



State of the Canadian Space Sector Report 2023



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About this Report

OBJECTIVE

The *State of the Canadian Space Sector Report* provides factual information about the Canadian space sector. The report, which is now in its 26th edition, is based on a questionnaire sent to companies, not-for-profit organizations, research centres and universities with space-related activities in Canada.

To align with international practices, the publication is identified by the year in which the survey took place (2023) but reports on data covering the year 2022. All of the information in the report represents data from 2022, with the exception of the work done in collaboration with Statistics Canada, where data covers up to 2020.

The organization-specific information used to compile this report remains strictly confidential and will not be released in any manner other than aggregate form. Consequently, in certain circumstances, a detailed explanation or in-depth reporting of the results cannot be provided in order to protect the confidentiality of the respondents.

Of note, the numbers presented throughout the report may not add up precisely to the totals provided due to rounding. Additionally, the findings presented throughout this report are provided at current prices (i.e. unadjusted for inflation).

ABOUT THE AUTHORS

Policy Branch

This report is produced by the Economic Analysis and Research Team, Policy Branch, at the Canadian Space Agency (CSA).

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FOR MORE INFORMATION

For more information about the Canadian space sector, or for an electronic copy of this report, please go to www.asc-csa.gc.ca/eng/publications.

ACKNOWLEDGMENTS

The CSA wishes to acknowledge all those in the Canadian space sector who responded to the questionnaire. Without them, this report would not have been possible.

President's Message and Executive Summary

I am pleased to present the *State of the Canadian Space Sector Report 2023*. The report, which has been published since 1996, contributes to our understanding of the sector by providing comprehensive data and trend analysis on the economic activity generated by the Canadian space sector.

The report is based on information gathered from almost 200 organizations involved in space activities from across Canada, including small businesses, multinational space companies, not-for-profit organizations, research centres and universities. Each of these organizations contributes to the Canadian space economy, with large organizations generating the highest revenues (58%), SMEs reporting the majority of exports (58%), and universities and research centres supporting a substantial workforce of over 2,500 employees.

Notably, the Canadian space sector experienced modest growth in 2022 and is still recovering from the lows experienced during the pandemic.

Revenues are recovering and our GDP impact is growing. Overall revenues grew 3.1% from last year, reaching \$5.0B. Exports were the primary area of growth, increasing 12% from 2021 to reach \$2.0B in 2022. Domestic revenues declined slightly to \$3.0B (-2%) but have mostly re-emerged from the impacts of the pandemic. The space sector is estimated to have contributed \$3.2B to Canada's GDP in 2022, a significant rise over 2021 and continuing a trend of growth in this area (+19% from 2018 to 2022).

The workforce continues to grow at a rapid pace. The Canadian space workforce expanded by 8.6% in 2022 to 12,624 space-related jobs. Workforce multiplier impacts indicate that activities in the space sector supported an additional 12,612 jobs in the wider Canadian economy. Organizations have increasingly highlighted that competition for experts in the sector is high, leading to labour shortages.

Research and Development (R&D) activity reached new peak levels. R&D expenditures continued to increase in 2022, reaching a new all-time high of \$593M (+8%). As in



**Lisa Campbell,
President of the Canadian Space Agency (CSA)**

previous years, the increased R&D activity is primarily led by the private sector, supporting a growing downstream market in Canada.

CSA funding programs are making a big difference.

An ongoing analysis of return on investment (ROI) for CSA space development programs revealed that for every dollar invested, three dollars are returned through follow-on revenues five years after a project has completed.

Space is often characterized as hard, expensive, and risky. It also supports all aspects of our daily lives. Space investments drive innovation, create high-quality jobs and fuel economic growth – as demonstrated in this report. Whether it's launching satellites, exploring our universe, developing cutting-edge technologies, or making novel scientific discoveries, these investments directly contribute to improving the lives of Canadians right here on Earth. As we continue to invest in the space sector, the economic benefits will continue to grow, positioning Canada as a key player in the global space industry for the long term.






I would like to convey my gratitude to all those who contributed to the 2023 survey. This publication would not be possible without the generous collaboration of members of the Canadian space industry and academia.

1 The Canadian Space Sector: Types of Organizations

HIGHLIGHTS

- Canada's top 30 space organizations (by revenues) accounted for 95% of total revenues and 67% of the total workforce in 2022, similar to previous years.
- In 2022, 93% of Canadian space companies were SMEs; they accounted for 39% of Canadian space sector revenues and 30% of all employees.
- University and research centre revenues amounted to \$129M, representing 2.6% of total revenue. They contributed 20% of the total space sector workforce with 2,517 full-time equivalents.

The survey included almost 200 organizations involved in space activities from across Canada. This ranges from large companies (5%), small and medium-sized enterprises (SMEs) (73%) as well as universities and research centres (22%). Each and every one of these organizations plays an important role in the Canadian space ecosystem, as demonstrated below:

	 Total Revenues	 Total Workforce	 Total STEM & Total HQP	 Total BERD	 Total Exports
Large Companies	\$2.9B (58%)	5,403 (43%)	(32%) & (40%)	\$188M (32%)	\$835M (42%)
SMEs	\$2.0B (39%)	3,809 (30%)	(34%) & (29%)	\$405M (68%)	\$1.2B (58%)
Universities & Research Centres	\$129M (2.6%)	2,517 (20%)	(29%) & (25%)	N/A	\$9M (<1%)

*The remaining percentage of the workforce, STEM, and HQP can be attributed to Canadian Space Agency employees. For definitions of STEM, HQP, and BERD, refer to Annex C.

LARGE COMPANIES

Only 5% of organizations in the space sector were large companies in 2022 (defined as employing >500 workers). These organizations represent the foundational infrastructure of the Canadian space sector, generating the majority of revenues, the largest portion of workforce and HQP, while also significantly contributing to STEM, BERD, and exports.

SMALL AND MEDIUM-SIZED ENTERPRISES






In 2022, 73% of Canadian space organizations were SMEs (defined as employing 1 to 499 workers). Despite the smaller workforce, SMEs contribute significantly to the Canadian space sector by providing the largest amount of STEM jobs, BERD, and exports.

UNIVERSITIES AND RESEARCH CENTRES

Over 40 universities and research centres across the country participate in the Canadian space sector. Universities and research centres' funding is primarily domestic, amounting to \$121M in 2022, and mostly from government: \$92M from the federal government, and \$12M from provincial governments. The remainder of domestic revenues (\$16M) came from private foundations and companies, with international sources supporting the final \$9M in funding. Contributions to overall revenues are small, but these organizations employed 20% of the total space sector workforce in 2022, of whom 86% are HQP and 95% are STEM employees.

CANADA'S LEADING SPACE ORGANIZATIONS

In 2022, Canada's top 30 space organizations (i.e. based on revenues) were comprised of 26 companies and 4 universities. The majority of these organizations are SMEs, displaying the diversity of organizations contributing to the Canadian space sector.

Top 30				
 <p>Workforce</p>	 <p>Inventions & Patents</p>	 <p>Revenues</p>	 <p>BERD</p>	 <p>Exports</p>
67%	50% & 41%	95%	81%	94%

2 Revenues and Economic Impact

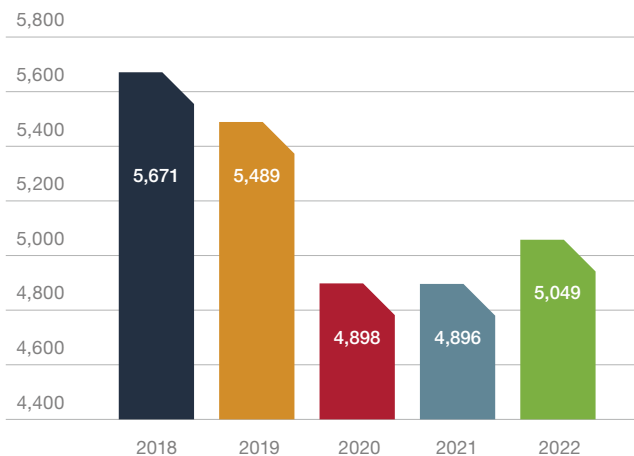
HIGHLIGHTS

- Total revenues in the Canadian space sector increased 3.1% to \$5.0B – and the sector contributed \$3.2B to Canada’s GDP.
- Domestic revenues declined slightly to \$3.0B (-2%), but export revenues grew to \$2.0B (+12%), recovering from pandemic lows.
- The upstream segment generated roughly \$1.07B in revenues, while the downstream segment generated \$3.98B in revenues.

TOTAL REVENUES

In 2022, total revenues in the Canadian space sector reached \$5.0B, a +3.1% (\$153M) increase year-over-year. The compound annual growth rate (CAGR) of the space sector between 2018 and 2022 was -2.86%.¹ Despite the negative CAGR, revenues in the Canadian space sector appear to be trending upward.

Total Space Sector Revenues: 2018–2022 (in \$M)



ECONOMIC IMPACT – GROSS DOMESTIC PRODUCT

The space sector contributed \$3.2B to Canada’s GDP in 2022. This represents the unduplicated value of goods and services produced in Canada by the space sector, and by other industries as a result of the Canadian space sector’s supply chain purchases and of associated employees’ consumer spending. Total GDP contribution was broken down into the following:

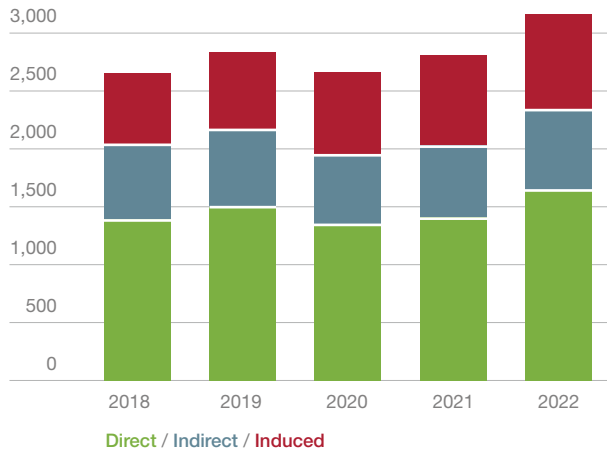
- \$1.63B in space sector impacts;
- \$0.70B in supply industry impacts; and
- \$0.83B in impacts related to consumer spending by associated employees.

The space sector therefore creates benefits in the larger economy with a GDP multiplier of 1.93. In other words, every dollar that the space sector contributed to GDP resulted in an additional \$0.93 in GDP contributions for the broader economy.

From 2018 to 2022, the GDP impact of the Canadian space sector increased by 19% (\$506M), translating into a 4.5% CAGR. In part, growth in GDP has been supported by an increasing workforce over the past five years.

¹ Calculated using compound annual growth rate (CAGR).

Total GDP Impact Trend: 2018–2022 (in \$M)



*Note: The GDP impact data has been backdated to fully incorporate changes to methodologies over the last five years.

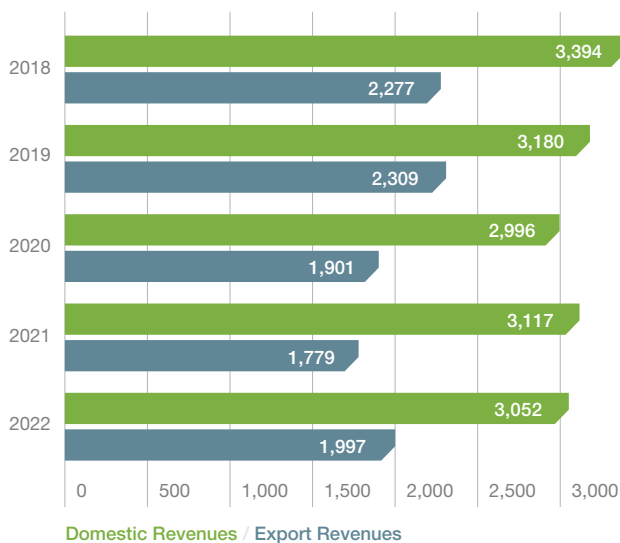
MARKET SHARE BY CUSTOMER LOCATION

Domestic vs. Export Revenues

In 2022, Canadian space revenues totalled \$5.0B, of which 60% (\$3.0B) were from domestic sources and 40% (\$2.0B) were from exports. Domestic revenues decreased by 2.0%, or \$65M, in 2022; exports increased significantly, rising 12%, or \$218M.

The compound annual growth rate (CAGR) between 2018 and 2022 was -2.86% for the entire space sector, -2.62% for domestic revenues, and -3.23% for exports.

Domestic vs. Export Revenues: 2018–2022 (in \$M)



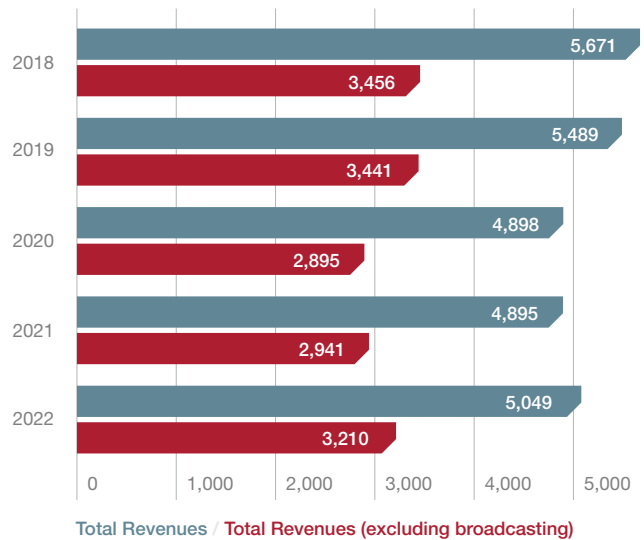
Domestic vs. Export Revenues: 2018–2022 (in \$)

YEAR	Domestic	Exports
2018	\$3,393,663,363	\$2,276,926,547
2019	\$3,180,456,544	\$2,308,782,280
2020	\$2,996,238,114	\$1,901,345,715
2021	\$3,116,936,798	\$1,778,880,183
2022	\$3,051,649,665	\$1,996,986,675

Domestic vs. Broadcasting Revenues

Broadcasting is a large contributor to the space economy but is in continual decline as reflected in the divergence in numbers when broadcasting is excluded vs. included in the analysis. When excluding broadcasting, total revenues generated by the Canadian space sector declined slightly, moving from \$3.5B in 2018 to \$3.2B in 2022.

Total Revenues vs. Total Revenues excluding broadcasting: 2018–2022 (in \$M)



Export Regions

Export revenues began to recover in 2022, rising 12% and generating \$2.0B in revenues. Increases were notable in every major trade region, with the exception of Africa in 2022.

The **U.S.** remained the main destination for Canadian space exports, totalling 59% of total exports. Revenues derived from exports to the U.S. expanded by 18%, or \$177M, from \$1.01B in 2021 to \$1.18B in 2022.

Europe remained Canada's second largest market for space exports. Canadian exports to Europe increased by 8%, or \$32M, from \$397M in 2021 to \$429M in 2022. Europe accounted for 21% of total exports.

Exports to **Asia** increased by 7%, or \$14M, from \$195M in 2021 to \$209M in 2022. Asia accounted for 11% of total exports.

Exports to **South America** increased by 7%, or \$6.3M, from \$97M in 2021 to \$103M in 2022. The region accounted for 5% of total exports.

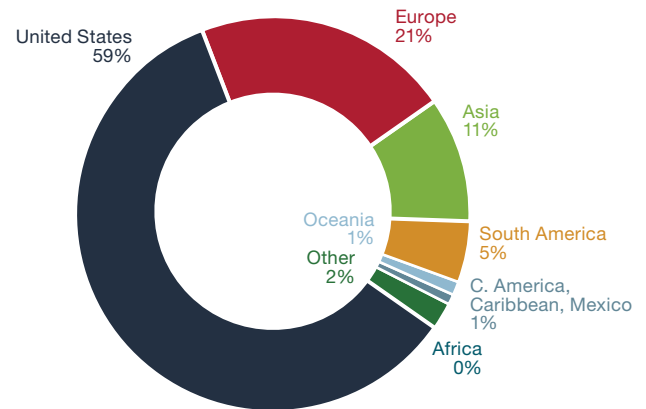
Exports to **Central America, the Caribbean and Mexico** declined by 25%, or \$4.4M, from \$18M in 2021 to \$13M in 2022. This region accounted for less than 1% of total export revenues.

Exports to **Oceania** increased by 47%, or \$5.1M, from \$11M in 2021 to \$16M in 2022. Oceania accounted for 1% of total export revenues.

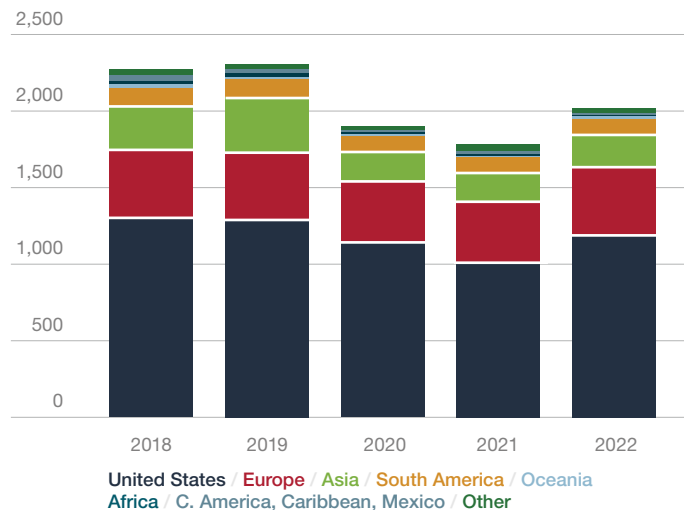
Export revenues from **Africa** decreased by 44%, or \$5.3M, from \$12M in 2021 to \$7M in 2022. Generally speaking, export growth to this region has been uneven; years of strong growth have been followed by declines and vice versa. Africa accounted for less than 1% of total Canadian space export revenues.

Finally, in 2022, 2% of total exports, or \$51M, were not allocated to a specific region of the world.

Proportion of Export Revenues: 2022



Sources of Export Revenues: 2018–2022 (in \$M)



MARKET SHARE BY CUSTOMER TYPE

Customers are categorized as either government or non-government. Government customers include domestic governments (municipal, provincial, federal) and foreign governments. Non-government customers include businesses, individual consumers and non-profit organizations or foundations (both domestic and foreign).

Overall, 14% of the space revenues in 2022 derived from government customers and 86% from non-government customers.

Both upstream and downstream segment organizations derived revenues from non-government clients in 2022. The upstream segment derived 59% of revenues from non-government clients, whereas the downstream segment derived 93% of revenues from non-government clients.

MARKET SHARE BY VALUE-CHAIN SEGMENTS

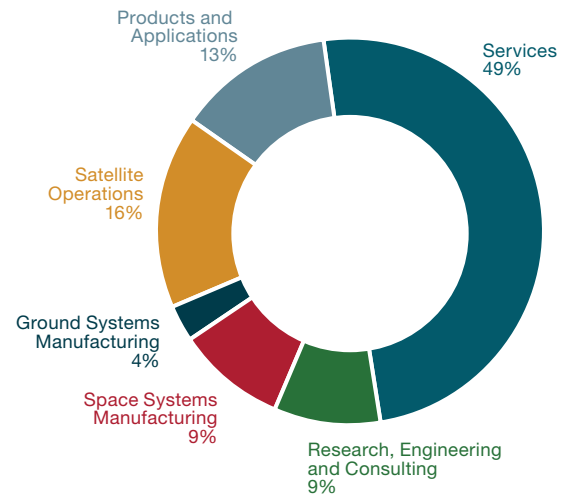
Space sector revenues can be broken down into value-chain segments and sub-segments based on the type of work that the organization is carrying out. The two main segments this analysis has been split into are upstream and downstream activities. The upstream segment – comprised of the research, engineering and consulting as well as the space segment manufacturing and ground segment manufacturing sub-segments – generated \$1.07B in revenues and grew +30% in 2022. The downstream segment – comprised of the satellite operations, manufacturing of products (e.g. terminals), development of software applications, and the provision of services (e.g. broadcasting) sub-segments – generated \$3.98B in revenues, declining by -2% in 2022.

A detailed description of the value-chain categorization is provided in Annex C. Revenues in each sub-segment can be broken down as follows:

- Research, Engineering and Consulting amounted to \$431M in 2022, a 32% increase (\$105M) from 2021. This sub-segment accounted for 9% of total revenues in 2022.
- Space Segment Manufacturing amounted to \$465M in 2022, an increase of 48% (\$150M) from 2021. It accounted for 9% of total revenues.
- Ground Segment Manufacturing amounted to \$175M in 2022, a 7% decline (\$13M) from 2021. It accounted for 4% of total revenues.
- Satellite Operations amounted to \$830M in 2022, a 2% increase (\$18M) from 2021. It accounted for 16% of total revenues.

- Products and Applications totalled \$664M in 2022, an increase of 8% (\$50M) from 2021. It accounted for 13% of total revenues.
- Services amounted to \$2.5B in 2022, a 6% decline (\$157M) from 2021. It accounted for 49% of total revenues in 2022.

Proportion of Revenues by Space Value-Chain Segments: 2022



MARKET SHARE BY SECTOR OF ACTIVITY

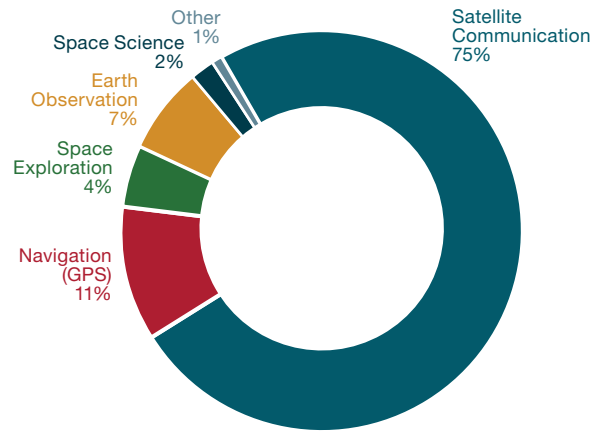
Space sector revenues can be further divided into sectors of activity based on the type of work that the organization is carrying out. In 2022, revenues returned to growth in most Canadian space sectors of activity from the impacts of the pandemic.

A detailed description of the sectors of activity categorization is provided in Annex C. Revenues for each sector of activity are as follows:

- Satellite Communication generated \$3.8B in revenues, decreasing by \$112M (-3%) from 2021, and accounting for 75% of total space revenues.
- Earth Observation (EO) revenues totalled \$349M, growing by \$79M (+29%), and accounting for 7% of total space revenues.
- Space Exploration revenues totalled \$231M in 2022, increasing by \$67M (+41%), and accounting for 4% of total space revenues.

- Navigation revenues grew to \$550M in 2022, an increase of 25% or \$110M, which represented 11% of total space revenues.
- Space Science revenues totalled \$101M in 2022, increasing by \$8M (+8%), which represents 2% of total space revenues.
- Other revenues increased by 2%, rising to \$38M, and accounting for 1% of total space revenues. Activities that fall into the “Other” sector are by nature variable and subject to re-categorization; therefore, changes in this sector are less statistically relevant than for the previously noted sectors.

Proportion of Revenues by Sector of Activity: 2022



2023-10-18. Investment of \$1.012 billion over the next 15 years in RADARSAT+, an initiative aimed at ensuring continuous, efficient, and sustainable access to critical and high-quality Earth observation (EO) data for Canada.

Credit: CSA

3 Workforce

HIGHLIGHTS

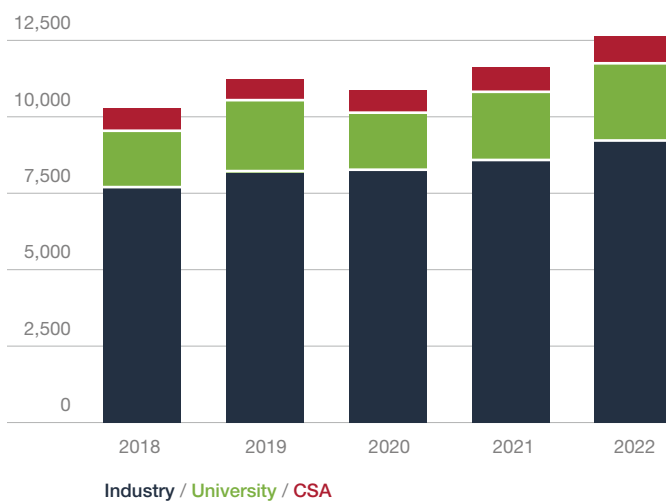
- The Canadian space workforce increased by 8.6% in 2022 to 12,624 space-related jobs – 67% of which were STEM-related jobs. The total workforce has increased significantly over the past five years.
- In 2022, the space sector supported a total of 25,236 jobs through direct, indirect, and induced impacts on the Canadian economy.
- Occupational categories have seen robust growth over the last five years: engineers and scientists (+1,432), students/interns (+592), other (+389). Remaining categories had slight growth/declines.

TOTAL WORKFORCE

In 2022, the space sector workforce totalled 12,624 jobs, an 8.6% increase, or 994 jobs. Over the past five years there has been significant growth in employment across the Canadian space sector.

The space sector workforce consists of 52% of jobs in the upstream segment, 41% of jobs in the downstream segment, and the remaining 7% of jobs at the CSA.

Space Sector Workforce: 2018–2022



2023-04-03. Artemis II – CSA astronaut Jeremy Hansen

Jeremy Hansen will be the first CSA astronaut to fly around the Moon as part of NASA's Artemis II mission.

Credit: CSA

ECONOMIC IMPACT – WORKFORCE

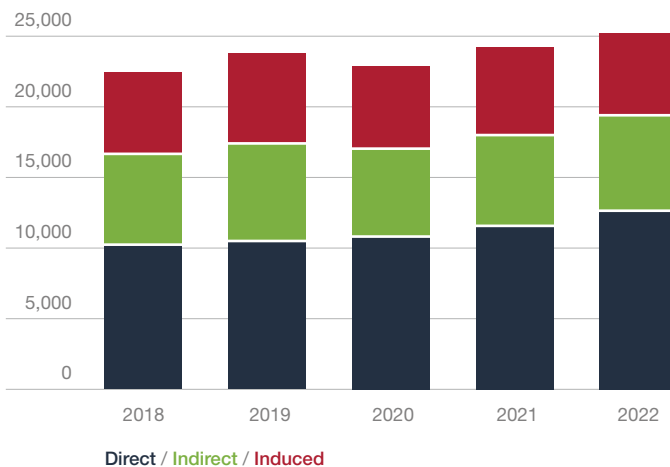
The space sector supported a total of 25,236 jobs in Canada. The total workforce contribution was broken down into the following:

- 12,624 space sector jobs; and
- 12,612 indirect and induced jobs:
 - 6,691 supply industry jobs; and
 - 5,921 jobs created and supported as a result of consumer spending by associated employees.

The space sector creates jobs in the broader economy with a workforce multiplier of 2.0. In other words, every job in the space sector supports an additional 1.0 job in the broader economy.

From 2018 to 2022, the workforce impact of the Canadian space sector increased by 12% (2,635 jobs), translating into a 2.8% CAGR. Workforce impacts have been influenced most significantly by increases in direct jobs in the space sector, as the indirect and induced impacts have been more modest.

Total Workforce Impact Trend: 2018–2022 (number of jobs)

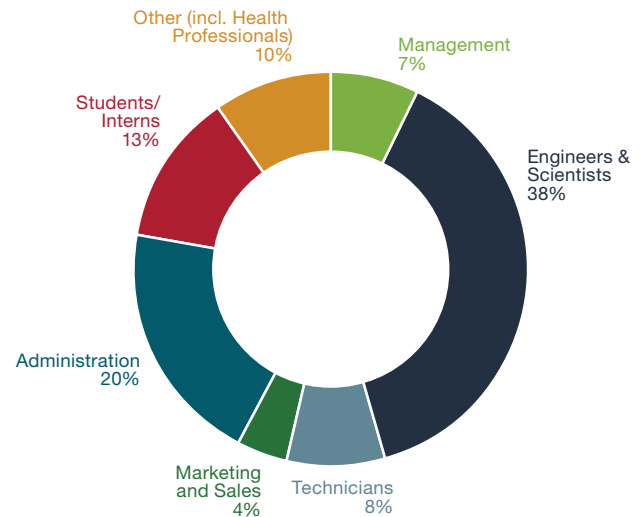


OCCUPATIONS

The CSA divides the space workforce into eight main occupation categories: Engineers and Scientists, Technicians, Management, Administration, Marketing and Sales, Students, Health Professionals, and Other

Employees. There were minimal shifts in the composition of the workforce in 2022 with a variability of +/-3%, as results were similar to previous years.

Canadian Space Sector Occupations: 2022



However, in reviewing the changes in employment across occupations over five years (2018–2022), there is significant growth in total employees amongst engineers and scientists (+1,432), students/interns (+592), other (+389), and management (+200). The remaining categories were relatively flat, with the exception of a decline in administration.



2023-06-06. The Canadian Space Agency awarded nine grants representing \$3.15 million under the CubeSats Initiative in Canada for STEM (CUBICS) to Canadian post-secondary institutions to advance space science and technology while training the next generation of space experts.

Credit: CSA

Canadian Space Sector Occupation Trends: 2018–2022

	Management	Engineers & Scientists	Technicians	Marketing and Sales	Administration	Students/ Interns	Other (includes health professionals)	Total
2018	722	3,406	1,026	487	2,790	1,006	829	10,260
2019	749	3,772	1,178	544	2,838	1,294	884	11,236
2020	674	3,669	1,022	560	2,719	1,146	1,101	10,868
2021	747	4,132	915	634	2,653	1,423	1,148	11,629
2022	922	4,838	1,031	505	2,531	1,598	1,218	12,624

STEM EMPLOYEES

The STEM indicator tracks the number of engineers, scientists, technicians, management, health professionals and students working in the space sector. STEM employees grew +16% and totalled 8,408 jobs in 2022, which represented 67% of the total Canadian space workforce.

Definition of STEM Employees

- STEM = Engineers, scientists, technicians, management, health professionals, and students

There are significant differences between the upstream and the downstream segments. In 2022, 86% of the workforce in the upstream segment were STEM, while only 44% of the workforce in the downstream segment were STEM.

HIGHLY QUALIFIED PERSONNEL (HQP)

The HQP indicator identifies the number of space sector employees with at minimum a bachelor's degree. HQP employees grew +10% and accounted for 8,593 jobs in 2022, which represented 68% of Canada's space workforce.

Definition of HQP Employees

- HQP = Employees having completed at least a bachelor's degree

The differences between HQP jobs in the upstream and the downstream segments are less pronounced than for STEM employees, but are still significant. While 76% of the upstream workforce were HQP in 2022, only 60% of the downstream workforce were HQP.



From October 30 to November 3, 2023, the United Nations Office of Outer Space Affairs and the Canadian Space Agency co-hosted the 4th edition of the Space4Women Expert Meeting. Experts from the global space community gathered in Montreal, Quebec, to discuss efforts to build capacity to promote and advance gender equality in the space sector.

Credit: CSA

SPACE LABOUR FORCE CHALLENGES AND NEEDS

In 2022, 65% of Canadian space companies faced difficulties hiring personnel to the extent that positions went unfilled.

The professions for which companies had the most difficulty finding employees were unchanged in 2022, and included engineers, scientists, technicians, and management, which is similar to the types of jobs that have been difficult to hire for since 2017.

The main reasons highlighted for hiring difficulties were applicants lacking the skills required for the position, followed by competition from other industrial sectors for the same talent, and a lack of relevant experience.

In 2022, companies dealing with employee shortages used three main strategies to deal with the problem: they provided internal training to their employees, offered overtime for existing employees, and/or outsourced some of the work.

Over the next five years, Canadian space companies will be looking for employees with sought-after skills related to software development, electrical engineering systems, mechanical engineering systems, as well as business development.

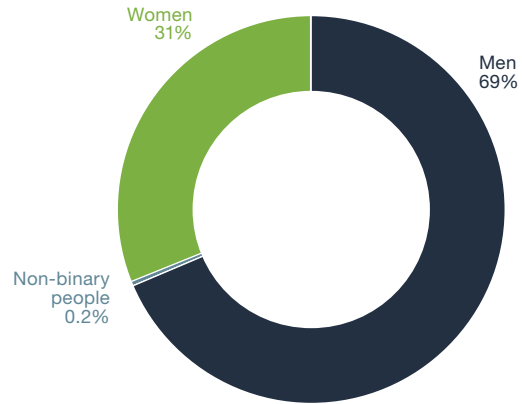
GENDER DISTRIBUTION OF EMPLOYEES

In total, 140 organizations responded to the workforce section on gender in the 2022 survey, representing 72% of organizations surveyed.

Results indicated that the Canadian space sector workforce is primarily made up of people who identify as men (69%)

and people who identify as women (31%), while those who identify as non-binary people represented 0.2% of employees in the Canadian space sector.

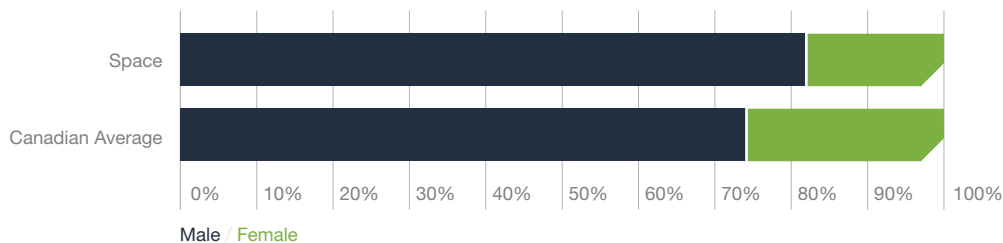
Space Sector Workforce Gender Distribution 2022



STATISTICS CANADA LINKABLE FILE ENVIRONMENT (LFE) DATA: SEX OF PRIMARY OWNERS

Based on our collaboration with Statistics Canada, we were able to determine that in 2020, most of the primary owners of space sector companies were male (82%) while a much smaller percentage were female (18%). These results have been relatively stable since 2017 – and the percentage of female primary owners in the space sector remains lower than organizations in the broader Canadian economy (26%).

Space Enterprises by Sex of Primary Owner vs. Canadian Economy (2020 Data)



4 Regional Distribution and Trends

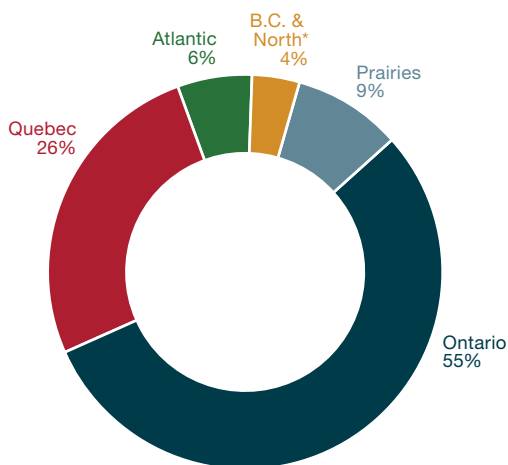
HIGHLIGHTS

- The proportional share of revenues did not fluctuate much in 2022, but revenue growth occurred across most regions of the Canadian space economy, led by the Prairies +18% (\$70M), B.C. & North +5% (\$9M), as well as Quebec +4% (\$50M).
- Revenue trends indicate that all regions declined between 2018 and 2022 – with the exception of the Prairies, which grew by +50% over this time period.
- Employment is concentrated in Ontario (36%) and Quebec (38%). Employment growth is also occurring across the space sector: led by the Atlantic region (+20%), Prairies (+18%), Ontario (+9%), and Quebec (+7%).

In 2022, the proportional share of total revenues and employment by province remained relatively stable ($\pm 1\%$) from year to year.

*Note: The North (Yukon, Northwest Territories, and Nunavut) reported revenues and workforce for the second time, but they are minimal, and therefore have been integrated with B.C. due to the small size.

Regional Distribution of Total Revenues: 2022



REVENUES AND WORKFORCE BY REGION

British Columbia & North (Northwest Territories, Nunavut, and Yukon)

- **Revenues:** \$193M (4%) of total space revenues, an increase of 5% (\$9M) from 2021.
- **Workforce:** 6% (733 jobs) of Canada's space workforce, a decrease of 9% (76 jobs) from 2021.

Upstream segment organizations generated 40% of the province's space revenues, and downstream segment organizations generated 60% of the province's space revenues. Between 2018 and 2022, B.C.'s total revenues decreased by 10%, which was driven by a 19% decline in export revenues. Over the same period, domestic revenues remained flat.

Prairies (Alberta, Saskatchewan and Manitoba)

- **Revenues:** \$466M (9%) of total space revenues, an increase of 18% (\$70M) from 2021.
- **Workforce:** 12% (1,566 jobs) of Canada's space workforce, an increase of 18% (243 jobs) from 2021.

Revenues in the upstream segment accounted for 24%, while 76% came from the downstream segment. Between 2018 and 2022, total revenues grew by 50%, primarily driven by a rise in domestic revenues by 131%. Exports grew a significant 38% in the same period.

Ontario

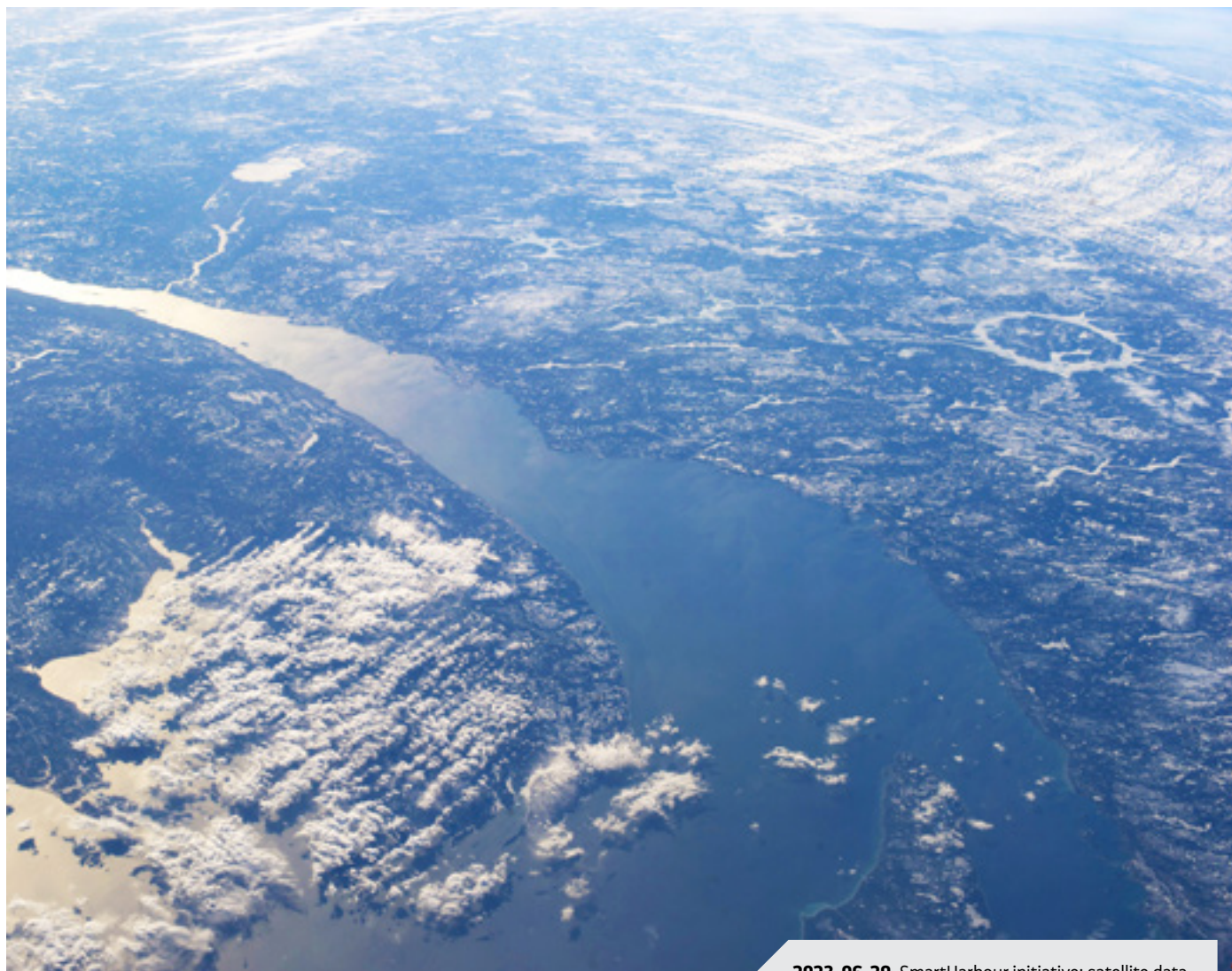
- **Revenues:** \$2.76B (55%) of total space revenues, an increase of 2% (\$57M) from 2021.
- **Workforce:** 36% (4,594 jobs) of Canada's space workforce, an increase of 9% (379 jobs) from 2021.

Upstream segment organizations accounted for 17% of revenues in Ontario, while downstream segment organizations accounted for 83% of revenues in the province. Total revenues in Ontario decreased by 16% between 2018 and 2022. Domestic and export revenues declined 11% and 23% over the same period, respectively. Ontario appears to still be dealing with the impacts of the pandemic.

Quebec

- **Revenues:** \$1.30B (26%) of total space revenues, an increase of 4% (\$50M) from 2021.
- **Workforce:** 38% (4,812 jobs) of Canada's space workforce, an increase of 7% (298 jobs) from 2021.

Revenues were concentrated in the downstream segment (69%) rather than in the upstream (31%). Between 2018 and 2022, Quebec's total revenues decreased by 10%, which has largely been driven by a 20% decline in domestic revenues as export revenues increased by 28% over the same period.



2023-06-29. SmartHarbour initiative: satellite data to help monitor and protect our ecosystems.

Credit: CSA/NASA

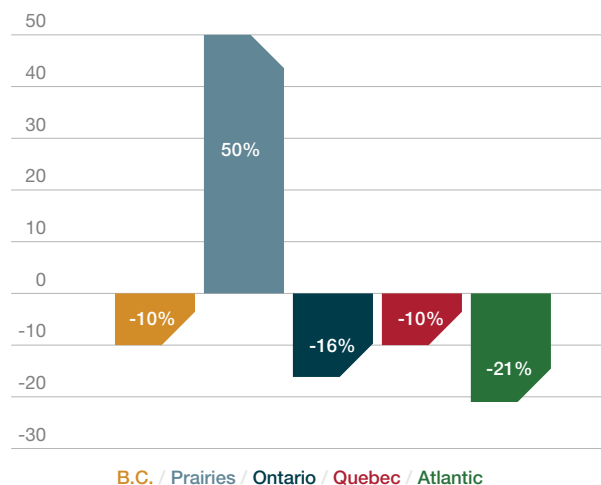
Atlantic (New Brunswick, Newfoundland and Labrador, Nova Scotia and Prince Edward Island)

- **Revenues:** \$328M (6%) of total space revenues, a decrease of 9% (\$33M) from 2021.
- **Workforce:** 7% (919 jobs) of Canada’s space workforce, an increase of 20% (151 jobs) from 2021.

Downstream segment organizations accounted for 97% of revenues in 2022, and upstream segment organizations accounted for the remaining 3%. Between 2018 and 2022, total revenues in the Atlantic region declined by 21%. This is explained by a decline in exports of 59%, while the smaller upstream segment saw 17% growth.

Note: Further regional workforce composition details on Gender, STEM, and HQP can be found in Annex A.

Percentage Change of Total Revenues by Region: 2018–2022



Revenues by Region, Domestic vs. Export Trend (in \$): 2018 & 2022

	2018		2022	
	Domestic	Exports	Domestic	Exports
B.C. & North	\$102,732,646	\$112,182,033	\$102,775,661	\$90,704,673
Prairies	\$39,533,957	\$271,349,257	\$91,127,545	\$375,186,045
Ontario	\$1,878,149,963	\$1,397,948,230	\$1,680,544,413	\$1,079,154,863
Quebec	\$1,165,090,910	\$288,150,452	\$933,742,958	\$367,526,669
Atlantic	\$208,155,888	\$207,296,576	\$243,436,532	\$84,436,982
Total	\$5,670,589,911		\$5,048,636,340	

5 Innovation

HIGHLIGHTS

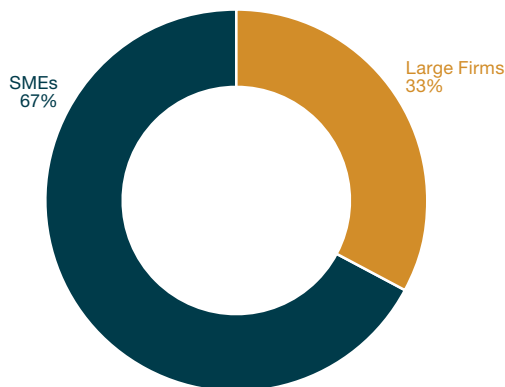
- Business Expenditures on R&D (BERD) continued to increase in 2022, rising from \$547M in 2021 to \$593M in 2022, an 8% increase.
- R&D intensity for space manufacturing was 13 times higher than the average for manufacturing in Canada.
- Return on Investment (ROI) for CSA space development programs after five years is 3.0. Meaning, for every \$1.00 invested, companies generated \$3.00 in additional follow-on revenues five years after a project finished.
- Space sector organizations reported a total of 256 inventions and 63 registered patents, similar to results in previous years.

BUSINESS EXPENDITURES ON R&D (BERD) (COMPANIES ONLY)

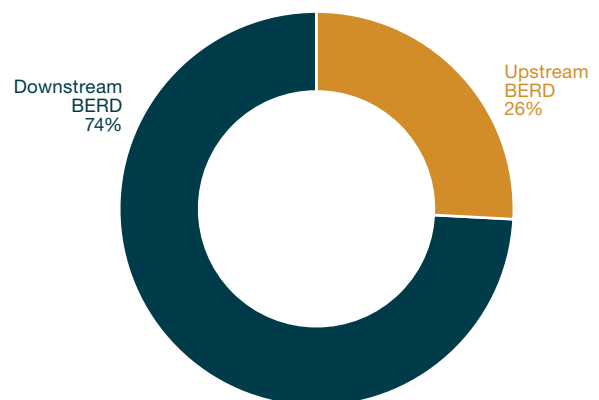
In 2022, there were 83 companies engaged in R&D activities, with BERD reaching \$593M. This represents an 8% increase from the \$547M spent on BERD in 2021. SMEs accounted for approximately two-thirds of BERD in 2022, while large firms made up the remaining one-third. Upstream organizations were responsible for 26% of total space sector BERD, while downstream organizations represented the bulk of investments at 74% of total space sector BERD.

R&D spending in 2022 was financed through internal sources (e.g. company profits reinvested in R&D) at 79% (\$469M), while the remaining 21% (\$124M) was financed through external funding sources (e.g. government grants and contributions).

Proportion of Business Expenditures on R&D by Firm Size: 2022



Proportion of Business Expenditures on R&D by Market Segment: 2022



R&D INTENSITY LEVEL (COMPANIES ONLY)

The industrial R&D intensity indicator reflects the ratio of BERD spending relative to the GDP contribution of the space sector. It serves as an indicator of the level of effort and investment by a company (or by an industry as a whole) in innovative activities such as the creation of new products, services and technologies, or the improvement of business functions such as production techniques. Industrial R&D intensity for companies operating in the space sector was 50% in 2022. The upstream segment is less R&D intensive than the downstream: upstream R&D intensity is 29%, while downstream R&D intensity is 66%.

The R&D intensity for the manufacturing sub-segment (in the upstream) is 37%, which is 13 times higher than the average for manufacturing in Canada.

COMMERCIALIZATION OF EXTERNALLY FUNDED R&D PROJECTS (ALL ORGANIZATIONS)

Organizations report on the level of commercialization of projects that were initially funded by government (externally funded R&D). Organizations derived \$213M (from 30 organizations in 2022) in revenues through the commercialization of externally funded R&D projects. This represents a 25% decline from the \$283M in 2018 commercialization revenues. The upstream segment accounted for 74% of commercialization revenues, while the downstream segment accounted for the remaining 26%. Almost all commercialization takes place through companies.

RETURN ON INVESTMENT

For the past six years the CSA has been surveying companies to determine the return on investment (ROI) from CSA space development programs.

The response rate for the ROI section of the survey was slightly lower this year, declining from 76% in 2021 to 65% of respondents answering the ROI questions in 2022.

While this result is lower, it is worth noting that a significant number of new projects were included in the analysis this year, impacting the overall response rate for ROI.

Overall, 70% of respondent companies indicated that CSA-financed projects generated positive reputation benefits, 76% have attempted to generate follow-on revenues, and 83% intend to generate follow-on revenues.

Previous interpretations of ROI at the CSA used the entire data set given a small sample size. Now that more data is available, a new methodology has been put in place that looks at the impact after a five-year period specifically:

The total ROI for CSA space development program projects after five years is 3.0 : 1.

(For every \$1.00 invested, companies generated \$3.00 in additional follow-on revenues – a multiplier of 3.0 times.)

Therefore, on average, CSA space development program investments see an ROI of 3.0 : 1.0, five years after the completion of the project.

A total of 42% of projects that finished in 2016–2021 generated an ROI. Of the projects that generated an ROI:

- 58 had an ROI >1
- 21 had an ROI >5
- 8 had an ROI >10

The analysis is conservative in nature, as the projects for which companies did not provide responses are counted as generating an ROI of zero.

To date, these measures have shown that CSA space development programs demonstrated success in generating follow-on revenues for companies. The intent is to continue to follow CSA-funded projects that have ended, in order to determine the cumulative total ROI for each space development project.

INVENTIONS AND PATENTS (ALL ORGANIZATIONS)

In 2022, 51 organizations reported having made an invention and 21 registered a patent. Between 2021 and 2022, the number of organizations with inventions and registered patents increased by 6% (from 48 organizations in 2021) and decreased by 9% (from 23 organizations in 2021), respectively. Between 2018 and 2022, the number of organizations with inventions increased by 19% (from 43 to 51), while the number of organizations registering patents decreased by 5% (from 22 to 21).

A total of 256 inventions and 63 registered patents were reported in 2022.

The number of inventions increased by 13%, from 226 in 2021 to 256 in 2022.

The number of registered patents decreased by 17%, from 76 in 2021 to 63 in 2022.



2023-09-24. NASA's OSIRIS-REx mission: Asteroid Bennu sample successfully lands on Earth. The Canadian OSIRIS-REx Laser Altimeter (OLA) instrument played a key role in the mission. It was used to scan and measure the shape of the entire surface of the asteroid and to help select the best site to collect the specimen.

Credit: NASA/Keegan Barber

6 Conclusion

The Canadian space economy experienced modest growth in 2022 and is still recovering from the effects of the pandemic. Revenues grew 3.1% to reach \$5.0B in 2022, led by growth in exports of 12%, while domestic revenues remained flat. Declining broadcasting revenues are a contributing factor to limited growth in the domestic space sector. Despite this, the space workforce continues to grow at a robust rate, increasing 9% in 2022 to reach over 12,600 jobs, a new peak.

BERD has continued to grow, again reaching a new high of \$593M in 2022, an 8% increase over the previous high in 2021. The R&D intensity for space manufacturing was 13 times higher than the average for manufacturing in Canada – demonstrating the innovative nature of space activities.

The CSA will continue to monitor the health and dynamics of the Canadian space economy.



2023-11-22. The Honourable François-Philippe Champagne, Minister of Innovation, Science and Industry, announces that CSA astronaut Joshua Kutryk is selected as crewmember for the Starliner-1 mission, and that CSA astronaut Jenni Gibbons is selected as the Canadian backup crewmember for the Artemis II mission.

Credit: CSA



A Annex A Economic Trends : 2018–2022

Total Space Revenues	
YEAR	TOTAL REVENUES
2018	\$5,670,589,911
2019	\$5,489,238,824
2020	\$4,897,583,829
2021	\$4,895,816,981
2022	\$5,048,636,340

Domestic vs. Export Revenues Overall					
	Domestic	%	Exports	%	Total
2018	\$3,393,663,363	59.8%	\$2,276,926,547	40.2%	\$5,670,589,911
2019	\$3,180,456,544	57.9%	\$2,308,782,280	42.1%	\$5,489,238,824
2020	\$2,996,238,114	61.2%	\$1,901,345,715	38.8%	\$4,897,583,829
2021	\$3,116,936,798	63.7%	\$1,778,880,183	36.3%	\$4,895,816,981
2022	\$3,051,649,665	60.4%	\$1,996,986,675	39.6%	\$5,048,636,340

Sources of Domestic Revenues Public vs. Private		
YEAR	Public Revenues	Private Revenues
2018	\$334,463,454	\$3,059,199,909
2019	\$341,561,639	\$2,838,894,905
2020	\$317,814,912	\$2,678,291,861
2021	\$391,644,769	\$2,725,292,029
2022	\$428,167,309	\$2,623,482,355

Sources of Export Revenues

	2018	2019	2020	2021	2022
United States	\$1,299,441,910	\$1,289,465,682	\$1,140,660,531	\$1,007,647,615	\$1,184,431,048
Europe	\$450,898,448	\$437,331,709	\$394,361,393	\$396,668,524	\$428,887,232
Asia	\$282,266,077	\$362,963,708	\$197,876,444	\$194,814,435	\$209,247,380
South America	\$117,568,822	\$117,005,504	\$101,220,609	\$96,698,504	\$103,020,501
Oceania	\$24,221,719	\$15,666,472	\$14,230,483	\$10,950,191	\$16,057,563
Africa	\$25,378,752	\$21,278,947	\$16,730,868	\$11,983,525	\$6,658,106
C. America, Caribbean, Mexico	\$38,795,654	\$30,029,638	\$12,390,313	\$17,936,913	\$13,497,579
Other	\$38,355,166	\$35,040,622	\$23,875,072	\$42,180,476	\$35,187,266

Revenues by Sectors of Activity

	Satellite Communication	Navigation (GPS)	Space Exploration	Earth Observation	Space Science	Other
2018	\$4,615,929,082	\$559,109,223	\$122,957,630	\$277,547,875	\$66,058,595	\$28,987,504
2019	\$4,562,739,085	\$418,054,090	\$118,684,514	\$247,689,131	\$111,020,253	\$31,051,651
2020	\$3,998,194,805	\$420,879,915	\$132,214,066	\$226,193,564	\$89,558,926	\$30,542,552
2021	\$3,891,182,123	\$439,781,649	\$164,153,878	\$269,778,700	\$94,097,657	\$36,822,973
2022	\$3,779,333,298	\$550,156,895	\$231,301,890	\$349,072,210	\$101,240,650	\$37,531,397

Total Workforce vs. STEM Employees

	Total Workforce	STEM	HQP
2018	10,260	6,166	6,601
2019	11,236	7,014	7,392
2020	10,868	6,532	6,902
2021	11,629	7,238	7,784
2022	12,624	8,408	8,593

Workforce by Canadian Region (Jobs)

	2018	2019	2020	2021	2022
B.C. & North	638	739	746	809	733
Prairies	966	1,116	1,109	1,324	1,566
Ontario	4,047	4,497	3,984	4,215	4,594
Quebec	3,875	4,089	4,287	4,514	4,812
Atlantic	734	795	742	768	919

Revenues by Canadian Region 2018–2022

	2018	2019	2020	2021	2022
B.C. & North	\$214,914,678	\$162,646,505	\$165,436,391	\$184,313,574	\$193,480,334
Prairies	\$310,883,213	\$368,163,142	\$385,869,507	\$396,398,755	\$466,313,589
Ontario	\$3,276,098,193	\$3,224,599,935	\$2,784,964,016	\$2,703,135,966	\$2,759,699,276
Quebec	\$1,453,241,361	\$1,302,444,860	\$1,188,485,809	\$1,251,287,427	\$1,301,269,627
Atlantic	\$415,452,464	\$431,384,383	\$372,828,105	\$360,681,259	\$327,873,514

Workforce Group by Region: 2022

	Management	Engineers & Scientists	Technicians	Marketing and Sales	Administration	Students/ Interns	Other (includes health professionals)	Total	% of Total Workforce
B.C. & North	63	368	49	33	38	125	57	733	6%
Prairies	117	672	113	24	59	543	38	1,566	12%
Ontario	385	1,957	301	256	632	497	566	4,594	36%
Quebec	257	1,699	527	148	1,731	340	110	4,812	38%
Atlantic	100	142	41	44	71	93	428	919	7%
Total	922	4,838	1,031	505	2,531	1,598	1,199	12,624	100%

Gender Composition by Region 2022

	Men	Women	Non-binary people	Total
B.C. & North	70.5%	29.4%	0.1%	100.0%
Prairies	74.2%	25.7%	0.1%	100.0%
Ontario	72.1%	27.7%	0.2%	100.0%
Quebec	64.2%	35.8%	0.0%	100.0%
Atlantic	63.9%	34.7%	1.5%	100.0%

STEM Workforce: 2022

	Total Workforce	Total STEM	% of STEM Relative to Total Regional Workforce	% of STEM Relative to Total Number of STEM in Canada's Space Workforce
B.C. & North	733	606	83%	7%
Prairies	1,566	1,455	93%	17%
Ontario	4,594	3,146	68%	37%
Quebec	4,812	2,825	59%	34%
Atlantic	919	376	41%	4%
Total	12,624	8,408	-	100%

Distribution of Highly Qualified Personnel in the Canadian Space Sector: 2022

	Total Workforce	Total HQP	% of HQP Relative to Total Regional Workforce	% of HQP Relative to Total Number of HQP in Canada's Space Workforce
B.C. & North	733	604	82%	7%
Prairies	1,566	1,203	77%	14%
Ontario	4,594	3,252	71%	38%
Quebec	4,812	3,044	63%	35%
Atlantic	919	490	53%	6%
Total	12,624	8,593	-	100%

Breakdown of Sectors of Activity along the Value-Chain: 2022

	Upstream			
	Research, Engineering and Consulting Services	Space Systems Manufacturing	Ground Systems Manufacturing	Total Upstream
Satellite Communication	\$88,520,624	\$299,642,342	\$130,055,016	\$518,217,982
Navigation (GPS)	\$7,380,394	\$514,231	\$543,023	\$8,437,648
Space Exploration	\$170,561,557	\$51,723,522	\$1,987,655	\$224,272,733
Earth Observation	\$72,662,363	\$82,657,506	\$40,719,402	\$196,039,272
Space Science	\$84,485,514	\$8,735,222	\$1,451,058	\$94,671,794
Other	\$7,413,807	\$21,708,629	\$561,123	\$29,683,559
Total	\$431,024,259	\$464,981,452	\$175,317,277	\$1,071,322,988

Breakdown of Sectors of Activity along the Value-Chain: 2022

	Downstream			
	Satellite Operations	Value-Added Products and Applications	Services	Total Downstream
Satellite Communication	\$758,248,857	\$286,096,278	\$2,216,770,181	\$3,261,115,316
Navigation (GPS)	\$131,815	\$321,327,961	\$220,259,471	\$541,719,248
Space Exploration	\$255,410	\$5,785,022	\$988,725	\$7,029,157
Earth Observation	\$70,582,410	\$38,762,386	\$43,688,141	\$153,032,937
Space Science	\$1,204,089	\$4,838,108	\$526,660	\$6,568,856
Other	\$0	\$7,572,489	\$275,349	\$7,847,838
Total	\$830,422,581	\$664,382,244	\$2,482,508,526	\$3,977,313,351

Breakdown of Sectors of Activity along the Value-Chain: 2022

	Total Upstream	Total Downstream	Total
Satellite Communication	\$518,217,982	\$3,261,115,316	\$3,779,333,298
Navigation (GPS)	\$8,437,648	\$541,719,248	\$550,156,895
Space Exploration	\$224,272,733	\$7,029,157	\$231,301,890
Earth Observation	\$196,039,272	\$153,032,937	\$349,072,210
Space Science	\$94,671,794	\$6,568,856	\$101,240,650
Other	\$29,683,559	\$7,847,838	\$37,531,397
Total	\$1,071,322,988	\$3,977,313,351	\$5,048,636,340

B Annex B Methodology

QUESTIONNAIRE

In order to measure the changes taking place in Canada's space sector each year, the CSA uses a questionnaire to collect baseline data. Questionnaires are sent to private sector enterprises, not-for-profit organizations, research centres and universities in Canada that engage in space activities. The questionnaire follows a census model and therefore aims to be as inclusive and exhaustive as possible.

Most organizations that responded to the 2022 questionnaire reported on a fiscal year (generally ending March 31, 2023), with the remainder reporting on a calendar year, from January 1 to December 31, 2022. As in previous years, the questionnaire had a high response rate covering 194 organizations, including all major space players.

Additionally, the CSA performs quality control measures on the survey data to ensure the accuracy of the findings.

ATTRIBUTION

Data are also supplemented based on CSA transfer payments (Contracts, Grants, and Contributions) in cases where this information has not been included as part of the survey responses to more fully capture revenues.

In addition, there is a limited number of cases where data are compiled from publicly disclosed reports (e.g. for publicly traded companies) and verified through consultation with company officials.

ECONOMIC TRENDS

The economic trend analysis for this report assesses the past five years (2018–2022). For information on the economic trends prior to 2018, readers are invited to consult previous editions of this report.

STATISTICS CANADA LINKABLE FILE ENVIRONMENT

Through a linkage process, the Linkable File Environment (LFE) leverages the single-subject ability of existing surveys and administrative data to inform on business and economic issues. It positions these surveys and administrative data to support longitudinal and cross-sectional analysis and offers opportunities to use additional variables to assess entrepreneurship, employment, productivity and competitiveness.

It is important to note that there are limitations in this information, as a portion of the data is characterized as unknown and/or not available. As a result, the data presented in this report does not include the unknown/not available data and excludes broadcasting companies.

ECONOMIC IMPACT ANALYSIS

As described in the OECD's 2012 Handbook on Measuring the Space Economy, measuring economic impacts in the space sector is a challenging task, as there is no single industrial classification for space activities. In order to overcome this difficulty, a model was developed jointly by the CSA and Innovation, Science and Economic Development Canada (ISED) to calculate the space sector's contribution to GDP (gross domestic product or value added). This process involved taking into account the various industrial classifications, weighing them and categorizing them using a value-chain approach, in order to develop a set of multipliers based on Statistics Canada's Input-Output tables. These multipliers are used to determine the impacts on GDP and employment of the space sector, the suppliers to the space sector, and the consumer spending by employees associated with both the space sector and its supply industry.

A detailed explanation of the Economic Impact Model follows:

1. North American Industry Classification System (NAICS) codes were retrieved for each space company through Statistics Canada's Business Register. This exercise generated a list of 11 separate industrial classifications that covered all active Canadian space sector companies.
2. Canadian space companies were categorized into a value-chain model based on the goods and services they provide: Research, Engineering and Consulting; Manufacturing; Satellite Operations; Service Providers; and Broadcasting Services.
3. Universities, research centres and associations were grouped together under Research, Engineering and Consulting, as in most cases their space sector activities are related to R&D.
4. The grouping of NAICS codes in each of the value-chain categories were then weighted for their relative importance within that particular category. Weighting was established on the basis of workforce tied to each NAICS code. The more workforce associated with organizations in a particular NAICS code, the heavier that NAICS code was weighted relative to the grouping of NAICS codes in that value-chain category.
5. Customized economic multipliers were then built for each value-chain category based on Statistics Canada's input-output accounts for existing NAICS codes. These multipliers are at three levels: space sector, supply industry and consumer spending by associated employees.
6. Employment levels for each value-chain segment of the space sector (collected directly from companies through the questionnaire) are entered in the Economic Impact Model. The customized economic multipliers are then applied to generate the space sector's total GDP and workforce impact numbers.

The "multiplier effect" refers to the total impacts (space sector, supply industry and consumer spending by associated employees) divided by the initial space sector impact. This gives the reader an idea of the impact that one job or one dollar in the space sector has on the wider economy.

Note: Two types of primary inputs can be used in an input-output model: revenues or employment. Employment has been chosen here, as it provides a more accurate portrait of the true level of economic activity being performed within Canada's borders. The results of this analysis can be considered a conservative estimate of Canada's space sector impact, particularly when compared to third-party studies or comparative international reports, which may use different methodologies.

C Annex C Definitions

CANADA'S SPACE SECTOR

The Canadian space sector is defined as organizations (private, public and academic) whose activities include the development and use of space assets and/or space data.

SPACE VALUE-CHAIN CATEGORIES

This report uses a methodology developed by the Organisation for Economic Co-operation and Development's (OECD) Space Forum, of which the CSA is a Steering Committee member, to characterize Canadian space activities on the basis of a value-chain approach. The definitions of space sector categories were updated in the 2014 edition of this report as per the value-chain approach, with findings presented on the basis of upstream and downstream segment activities. This re-categorization is intended to improve the measurement of the space sector and enable international comparisons.

Under this value-chain approach, data have been organized into categories that align with the stages of producing space goods and services: Research, Engineering and Consulting; Space Segment Manufacturing; Ground Segment Manufacturing; Satellite Operations; Products and Applications; and Services. This approach replaces the space categories used in the annual State of the Canadian Space Sector Reports from 1996 to 2013.

Upstream Segment

The upstream segment refers to the effort required to design, test, build, integrate, and launch² assets into space.

- **Research, Engineering and Consulting:** Research and development (R&D) related to non-commercial or pre-commercial activities; applied science; design and testing of spacecraft, satellites and payloads or components thereof; support services directed at enabling other space sector actors throughout the value chain, including outreach activities, legal services, insurance provision, market research, policy and management services.
- **Space Segment Manufacturing:** Building and integration of spacecraft, satellites, payloads or any component thereof.

- **Ground Segment Manufacturing:** Building and integration of facilities and equipment on Earth for satellite operations, often known as "ground stations."

Downstream Segment

The downstream segment refers to the effort required for the day-to-day operation of space assets, manufacturing of products and software applications that transform space data and signals into useful end products, and services provided to end-users.

- **Satellite Operations:** Day-to-day management of satellites and spacecraft once they are in space, e.g. telemetry, tracking and command; monitoring, recovery operations and collision avoidance; mission planning for satellite passes; uplinks and downlinks for signal processing to reception facility; lease or sale of satellite capacity.
- **Products and Applications:** Manufacturing/development of software or hardware that enable the transformation of space-derived resources into a usable/useful format, e.g. computer software applications, chipsets, Very Small Aperture Terminals and other terminals, antennas, satellite phones, video and audio receivers-decoders, and GPS devices. This category also includes publishing digital or print books, atlases and maps using space-based data.
- **Services:** Provision of services which are dependent on space-based signals or data to various end-users (individual consumers, government departments, or businesses), e.g. subscriptions to satellite radio, phone, television or Internet services; engineering, architectural and environmental consulting based on the processing and analysis of Positioning, Navigation and Timing (PNT) or Earth Observation (EO) data; support services provided to users of space-based products and applications, such as provision of computer consulting and facilities management, data processing, Web hosting and portals, and streaming services.

² Note that launch-related activities do not represent a significant area of activity in the Canadian space sector, hence why it is not included as a separate value-chain category in this report. Launch-related activities include the building and integration of space transportation vehicles (rockets), launch pads, space ports and related technologies, as well as launch service provision.

SECTORS OF ACTIVITY

The activities of space organizations can also be broken down, as has been done in previous reports, according to the ultimate use or purpose of the research carried out or the goods and services produced. Space sector activities can serve commercial, civil or military purposes, and refer to activities across the value chain:

- **Navigation:** The development and use of satellites for localization, positioning and timing services. Navigation is used for air, maritime and land transport, or the localization of individuals and vehicles. It also provides a universal referential time and location standard for a number of systems.
- **Satellite Communication:** The development and use of satellites to send signals to Earth for the purpose of fixed or mobile telecommunications services (voice, data, Internet, and multimedia) and broadcasting (TV and radio services, video services, Internet content).
- **Earth Observation (EO):** The development and use of satellites to measure and monitor Earth (including its climate, environment and people) for a number of purposes such as resource management, mineral exploration, disaster assessment, security and defence.
- **Space Exploration:** The development and use of crewed and uncrewed spacecraft (space stations, rovers and probes) to investigate the reaches of the universe beyond Earth's atmosphere (e.g. the Moon, other planets, asteroids). The International Space Station and astronaut-related activities are considered in this sector.
- **Space Science:** The various science fields that relate to space flight or any phenomena occurring in space or on other planets (e.g. astrophysics, planetary science, space-related life science).
- **Other:** Generic technologies or components that are not destined for use on a specific space system or for a specific space application. This could be the case for early-phase research, small off-the-shelf components used in various systems, or services based on integrated applications.

RETURN ON INVESTMENT (ROI)

ROI is defined as the ratio rate of return between net income and investment.

For the past five years the CSA has been surveying companies to determine the return on investment (ROI) from CSA space development programs. The process involved asking a series of questions related to reputation effects,

intent to generate revenues, and revenues generated for each project supported by space development programs.

JOBS

Jobs impact is reported on an annual average basis and measured in terms of full-time equivalent (FTE) employment.

HIGHLY QUALIFIED PERSONNEL (HQP)

HQP is defined as space-related employees who have at least a bachelor's degree. This definition aligns with Statistics Canada's definition of HQP, enabling comparisons with other sectors of the economy.

SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) EMPLOYEES

STEM are space-related employees involved in science, technology, engineering or mathematics activities. For the purpose of this survey, STEM employees include engineers, scientists, technicians, management, health professionals and students working in the space sector. Management employees are included in the STEM indicator because the vast majority of employees in this category are managing STEM-related activities. Similarly, students were included in this indicator, because the vast majority of students employed by space companies are directly involved in STEM activities. This approach aligns more closely with Statistics Canada's and the OECD's definitions of STEM employees.

CANADIAN SPACE AGENCY (CSA) EMPLOYEES

The report now includes data on CSA employees as members of the space sector, and will look to incorporate other government departments in the future. Data related to CSA employees have also been backdated in order to be consistent with trend analyses throughout the report.

BUSINESS EXPENDITURES ON RESEARCH AND DEVELOPMENT (BERD)

BERD measures the spending towards R&D activities in a company. The source of funds could include their own internal private investment (cash on hand; debt; private injection) or external funding sources (government funding, other).



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