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THE STATE OF THE CANADIAN SPACE SECTOR 1998 AND 1999

EXTERNAL RELATIONS DIRECTORATE
CANADIAN SPACE AGENCY



Canada

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The Canadian Space Agency is committed to leading the development and application of space knowledge for the benefit of Canadians and humanity.

About the Authors

The External Relations Directorate manages the strategic relationships between the Canadian Space Agency and its domestic and international partners. Key mandates include the development and implementation of policies and strategies relating to co-operation partnerships with domestic stakeholders (Federal and Provincial governments, industry and academia) and international agencies and industries. The Directorate plays a pivotal role in supporting the commercial initiatives of Canadian space companies on world markets and in providing stakeholders with strategic and timely information.

Message from Michel Giroux, Director of CSA External Relations Directorate

The *State of the Canadian Space Sector* report provides those working in the space sector—government and industry alike—with invaluable knowledge of the sector in which we operate. In turn, this insight supports decision makers in their endeavour to making informed and strategic choices for the future.

The CSA wishes to acknowledge the important contribution of the many organizations, both public and private, without which this report would simply not be possible. We hope that the report proves to be as effective a tool for your organization as it is for ours.

For more information

Information specific to Canadian space business and industry, including an electronic version of this report, is found at the following address: www.space.gc.ca/business/. Inquiries on this report can be made by phone or sent in writing to:

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Message from W.M. (Mac) Evans, CSA President

A decade ago, nobody could have fully envisioned the extent to which the global space market would evolve. Fiscal constraints, privatization, commercialization, mergers and newly emerging players soon intensified pressures to adapt and reshape the industry. As for Canada's modestly-sized space sector, keen observers kept a watchful eye on just how it would fair in such turbulent times.

As this edition of the *State of the Canadian Space Sector* illustrates, I am pleased to report that our nation's space industry has embraced the changes with remarkable fervour. With revenues in the order of \$1.8 billion¹ Canada has positioned itself well in this unpredictable environment and continues to grow in influence and stature on the world stage.

The results give reason for optimism over the future of Canada's place in space. Current trends lead to projections of steady growth in the industry in terms of revenues and a growing workforce of highly-skilled professionals. This leads to more opportunities for collaborative and profitable ventures in space science and technology. It also translates into a stronger presence of Canadian expertise in one of the most fertile and exciting sectors of the world economy—space.

A handwritten signature in black ink, appearing to read "W. Evans". The signature is fluid and cursive.

¹ Unless stated otherwise, all dollar amounts cited in the report are in Canadian dollars. \$1.00 CDN = approx 1.50 USD.

In 1998, total revenues in Canada's space sector rose 31% to \$1.65B, compared to \$1.26B in 1997. In 1999, revenues rose another 11% to \$1.83B. Over the past four years, total revenues in Canada's space sector have increased 89%—from \$969M in 1996 to \$1.83B in 1999.

From 1997 to 1998, domestic revenues experienced a marked increase of 36%, from \$690M to \$941M with export revenues also up by 25% to \$707M from \$566M. The rate of growth in both domestic and export revenues decelerated somewhat in 1999, with domestic results rising by 18% to \$1.12B and exports by 1% to \$717M. This slight waning should not overshadow the overall results between 1996 to 1999 over which time domestic revenues rose 67% and export revenues rose more than twice this rate, up an impressive 138%.

Of the four surveyed Categories, Applications and Services recorded the strongest revenue growth—up 88% from \$558M in 1997, to \$1.05B in 1998 and \$1.12B in 1999. The Space Segment, on the other hand, was down 37% in 1998 from \$466M in 1997 to \$295M, only to rebound back 65% to \$487 in 1999. Some growth was registered in the Ground Segment in 1998, up 2% to \$215M, although the sector declined by 12% in 1999 to \$190M.

In terms of Sectors of Activities, Telecommunications continued to dominate the field with revenues of \$1.19B or 72% of total revenues in 1998 and \$1.16B or 63% of total revenues in 1999. Robotics and Earth Observation were also on the rise in 1999, increasing respectively by 67% and 57%.

Regionally, strong gains were made in Quebec with a 44% increase in revenues, from \$467M in 1997, to \$672M in 1998, to \$673.5 in 1999. These results were strong enough to take over the lead from Ontario which generated revenues in the order of \$614M (+17%) in 1998 and \$611M (-0.5%) in 1999. Through 1998 and 1999, British Columbia prospered with revenue growth of 65% to \$229M in 1998 and up another 56% to \$357M in 1999. Revenues remained healthy in the Prairies, up 8% in 1998 to \$72M and another 17% in 1999 to \$85M. Strong gains were also recorded in Atlantic Canada, \$60M (+4%) in 1998 and \$103M (+72%) in 1999.

Despite claims of brain-drain in the high-tech industry, employment in the space sector continued to grow. The total workforce rose from 5,336 in 1997, to 5,930 in 1998 (+11%) and to 6,911 in 1999 (+17%). Between 1996 and 1999, the workforce increased by a solid 44%.

Overall Survey Results 1998

Category	Total Revenues		Domestic Revenues		Exports Revenues		Employees n
	\$	%	\$	%	\$	%	
Space Segment	294,598,054	100	142,465,559	48	152,132,495	52	2,080
Ground Segment	215,270,859	100	62,380,344	29	152,890,515	71	1,267
Applications and Other Services	1,103,791,188	100	713,037,327	65	390,753,862	35	2,160
Space Research	33,843,384	100	22,945,800	65	10,897,585	35	423
Total:	1,647,503,485	100	940,829,029	57	706,674,456	43	5,930

Overall Survey Results 1999

Category	Total Revenues		Domestic Revenues		Exports Revenues		Employees n
	\$	%	\$	%	\$	%	
Space Segment	486,842,097	100	287,882,185	59	198,959,912	41	2,721
Ground Segment	189,535,573	100	74,657,071	39	114,878,502	61	1,191
Applications and Other Services	1,115,936,346	100	724,345,046	65	391,591,300	35	2,593
Space Research	37,446,175	100	26,321,578	65	11,124,597	35	406
Total:	1,829,760,191	100	1,113,205,880	61	716,554,311	39	6,911

OVERVIEW OF THE REPORT

A Changing Environment

A CHANGING ENVIRONMENT

Increasingly, Canada's space industry is faced with the similar challenges imposed on all players in the global space market. Fiscal restraints in public funding, government regulations, rising consumer demand for space-based services, particularly in telecommunications, scarcity of human resources, changes in regional economies, and fluctuating financial markets constitute a recipe for an increasingly competitive and commercialized global space marketplace.

All this has led to a more intense focus on leveraging market demand for space-related products and services. Key players are pursuing strategic mergers in order to enhance the critical mass deemed vital to delivering complex end-to-end services. The "end" delivery has also taken on new dimensions—beyond the design through to launch phases, and further driven by the needs of the ever-demanding, increasingly-mobile and often technologically-starved end user.

Through it all, reports coming out of the global space industry point upwards. World-wide space revenues in 1999 were in the order of US\$87B and are forecasted to top US\$123B by the year 2002.² Among the drivers, the Global Positioning Satellites (GPS) equipment and services sector is predicted to double in this same period. In 1999, satellite-delivered Internet traffic through Intelsat, a leading satellite communications company, more than tripled, and analysts estimate that the satellite/wireless delivery systems will grow to 6% of the U.S. broadband market over the next few years.³

As the Internet has changed the way we use the home computer, advancements in satellite technologies are gradually changing the way we watch TV. Direct Broadcast Satellite (DBS) television services rose 39% in 1999 to 10 million subscribers and analysts expect this number to increase to nearly 21 million by 2007 in the U.S. alone. Potential growth rates of DBS are even greater in Europe and Asia where market demand for channels and programming in multiple languages is far more acute.⁴

Despite the setbacks in large satellite constellation ventures, most notably Iridium, interest in the use of satellite technologies to fill the "last mile" gap to the masses is on the rise as data capacity and delivery speeds increase and prices decline. As one analyst stated, "We, as an industry, should take a harder look at broadband, which seems to be the satellite industry's next large economic opportunity."⁵

In Canada, the space industry rode out the millennium in stride with the international players, yet not without its fair share of challenges. The country's competitive niche in satellite communications faced considerable industry-wide challenges through 1997 and 1998, including stiff rivalry and market deregulation. Our maturing remote sensing industry found itself driving—and being driven by—improved sensor capacities, converging technologies, and a growing demand for off-the-shelf, near-real-time turnkey solutions. In addition, U.S. concerns over exports and data distribution extended initial timetables or changed plans altogether.

² *International Space Business Council, State of the Space Industry* (p. 17, June 2000).

³ *Ibid.*: p. 33.

⁴ *Ibid.*: p. 36.

⁵ *William Kidd, Managing Director and Satellite Equity Analyst, CE Unterberg, Towbin, "Broadband: Discovering the New World" in Satellite Finance* (Issue 29: Oct. 11, 2000: pp. 41-42).



Canada's renowned expertise in space robotics, initially developed under the Space Shuttle's Canadarm technology, maintained its notoriety with the development and delivery to NASA of the Canadarm's successor destined for the International Space Station—Canadarm2. Future robot-led missions to Mars are certain to involve Canadian expertise. Commercially, the gradual adoption of robots for operations in healthcare, peacekeeping, inspection, monitoring, even toy manufacturing, to name just a few, point to new sources of revenue.

Market access continued to be a motivating force for Canada's telecommunications industry. Telesat, wholly owned by BCE Inc. which recently acquired Teleglobe Canada, reinforced its influence on the world's commercial satellite operator industry through increased access to the U.S. fixed satellite market. As the company geared up for the launch of Anik F1⁶—one of the world's most advanced communications satellites—it expanded offices into South America to profit from this region's exploding telecommunications market. Similarly, Norsat of Surrey, B.C., moved to capture a larger share of the growing Direct-to-Home satellite marketplace south of the border with investments into the company's U.S. subsidiary Norsat America.⁷

Most importantly, the industry's labour force—the brains of the entire sector—lived up to its mobile character with shifts along the TransCanada.

Luring new blood became as important as securing new contracts, and recruiters in the personnel department were being asked to be as innovative in launching attractive hiring campaigns as the engineers in developing newfangled technologies.

MEASURING CHANGE

In order to measure all of these ongoing changes occurring in Canada's space sector, the CSA undertakes an annual survey and publishes the results in this report on the *State of the Canadian Space Sector*. The 1998-1999 edition profiles the sector over this two-year period in terms of domestic and export revenues, market concentration, revenues by category (Space Segment, Ground Segment, Applications and Services, and Space Research), by sector of activities (Telecommunications, Robotics, Earth Observation, Space Science, and Navigation) and by region (British Columbia, Prairies, Ontario, Quebec, and Atlantic Canada). The report also offers information on the space sector's total workforce and areas of expertise.

METHODOLOGY

Questionnaires were sent to over 250 private sector companies, research organizations and universities in Canada who have a defined interest in the space sector. Additional data were collected through internal consultation with a number of CSA and government officials whose dealings with stakeholders were deemed statistically relevant.

It is important to note that the company-specific information used to compile this report remains strictly confidential and cannot be released in a manner other than in an aggregate form.⁸ Consequently, in certain circumstances, the authors are prevented from providing a more detailed explanation or in-depth analysis of the survey results presented in this report in order to respect this level of confidentiality.

DEFINITIONS

The Canadian space sector is defined as organizations (private, public and academic) whose activities rely on the development and use of space assets and/or space data. Accordingly, with this definition, the sector encompasses the following activities:

Space Segment: Research and Development (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 Services: 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: Primarily research related to non-commercial space activities.

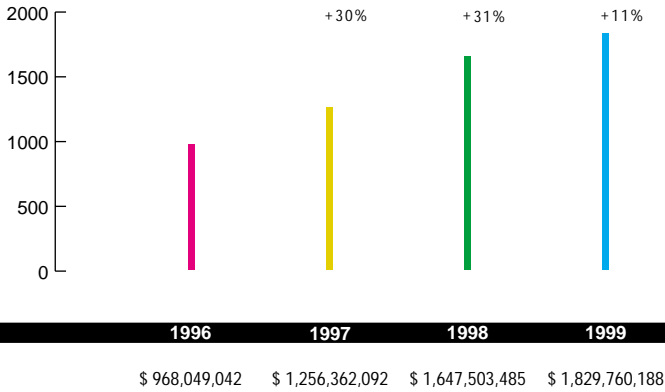
⁶ Anik F1, manufactured by Boeing Satellite Systems, was successfully launched on 21 Nov. 2001 aboard an Ariane rocket from the Guiana Space Centre.

⁷ For a more elaborate account of trends in telecommunications, robotics, Earth observation and navigation, refer to the CSA publication *Global Space Sector Market Trends and Drivers 2000*.

⁸ Results in past editions were weighted in order to account for uncollected data from non-respondents. In earlier reports, calculations showed that the weighting accounted for 2 to 2.5% of the cumulative total, which represents an acceptable margin of error for survey results. For this reason the CSA has foregone the weighting of the results for 1998-1999 and acknowledges a margin of error in the final results of approximately 2.5%.

OVERALL REVENUES Domestic Revenues

Total Space Revenues in Canada
In Millions



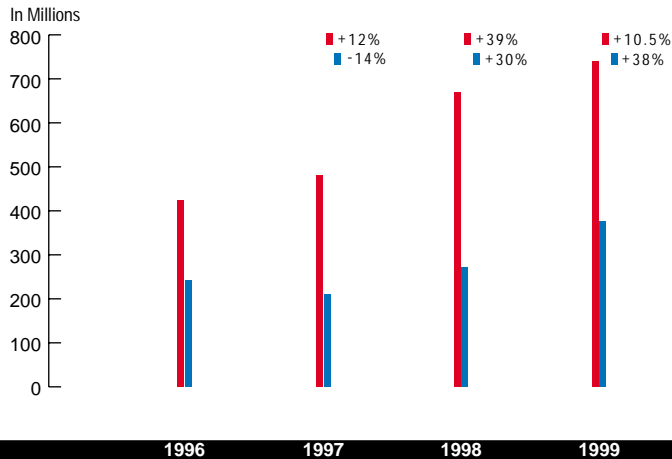
OVERALL REVENUES

In 1998, total revenues in Canada's space sector rose 31% to \$1.65B compared to \$1.26B in 1997. In 1999, revenues rose another 11% to \$1.83B. Over the past four years, total revenues in Canada's space sector have increased 89% from \$969M in 1996 to \$1.83B in 1999.

DOMESTIC REVENUES

From 1997 to 1998, domestic revenues increased by 36%, from \$690M to \$941M. In 1998, domestic revenues from non-governmental sources ("Other") rose 39% from \$482M to \$670M while revenues attributed to government were up 30% from \$208M to \$271M. In 1999, total domestic revenues increased once again, although less sharply, by 18% to \$1.1B. In this same year, revenues from non-government sources improved by 10.5% from \$670M to \$740.5M, whereas revenues from government sourced revenues rose from \$271M to \$372M or nearly 38%.

Domestic Revenues in Term of
Non-Government (other)
and Government Sources



In 1998 and 1999, the overall ratio of domestic revenues generated by government/non-government sources remained generally constant over both years, respectively 29%/71% and 33%/67%. Canada continues to compare more favourably to the rest of the world in this regard as the percentage of world-wide space industry revenues relating to commercial activity in 1998 was estimated at 64% while Canada surpasses this level on domestic non-government revenues alone.⁹

As a proportion of total revenues, domestic revenues' proportion was up 2% to 57% in 1998 and up again in 1999 to 61%, still considerably below the 1996 proportion of nearly 70%.

Between 1996 and 1999, overall domestic revenues rose \$442.5M or 66%, from \$671M to \$1.1B. Non-government-sourced domestic revenues grew by a sound 72%—from \$430M to \$740.5M—and government-sourced revenues by 55%—from \$241M to \$373M.

Other	\$ 429,832,930	\$ 481,989,510	\$ 669,921,918	\$ 740,459,065
Government	240,845,346	208,016,812	270,907,111	372,746,812

⁹ State of the Space Industry 1999
(Space Publications and A. T. Kearney Management Consultants).

EXPORT REVENUES

While the total volume of Canadian space exports did not increase as sharply as in 1997 (+88%), export revenues were up by a respectable 25% in 1998, from \$566M to \$707M. This increase subsided in 1999 to \$717M, up 1.4%. With domestic revenues on the rise in terms of the proportion of overall revenues, export revenues declined by the same proportions—down 2% in 1998 to 43% of total revenues and to 39% in 1999. Despite the decline, overall export revenues rose 138% between 1996 and 1999, largely due to effective marketing efforts on the part of Canadian space organizations and a low Canadian dollar.

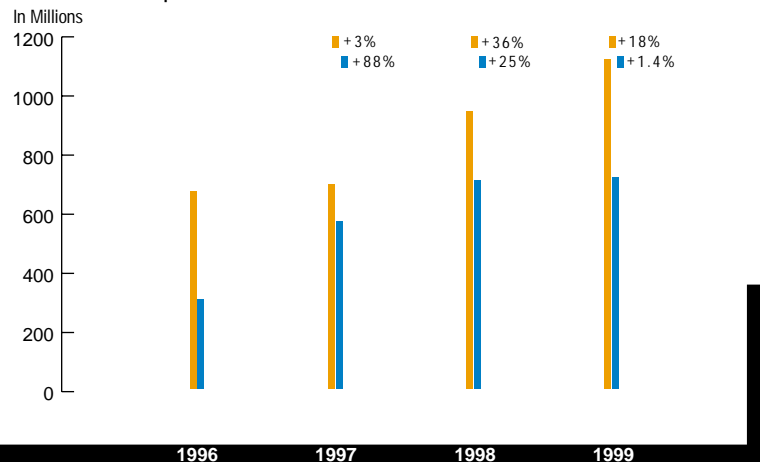
Of the main targeted regions of the world for exports—United States, Europe and Asia—the U.S. market continued to dominate with \$445M or 63% of total export revenues in 1998 and \$466M or 65% in 1999. In terms of growth, export revenues from the U.S. rose 22% in 1998, a marked slow down from the 102% increase between 1996 and 1997. This growth rate continued to slide to just under 5% in 1999.

Exports to Europe grew by 16%, from \$100M in 1997 to \$116M in 1998. Some of this increase stems from Canada's long-standing participation in European Space Agency programs. Export revenues increased further in 1999, up 17% to \$136M.

In the Asia-Pacific region exports grew in 1998 by 14% from \$73M to \$83M. Exports to this region fell back in 1999 to \$75M, a decline of 10%. The upturn in the Asian economy, in addition to a growing demand for satellite-based services, should generate more opportunities and robust sales for Canadian industry in the coming years.

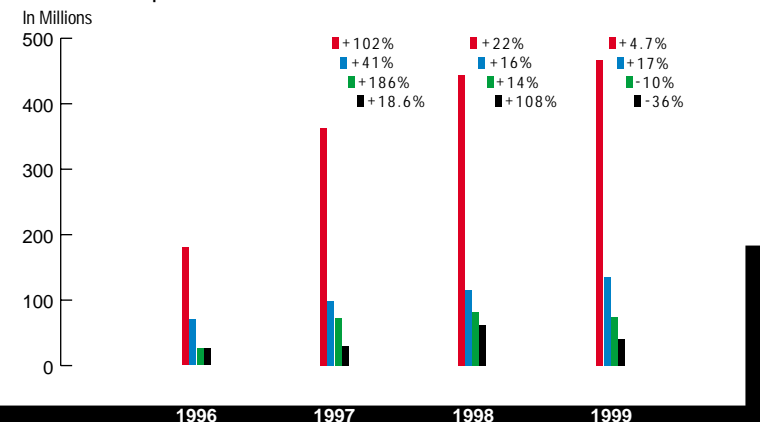
Revenues to Other regions of the world registered the greatest improvement in 1998, rising 108% to nearly \$63M, with particularly strong returns from South America. Exports to Other regions declined in 1999 to \$40M (-36%), yet to a level more consistent with previous survey results—\$25M in 1996 and \$30M in 1997. In addition to South America, Australia and Russia were also among the Other destinations of Canadian technology and expertise over 1998 and 1999.¹⁰

Domestic / Export Revenues



	1996	1997	1998	1999
Domestic	\$ 667,678,276	\$ 690,006,322	\$ 940,829,029	\$ 1,113,205,877
Export	301,170,766	566,355,770	706,674,456	716,554,311

Source of Export Revenues

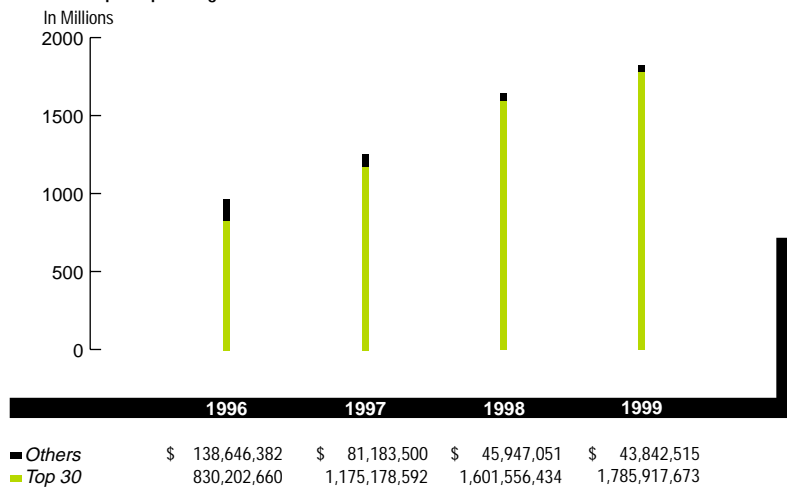


	1996	1997	1998	1999
U.S.	\$ 179,883,987	\$ 363,655,934	\$ 444,945,886	\$ 466,040,021
Europe	70,605,692	99,812,451	116,088,499	135,633,973
Asia	25,389,788	72,667,622	82,655,851	74,501,803
Other	25,491,299	62,984,220	62,984,220	40,378,514

¹⁰ Efforts will be made in future surveys to provide a further breakdown of key regions or countries emerging from the "Other" category.

Revenues of Canada's Top 30 Revenues by Space Categories

Top 30 Space Organizations



REVENUES OF CANADA'S TOP 30 SPACE ORGANIZATIONS

Of total revenues in 1998, 97% were generated by the top 30 Canadian companies compared to 94% in 1997 and 86% in 1996. This concentration rose to 97.6% in 1999. The total number of organizations exceeding \$1M in revenues also grew from 42 in 1997, to 44 in 1998, and to 45 in 1999.

REVENUES BY SPACE CATEGORIES

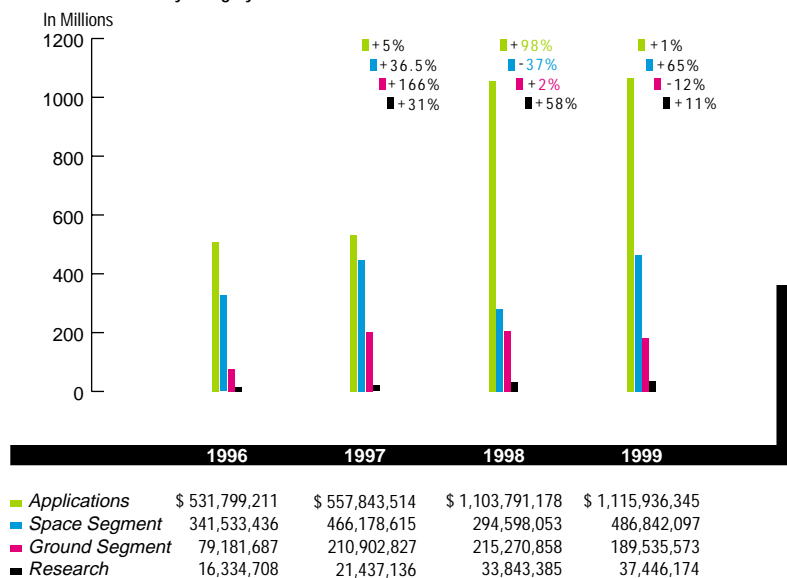
Space sector categories experienced their share of peaks and valleys through 1998 and 1999:

Space Segment: Down 37% to \$295M in 1998; rebounded up 65% in 1999 to \$487M. Overall, a 43% increase between 1996 and 1999. As a proportion of total revenues generated by all categories, Space Segment accounted for 18% in 1998 and up to 27% in 1999. Renewed opportunities for space technologies being pursued by the Canadian and European space agencies were of clear benefit to industry, particularly those supporting space science, earth observation and robotics initiatives.

Ground Segment: Increase of 2% to \$215M in 1998; decrease of 12% to \$190M in 1999. As a proportion of total revenues, Ground Segments accounted for 13% in 1998 yet slipped to 10% in 1999. Overall increase of 139% over 1996-1999 period, although 1997 increases account for lion's share. An upturn in the space segment is expected to strengthen returns in the ground segment.

Applications and Services: Solid increase of 97% to \$1.1B in 1998; slight increase of 1% in 1999 with revenues of \$1.12B. Solid growth of 110% between 1996 and 1999—most significantly from the telecommunications service sector. This category made up 67% of total revenues in 1998 and 61% in 1999.

Revenues by Category



Space Research: Increase of 58% in 1998 over 1997 (from \$21M to \$34M) and another 11% in 1999 (from \$34M to \$37M). Overall increase of 129% between 1996 and 1999, up from \$16M to \$37M. As a proportion of total revenues, Space Research accounted for approximately 2%. Increases were most significant in R&D in the Earth Observation category, up 353% from \$2.6M to \$11.6M in 1998 and to \$14M in 1999 (+24%), thereby accounting for 34% of all space research amongst the various categories in 1998 and 38% in 1999. Space Science, which in 1998 and 1999 accounted for respectively 57% and 55% of all space research, registered \$19M in 1998—up by 58% from \$12M the year prior and a further 6%, to \$20M, in 1999.

REVENUES BY SECTORS OF SPACE ACTIVITIES

Telecommunications activities constituted by far the largest space-sector activity in Canada. In 1998, satellite telecommunications generated 72% or \$1.19B of the total space revenues, an increase of 38% from the previous year. Revenues from this activity declined slightly in 1999 by 2% to \$1.16B, still representing 63% of total revenues.

On global markets, satellite systems are becoming more viable supplements and/or alternatives to terrestrial systems as in the case of Direct Broadcast Satellite (DBS) systems. As DBS-related technologies evolve, particularly in terms of expanding bandwidth, service providers are better positioned to offer faster and cheaper services to a growing number of subscribers. Competition is intensifying between the satellite companies and the existing terrestrial services sector (for the most part cable service providers). Increasing merger and acquisition activity is anticipated on the horizon as the marketplace of satellite services providers for television, the Internet and eventually radio expands.

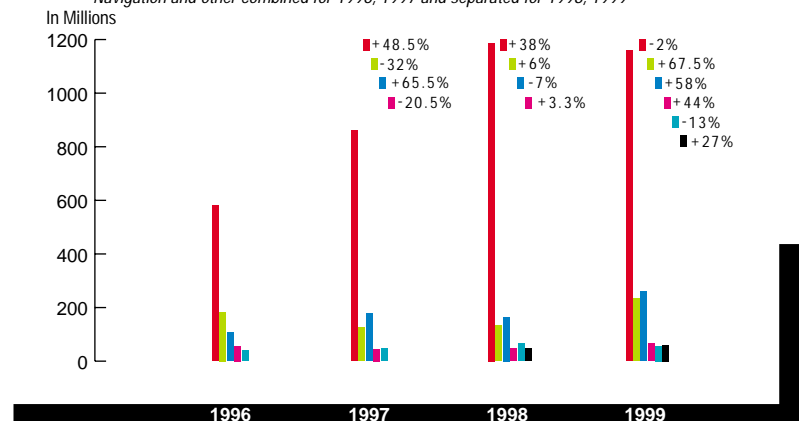
Earth Observation (EO) activities made up the second largest space sector activity in both 1998 and 1999. Earth observation revenues in 1998 were \$166M, a decline of almost 7% from 1997 (\$177M). In comparison to other sectors, EO comprised a 10% proportion of total space revenues. Revenues in this activity bounced back in 1999, up nearly 58% to \$261M, to occupy 14% of total revenues. Between 1996 and 1999, EO revenues rose an impressive 144% which bodes well for Canada's evolving remote sensing community.

Despite an upturn in the commercialization of the EO industry, governments (civilian and military) remain the most important clients for data and services. In Canada, for example, the Canadian Ice Service of Environment Canada relies heavily on RADARSAT-1 data, which makes ice monitoring the top commercial market for RADARSAT International (RSI) whose clientele currently numbers over 500 in 57 countries.¹¹

Internationally, the effectiveness of RADARSAT in supporting disaster management and crop monitoring is becoming increasingly attractive to foreign clients, particularly Asian governments. Growth rates should persist as: remote sensing technologies converge with other space and non-space technologies (i.e. GPS); inter-agency efforts to support disaster management move further into operation¹²; and the demand for, and ensuing supply of, turnkey solutions for a host of different users amplify.

Revenues by Sector of Activities

Navigation and other combined for 1996, 1997 and separated for 1998, 1999



Sector	1996	1997	1998	1999
Telecom	\$ 580,018,610	\$ 861,200,251	\$ 1,187,604,467	\$ 1,159,496,563
Robotics	184,435,763	125,982,175	133,557,973	223,768,663
Earth Obs.	107,014,610	177,128,168	165,522,459	260,987,278
Space Science	56,789,746	45,160,204	46,671,772	67,350,046
Navigation	-	-	66,840,621	57,952,059
Other	-	-	47,306,186	60,205,580

¹¹ RADARSAT Annual Review: 1999: Canadian Space Agency.

¹² In Oct. 2000, the CSA, French Space Agency and European Space Agency signed an agreement to improve mobilizing rescue and relief efforts to deal with natural or technological disasters. Starting Nov. 1, 2000, emergency relief and rescue authorities were provided with a confidential telephone number to agency officials responsible for the quick deployment of space resources including RADARSAT-1.

Revenues by Sectors of Space Activities



Robotics activities increased by 6% in 1998, from \$126M to \$134M. As a proportion of all activities, Robotics decreased from 10% in 1997 to 8% in 1998. Results in 1999 were more positive—revenues rose 68% to \$224M thereby raising the proportion of total space revenues to 12%. In both 1998 and 1999, as in other years, revenues from Robotics activities in the categories Ground Segment (\$6.9M or -5% in 1998, and \$5.6M or -19% in 1999) and Applications & Services (\$11.5M or +62% in 1998, and \$9M or -21% in 1999) were lower than those generated in the Space Segment, which registered revenues of \$114M in 1998 (+3%), and \$208M in 1999 (+83%). Beyond the Mobile Servicing System project, Canada's

fully government-funded contribution to the International Space Station (ISS), robotics space initiatives relating to on-orbit spacecraft servicing and space exploration to Mars present promising opportunities. Combined with terrestrial opportunities in such fields as inspection, mining, surveillance, manufacturing and healthcare, the commercial viability of robotic activity in the industry as a whole should gain momentum.

Contrary to a decline in **Space Science** activities in 1997, the subsequent year registered a slight increase of 3%, from \$45M to \$47M. Space Science activity increased significantly in 1999, up 44% to \$67M. Included within Space Science is planetary exploration and the new era soon to be opened by the ISS which holds promise for advancements in such fields as pharmaceutical R&D, biotechnology, and advanced electronics. Canada's participation in the ISS project affords Canadian scientists and industry access to the microgravity laboratory and aims to ensure Canada's continuing influence in the space science community.

In previous surveys revenues from **Navigation** activities were largely folded under the "Other" activities, which in 1997 recorded revenues of \$47M. In 1998, for the first time, Navigation was included as a separate space activity. Interestingly, Navigation on its own recorded close to \$67M in revenues in 1998 and \$58M in 1999, both figures well above the previous totals in the "Other" category.

Driving this nascent market is the growing use of GPS for use in aviation, in-car navigation systems, emergency vehicles, search and rescue, and sports and leisure. Some industry analysts place the current rate of growth between 25 and 40 percent per year, while others are more optimistic.¹³ As one analyst put it, "In many ways, GPS is like the Internet, another phenomenon that seems to have burst upon the world suddenly and full-blown in recent years, although actually they've both been a long time coming."¹⁴

Other activities also change to "reported" well even with Navigation revenues taken out of the mix: \$47M in 1998 and \$60M in 1999, up 27%. A variety of space-related activities were attributed to this area, from military operations to structural engineering to market studies. When combined with Navigation activities, increases were in the tune of 152%, from \$47M to \$118M between 1997 and 1999.

¹³ *GPS World's Big Book of GPS 2000*
(Advanced Star Communications: 2000; p. 161)

¹⁴ *Ibid.*, (p. 10)

ACTIVITIES BY REGION

Ontario revenues increased 17% from \$525M in 1997 to \$614M in 1998. Compared to other regions, Ontario continued to lead with 37% of total nation-wide revenues, although down from a 53% share in 1996 and 42% in 1997. Survey results in 1999 were down, although slightly, by 0.5% to \$611M. In terms of nation-wide revenues, Ontario lost more ground to other regions in 1999 with a further 4% decline to 33% of overall revenues.

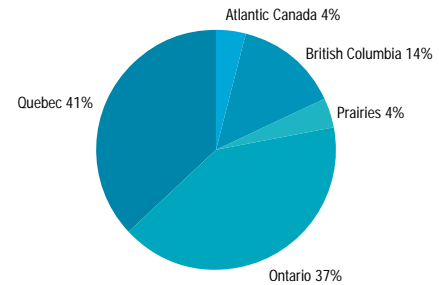
Revenues in **Quebec** rose 44% in 1998, from \$467M to \$672M, and took over the lead from Ontario in generating the most revenues. The province maintained its lead in 1999 with revenues of \$674M, up slightly by 0.2%. In terms of total nation-wide revenues, Quebec's proportion rose from 37% in 1997 to 41% in 1998, and then back down to 37% in 1999.

British Columbia (B.C.) continued to rank third in terms of total revenues, yet beat out all other regions in terms of percentage increases. B.C. revenues were up 65% in 1998 to \$229M compared to \$139M in 1997. Revenues were up again in 1999 by 56% to \$357M. In terms of national revenues, B.C. made up the most ground: 7.6% in 1996, 11% in 1997, 14% in 1998 and nearly 20% in 1999. The province's remote sensing industry has proved a key market strength for the region's overall results. Since the 1997 survey, B.C.'s share of national revenues has increased by 76%.

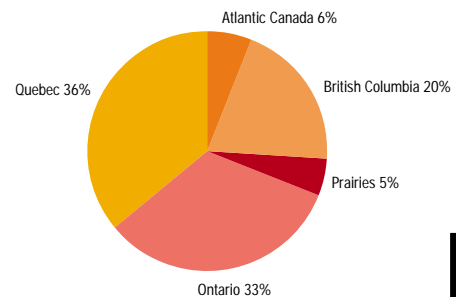
In the neighbouring **Prairies** (defined by Alberta, Saskatchewan and Manitoba), revenues rose in 1998, from \$67M to \$72M or 8%. Revenues rose again in 1999 by 17% to \$85M. The region's capacity in Ground Systems Control and Space Science projects, including satellite manufacturing, keep the future outlook optimistic.

On Canada's east coast, **Atlantic Canada** (defined by Newfoundland, New Brunswick, Nova Scotia, and Prince Edward Island) revenues rose 4% in 1998—from \$58M to \$60M—and a further 72% in 1999 to \$103M. The telecommunications applications and services have generated strong results for this region. Given the global projections in this field of expertise, this regional niche should continue to bring in beneficial returns.

Regional Revenues as a % of Total Revenues: 1998



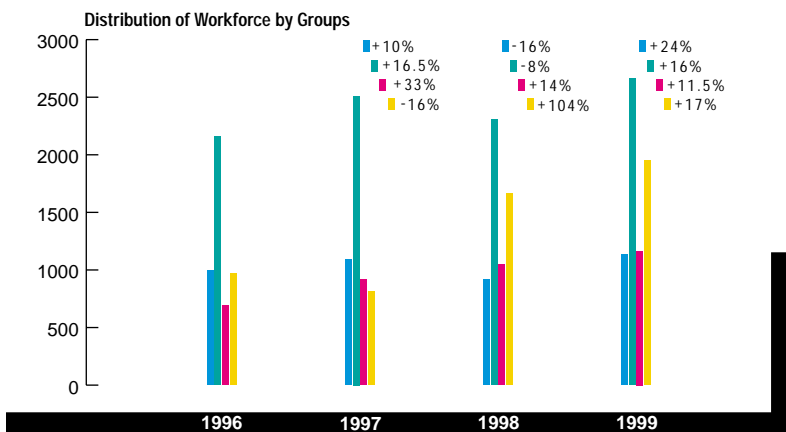
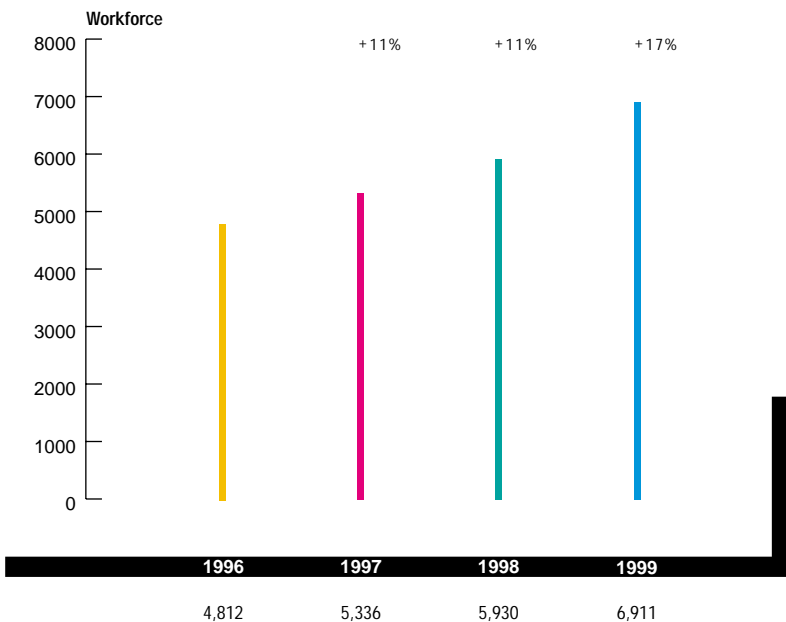
Regional Revenues as a % of Total Revenues: 1999



EMPLOYMENT

Employment Groups

Employment in Space Categories



Mgmt./Admin.	995	1,093	915	1,132
Eng./Scient.	2,156	2,511	2,304	2,664
Technical	690	916	1,045	1,165
Other	971	816	1,666	1,950

EMPLOYMENT

The workforce in Canada's space industry grew alongside total revenues. In 1998, the space sector employed 5,930 people compared to 5,336 in 1997. This represents an 11% increase in a year in which revenues were up 31%. Total number of employees grew again in 1999 to 6,911 or 17%, compared to an 11% rise in overall revenues. Since 1996, the total space sector workforce has risen by 2,099 employees or 44%, from 4,812 to 6,911.

Employment Groups

Of the four employment groups (Management/ Administration; Engineers/Scientists; Technicians; Other), "Engineers/Scientist" constituted the largest group with 2,304 employees in 1998, down 8%, only to rebound up 16% in 1999 to 2,664. The "Other" group has experienced considerable growth in recent years, up 139% since 1997.¹⁵ The Management group valleyed and peaked over the same period, down 16% in 1998 from 1,093 to 915 employees, and then up by 23% in 1999 to 1,132 employees.

Employment in Space Categories

Within each of the four space categories, the number of employees in the *Applications and Services* category was up by 30% in 1998 to 2,160 and again by 20% in 1999 to 2,593. The numbers in the *Space Segment* category fell to some extent in 1998, down 9% to 2,080. This total sprung back the year after by 31% to 2,721 thereby beating out *Applications and Services* as the main employment category, as it did in 1997.

Those working in the *Research* category made up for losses incurred in the previous survey (-38% in 1997, from 392 to 245), with a 73% increase in 1998 to 423 employees. The numbers fell slightly in 1999, a drop of 4% to 406, yet remained above the 1996 and 1997 results. Following a significant increase in the number of employees in the *Ground Segment* in 1997 (up 79% from 645 to 1,154) this workforce levelled off in 1998 at 1,267, an increase of 10%. The number of workers fell 6% in 1999 to 1,191.

¹⁵ Growth in the "Other" group has been such that a further breakdown is being examined for future reports.

Employment by Region

Regionally, **Ontario** continued to employ the most people—up 36% in 1998 to 2,870 and up again in 1999 by 7% to 3,066. Also on the rise in 1998 was the province's overall share of Canada's total space sector workforce, up to 48% from 40%, only to fall back to 44% in 1999. Since 1997, Ontario's workforce has risen a heady 100%.

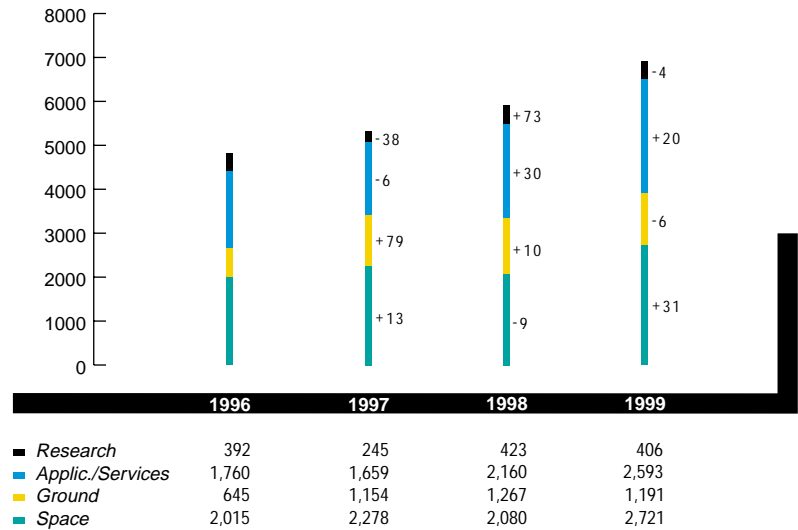
In contrast to the region's revenue growth, **Quebec** experienced a decline in its workforce in 1998, down 16% from 1,534 to 1,292. Some recovery was made in 1999, up 3% to 1,335. Between 1997 and 1999, Quebec's space sector workforce fell 13% while revenues rose 105% over this same period.

In 1998, declines were also recorded in **Atlantic Canada** where the space sector workforce fell 16% from 335 to 282. The trend was reversed in 1999 with gains of 42% to over 400 workers. These numbers represented approximately 6% of the nation's space sector workforce. Growth has been most notable in the delivery of tele-communications applications and services by Atlantic Canada industry. Since 1997, the region's workforce has risen by nearly 20%.

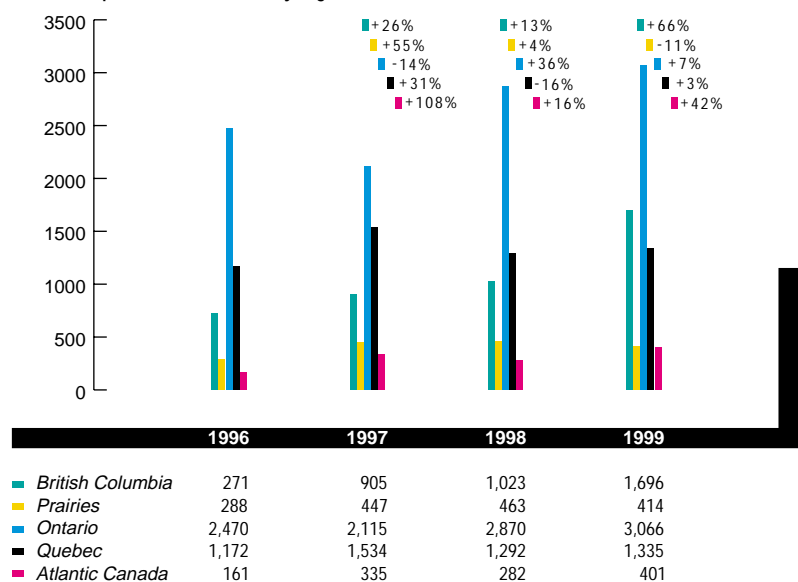
While employment had shot up in the **Prairies** in 1997 by 55% (from 288 to 447), the surge subsided in 1998 with a slightly smaller increase of approximately 4% to 463. In 1999, the employment results slipped down 11% to 414 employees. Since 1997, the Prairies' overall space sector workforce has declined by approximately 7%.

Finally, on Canada's west coast, **British Columbia** recorded strong employment numbers—up 13% in 1998 (from 905 to 1,023) and 66% in 1999 (to 1,696). Since 1997, B.C.'s workforce has risen 87%, making it one of three regions in Canada that registered positive growth (Ontario +100% and Atlantic Canada +20%) between 1997 and 1999.

Space Sector Workforce by Space Category



Space Sector Workforce by Region



CONCLUSION



CONCLUSION

Both 1998 and 1999 were successful years for Canada's space sector. Between the 1997 and 1998/1999 survey results, overall revenues rose 46% of which domestic revenues rose by 61% and export revenues by 27%. Space Applications and Services outpaced all the other categories with 100% growth rates, a phenomenon consistent with global trends.

Thirty per cent more employees were working in the space sector in 1999 compared to 1997. While the total workforce in Canada's aerospace industry rose 12% between 1998 and 1999,¹⁶ Canada's space industry rose a respectable 17% over this same one-year period, for the most part in British Columbia where almost a quarter of all space sector jobs were recorded. Atlantic Canada employment numbers also progressed well with 42% growth in 1999. Between 1998 and 1999, four of the five regions in Canada registered positive numbers.

At the current rates of growth in overall revenues and employment figures, the future looks promising for Canada's space industry. In certain fields, such as earth observation, there remains a strong technology push in the marketplace and commercial opportunities are maturing at a sound rate. The space robotics market finds itself on a similar cycle, although the spin-off and commercialization of space-borne robotic technologies into terrestrial applications are being realized at a much slower rate.

In the field of global telecommunications, this marketplace continues to drive the space commercialization agenda across the board. Market estimates are now in the trillion dollar range and Canada's industrial niche constitutes real advantages for industry and a growing Canadian user community.

The CSA is committed to ensuring a competitive space sector for the many organizations across Canada—from small and medium size enterprises to larger firms trying to break into new markets abroad. In the end, our efforts are helping to advance science, generate industrial opportunities and secure a prosperous future for all Canadians.

¹⁶ *Canada's Aerospace Industry: 1999-2000*
(Industry Canada Report: Sept. 2000)