from the use of space systems and/or data, and the provision of consulting and engineering services.

**Space Research**

The research related to non-commercial space activities.