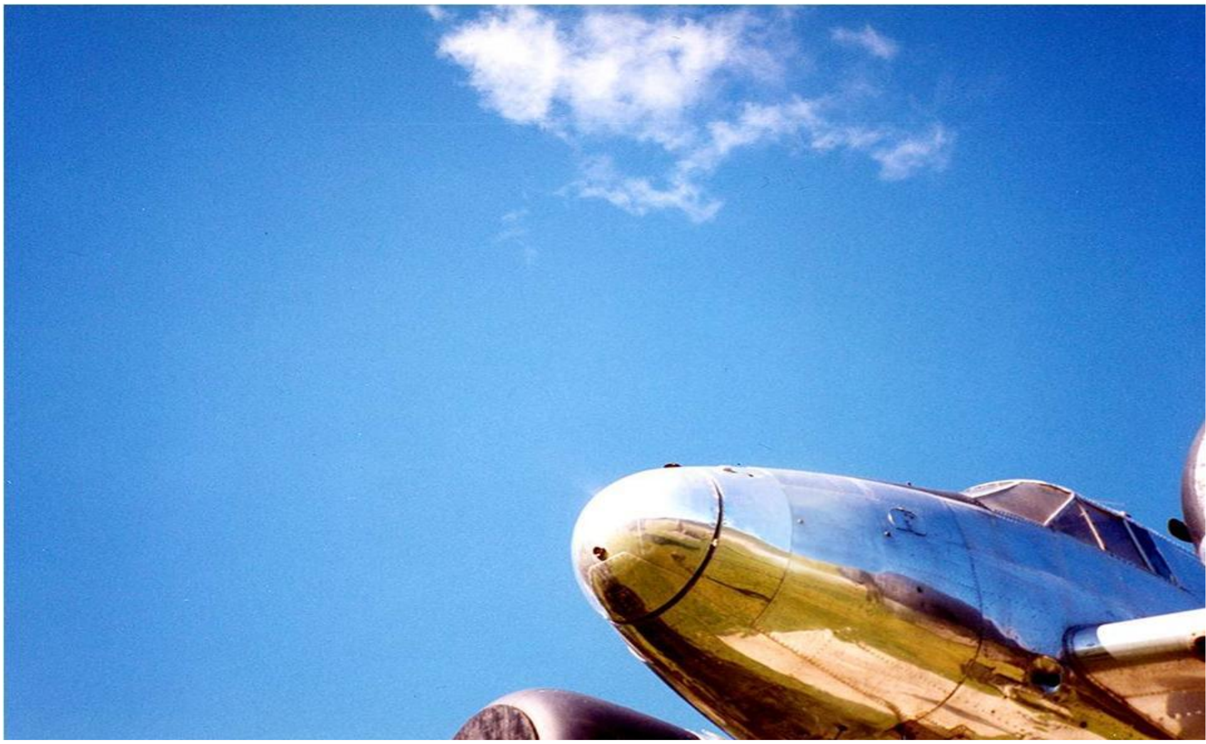
Deloitte.



Impact of the Canadian Aerospace Industry

October, 2010
AIAC Phase 2 Report

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1 Glossary of terms

Abbreviations	
A&AP	Aircraft & Aircraft Parts
A&ES	Avionics & Electro Systems
AIAC	Aerospace Industries Association of Canada
BE-LF	Break-Even Load Factor
BRIC countries	Brazil, Russia, India, and China
CAGR	Compound Annual Growth Rate
CAS	Civil Aerospace Sector
Category I members	The second largest (in terms of revenue per company) of the three strata of AIAC direct members analyzed as part of this study
Category II members	The smallest (in terms of revenue per company) of the three strata of AIAC direct members analyzed as part of this study
CDDP	Canadian Department of Defence Production
COMAC	Commercial Aircraft Corporation of China, Ltd.
Deloitte	Deloitte & Touche LLP
DoD	US Department of Defense
E&EP	Aircraft Engines & Engine Parts
EDC	Export Development Canada
FTK	Revenue per Tonne of Freight
GARDN	Green Aviation Research & Development Network
GDP	Gross Domestic Product
GEO	Geosynchronous-Earth Orbit
IATA	International Air Transport Association
IMF	International Monetary Fund
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
"large companies"	Respondents to the 2009 AIAC Annual Membership Survey with revenues greater than $15 million
LCA	Large Commercial Aircraft
LCC	Low Cost Carriers
LEO	Low-Earth Orbit
M&A	Mergers & Acquisitions
MA&D	Military Aerospace & Defense
MAS	Military Aerospace Sector
MRO	Aircraft Maintenance, Repair & Overhaul
MTOW	Maximum Take-Off Weight
NRC-IRAP	National Research Council Industrial Research Assistance Program

Abbreviations	
Other AP&S	Other Industry Related Products & Services
PPE	Property, Plant, & Equipment
Provincial members	The fourth strata analyzed as part of this study, consisting of companies belonging to aerospace industry provincial associations
R&BA	Regional & Business Aircraft
R&D	Research & Development
RPK	Revenues per Passenger Kilometres
SADI	Strategic Aerospace & Defence Initiative
SIPRI	Stockholm International Peace Research Institute
"small companies"	Respondents to the 2009 AIAC Annual Membership Survey with revenues less than $15 million
Special Category members	The largest (in terms of revenue per company) of the three strata of AIAC direct members analyzed as part of this study
SR&ED	Scientific Research & Experimental Development Program
"survey respondents"	Respondents to the 2009 AIAC Annual Membership Survey
SWOT	Analysis of Strengths, Weaknesses, Opportunity, & Threats
the AIAC Survey	the 2009 AIAC Annual Membership Survey
UAC	United Aircraft Corporation
UAV	Unmanned Aerial Vehicles
US	United States
YoY	Year-over-Year

2 Introduction

Deloitte & Touche LLP ("Deloitte") was retained by the Aerospace Industries Association of Canada ("AIAC") to assist in analyzing the contribution of the Canadian aerospace industry to the Canadian economy. This analysis consists of three related but distinct phases and corresponding reports:

- Phase 1: provides a synopsis of the Canadian aerospace industry based on a statistical analysis of the 2009 AIAC annual membership survey ("the AIAC Survey"). This report also includes a discussion of the membership's outlook for the sector.
- Phase 2: evaluates the contribution of the aerospace industry to the Canadian economy by quantifying the direct, indirect and associated impacts of the aerospace industry on measures such as expenditure and investment, employment and gross domestic product ("GDP"). This report uses macroeconomic and sectoral data, including the AIAC Survey results from Phase 1, to parameterize Deloitte's input-output model and generate numerical results. To further highlight the different ways in which the socioeconomic impacts of the aerospace industry can be felt in the broader economy, this report also presents four case studies drawn from specific development programs in the aerospace industry.
- Phase 3: provides a 10 year market growth forecast and competitive analysis for the global aerospace industry. This report includes a global market analysis, an analysis of external market drivers as well as an analysis of the trends in the Canadian and international markets which could positively and negatively affect the aerospace industry in the short term (1-2 years) and the long term (10 years). Also, a global report card is presented to highlight the strengths, weaknesses, opportunity and threats facing the Canadian aerospace industry. To highlight some of the opportunities and challenges faced by the aerospace industry, this report concludes by examining four scenarios that relate the long term aerospace forecast to policy-relevant issues facing the domestic aerospace industry.

Each phase is covered by a separate report. There are also a number of appendices that contain supplementary information.

For our analyses and reports, the Canadian aerospace industry is defined to include companies that perform the following activities: aircraft and aircraft parts design and manufacturing ("A&AP"); aircraft engines and engine parts ("E&EP"); avionics and electro systems ("A&ES"); maintenance, repair and overhaul ("MRO"); simulation and training and space related design and manufacturing.[1] The A&AP sector is the most diverse as a result of a wide range of aircraft types (i.e., business jets, regional aircraft, narrow-body commercial aircraft, wide-body commercial, freighters, military jets, etc.) and the associated range of components and technology used in each aircraft type. Furthermore, each sector within the industry has both military and civil end-users that often have unique requirements and objectives.

The purpose of this Phase 2 report is to present the economic impacts of the Canadian aerospace industry. To place this industry in perspective, a summary of the global and Canadian aerospace industries (taken from the Phase 1 report) is included within this report.

Unless otherwise noted, all revenue and expenses items are presented in Canadian dollars.

[1] Only selected companies and sub-sectors from the space sector are included in the membership survey and statistical analysis of the Canadian aerospace industry.

3 Global aerospace industry

The global aerospace industry includes both the civil and military sectors, and is estimated to have generated total sales of approximately US$380 billion in 2009, including all components of the value chain from A&AP to MRO. The global civil aerospace sector (“CAS”) is estimated to comprise 46% of total aerospace industry revenue, while the military aerospace sector (“MAS”) constitutes approximately 54% of revenue.[2] The MAS is a subset of the military aerospace and defense (“MA&D”) industry, which also includes many non-aerospace defense products and services.

3.1 The global civil aerospace market

The global CAS can be defined to include and segmented into A&AP (including A&ES) manufacturing, E&EP manufacturing, MRO service providers, training and simulation, and space related manufacturing. The largest end-users for CAS products are passenger airlines. Other end-users include logistics (freight) companies, businesses, individuals, and non-military government sectors (including, for example, government search and rescue aircraft).

The CAS sector is influenced by a number of factors, the most important being GDP, aircraft deliveries and backlogs, fleet renewal and expansion, emerging markets, long term pilot and workforce shortages, regulatory changes, and moves to more green technologies and the associated changes in research and development (“R&D”) intensity. Beyond revenues and income, key factors indicating the health of the CAS include revenue per passenger kilometre (“RPK”), revenue per tonne of freight (“FTK”), and passenger and freight load-factors.

The global CAS industry comprises 46% of the total aerospace market in terms of revenue. Global revenue for the CAS was approximately US$176 billion in fiscal year 2009. The majority of the CAS revenue is generated by the A&AP sub-sector (56%) followed by MRO (20 %) and E&EP manufactures (16%). The CAS is now beginning to see an improvement in passenger traffic as the developed countries begin to emerge from the recent global recession.[3]

The top three CAS revenue producing countries in 2009 were the United States (“US”), France, and Canada. The CAS is still concentrated in the developed world with North America controlling approximately 40% of revenue and Europe controlling approximately 37.0% of revenue. However, a shift in the industry is underway towards low-cost high-GDP areas including Asia-Pacific and Latin America. In 2009, CAS manufacturing revenue came predominantly from the world’s 500 major airlines at 78.5%, followed by freight, at 10%, and other end-users at 11.5%.[4]

IBIS World reports that nine companies control over 95% of global CAS manufacturing revenue. Major manufacturers in the global CAS include EADS, Boeing, United Technologies, General Electric and Bombardier.

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2 DataMonitor, “Global – Aerospace and Defense.” December 2009.

3 Please note that this section is a summary of the Phase 3 analysis, and is reproduced herein for the purposes of assisting the reader with the contextual positioning of the survey analysis. For more details on the current environment of the global aerospace industry, please refer to the Phase 3 report.

4 IBISWorld Global Civil Aerospace Products Manufacturing, February 2010.

Going forward, rising global GDP is expected to spur activity in the global civil aerospace industry. With the International Monetary Fund ("IMF") forecasting global GDP to increase by 4.6% in 2010 and 4.3% in 2011,[5] increased air travel is expected to boost airline profitability and increase revenue for the CAS. In addition, other key developments are also expected to have a positive impact on the aerospace industry, including active fleet renewal and expansion, increasingly green (i.e., environmentally friendly) technologies and associated increases in R&D spending, a growth in MRO activity as companies shift to new technologies, the appearance of emerging markets as serious competitors, and long term pilot and workforce shortages.

3.2 The global military aerospace market

The global MAS industry is comprised of producers and suppliers of aerospace products and services designed to address the needs of the military departments around the world. Over recent years, the MAS has experienced sustained revenue growth due to strong military spending in North America and Europe.[6]

Military spending by the world's ten largest governments has increased by some 15.9% over the last nine years with the US accounting for approximately 43.0% of the global military spend in 2009. Other major world players include China (with approximately 6.6% of global military spending) France (4.2%) and the United Kingdom ("UK") with 3.8%.[7] Collectively, the top five ranking countries are responsible for 57.6% of global military expenditures, which is estimated to have been some US$1.53 trillion in 2009.[8]

The global MAS industry comprises 54% of the total aerospace market in terms of revenue. Global revenue for the MAS was approximately US$205 billion in fiscal year 2009. The majority of the MAS revenue is generated by the A&AP sub-sector (50%) followed by MRO (30%) and E&EP manufactures (14%).

The MAS is dominated by large players based in the US, with the top 100 military contractors generating US$399 billion in revenue in 2009, representing an increase of 4% from 2008.[9] Major industry participants in the global MAS sector include Lockheed Martin Corporation, BAE Systems, Boeing, Northrup Grumman and General Dynamics. In 2009, Canada's CAE ranked 77th on the list of top military contractors with military related revenue of US$742 million. With respect to the MRO sector, prominent Canadian companies operating in this sub-sector include Cascade Aerospace, L-3 Communications MAS, IMP Group, StandardAero and Vector Aerospace.

The MAS will be negatively impacted by any reductions in US and European defense budgets enacted to combat growing budget deficits. On the positive side, growth in the Indian and Chinese markets is expected to partially offset reductions in military spending in developed countries. As a result, more MAS companies are expected to focus their growth strategies on these growing economies. Military spending is, however, expected to shift toward fleet modernization, as the average age of global MAS equipment continues to rise.

3.3 The global space market

The space sector (including guided missiles) is mall and evolving compared to the rest of the aerospace industry, accounting for approximately 5% of total aerospace revenue in 2009. Canadian companies operating in the global space market include MDA, COM DEV and Neptec.

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5 IMF, "World Economic Outlook Update: Restoring Confidence without Harming Recovery", July 2010.

6 Deloitte. Phase 3 forecast model, 2010.

7 SIPRI website. http://www.sipri.org/research/armaments/milex/resultoutput/trends

8 *Ibid.*

9 Defense News, Top 100 for 2009. June 2010. http://www.defensenews.com/static/features/top100/charts/rank_2009.php?c=FEA&s=T1C

Over the next 20 years, the space sector is expected to become dominated by civilian customers with forecasts by Teal Group stating that civilian payloads will make up 77% of proposed payloads through 2028.[10]

In terms of technology, the industry is trending toward launching more profitable micro- and nano-satellites. In addition, the service market for the International Space Station ("ISS") is expected to account for one quarter of new launches through 2020 because of the cancelation of the space shuttle program.[11] Additional sector growth will revolve around the growing demand for high-speed bandwidth for use in communications and data transfer.[12]

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10 Teal Group, Teal Mission Model Counts 2,033 Space Payloads through 2028", online article: https://www.tealgroup.com/index.php?option=com_content&view=article&id=41:teal-mission-model-counts-2033-space-payloads-through-2028&catid=3&Itemid=16 published on March 25, 2009.

11 *Ibid.*

12 The Teal Group has highlighted two other future major sources of growth: the replacement of Globalstar and Orbcomm LEO mobile communications constellations in the next two to three years, and Iridium LEO satellites in the next decade.

4 Canadian aerospace industry: profile and recent developments

The following section provides a summary of the Canadian aerospace industry based on information contained in the Phase 1 report.

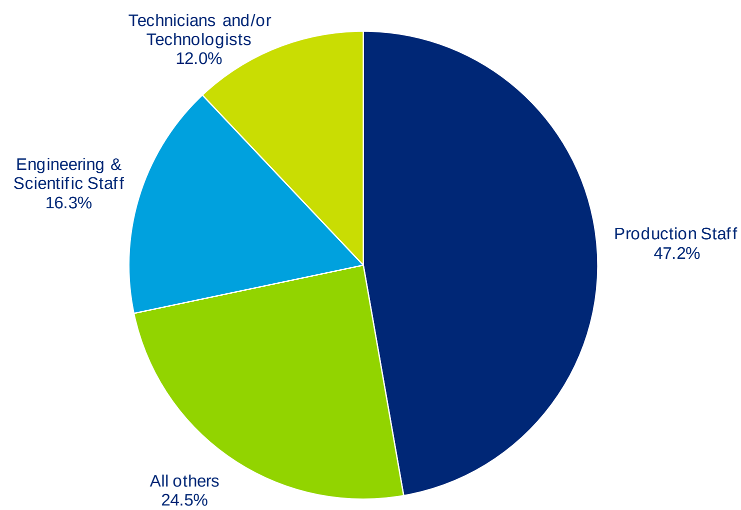
4.1 Description of the Canadian aerospace industry

In 2009, the Canadian aerospace industry was estimated to have generated $22.2 billion in revenue. The industry is a significant source of employment, employing an estimated 78,965 people in 2009, with a corresponding payroll cost of approximately $4.6 billion.

The Canadian aerospace industry is dominated by a small group of large companies; the 14 largest aerospace companies in Canada generated $16.1 billion in revenue in 2009, representing close to three-quarters of total Canadian aerospace revenue. These 14 companies also dominate in terms of employment with some 40,738 jobs (51.6% of total aerospace employment) and $3.0 billion in payroll (64.9% of total aerospace payroll).

Employment within the Canadian aerospace industry can generally be broken up into four categories; engineering and scientific staff, production staff, technicians and/or technologists, and all others. Of these four groups, production staff is the largest category with an estimated 47.2% of the Canadian aerospace workforce. Figure 1, following, illustrates the relative proportions of each category of employment.

Figure 1: Canadian aerospace employment by category[13]



[13] Source: AIAC Survey (2009), Deloitte

4.1.1 Geographic distribution

The Canadian aerospace industry spans the entire country, with companies, research centres and post-secondary institutions with programs focusing on the sector located in each province[14]. These "centres of aerospace excellence" and industry clusters include the following:

Nova Scotia

Halifax is home to a number of world-renowned aerospace firms specializing in composite fabrication, electronic assemblies, simulation and modeling technologies, and engine manufacturing. Companies located in Halifax / Nova Scotia include Lockheed Martin, Pratt & Whitney Canada, IMP Group and Composites Atlantic.

Prince Edward Island

The Charlottetown cluster specializes in engine maintenance, repair and overhaul and the manufacturing of precision components, engine coatings and airplane interiors. Nine aerospace firms, including Honeywell Canada, Wiebel Aerospace and Vector Aerospace operate in the province, specifically as a part of Slemon Park, "home of Prince Edward Island's aerospace industry." Holland College's Aerospace Technology Centre provides a range of training opportunities for the burgeoning aerospace industry.

Quebec

Montreal is the hub of Canada's largest aerospace cluster and is renowned for its expertise in aircraft assembly, engine manufacturing, maintenance repair and overhaul, avionics and landing gear. Quebec aerospace industry firms include Bombardier Aerospace, Bell Helicopter Textron Canada, Pratt & Whitney Canada, Rolls-Royce Canada, CAE, Esterline CMC Electronics, L-3 MAS, GE Bromont, Heroux Devtek, Safran, Thales, Mecachrome, Carillion Aerospace and Marinvent. In 2008, Quebec's aerospace exports totaled over $8 billion.

Montreal is also home to ten aerospace research centers, including the Canadian Space Agency, the Aerospace Manufacturing Technology Centre and the Consortium for Research and Innovation in Aerospace in Quebec. In addition, Montreal has a well integrated network of support agencies, hosting the Quebec Aerospace Association, Aéro Montreal and the headquarters of the International Air Transport Association ("IATA"), the International Business Aviation Council ("IBAC") and the International Civil Aviation Organization ("ICAO").

Ontario

Southwestern Ontario represents Canada's second largest aerospace cluster with over 200 firms. The core of this cluster is Toronto and the Greater Toronto Area, a region whose key strengths lie in aircraft parts manufacturing, aircraft systems development, and maintenance and overhaul. The Greater Toronto Area also hosts many world-leading aerospace firms, including Bombardier Aerospace, Pratt & Whitney Canada, Honeywell Canada, Magellan, Northstar Aerospace, Goodrich, COM DEV, Neptec and General Dynamics. The University of Toronto Institute for Aerospace Study and Ryerson University's Institute for Aerospace Design and Innovation collaborate with industry partners on numerous R&D projects.

Manitoba

Winnipeg is the largest aerospace cluster in western Canada, and is a major centre in North America for manufacturing composite aircraft components, and aircraft maintenance, repair and overhaul. It is home to one of Boeing's ten major global sites for commercial aircraft, one of only three such sites outside the United States. Boeing's composite manufacturing facility in Winnipeg is the largest such facility in North America.

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[14] www.investincanada.gc.ca/eng/industry-sectors/aerospace/aerospace-map.aspx

The cluster is led by four global leading firms including Boeing Technology Canada, Magellan Aerospace and StandardAero (one of the largest independent MRO firms in the world), plus 23 other established regional and national firms and several mid-sized aerospace suppliers.

Saskatchewan

Saskatchewan's aerospace companies operate in satellite technology, wireless communication systems, atmospheric research and testing, synchrotron research and development, microelectromechanical devices, building structures, cases and harnesses, mini unmanned aerial vehicles and training programs. The province's aerospace companies are located near Saskatoon, including SED Systems, Vecima Networks, Scientific Instrumentations, Summit Structures, SBC Case and Dragonfly Innovations.

Alberta

Alberta's aerospace and defence industry contributes $1.3 billion in revenue yearly to the economy. Approximately 40% of the industry's output is exported. The province offers competitive strengths in robotics and unmanned vehicle systems ("UVS"), space science, geomatics and navigation systems, and maintenance, repair and overhaul. Over 50 aerospace companies are located in the Calgary area, with strong clusters in maintenance, repair and overhaul, and information communication technology. Major aerospace companies in Alberta include Field Aviation, Pratt & Whitney, NovAtel, Raytheon and L-3 SPAR.

British Columbia

Greater Vancouver, the province's main aerospace cluster, benefits from its proximity to Boeing's home in neighbouring Washington State. The cluster's aerospace strengths include: helicopter services, aero engine overhaul, multi-role aircraft maintenance, repair and overhaul, space systems, and advanced composite aerostructures.

The industry is also supported by one of Canada's largest aerospace training centres at the British Columbia Institute of Technology.

Leading BC aerospace firms include ASCO Aerospace, Avcorp Industries, Cascade Aerospace, Kelowna Flightcraft, MDA Corp., MTU Maintenance, Viking Air and Vector Aerospace.

Figure 2, following, identifies Canada's various regional aerospace clusters, noting aerospace companies, research centres and universities present in that market.

4.1.2 Regional breakdown of the Canadian aerospace industry

In 2009, the majority of aerospace industry revenue was earned by entities headquartered in Quebec (an estimated $11.5 billion or 51.9% of revenue) and Ontario (an estimated $6.4 billion or 28.9% of revenue). In addition, the 14 largest aerospace companies in Canada produced 62.6% of their collective revenue in Quebec and 26.9% in Ontario. A summary of estimated aerospace revenue by region is provided in Figure 3, following.

Similar to revenue, the majority of aerospace industry employment is reported to be based in Quebec (an estimated 45.7% of employment) and Ontario (an estimated 27.8% of employment). In addition, the 14 largest aerospace companies in Canada employ 65.5% of their collective workforce in Quebec and 24.8% in Ontario. A summary of estimated aerospace employment by region is provided in Figure 4, following.

Consistent with these findings, the majority of aerospace payroll is earned by employees in Quebec ($2.3 billion or 49.0% of payroll), followed by Ontario ($1.4 billion or 29.2% of payroll), Western Canada ($0.6 billion or 13.0% of payroll), and Atlantic Canada ($0.4 billion or 8.8% of payroll).

Figure 2: Canadian aerospace industry clusters[15]

Province	City	Component	Features / Companies	
Newfoundland and Labrador	Gander	Companies	CHC Composites Inc.	GFT Aerospace Technologies
		Research Centres	College of the North Atlantic	
		Universities	n/a	
	St. John's	Companies	Provincial Aerospace Ltd.	
		Research Centres	n/a	
		Universities	Memorial University	
Prince Edward Island	Summerside	Companies	Atlantic Turbines Inc.	Tube-Fab Ltd.
			Honeywell	Wiebel Aerospace
			MDS-Prad	Testori
			Tronos Jet	Marand Engineering
		Research Centres	n/a	
		Universities	n/a	
Nova Scotia	Halifax	Companies	IMP Aerospace	Pratt & Whitney Canada
			L-3 Communications	Seimac Limited
			Lockheed Martin Canada	Ultra Electronics
			MDA Corp.	Xwave
		Research Centres	Defence R&D Canada - Atlantic	Nova Scotia Community College Aviation Institute
		Universities	Dalhousie University	Saint Marys University
			Mount Saint Vincent University	University of King's College
	Lunenburg	Companies	Composites Atlantic	
		Research Centres	n/a	
		Universities	n/a	
New Brunswick	Bathurst	Companies	Industrial Rubber Company	
		Research Centres	n/a	
		Universities	n/a	
	Moncton	Companies	Apex Industries	
		Research Centres	Moncton Flight College	
		Universities	University of Moncton	
Quebec	Longueuil	Companies	Heroux-Devtek Inc.	Pratt & Whitney Canada
		Research Centres	n/a	
		Universities	n/a	
	Mirabel	Companies	Bell Helicopter Textron Canada Ltd.	Lockheed Martin Canada
			Bombardier	Messier Dowty
			GE Aviation	Sonaca NMF Canada
			L3 Communications MAS (Canada) Ltd.	
		Research Centres	n/a	
		Universities	n/a	
	Montreal	Companies	Bombardier	MDS-Prad
			CAE	Mecaer America Inc.
			CMC Esterline	Mecachrome Technologies
			Honeywell	Rolls-Royce Canada
			MDA Corp.	Thales Canada
			ACTS (Air Canada Technical Services)	
		Research Centres	Canadian Space Agency	Industrial Materials Institute
			Centre de Technologie en Aerospatial	NRC Institute for Aerospace Research
			Composites Development Centre of Canada	
			Aerospace Manufacturing Technology Centre	
			Consortium for Research and Innovation in Aerospace in Quebec	
		Universities	Concordia University	Universite du Québec a Montreal
			McGill University	École Polytechnique
			Universite de Montreal	École Nationale d'Aerotechnique
			École de Technologie Supérieure	École des Métiers de l'Aerospatiale de Montreal
	St. Jean-sur-Richelieu	Companies	Oerlikon Contraves	
		Research Centres	n/a	
		Universities	n/a	

15 Source: www.investincanada.gc.ca/eng/industry-sectors/aerospace/aerospace-map/aerospace-clusters.aspx, Bombardier

Figure 2 (continued): Canadian aerospace industry clusters[16]

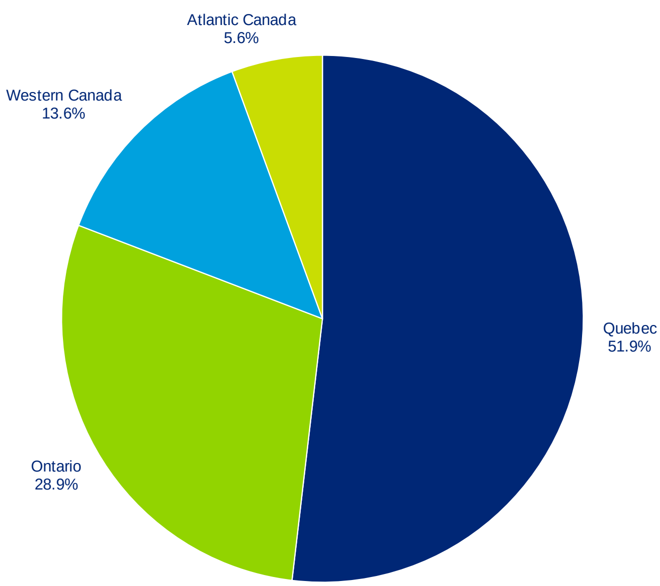
Province	City	Component	Features / Companies	
Ontario	Burlington	Companies	Comptek Advanced Structures Eurocopter Canada	Goodrich Canada L3 Wescam
		Research Centres	n/a	
		Universities	McMaster University	
	Canada Technology Triangle	Companies	COM DEV Heroux-Devtek Inc.	Northstar Aerospace
		Research Centres	n/a	
		Universities	University of Waterloo	
	Hamilton	Companies	Kelowna Flightcraft Ltd.	
		Research Centres	n/a	
		Universities	McMaster University	
	London	Companies	3M Canada Company Diamond Aircraft Industrie	General Dynamics - Land Systems Canada Sparton Electronics
		Research Centres	n/a	
		Universities	University of Western Ontario	
	Mississauga	Companies	Comtek Advanced Structures Honeywell Magellan Aerospace Corp. MDA Corp.	Curtiss-Wright Controls, Engineered Systems Mitsubishi Heavy Industry Canada Northstar Aerospace Pratt & Whitney Canada
		Research Centres	Centre of Excellence for Materials and Manufacturing	
		Universities	n/a	
	Ottawa	Companies	Arnprior Aerospace CMC Electronics	Neptec Design Group Raytheon Canada
		Research Centres	NRC Institute for Aerospace Research National Research Council - Aerospace Manufacturing Technology Centre	NRC Institute for Research in Construction
		Universities	Carleton University	University of Ottawa
	North Bay	Companies	Bombardier	
		Research Centres	n/a	
		Universities	n/a	
	Toronto	Companies	Atlantis Systems International Bombardier Boeing Canada Celestica Inc. Field Aviation	Goodrich Canada L-3 Electronic Systems Messier Dowty Sky services
		Research Centres	Holland College	
		Universities	Ryerson University University of Toronto	York University
	Windsor	Companies	Northstar Aerospace	
		Research Centres	n/a	
		Universities	University of Windsor	
Manitoba	Winnipeg	Companies	ACTS (Air Canada Technical Services) Boeing Canada Cormer Aerospace	Magellan Aerospace Corp. (Bristol) Standard Aero
		Research Centres	Red River College	
		Universities	University of Manitoba	University of Winnipeg
Saskatchewan	Moose Jaw	Companies	Bombardier	
		Research Centres	n/a	
		Universities	n/a	
	Saskatoon	Companies	SED Systems (Calian)	
		Research Centres	n/a	
		Universities	University of Saskatchewan	

16 Source: www.investincanada.gc.ca/eng/industry-sectors/aerospace/aerospace-map/aerospace-clusters.aspx, Bombardier

Figure 2 (continued): Canadian aerospace industry clusters[17]

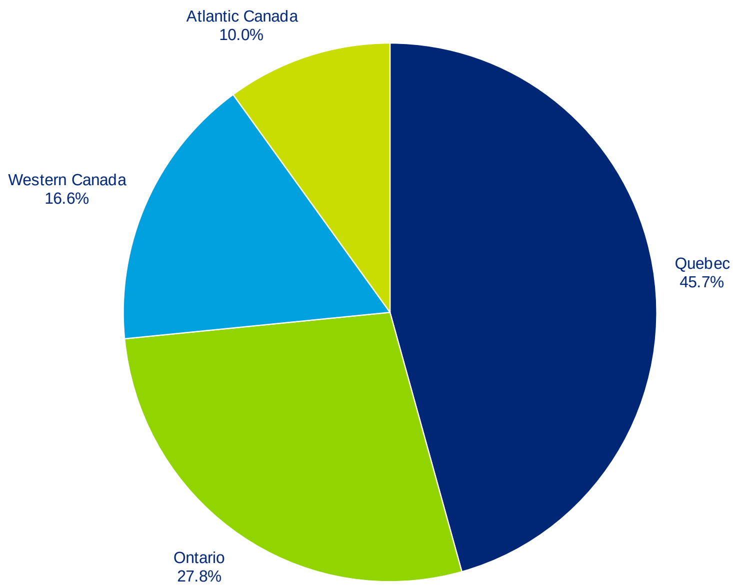
Province	City	Component	Features / Companies	
Alberta	Calgary	Companies	Avmax Group Inc. Field Aviation General Dynamics Canada	NovAtel Inc. Pratt & Whitney Canada Raytheon Canada
		Research Centres	n/a	
		Universities	University of Calgary	
	Cold Lake	Companies	Bombardier	
		Research Centres	Aerospace Engineering Test Establishment	
		Universities	n/a	
	Edmonton	Companies	L-3 Spar	
		Research Centres	n/a	
		Universities	University of Alberta The King's University College	Concordia University College of Alberta
	Medicine Hat	Companies	Meggitt Defence Systems Canada	Cdn Centre for Unmanned Vehicle Systems
		Research Centres	n/a	
		Universities	n/a	
British Columbia	Abbotsford	Companies	Cascade Aerospace	Magellan Aerospace Corp.
		Research Centres	n/a	
		Universities	University College of the Fraser Valley	
	Burnaby	Companies	n/a	
		Research Centres	n/a	
		Universities	British Columbia Institute of Technology - Aerospace Technology Campus	
	Kelowna	Companies	Alpine Aerotech Kelowna Flightcraft Ltd.	Northern Airborne Technology
		Research Centres	n/a	
		Universities	Okanagan University College	
	Vancouver	Companies	AcroHelipro ASCO Aerospace Avcorp Industries	MDA Corporation MTU Maintenance Canada Viking Air
		Research Centres	British Columbia Institute of Technology - Aerospace Technology Campus	
		Universities	Simon Fraser University	University of British Columbia

Figure 3: Canadian aerospace 2009 revenue by region[18]



[17] Source: www.investincanada.gc.ca/eng/industry-sectors/aerospace/aerospace-map/aerospace-clusters.aspx, Bombardier
[18] Source: AIAC Survey (2009), Deloitte

Figure 4: Canadian aerospace 2009 employment by region[19]



4.1.3 Forecast 2010 revenue and employment

In 2010, the Canadian aerospace industry is projected to have generated revenue of $24.1 billion, employing some 82,956 individuals. Canada's 14 largest aerospace companies predicted a modest decrease in both aerospace revenue and employment (year-over-year decreases of 0.7% for both measures). Aerospace companies that are not directly AIAC members are forecast to make-up $1.8 billion of the forecasted $2.0 billion increase in total aerospace industry revenue as well as 2,954 of the forecast 5,316 increase in aerospace related employment. [20]

4.2 Composition of the Canadian aerospace industry

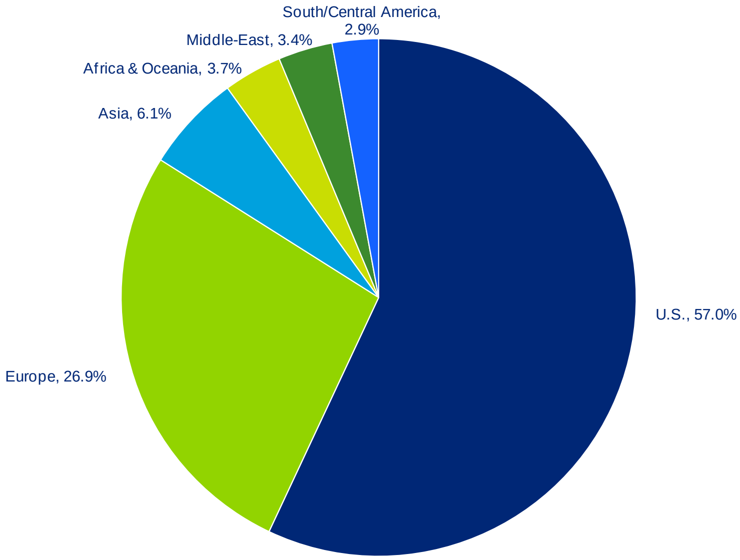
Canada's aerospace industry primarily operates within the CAS. In 2009, an estimated 83.4% of revenue generated by the Canadian aerospace industry were in the CAS, compared to only 16.6% of revenue generated within the MAS. As might be expected, the Canadian aerospace industry also employs a larger number of workers in the CAS as opposed to the MAS, with 80.4% of employees working in the CAS and 19.6% working in the MAS.

4.2.1 Final markets for Canadian aerospace products and services

The Canadian aerospace industry is largely export based, with an estimated $17.3 billion in revenue (or 77.9% of total aerospace revenue) being generated from sales to foreign markets. The proportion of sales to foreign markets differs by size of company, with the largest 14 aerospace companies in Canada generating 86.6% of their revenue from the export market, while the rest of the industry is estimated to generate an estimated 55.0% of their revenue from exports. Overall the largest foreign market for Canadian aerospace products and services is the US, which accounts for an estimated $9.9 billion of revenue (or 57.0% of total industry exports). Figure 5, following illustrates the geographic distribution of Canadian exports.

[19] Source: AIAC Survey (2009), Deloitte
[20] For more detail on the breakdown of forecast growth by stratum, please refer to Appendix 2 of the Phase 1 report.

Figure 5: Distribution of 2009 Canadian aerospace exports by final market[21]



4.2.2 Size of sub-sectors of the Canadian aerospace industry

The Canadian aerospace industry can be broken into the following seven sub-sectors:

- Aircraft, Aircraft Parts & Components (“A&AP”);
- Aircraft Engines & Engine Parts (“E&EP”);
- Avionics & Electro Systems (“A&ES”);
- Simulations & Training;
- Aircraft MRO;
- Space; and
- Other Industry Related Products & Services (“Other AP&S”).

The largest sub-sector of the Canadian aerospace industry is the manufacturing of A&AP. This sub-sector generated revenue of approximately $11.0 billion in 2009, representing some 49.2% of total industry revenue. The second largest sub-sector is MRO, which generated an estimated $4.3 billion in 2009 (19.2% of estimated 2009 industry revenue). Figure 6, following, illustrates the relative size of the various sub-sectors in the Canadian aerospace industry.

4.3 Investment in the Canadian aerospace industry

Investment in the Canadian aerospace industry is geared towards R&D and investments in physical capital or property, plant, and equipment (“PPE”). In 2009 the Canadian aerospace industry invested an estimated total of $1.9 billion in R&D and PPE, of which R&D comprised 72.7% ($1.4 billion) and PPE comprised 27.3% ($0.5 billion).

In 2009, government programs provided an estimated $0.5 billion in funding for R&D activities by Canadian aerospace companies, representing approximately 34% of total R&D spend. The sector’s largest source of financing for R&D projects comes from internal company financing, which funded 66.2% of R&D spend.

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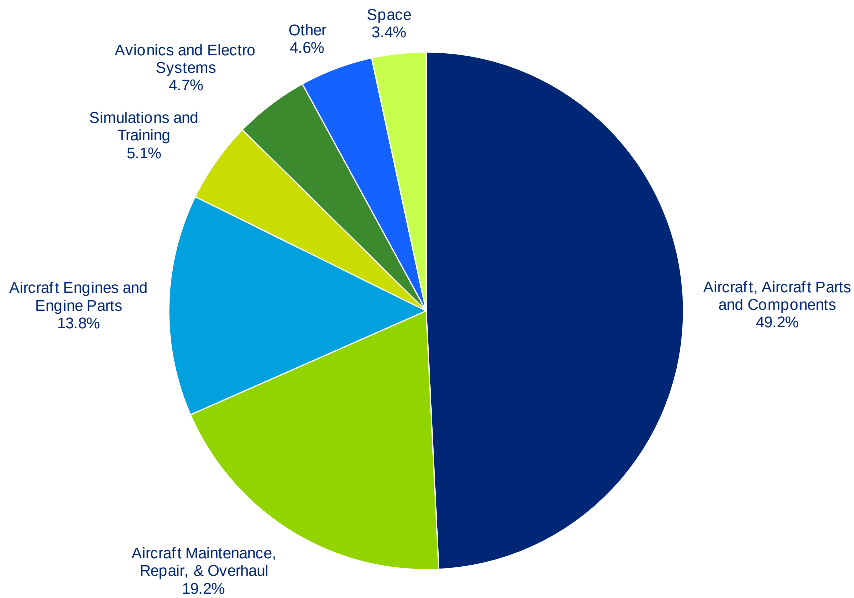
[21] Source: AIAC Survey (2009), Deloitte

Figure 6: Distribution of 2009 Canadian aerospace revenue by sub-sector[22]



22 Source: AIAC Survey (2009), Deloitte

5 Economic impact

5.1 Economic impact defined

Economic impacts are generally defined as changes to an economy as a result of an undertaking, activity or development As such, economic impacts measure changes in the size and structure of a jurisdiction's economy when goods and services are purchased and goods are produced, or as the result of an infusion of capital for the construction of a new facility or service. Almost all activities can generate economic impact.

The two most common measures of economic contribution (in addition to employment and taxes) are gross output and gross domestic product ("GDP"). Economic output roughly corresponds to the gross revenue of goods or services produced by an economic sector, while GDP measures only the value of goods and services produced. As such, GDP removes items such as revenues to the suppliers of intermediate goods and services and only includes revenue from value-added activities (labour and capital). Alternatively, economic output adds all revenues at each stage of production together as a measure of total production in the economy. As such economic output will always be greater than GDP (also termed as value-added).

To estimate economic output for a sector, one must identify the gross revenue of the various firms in that sector. However, to find GDP for a sector, care must be taken to avoid double counting, as the revenues of one firm providing service to another are not incremental GDP. For example, in the aerospace sector, one cannot add the value (gross revenue) of a finished aircraft to the value of the tires, fuselage, aviation system components, etc. that were purchased in order to produce the aircraft (as the tires, fuselage, aviation system components, etc. are already included in the value of the aircraft). As such, economic output will always be greater than GDP (also termed as value-added), and in this regard, the economic output multiplier for an industry will always be 1.00, whereas as the direct GDP multiplier will always be less than 1.00 (i.e., for a given expenditure in an industry, the direct GDP impact of that expenditure will be less than 1.00 – in the case of the aerospace industry, the GDP multiplier for Canada is approximately 0.47).

In evaluating and quantifying the economic impact of an industry, undertaking, project, etc., four types of impacts are typically reviewed:

- ***Direct Economic Impacts:*** measure total expenditures on goods and services, including wages and salaries, to operate a business, construct a project, operate a system or service, stage an event, etc.
- ***Indirect Economic Impacts:*** refer to the purchase of goods and services needed to then produce the goods and services that are directly purchased in support of business operations, the construction of a facility, the operation of that facility or service, the staging of the event, etc. Indirect impacts therefore measure the magnitude of interactions with other businesses which supply the necessary materials and services, and lead to indirect demand for goods and services from other industries.
- ***Induced Economic Impacts:*** refer to the impact of personal expenditures by people who have been paid wages and salaries, whether in support of business operations, for the construction of a facility, the operations of the facility or service, the staging of the event, etc., and for the production of indirect goods and services.
- ***Associated Economic Impacts:*** refer to the spin-off impacts generated by the construction of the facility or the operations of a business, including ancillary spending by visitors, tourists and, for example, by research institutions.

For the purposes of this assignment, the direct, indirect and induced impacts associated with the Canadian aerospace industry have been estimated nationally and for each province (in the case of Ontario and Quebec) and region (in the case of Atlantic and Western Canada) under review. Associated impacts are identified and discussed in a subsequent section dealing with four case studies.

Figure 7: Components of Economic Impact[23]

5.2 Nature of economic impacts evaluated

In evaluating the economic impact of the Canadian aerospace industry, the following economic impacts were quantified:

- GDP impacts – an industry's contribution to GDP represents the broadest measure of economic impact. The domestic product of the aerospace sector captures the value it adds to purchased inputs (including, for example, equipment and parts, electronics and systems components, etc.) through the application of labour and capital, and as such represents the sum of the value added by all firms in an industry. As noted previously, value added should not be confused with total output value (or an industry's gross sales), since the latter includes the value of purchased inputs.
- Economic output (spending) impacts – spending impacts measure the sum of gross sales in the economy, including the value of purchased goods and services needed to sustain the operations of the industry, as well as "value added GDP" (essentially the difference between GDP impacts and Economic output impacts.
- Employment impacts – industry employment is important because of the significance traditionally attached to jobs. From a purely economic impact perspective, the significance lies in the economic impacts generated from a worker's personal spending in the broader economy.
- Labour income impacts – labour income captures payments in the form of wages and salaries earned in an industry, and form a key component of GDP.
- Tax impacts – the estimated amount of personal and corporate income taxes generated from operations and employment.

5.3 Methodology

In order to quantify the economic impacts of the Canadian aerospace industry, Deloitte developed an impact model that utilized the following inputs:

- NAICS codes for the aerospace industry were initially identified and industry data from Statistics Canada's CANSIM database was acquired. Industry sectors examined include:
  - 336410 (aerospace product and parts manufacturing);
  - 334511 (navigational and guidance instruments manufacturing); and
  - 333310 (commercial and service industry machinery manufacturing).

[23] Source: Deloitte

It should be noted, however, there does not exist one single industry classification code covering the entire aerospace industry; with the exception of 336410 (aerospace product and parts manufacturing), other subs-sectors of the aerospace industry are classified under numerous NAICS codes and therefore reporting metrics of these codes will overlap multiple industry sectors (for example, flight simulator manufacturing is included as part of “commercial and service industry machinery manufacturing” which is NAICS code 333310).

Information for the above noted three codes was collected and analyzed for the period covering 2004 through 2008, nationally and by province:

- Total revenue;
- Total expenses;
- Total salaries and wages;
- Total cost of energy, water utility and vehicle fuel;
- Cost of materials and supplies; and
- Total number of employees.

Summary data for NAICS codes 336410 (aerospace product and parts manufacturing), 334511 (navigational and guidance instruments manufacturing) and 333310 (commercial and service industry machinery manufacturing) is included in Figures 8, 9 and 10 following. Figure 11 provides the total of these three NAICS codes.

Figure 8: Summary statistics, NAICS 336410 (aerospace product and parts manufacturing)[24]

Principal statistics	2004	2005	2006	2007	2008
Total Revenue	14,373,302	14,392,987	14,436,712	16,252,326	17,560,162
Total Expenses	13,602,021	13,095,092	13,770,197	14,714,613	16,517,384
Total salaries and wages, direct and indirect labour (x 1,000)	2,385,224	2,302,608	2,479,280	2,600,306	2,963,086
Total cost of energy, water utility and vehicle fuel (x 1,000)	88,725	89,783	93,526	95,485	107,567
Cost of materials and supplies (x 1,000)	7,884,987	8,149,223	7,687,034	8,255,832	9,182,110
Research & Development	905,300	906,600	912,000	1,021,000	1,106,100
Other	2,337,785	1,646,878	2,598,357	2,741,990	3,158,521
Total number of employees, direct and indirect labour (persons)	37,865	38,132	40,126	41,269	44,124
Average Salary	63,000	60,400	61,800	63,000	67,200

24 Source: CANSIM Table 301-00061,2,3,5,11,12

Figure 9: Summary statistics, NAICS 334511 (navigational and guidance instruments manufacturing)[25]

Principal statistics	2004	2005	2006	2007	2008
Total Revenue	1,335,129	1,400,158	1,489,453	1,438,369	1,385,634
Total Expenses	1,205,961	1,278,315	1,363,218	1,337,417	1,299,035
Total salaries and wages, direct and indirect labour (x 1,000)	416,761	443,421	509,333	536,890	504,275
Total cost of energy, water utility and vehicle fuel (x 1,000)[9]	8,676	9,305	10,283	9,376	8,868
Cost of materials and supplies (x 1,000)[7]	480,236	507,161	586,705	543,011	517,968
Other	300,288	318,428	256,897	248,140	267,924
Total number of employees, direct and indirect labour (persons)	6,574	6,925	7,152	6,978	6,548
Average Salary	63,400	64,000	71,200	76,900	77,000

Figure 10: Summary statistics, NAICS 333310 (commercial and service industry machinery manufacturing)[26]

Principal statistics	2004	2005	2006	2007	2008
Total Revenue	2,547,523	2,665,464	2,911,142	3,280,552	3,901,175
Total Expenses	2,369,935	2,514,681	2,712,105	3,163,805	3,565,517
Total salaries and wages, direct and indirect labour (x 1,000)	578,142	642,125	690,016	764,001	831,796
Total cost of energy, water utility and vehicle fuel (x 1,000)	13,782	18,001	20,272	20,455	21,739
Cost of materials and supplies (x 1,000)	1,090,085	1,170,284	1,262,784	1,510,470	1,714,262
Other	687,926	684,271	739,033	868,879	997,720
Total number of employees, direct and indirect labour (persons)	10,616	12,652	12,972	14,079	14,616
Average Salary	54,500	50,800	53,200	54,300	56,900

25 Source: CANSIM Table 301-00061,2,3,5,11,12
26 Source: CANSIM Table 301-00061,2,3,5,11,12

Figure 11: Summary statistics, NAICS codes 336410, 334511 and 333310[27]

Principal statistics	2004	2005	2006	2007	2008
Total Revenue	18,255,954	18,458,609	18,837,307	20,971,247	22,846,971
Total Expenses	17,177,917	16,888,088	17,845,520	19,215,835	21,381,936
Total salaries and wages, direct and indirect labour (x 1,000)	3,380,127	3,388,154	3,678,629	3,901,197	4,299,157
Total cost of energy, water utility and vehicle fuel (x 1,000)	111,183	117,089	124,081	125,316	138,174
Cost of materials and supplies (x 1,000)	9,455,308	9,826,668	9,536,523	10,309,313	11,414,340
Research & Development	905,300	906,600	912,000	1,021,000	1,106,100
Other	4,231,299	3,556,177	4,506,287	4,880,009	5,530,265
Total number of employees, direct and indirect labour (persons)	55,055	57,709	60,250	62,326	65,288
Average Salary	61,400	58,700	61,100	62,600	65,800

- Sectoral data for the "aerospace" industry was also acquired from Industry Canada (comprising both commercial aerospace activities and aerospace activities related to defence). Like the data available from the CANSIM database, this information details the total size of the industry, albeit for a single point in time (2007), and includes information detailing total revenue (divided between domestic and foreign sales), expenditures on research and development in new of existing products or process improvements, and total employment. Unlike the above described CANSIM data, this information comprises Industry Canada's definition of the aerospace industry. This data is presented in Figure 12, following.

Figure 12: Canadian Commercial Aerospace, Defence, Industrial Marine and Industrial Security Sector Survey (2007)[28]

	Aerospace Sector	Defence Sector	Industrial Marine Sector	Industrial Security Sector
Domestic Sales	$4,931.1	$3,508.8	$731.0	$331.1
Export Sales	$14,014.3	$4,057.7	$548.7	$352.4
Total Sales	$18,945.4	$7,566.5	$1,279.7	$683.5
Research and Development in new or existing product or process improvement	$700.8	$152.6	$20.8	$27.6
Employment	73,750	31,750	6,500	3,800

Note: aerospace sector includes both commercial aerospace activities and aerospace activities related to defence

- Finally information taken from the AIAC survey and analyzed as part of the Phase 1 report, was reviewed (specifically revenue, employment and payroll, by province / region), and industry average EBITDA margins (obtained from the Phase 3) report, were then used to estimate total industry expenditures. This industry profile is presented in Figure 13, following.

[27] Source: CANSIM Table 301-00061,2,3,5,11,12

[28] Source: Statistics Canada, November 2009

Figure 13: Canadian aerospace industry operating statistics, 2009-2010[29]

	2009 Central Estimate	2010 Central Estimate
Revenue ($ millions)		
Atlantic Canada	1,251.0	1,359.0
Quebec	11,511.0	12,503.0
Ontario	6,415.0	6,968.0
Western Canada	3,019.0	3,279.0
Total	22,196.0	24,109.0
Employment (FTE)		
Atlantic Canada	7,902.0	8,301.0
Quebec	36,054.0	37,876.0
Ontario	21,935.0	23,044.0
Western Canada	13,073.0	13,734.0
Total	78,965.0	82,956.0
Payroll ($ millions)		
Atlantic Canada	410.0	445.0
Quebec	2,269.0	2,465.0
Ontario	1,355.0	1,472.0
Western Canada	600.0	652.0
Total	4,633.0	5,034.0
Non-Payroll Operating Expenses ($ millions)		
Atlantic Canada	665.8	723.7
Quebec	7,629.8	8,286.8
Ontario	4,161.5	4,520.1
Western Canada	1,996.2	2,167.7
Total	14,453.2	15,698.3
Total Operating Expenses ($ millions)		
Atlantic Canada	1,075.8	1,168.7
Quebec	9,898.8	10,751.8
Ontario	5,516.5	5,992.1
Western Canada	2,596.2	2,819.7
Total	19,087.2	20,732.3

In adapting the data presented in Figure 13 from that presented in the Phase 1 report, the following assumptions were utilized:

- 2009 industry revenue, payroll expenses and employment are as reported in the Phase 1 report;
- 2009 total operating expenses were estimated based on an assumed EBITDA margin of 14.1% of gross revenue (as inferred from the Phase 3 report);
- 2009 non-payroll operating expenses were determined based on the difference between total operating expenses (as calculated) and total payroll expenses;

[29] Source: AIAC Survey (2009), Deloitte

- 2010 employment levels were calculated on a pro-rate basis based on estimated 2010 employment (82,596 jobs) and the distribution of 2009 employment by province / region;
- 2010 payroll expenses were calculated on a pro-rate basis based on estimated 2010 revenue and the relationship between total revenue and payroll expenses in 2009 employment by province / region; and
- 2010 non-payroll operating expenses and total operating expenses were estimated based on the assumed EBITDA margin of 14.1% of gross revenue (as inferred from the Phase 3 report).

Together, these three sources of information formed the basis from which industry revenue, employment, payroll and other operating expenses could be identified and estimates of economic impact could be identified. In this regard, a series of industry estimates were produced which generally fell within the estimated size of the Canadian aerospace industry as determined in the Phase 1 report (as illustrated by the 2009 lower, central and upper bound estimated). For the purpose of calculating the total economic impact of the aerospace industry in Canada and within Atlantic Canada (comprising Newfoundland and Labrador, Nova Scotia, Prince Edward Island and New Brunswick), Quebec, Ontario and Western Canada (comprising Manitoba, Saskatchewan, Alberta and British Columbia) the estimates of industry revenue, employment, payroll expenses and total operating expenses as illustrated in Figure 13, above, were utilized.

5.4 Economic impact multipliers

Statistics Canada input-output multipliers (for Canada and for each province) were utilized to prepare estimates of economic impact. As noted previously, no specific industry sector multipliers exist for the aerospace sector; as such, identified multipliers for "aerospace products and parts manufacturing" (NAICS 336410) were utilized as a proxy for the entire aerospace sector (as can be inferred from Figure 8 and 13, above, NAICS code 336410 comprises approximately 80% to 85% of the estimated total Canadian aerospace industry, and as such, is concluded to constitute an appropriate proxy for the entire industry).

In addition, for Canada, Ontario and Quebec, published data was utilized. For Atlantic Canada, a proxy estimate for each province (Newfoundland and Labrador, Prince Edward Island, Nova Scotia and New Brunswick) was estimated based on average "Total GDP", "Output" and "Employment" multipliers for each province (where estimates did not exist, they were excluded). A similar approach was adopted for Western Canada.

Finally, induced impacts were estimated based on the induced premium calculated nationally (i.e., the differential impact of the direct, indirect and induced impact over direct and indirect impacts).

Specific industry multipliers utilized as part of this analysis are summarized in Figure 14, following.

Figure 14: Economic Impact Multipliers[30]

	Output			GDP			Employment[1]			Incomes		
	D[2]	D + I[3]	D + I + I[4]	D[2]	D + I[3]	D + I + I[4]	D[2]	D + I[3]	D + I + I[4]	D[2]	D + I[3]	D + I + I[4]
Atlantic Canada	1.00	1.14	1.37	0.44	0.59	1.72	6.31	7.65	10.71	0.26	0.42	0.58
Quebec	1.00	1.28	1.54	0.38	0.51	1.73	3.14	4.08	5.70	0.21	0.29	0.41
Ontario	1.00	1.34	1.60	0.59	0.75	1.64	3.41	6.96	9.71	0.34	0.44	0.62
Western Canada	1.00	1.26	1.51	0.45	0.60	1.72	4.34	5.89	8.21	0.35	0.40	0.55
Canada	1.00	1.46	1.75	0.47	0.62	1.69	3.56	4.85	6.77	0.29	0.39	0.54

Note: 1. Employment multipliers are per million dollars of output. All other multipliers are per $1 of exogenous industry output shock.
2. "D" – Direct impacts
3. "D + I" – Direct and indirect impacts
4. "D + I + I" – Direct, indirect and induced impacts

30 Source: Statistics Canada, Deloitte

5.5 Tax impacts

The tax revenue generated by the aerospace industry was determined at two distinct levels, corporate and personal income taxes paid by workers:

- Corporate taxes were derived from Statistics Canada information detailing revenue and corporate taxes paid in the “air, rail and ship products and other transportation equipment manufacturing” sectors (Statistics Canada publication 61-219). Proxy estimates for the Canadian aerospace industry were derived from this data based on the ratio of NAICS code 336410 to this broader industry. Estimates were then grossed up to reflect the definition of the aerospace industry used in this study.

  It should be noted that corporate income tax information is not generally available by province (i.e., provincial aggregate data would need to be estimated based on the head office locations of individual enterprises; however, if an enterprise had their head office location in, say, Ontario, but has operations across Canada, all of the financial data would be presented as Ontario data; Statistics Canada does not have a method by which to re-allocate the data back to each province in which they operate).

  As such, only corporate tax revenue at the national level has been estimated.

- Personal income taxes were derived based on the average salary paid to workers in each province.

5.6 Interpretation

The reader should note that because of the way impacts were calculated (including, for example, the use of average multipliers for each of the individual Atlantic Canadian and Western Canadian provinces), the sum of total impacts (i.e., direct, indirect and induced) for each province and region will not equal the quoted impacts cited for Canada (i.e., their sum may be higher or lower). In addition, it should also be noted that the impacts expressed for each province / region are those estimated to have occurred within that particular region / province.

5.7 General industry impacts

As noted, Statistics Canada Input-Output multipliers (W-level) were utilized to quantify the various economic impacts associated with the Canadian aerospace industry. In its simplest terms, the Canadian aerospace industry is projected to generate the following benefits on the economy of Canada:

National

- In general, for each additional $100 million of output generated by the Canadian aerospace industry, output in the rest of the Canadian economy (i.e., its indirect impact) would be expected, in general, to increase by approximately $45.6 million. Including induced impacts, output in the rest of the Canadian economy would be expected to increase by almost $75.0 million.
- For each additional $100 million of output generated, the Canadian aerospace industry would be expected, in general, to realize a total increase in employment of some 355 direct jobs (FTEs). Including indirect and induced impacts, total employment would be expected to increase by 675 jobs (FTEs) across the country.
- Finally, the Canadian aerospace industry is projected to have directly accounted for some $10.4 billion in GDP in 2009, representing approximately 6.9% of Canada’s total manufacturing GDP. Including indirect and induced GDP impacts, the Canadian aerospace industry is projected to have accounted for some $17.5 billion in GDP.

Atlantic Canada

- For each additional $100 million of output generated by the aerospace industry in Atlantic Canada, output in Atlantic Canada’s regional economy (i.e., its indirect impact) would be expected, in general, to increase by approximately $13.8 million. Including induced impacts, total output in Atlantic Canada would be expected to increase by almost $36.8 million.

- For each additional $100 million of output generated, the aerospace industry in Atlantic Canada would be expected, in general, to realize a total increase in employment of some 630 direct jobs (FTEs) in Atlantic Canada. Including indirect and induced impacts, total employment in the Atlantic region would be expected to increase by almost 1,070 jobs (FTEs).
- Finally, the aerospace industry in Atlantic Canada is projected to have directly accounted for some $0.55 billion in GDP in 2009 within Atlantic Canada. Including indirect and induced GDP impacts, the aerospace industry in Atlantic Canada is projected to have accounted for some $0.94 billion in GDP.

Quebec

- For each additional $100 million of output generated by the aerospace industry in Quebec, output in the rest of the provincial economy (i.e., its indirect impact) would be expected, in general, to increase by approximately $28.3 million. Including induced impacts, total output in the provincial economy would be expected to increase by some $54.1 million.
- For each additional $100 million of output generated, the aerospace industry in Quebec would be expected, in general, to realize a total increase in employment of some 310 direct jobs (FTEs) within the province. Including indirect and induced impacts, total employment in the province would be expected to increase by almost 570 jobs (FTEs).
- Finally, the Quebec aerospace sector is projected to have directly accounted for more than $4.3 billion in GDP in 2009. Including indirect and induced GDP impacts, the aerospace industry in Quebec is projected to have accounted for almost $7.5 billion in GDP.

Ontario

- For each additional $100 million of output generated by the aerospace industry in Ontario, output in the rest of the provincial economy (i.e., its indirect impact) would be expected, in general, to increase by approximately $33.5 million. Including induced impacts, total output in the provincial economy would be expected to increase by some $60.5 million.
- For each additional $100 million of output generated, the aerospace industry in Ontario would be expected, in general, to realize a total increase in employment of some 340 direct jobs (FTEs) within the province. Including indirect and induced impacts, total employment in the province would be expected to increase by over 970 jobs (FTEs).
- Finally, the Ontario aerospace sector is projected to have directly accounted for more than $3.8 billion in GDP in 2009. Including indirect and induced GDP impacts, the aerospace industry in Ontario is projected to have accounted for almost $6.2 billion in GDP.

Western Canada

- For each additional $100 million of output generated by the aerospace industry in Western Canada, output in Western Canada's regional economy (i.e., its indirect impact) would be expected, in general, to increase by approximately $26.0 million. Including induced impacts, total output in Western Canada would be expected to increase by almost $51.4 million.
- For each additional $100 million of output generated, the aerospace industry in Western Canada would be expected, in general, to realize a total increase in employment of some 430 direct jobs (FTEs) in Western Canada. Including indirect and induced impacts, total employment in the Western Canadian region would be expected to increase by over 820 jobs (FTEs).
- Finally, the aerospace industry in Western Canada is projected to have directly accounted for some $1.4 billion in GDP in 2009 within Western Canada. Including indirect and induced GDP impacts, the aerospace industry in Western Canada is projected to have accounted for some $2.3 billion in GDP.

Figure 15: Impact of an additional $100 million on total economic output ($ millions)[31]

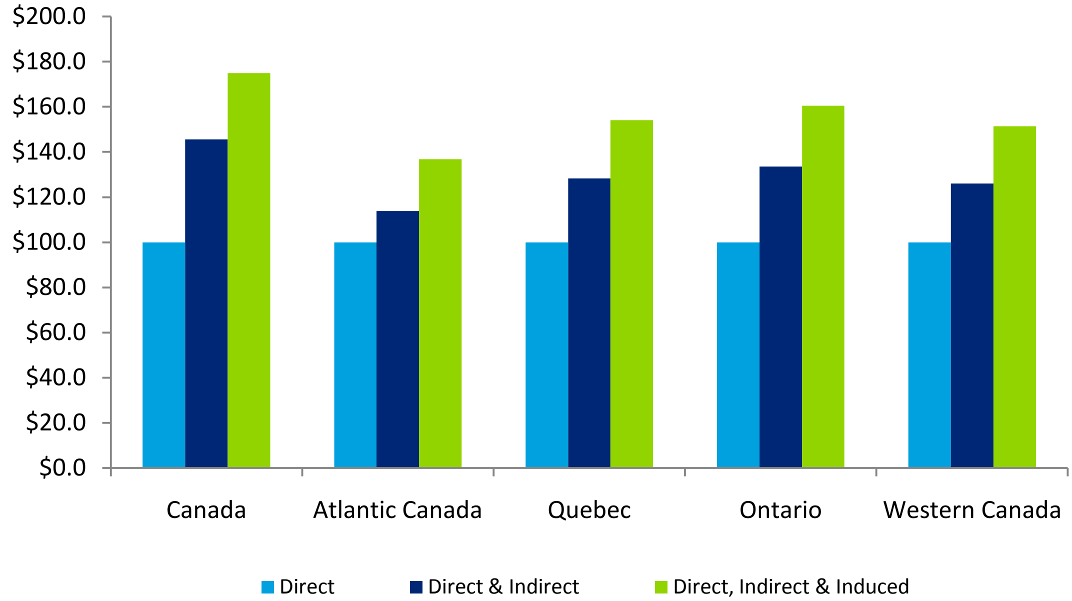
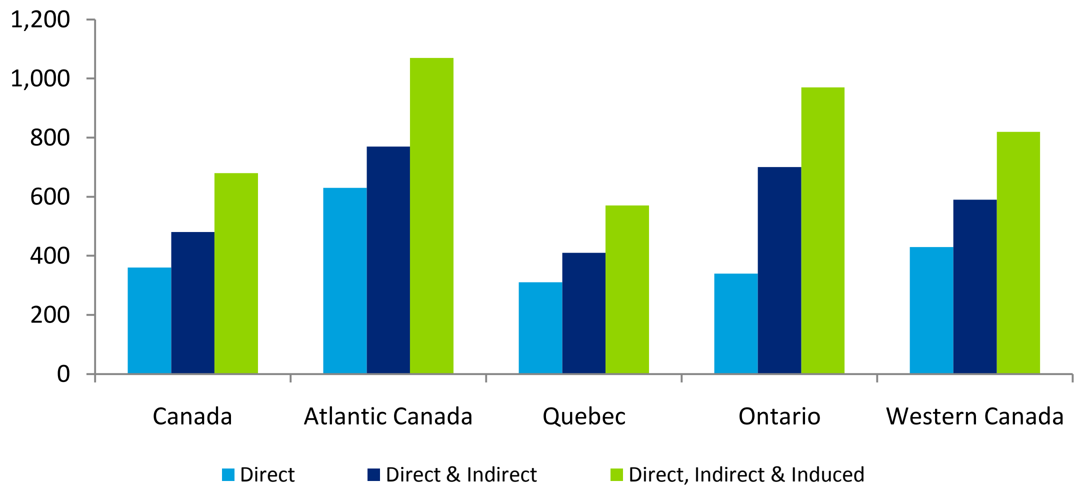
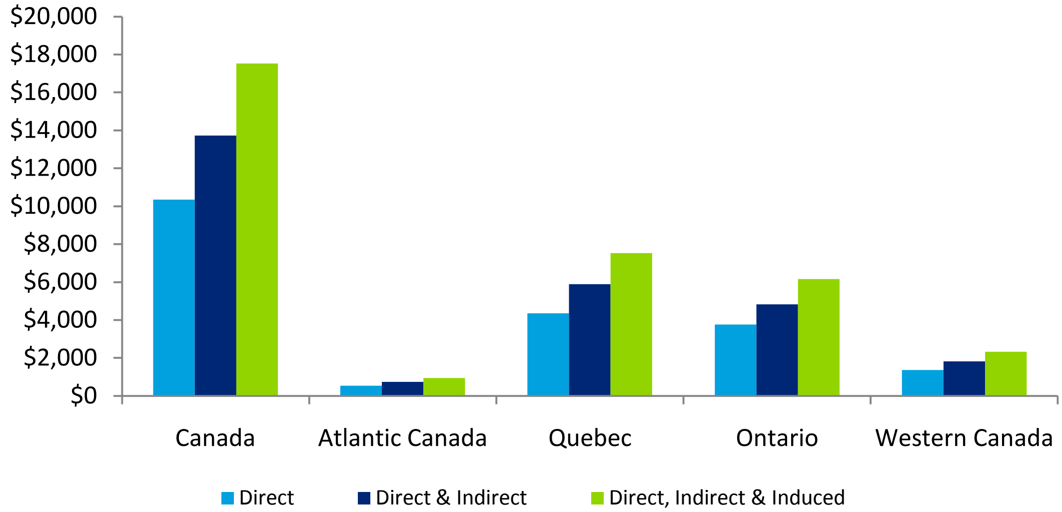


Figure 16: Impact of an additional $100 million on employment (number of FTEs)[32]



31 Source: Deloitte
32 Source: Deloitte (figures represent the number of FTE's created)

Figure 17: GDP contribution of the Canadian aerospace industry ($ millions)[33]



5.8 Impact assessment

5.8.1 Canada

As noted in Figure 13, above, the Canadian aerospace industry generated almost $22.2 billion in sales in 2009, with total industry output projected to increase by 8.6% in 2010, achieving total sales of more than $24.1 billion. In generating these sales, the industry is projected to incur total costs of some $19.1 billion in 2009 ($20.7 billion in 2010), including $4.6 billion in payroll costs (growing to approximately $5.0 billion in 2010). Total employment in the sector is estimated at almost 79,000 people in 2009, and almost 83,000 personnel in 2010.

This level of activity is projected to generate significant economic impacts within the Canada and within the various regions where economic clusters of aerospace activity exists.

Generally within Canada, the aerospace industry is concluded to have given rise to significant economic activity and impact. In particular:

- The Canadian aerospace industry is projected to have generated some $22.2 billion in total economic output. Including indirect impacts (from feeder industries) and induced impacts (impacts generated from the wages paid individuals employed in the direct and indirect production of goods and services), the total economic output of the aerospace industry in Canada is projected to have totaled more than $38.8 million in 2009. In 2010, these figures are projected to increase to $24.1 billion and $42.2 billion respectively.
- From a GDP perspective, the Canadian aerospace industry is projected to have directly supported almost $10.4 billion in total GDP. Including indirect and induced impacts, the total GDP contribution of the Canadian aerospace industry is estimated to have been some $17.5 billion in 2009. In 2010, the Canadian aerospace industry is forecast to be able to support more than $11.2 billion in direct GDP contribution, and approximately $19.0 billion including indirect and induced impacts.
- From an economic value added perspective, the Canadian aerospace industry is projected to have generated some $11.8 billion in direct and more than $21.3 billion in total economic value added. In 2010, these figures are projected to increase to some $12.9 billion and $23.1 billion respectively.

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33 Source: Deloitte

Figure 18: Economic Impact of the Canadian aerospace industry within Canada ($ millions)[34]

	Direct	Direct & Indirect	Direct, Indirect & Induced
2009			
Economic Output	$22,196.0	$32,320.1	$38,837.9
GDP	$10,351.6	$13,718.4	$17,532.1
Value Added	$11,844.4	$18,601.7	$21,305.8
Employment (FTE)	79,000	107,600	150,200
Labour Income	$4,633.0	$6,222.4	$8,685.4
Taxes			
Corporate Taxes	$362.7	n/a	n/a
Provincial Income Taxes	$493.2	n/a	n/a
Federal Income Taxes	$615.9	n/a	n/a
Total	$1,471.8	n/a	n/a
2010			
Economic Output	$24,109.0	$35,105.7	$42,185.3
GDP	$11,243.8	$14,900.7	$19,043.1
Value Added	$12,865.2	$20,205.0	$23,142.2
Employment (FTE)	83,000	116,800	163,000
Labour Income	$5,034.0	$6,761.0	$9,437.2
Taxes			
Corporate Taxes	$393.9	n/a	n/a
Provincial Income Taxes	$544.1	n/a	n/a
Federal Income Taxes	$680.6	n/a	n/a
Total	$1,618.6	n/a	n/a

- Direct employment in the Canadian aerospace industry is estimated to have been 79,000 FTEs in 2009. Including direct, indirect and induced impacts, the total amount of employment supported by the Canadian aerospace industry is estimated to have been 150,200 FTEs. In 2010, total direct employment is estimated at 83,000 FTEs, while the total direct, indirect and induced employment is projected to be supported by the Canadian aerospace industry is estimated to be 163,000 FTEs.
- Direct labour income is estimated to have been $4.6 billion in 2009. Including employment supported by the Canadian aerospace industry from an indirect and induced perspective, the Canadian aerospace industry is estimated to have supported almost $8.7 billion in total income. In 2010, these figures are estimated to be some $5.0 billion in direct income, and more than $9.4 billion in total income (including indirect and induced impacts).
- Finally, the Canadian aerospace industry is projected to have supported almost $1.5 billion in revenue to the federal and provincial governments (note, property taxes and other revenue to municipal governments have not been estimated as part of this assignment). This level of support is divided between revenue to the federal government ($978.6 million) and Canada's various provincial governments ($493.2 million). In 2010, total government tax revenue is projected to increase to $1.6 billion ($1.07 billion to the federal and $544.1 million to the various provincial governments).

34 Source: Deloitte

5.8.2 Atlantic Canada

Within Atlantic Canada, the aerospace industry is projected to have generated sales of $1.25 billion in 2009, with total industry output projected to increase to $1.36 billion in 2010. In generating these sales, the industry is projected to have incurred total costs of some $1.1 billion in 2009 (increasing to $1.2 billion in 2010), including $0.41 billion in payroll costs (approximately $0.45 billion in 2010). Total employment in the sector is estimated at some 7,900 people in 2009, and almost 8,300 in 2010.

Similar to the broader Canadian industry, this level of activity is projected to generate significant economic impacts within Atlantic Canada and within the various regions where economic clusters of aerospace activity exists. Within Atlantic Canada, the aerospace industry is concluded to have given rise to significant economic activity and impact. In particular,

- The aerospace industry in Atlantic Canada is projected to have generated some $1.25 billion in total economic output. Including indirect impacts (from feeder industries) and induced impacts (impacts generated from the wages paid individuals employed in the direct and indirect production of goods and services), the total economic output of the aerospace industry in Atlantic Canada is projected to have totaled more than $1.71 billion in 2009. In 2010, these figures are projected to increase to $1.36 billion and $2.38 billion respectively.
- From a GDP perspective, the aerospace industry in Atlantic Canada is projected to have directly supported $546 million in total GDP in the region. Including indirect and induced impacts, the total GDP contribution of the aerospace industry within Atlantic Canada is estimated to have been some $940 million in 2009. In 2010, the aerospace industry in Atlantic Canada is forecast to be able to support more than $593 million in direct GDP contribution within the four Maritime Provinces, and approximately $1.02 billion including indirect and induced impacts.
- From an economic value added perspective, the aerospace industry in Atlantic Canada is projected to have generated some $705 million in direct and more than $770 million in total economic value added. In 2010, these figures are projected to increase to some $766 million and $1.36 billion respectively.
- Direct employment in Atlantic Canada’s aerospace industry is estimated to have been 7,900 FTEs in 2009. Including direct, indirect and induced impacts, the total amount of employment supported by the aerospace industry in Atlantic Canada is estimated to have been 13,400 FTEs. In 2010, total direct employment is estimated at 8,300 FTEs, while the total direct, indirect and induced employment in Atlantic Canada is projected to be 14,500 FTEs in 2010.
- Direct labour income is estimated to have been $410 million in 2009. Including employment supported by feeder industries, the aerospace industry in Atlantic Canada is estimated to have supported almost $932 million in total income. In 2010, these figures are estimated to be some $445 million in direct income, and more than $1.01 billion in total income (including indirect and induced impacts).
- Finally, the aerospace industry in Atlantic Canada is projected to have supported some $94.5 million in personal income tax revenue to the federal and provincial governments. This level of support is divided between revenue to the federal government ($55.4 million) and to Atlantic Canada’s various provincial governments ($39.1 million). In 2010, total government tax revenue is projected to increase to $104.4 million ($61.4 million to the federal government and $43.1 million to the various provincial governments).

Figure 19: Economic Impact of the aerospace industry within Atlantic Canada[35]

	Direct	Direct & Indirect	Direct, Indirect & Induced
2009			
Economic Output	$1,251.0	$1,423.8	$1,710.9
GDP	$546.0	$735.7	$940.2
Value Added	$705.0	$688.1	$770.7
Employment (FTE)	7,900	9,600	13,400
Labour Income	$410.0	$670.9	$931.8
Taxes			
Provincial Income Taxes	$39.1	n/a	n/a
Federal Income Taxes	$55.4	n/a	n/a
Total	$94.5	n/a	n/a
2010			
Economic Output	$1,359.0	$1,978.9	$2,378.0
GDP	$593.1	$799.2	$1,021.4
Value Added	$765.9	$1,179.7	$1,356.6
Employment (FTE)	8,300	10,400	14,500
Labour Income	$445.0	$728.2	$1,011.4
Taxes			
Provincial Income Taxes	$43.1	n/a	n/a
Federal Income Taxes	$61.4	n/a	n/a
Total	$104.4	n/a	n/a

5.8.3 Quebec

Within Quebec, the aerospace industry is projected to have generated sales of $11.5 billion in 2009, with total industry output projected to increase to $12.5 billion in 2010. In generating these sales, the industry is projected to have incurred total costs of some $9.9 billion in 2009 (increasing to $10.8 billion in 2010), including $2.3 billion in payroll costs (approximately $2.5 billion in 2010). Total employment in the sector is estimated at some 36,100 people in 2009, and almost 37,900 people in 2010.

Similar to the broader Canadian industry, this level of activity is projected to generate significant economic impacts within the province of Quebec and within the various regions where economic clusters of aerospace activity exists. Within Quebec, the aerospace industry is concluded to have given rise to significant economic activity and impact. In particular,

- The aerospace industry in Quebec is projected to have generated some $11.5 billion in total economic output. Including indirect impacts (from feeder industries) and induced impacts (impacts generated from the wages paid individuals employed in the direct and indirect production of goods and services), the total economic output of the aerospace industry in Quebec is projected to have totaled more than $17.7 billion in 2009. In 2010, these figures are projected to increase to $12.5 billion and $19.3 billion respectively.

35 Source: Deloitte

- From a GDP perspective, the aerospace industry in Quebec is projected to have directly supported more than $4.3 billion in total GDP in the province. Including indirect and induced impacts, the total GDP contribution of the aerospace industry within Quebec is estimated to have been more than $7.5 billion in 2009. In 2010, the Quebec aerospace industry is forecast to be able to support more than $4.7 billion in direct GDP contribution, and approximately $8.2 billion including indirect and induced impacts.

Figure 20: Economic Impact of the aerospace industry within Quebec[36]

	Direct	Direct & Indirect	Direct, Indirect & Induced
2009			
Economic Output	$11,511.0	$14,765.7	$17,743.4
GDP	$4,349.2	$5,896.2	$7,535.4
Value Added	$7,161.8	$8,869.5	$10,208.0
Employment (FTE)	36,100	47,000	65,600
Labour Income	$2,269.0	$3,195.7	$4,463.7
Taxes			
Provincial	$323.1	n/a	n/a
Federal	$284.4	n/a	n/a
Total	$607.4	n/a	n/a
2010			
Economic Output	$12,503.0	$16,038.2	$19,272.5
GDP	$4,724.0	$6,404.4	$8,184.8
Value Added	$7,779.0	$9,633.8	$11,087.7
Employment (FTE)	37,900	51,000	71,200
Labour Income	$2,465.0	$3,471.7	$4,849.2
Taxes			
Provincial	$355.6	n/a	n/a
Federal	$313.7	n/a	n/a
Total	$669.4	n/a	n/a

- From an economic value added perspective, the aerospace industry in Quebec is projected to have generated some $7.2 billion in direct and more than $10.2 billion in total economic value added. In 2010, these figures are projected to increase to some $7.8 billion and $11.1 billion respectively.
- Direct employment in Quebec's aerospace industry is estimated to have been 36,100 FTEs in 2009. Including direct, indirect and induced impacts, the total amount of employment supported by the aerospace industry in Quebec is estimated to have been 65,600 FTEs. In 2010, total direct employment is estimated at 37,900 FTEs, while the total direct, indirect and induced employment is projected to be 71,200 FTEs in 2010.
- Direct labour income is estimated to have been $2.3 billion in 2009. Including employment supported by feeder industries, the aerospace industry in Quebec is estimated to have supported almost $4.5 billion in total income. In 2010, these figures are estimated to be some $2.5 billion in direct income, and more than $4.8 billion in total income (including indirect and induced impacts).

36 Source: Deloitte

- Finally, the aerospace industry in Quebec is projected to have supported some $607.4 million in personal income tax revenue to the federal and provincial governments. This level of support is divided between revenue to the federal government ($284.4 million) and revenue to province of Quebec ($323.1 million). In 2010, total government tax revenue is projected to increase to $669.4 million ($313.7 million to the federal government and $355.6 million to the Quebec government).

5.8.4 Ontario

Within Ontario, the aerospace industry is projected to have generated sales of $6.4 billion in 2009, with total industry output projected to increase to $7.0 billion in 2010. In generating these sales, the industry is projected to have incurred total costs of some $5.5 billion in 2009 (increasing to $6.0 billion in 2010), including $1.4 billion in payroll costs (approximately $1.5 billion in 2010). Total employment in the sector is estimated at some 21,900 people in 2009, and approximately 23,000 people in 2010.

Similar to the broader Canadian industry, this level of activity is projected to generate significant economic impacts within the province of Ontario and within the various regions where economic clusters of aerospace activity exists. Within Ontario, the aerospace industry is concluded to have given rise to significant economic activity and impact. In particular,

- The aerospace industry in Ontario is projected to have generated some $6.4 billion in total economic output. Including indirect impacts (from feeder industries) and induced impacts (impacts generated from the wages paid individuals employed in the direct and indirect production of goods and services), the total economic output of the aerospace industry in Ontario is projected to have totaled almost $10.3 billion in 2009. In 2010, these figures are projected to increase to almost $7.0 billion and $11.2 billion respectively.
- From a GDP perspective, the aerospace industry in Ontario is projected to have directly supported more than $3.8 billion in total GDP in the province. Including indirect and induced impacts, the total GDP contribution of the aerospace industry within Ontario is estimated to have been some $6.2 billion in 2009. In 2010, the Ontario aerospace industry is forecast to be able to support almost $4.1 billion in direct GDP contribution, and approximately $6.7 billion including indirect and induced impacts.
- From an economic value added perspective, the aerospace industry in Ontario is projected to have generated some $2.7 billion in direct and more than $4.1 billion in total economic value added. In 2010, these figures are projected to increase to some $2.9 billion and $4.5 billion respectively.
- Direct employment in Ontario's aerospace industry is estimated to have been 21,900 FTEs in 2009. Including direct, indirect and induced impacts, the total amount of employment supported by the aerospace industry in Ontario is estimated to have been 62,300 FTEs. In 2010, total direct employment is estimated at 23,000 FTEs, while the total direct, indirect and induced employment is projected to be 67,700 FTEs in 2010.
- Direct labour income is estimated to have been $1.4 billion in 2009. Including employment supported by feeder industries, the aerospace industry in Ontario is estimated to have supported almost $2.5 billion in total income. In 2010, these figures are estimated to be some $1.5 billion in direct income, and more than $2.7 billion in total income (including indirect and induced impacts).
- Finally, the aerospace industry in Ontario is projected to have supported some $289.9 million in personal income tax revenue to the federal and provincial governments. This level of support is divided between revenue to the federal government ($201.6 million) and revenue to province of Ontario ($88.2 million). In 2010, total government tax revenue is projected to increase to $320.5 million ($222.5 million to the federal government and $98.0 million to the Ontario government).

Figure 21: Economic Impact of the aerospace industry within Ontario[37]

	Direct	Direct & Indirect	Direct, Indirect & Induced
2009			
Economic Output	$6,415.0	$8,566.0	$10,293.5
GDP	$3,756.6	$4,824.7	$6,166.0
Value Added	$2,658.4	$3,741.3	$4,127.5
Employment (FTE)	21,900	44,600	62,300
Labour Income	$1,355.0	$1,789.1	$2,495.9
Taxes			
Provincial Income Taxes	$88.2	n/a	n/a
Federal Income Taxes	$201.6	n/a	n/a
Total	$289.9	n/a	n/a
2010			
Economic Output	$6,968.0	$9,304.4	$11,180.8
GDP	$4,080.5	$5,240.6	$6,697.5
Value Added	$2,887.5	$4,063.8	$4,483.3
Employment (FTE)	23,000	48,500	67,700
Labour Income	$1,472.0	$1,943.6	$2,711.4
Taxes			
Provincial Income Taxes	$98.0	n/a	n/a
Federal Income Taxes	$222.5	n/a	n/a
Total	$320.5	n/a	n/a

Source: Deloitte

5.8.5 Western Canada

Within Western Canada, the aerospace industry is projected to have generated sales of $3.0 billion in 2009, with total industry output projected to increase to $3.3 billion in 2010. In generating these sales, the industry is projected to have incurred total costs of some $2.6 billion in 2009 (increasing to $2.8 billion in 2010), including $0.60 billion in payroll costs (approximately $0.65 billion in 2010). Total employment in the sector is estimated at some 13,100 people in 2009, and over 13,700 people in 2010.

Similar to the broader Canadian industry, this level of activity is projected to generate significant economic impacts within Western Canada and within the various regions where economic clusters of aerospace activity exists. Within Western Canada, the aerospace industry is concluded to have given rise to significant economic activity and impact.

In particular,

- The aerospace industry in Western Canada is projected to have generated some $3.0 billion in total economic output. Including indirect and induced impacts, the total economic output of the aerospace industry in Western Canada is projected to have totaled some $4.6 billion in 2009. In 2010, these figures are projected to increase to $3.3 billion and more than $4.9 billion respectively.

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[37] Source: Deloitte

- From a GDP perspective, the aerospace industry in Western Canada is projected to have directly supported $1.4 billion in total GDP in the region. Including indirect and induced impacts, the total GDP contribution of the aerospace industry within Western Canada is estimated to have been some $2.3 billion in 2009. In 2010, the aerospace industry in Western Canada is forecast to be able to support almost $1.5 billion in direct GDP contribution within the four western provinces, and more than $2.5 billion including indirect and induced impacts.
- From an economic value added perspective, the aerospace industry in Western Canada is projected to have generated some $1.7 billion in direct and more than $2.2 billion in total economic value added. In 2010, these figures are projected to increase to some $1.8 billion and $2.4 billion respectively.

Figure 22: Economic Impact of the aerospace industry within Western Canada[38]

	Direct	Direct & Indirect	Direct, Indirect & Induced
2009			
Economic Output	$3,019.0	$3,802.7	$4,569.6
GDP	$1,358.6	$1,824.0	$2,331.1
Value Added	$1,660.4	$1,978.7	$2,238.5
Employment (FTE)	13,100	17,800	24,800
Labour Income	$600.0	$668.4	$933.7
Taxes			
Provincial	$42.8	n/a	n/a
Federal	$74.5	n/a	n/a
Total	$117.3	n/a	n/a
2010			
Economic Output	$3,279.0	$4,106.4	$4,934.5
GDP	$1,475.6	$1,981.1	$2,531.8
Value Added	$1,803.4	$2,125.3	$2,402.7
Employment (FTE)	13,700	19,300	26,900
Labour Income	$652.0	$726.3	$1,014.7
Taxes			
Provincial	$47.4	n/a	n/a
Federal	$83.0	n/a	n/a
Total	$130.4	n/a	n/a

- Direct employment in Western Canada's aerospace industry is estimated to have been 13,100 FTEs in 2009. Including direct, indirect and induced impacts, the total amount of employment supported by the aerospace industry in Western Canada is estimated to have been 24,800 FTEs. In 2010, total direct employment is estimated at 13,700 FTEs, while the total direct, indirect and induced employment in Western Canada is projected to be 26,900 FTEs in 2010.
- Direct labour income is estimated to have been $600.0 million in 2009. Including employment supported by feeder industries, the aerospace industry in Western Canada is estimated to have supported $933.7 million in total income. In 2010, these figures are estimated to be some $652.0 million in direct income, and more than $1.01 billion in total income (including indirect and induced impacts).

38 Source: Deloitte

- Finally, the aerospace industry in Western Canada is projected to have supported some $117.3 million in personal income tax revenue to the federal and provincial governments. This level of support is divided between revenue to the federal government ($74.5 million) and to Western Canada's various provincial governments ($42.8 million). In 2010, total government tax revenue is projected to increase to $130.4 million ($83.0 million to the federal government and $47.4 million to the various provincial governments).

5.9 Industry outlook impact assessment

The Phase 3 industry outlook report identified a series of growth forecasts for the Canadian aerospace industry through 2020. These forecasts were based on alternative growth assumptions, and presumed the following:

- Scenario 1: presumes the Canadian share of global aerospace market remains the same; and
- Scenario 2: presumes that the Canadian share of global aerospace market increases linearly by 10% by 2020 (i.e., Canada's market share grows to become 1.1 times greater in 2010 than it is in 2009).

Assuming that the cost structure of the Canadian aerospace industry remains relatively similar to that which existed in 2009 (from a cost and employment perspective), the following impacts could be inferred:

- Under Scenario 1, the total size of the industry, in terms of total sales, is projected to grow from approximately $22.2 billion to $31.7 billion by 2020 (42.8% total growth, with annual compound growth of 3.6%);

  Assuming similar cost profiles as existed in 2009, total industry operating costs would be expected to approximate $27.3 billion. Total direct employment could approximately some 112,400 persons (FTEs).
- Under Scenario 2, the total size of the industry, in terms of total sales, is projected to approximate $34.9 billion (44.6% total growth, with annual compound growth of 4.5%);

  Assuming similar cost profiles as existed in 2009, total industry operating costs would be expected to approximate $30.0 billion. Total direct employment could approximately some 123,700 persons (FTEs).

Should the Canadian aerospace industry realize such growth, and assuming that the relationships between the aerospace sector and the rest of the national economy is similar to that which currently exists, the economic activity and impact which the sector could impart nationally could include:

- From an economic output perspective, the Canadian aerospace industry would support between $31.7 billion (Scenario 1) and $34.9 billion (Scenario 2) in total economic output. Including indirect impacts (from feeder industries) and induced impacts (impacts generated from the wages paid individuals employed in the direct and indirect production of goods and services), the total economic output supported by the Canadian aerospace industry in 2020 would approximate $55.5 billion (Scenario 1) to over $61.0 billion (Scenario 2).
- From a GDP perspective, the Canadian aerospace industry would support some $14.8 billion (Scenario 1) to $16.3 billion (Scenario 2) in total GDP across the country. Including indirect and induced impacts, the total GDP impact of the Canadian aerospace industry in 2020 could increase to between $25.1 billion (Scenario 1) and $27.6 billion (Scenario 2).
- From an economic value added perspective, the 2020 Canadian aerospace industry could be expected to generate between $16.9 billion (Scenario 1) and $18.6 billion (Scenario 2) in direct value added impact. Including indirect and induced impacts, the 2010 Canadian aerospace industry could be expect to impart between $30.4 billion (Scenario 1) and $33.5 billion (Scenario 2) in total value added impact.
- Finally, direct employment in the Canadian aerospace industry in 2020 could reach more than 112,400 persons (Scenario 1) to as many as 123,700 persons (Scenario 2). Including direct, indirect and induced impacts, the total amount of employment supported by the Canadian aerospace industry in 2020 could reach between 214,600 (Scenario 1) and 236,000 individuals (Scenario 2).

Figure 23: Economic Impact of the aerospace industry's outlook[39]

	Direct	Direct & Indirect	Direct, Indirect & Induced
Scenario 1			
Economic Output	$31,716.8	$46,183.5	$55,497.1
GDP	$14,791.8	$19,602.8	$25,052.4
Value Added	$16,925.0	$26,580.7	$30,444.7
Employment (FTE)	112,400	153,700	214,600
Scenario 2			
Economic Output	$34,888.5	$50,801.9	$61,046.8
GDP	$16,271.0	$21,563.1	$27,557.7
Value Added	$18,617.5	$29,238.8	$33,489.1
Employment (FTE)	123,700	169,100	236,000

5.10 Summary

The Canadian aerospace industry is a key and growing economic sector within Canada. In 2009, the Canadian aerospace industry contributed some $10.4 billion in direct GDP impact, constituting approximately 7% of the total GDP impact of the entire manufacturing sector. Including indirect and induced impacts, the Canadian aerospace industry contribution some $17.5 billion in total GDP impacts. In 2010, this impact is projected to have grown to more than $11.2 billion in direct GDP impact, and to more than $19.0 billion including indirect and induced effects. Projecting forward to 2020, it is estimated that the Canadian aerospace industry could achieve a direct GDP impact of between $14.8 billion and $16.3 billion, and a total GDP impact ranging between $25.1 billion and $27.6 billion including indirect and induced impacts. Every $100 million in additional economic output will add approximately $46.6 million in additional direct GDP, and almost $1.7 billion, including indirect and induced impacts.

The Canadian aerospace industry is also a leading employer in the Canadian economy, as evidenced by its almost 79,000 direct employees in 2009 and estimated 83,000 in 2010. These individuals were paid more than $4.6 billion in 2009 (more than $5.0 million in 2010), and the industry paid almost $1.5 billion in total taxes (more than $1.6 billion in 2010). Including indirect and induced impacts, the Canadian aerospace industry supported 150,2000 FTE positions in 2009 and approximately 163,000 positions in 2010.

Finally, from a total economic output perspective, the Canadian aerospace is projected to have generated $22.2 billion in total economic output in 2009; including indirect and induced impacts, economic impact totaled $38.8 billion. In 2010, total economic output is projected to be $42.2 billion.

At the regional (in the case of Western Canada and Atlantic Canada) and provincial level (in the case of Ontario and Quebec), the aerospace industry is estimated to have had the following impacts:

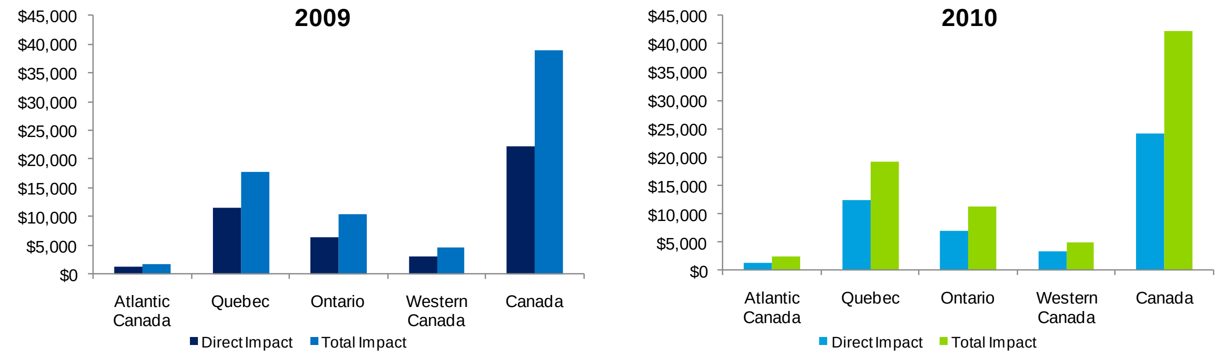
Total economic output:

- Atlantic Canada: $1.3 billion in direct economic output, with a total impact of more than $1.7 billion in 2009 ($1.4 billion and $2.4 billion, respectively, in 2010);
- Quebec: $11.5 billion in direct economic output, with a total impact of more than $17.7 billion in 2009 ($12.5 billion and $19.3 billion, respectively, in 2010);

[39] Source: Deloitte

- Ontario: $6.4 billion in direct economic output and a total impact of almost $10.3 billion in 2009 ($7.0 billion and $11.2 billion in 2010); and
- Western Canada: $3.0 billion in direct economic output and a total impact of almost $4.6 billion in 2009 ($3.3 billion and $4.9 billion, respectively, in 2010).

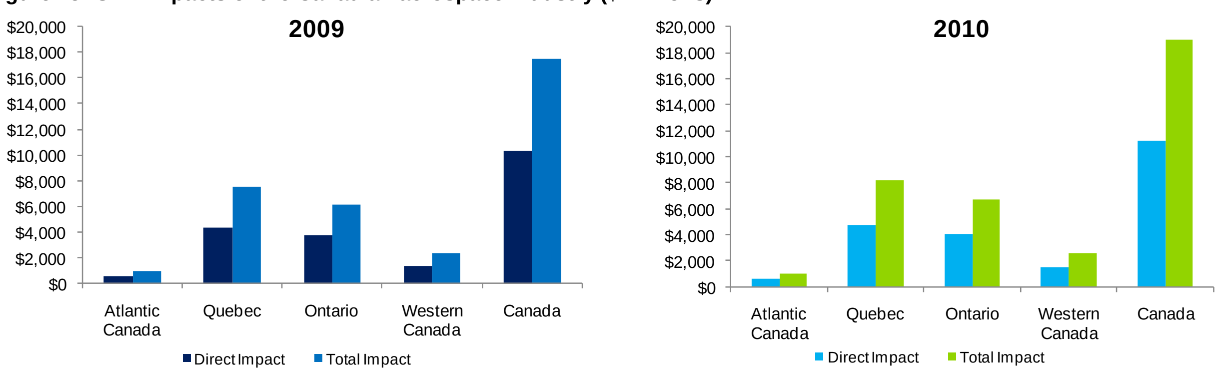
Figure 24: Economic output impacts of the Canadian aerospace industry ($ millions)[40]



Total GDP contribution

- Atlantic Canada: $0.5 billion (direct) and $0.9 billion (total) in 2009 ($0.6 billion and $1.0 billion in 2010);
- Quebec: $4.3 billion (direct) and $7.5 billion (total) in 2009 ($4.7 billion and $8.2 billion in 2010);
- Ontario: $3.8 billion (direct) and $6.2 billion (total) in 2009 ($4.1 billion and $6.7 billion in 2010); and
- Western Canada: $1.4 billion (direct) and $2.3 billion (total) in 2009 ($1.5 billion and $2.5 billion in 2010).

Figure 25: GDP impacts of the Canadian aerospace industry ($ millions)[41]

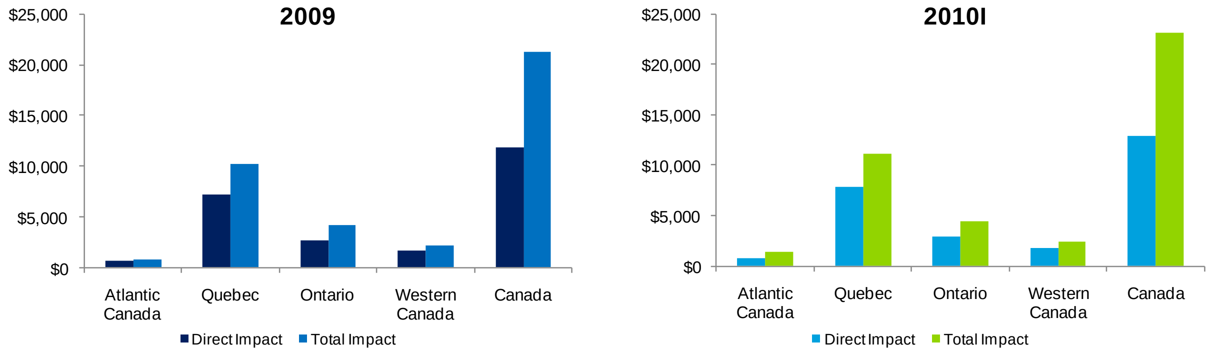


Total economic value added

- Atlantic Canada $0.7 billion (direct) and $0.8 billion (total) in 2009 ($0.8 billion and $1.4 billion in 2010);
- Quebec: $7.2 billion (direct) and $10.2 billion (total) in 2009 ($7.8 billion and $11.1 billion in 2010);
- Ontario: $2.7 billion (direct) and $4.1 billion (total) in 2009 ($2.9 billion and $4.5 billion in 2010); and
- Western Canada: $1.7 billion (direct) and $2.2 billion (total) in 2009 ($1.8 billion and $2.4 billion in 2010).

40 Source: Deloitte
41 Source: Deloitte

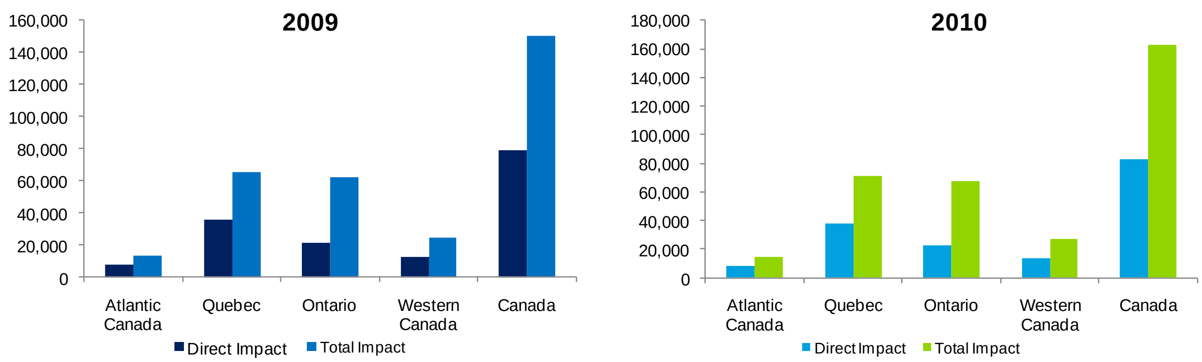
Figure 26: Value-added impacts of the Canadian aerospace industry ($ millions)[42]



Total employment

- Atlantic Canada: 7,900 (direct) and 13,400 FTEs (total) in 2009 (8,300 and 14,500 FTEs in 2010);
- Quebec: 36,100 (direct) and 65,600 FTEs (total) in 2009 (37,900 and 71,200 FTEs in 2010);
- Ontario: 21,900 (direct) and 62,300 FTEs (total) in 2009 (23,000 and 67,700 FTEs in 2010); and
- Western Canada: 13,100 (direct) and 24,800 FTEs (total) in 2009 (13,700 and 26,900 FTEs in 2010).

Figure 27: Employment impacts of the Canadian aerospace industry (FTEs)[43]

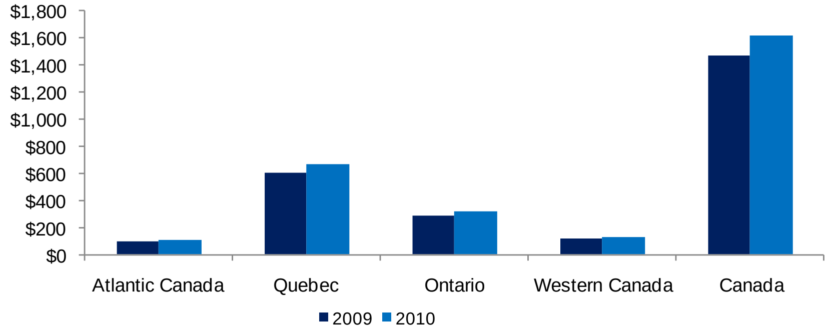


Total government revenue

- Atlantic Canada: $94.5 million in total government revenue ($104.4 million in 2010);
- Quebec: $607.4 million in total government revenue ($669.4 million in 2010);
- Ontario: $289.9 million in total government revenue ($320.5 million in 2010); and
- Western Canada: $117.3 million in total government revenue ($130.4 million in 2010).

42 Source: Deloitte
43 Source: Deloitte

Figure 28: Tax impacts of the Canadian aerospace industry ($ millions)[44]



Going forward, the Canadian aerospace industry is projected to continue to be significant contributor within the national and provincial / regional economies.

[44] Source: Deloitte

6 Associated impacts

In addition to directly impacting the provincial and Canada's national economy, the Canadian aerospace industry directly imparts a number of associated benefits within numerous local and regional jurisdictions. These associated impacts generally include such community, social and broader public policy and economic development goals as:

- Talent development and deployment;
- Fostering innovation and technological advancements;
- Strengthening Canada’s security;
- Fostering environmental sustainability; and
- Local economic development through economic cluster development

6.1 Talent development and deployment

Canada's universities and colleges have internationally recognized programs to train and provide the environment to conduct research in aerospace engineering, aerospace manufacturing engineering, aviation and aircraft maintenance engineering. According to several Canadian universities, there is a demand for such talent and skill sets, and as such, the future development of such programs is expected to continue.

In recent years, Canadian universities have become more welcoming to international students who wish to carry out research and study in the aerospace sector. With the global shortage of aerospace engineers, this shift is expected to help meet the demand for such skills within Canada and internationally. The Canadian Aviation Maintenance Council (“CAMC”) has also played a key role in developing curricula as well as accrediting programs for training institutions focusing on the aerospace maintenance sector.

Additionally, these institutions are generally located near several major clusters of aerospace firms / organizations in Canada. This close proximity allows for collaboration between these institutions and such clusters, for example through research and development, innovation and access to talent / skills in the industry. Canadian universities and colleges currently work with various Canadian aerospace companies and research centre, providing focused undergraduate and graduate programs and thus contribute to greatly expanding Canada’s talent pool in aerospace fields (these institutions are noted in Figure 29, following).

6.2 Fostering critical innovation and technology

Investing in aerospace and defence promotes significant technology development within the Canadian economy. Not only does this investment promote the development of aerospace and defence technology, but it also helps promote development in other sectors of the Canadian economy. In this regard, the aerospace and defence industry is at the forefront of developing and utilizing new technologies. As a first user, the aerospace and defence industry utilizes the output of several high technology industries including electronics, information technology and new materials.

Figure 29: Canadian University Aerospace Programs[45]

University / College	Program
University of Toronto	MEng in Aerospace Engineering, MASc in Aerospace Engineering, PhD in Aerospace Engineering
York University	Undergraduate program in Space Engineering
Ryerson University	MEng in Aerospace Engineering, MASc in Aerospace Engineering, PhD in Aerospace Engineering
University of Ottawa	MASc in Aerospace Engineering, MEng in Aerospace Engineering
Carleton University	BEng in Aerospace Engineering, MEng in Aerospace Engineering, MASc in Aerospace Engineering, PhD in Aerospace Engineering
McGill University	MEng in Aerospace Engineering
Concordia University	Master in Aerospace Engineering
University of Sherbrooke	Master Degree in Aerospace Engineering
Laval University	MSc in Aerospace Engineering
University of Alberta (U of A)	Undergraduate program in Mechanical Engineering (Aerospace)
University of Manitoba	Undergraduate program in Aerospace Engineering
École de technologie supérieure (ETS)	MEng Aerospace Engineering
École Polytechnique de Montréal (EPM)	MEng Aerospace Engineering
Royal Military College of Canada (RMC)	M.A.Sc in Aeronautical Engineering, Ph.D. in Aeronautical Engineering

Examples of aerospace technology spin-offs include those that have found important commercial application such as:

- microminiaturization technology used to produce the first single-chip pacemaker;
- carbon pistons that are lighter and more heat-resistant than aluminum pistons for automotive applications; and
- non-destructive evaluation technologies for steel structures and other structures where detection of fatigue and corrosion is critical.

Additionally, as a subsequent case study will discuss, Canada's Shuttle Remote Manipulator System ("SRMS"), or "Canadarm" has led to several spin-off uses / commercial adaptations in various industries both within and outside of aerospace sector.

The aerospace and defence industry is a major performer of R&D in Canada, and the levels compare well with those in other major industrial sectors. For example, the aerospace sector has invested an average of $873 million annually in R&D between 1994 and 2003, representing an average of approximately 8% of industry sales and accounting for an average of 14% of all manufacturing R&D. Total cumulative R&D investment over the 10-year period totaled $8.7 billion. In 2004, three of Canada's top 20 industrial R&D performers were aerospace and defence firms.

[45] Source: www.theknowledgeworld.com

Furthering investment towards research and innovation development in aerospace will not only draw on the talent and skills that Canada has, but it will also showcase and build upon the potential of Canada as an industry leader.

6.3 Economic cluster development

6.3.1 Introduction

Centres or clusters of aerospace excellence can be found in all corners of the country. As noted previously, British Columbia is gaining global notice for program management, engineering, maintenance, material and information systems support for military fleets; maintenance, repair and overhaul to rotary and all fixed-wing aircraft; helicopter services. Alberta and Saskatchewan boast expertise in the maintenance, repair and overhaul sector; an emerging centre for unmanned vehicle systems; and excellence in after-market products and services. The two provinces are also home to a number of world class defence electronics companies and have strong capabilities in satellite systems. And Canada's Atlantic region is recognized for maintenance, repair and overhaul sector, helicopter services; gas turbines; software development, system integration, training and simulation.

Economic clusters are defined as "geographic concentrations of interconnected companies, specialized suppliers, service providers, and associated institutions in a particular field".[46] Economic clusters are not new, but their evolution and economic significance has been increasingly recognized over the past twenty plus years. Research by Michael Porter of the Harvard-based Institute for Strategy and Competitiveness has helped to define economic clusters in the modern era and provide insight into their advantages and their important role within an economy. Clusters "represent an important forum in which new types of dialogue can and must take place among companies, government agencies, and institutions such as universities".[47]

6.3.2 Key components of a cluster

An industry based cluster may begin as a result of various factors, including access to employees with specialized skills, a university research centre, advantageous physical location, and well-developed infrastructure.[48] There are also many factors that come into play which may determine how successful an economic cluster is. Christian Ketels, of the Harvard Business School, notes that firms and organizations in a particular cluster share four critical characteristics.[49]

- ***Proximity*** - Organizations need to be sufficiently close in space to allow any positive spill-overs and the sharing of common resources.
- ***Linkages*** - The activities of the organizations need to share a common goal.
- ***Interactions*** - There should be a certain level of interaction amongst the organizations.
- ***Critical Mass*** - There needs to be a sufficient number of participants present.

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46 http://www.isc.hbs.edu/econ-clusters.htm
47 Porter, Michael E. (2000). Location, Competition, and Economic Development: Local Clusters in a Global Economy.
48 http://www.photonicsclusters.org/whatisacluster.html
49 "European Clusters", Christian Ketels, Harvard Business School, 2004

6.3.3 Cluster advantages

From an economic standpoint, a cluster may attract new investment, encourage local expansion, and stimulate entrepreneurship.[50] Clusters provide benefits to organizations within a cluster such as synergies amongst participants and knowledge sharing though close interaction, as well as overall macroeconomic advantages including new infrastructure and the attraction of investment. Importantly, cluster development, nurturing and expansion are a central and critical component of a local municipality's economic development strategy as they serve as a mechanism to attract additional growth, employment and wealth to an area.

Additional prominent cluster advantages include:

- Increased productivity and efficiency;
- Innovation;
- Increased business formation and entrepreneurship; and
- Access to human and capital resources.

6.3.4 Canadian aerospace clusters

Several Canadian clusters are among the top ranked in North America. Compared to many other locations, Canada's three largest cities, Toronto, Montreal and Vancouver, also provide access to large pools of potential employees experienced in the manufacturing of aerospace components. Canadian cities, such as Winnipeg and Calgary, compare favourably with cities of similar size in North America, in areas such as the presence of related industries or clusters. Specifics associated with aerospace clusters are discussed in an earlier section of this report.

6.4 Fostering environmental sustainability

Technology from the aerospace and defence industry has played, and will continue to play, an important role in helping to achieve environmental and sustainable development goals. These are areas where research and development play a major role, and technology is constantly advancing. In keeping with the industry's push towards addressing climate change, building environmentally sustainable or green technologies are a major focus of many firms, researchers, institutions and government agencies operating in aerospace fields.

By way of example, Canadian-developed remote sensing technology is playing a key role in monitoring the environment. Earth observation satellites such as RADARSAT I, RADARSAT II and SCISAT help raise our understanding of environmental changes and improve environmental management.

A second example centres around R&D investment into more environmentally friendly aerospace technologies that will help reduce the impact of aviation on the environment. Pratt & Whitney Canada, for example, is undertaking long-term research aimed at developing engine technology that is more fuel efficient, makes less noise and gives off fewer emissions than existing engines. Additionally, as will be discussed in a subsequent case study, Bombardier's Q400 regional aircraft will be used in a biofuel test in 2012

6.5 Strengthening Canada's security

The products and services produced by the aerospace industry are used in support of the federal government's defence and national security requirements. The industry is heavily involved in providing equipment and related support services to the Department of National Defence ("DND"), Canadian Forces ("CF") and agencies entrusted with public security.

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[50] http://www.business-sa.com/Content.aspx?p=58

When DND purchases a foreign-made defence platform, Canadian suppliers play a crucial role in meeting Canadian requirements and providing life cycle support for those platforms. Technologies produced by the sector, such as remote sensing, satellite communications and vehicle systems, are key tools in confronting the emerging threats to national security. The sector also allows Canada to contribute to international cooperation, peace and security through partnerships with its allies to develop and procure defence technology.

7 Case studies

As part of demonstrating the value and impact which the Canadian aerospace industry has had and will continue to have on the Canadian and global economies, as well as on society in general, Deloitte undertook four "case study" examinations of aspects / features of the industry, the intent of which is to document noteworthy achievements, features, companies, products made or pioneered by the Canadian aerospace industry. These case studies, selected to represent a broad geographic and / or technological cross-section of the industry, involve the following:

- The Canadarm - demonstrates a high level of industry innovation and technological growth, a major national contribution to the US / Canadian space programs, as well as spin-off activity leading to technological advancement in other industries;
- The Bombardier Q400 aircraft - an example of a nationwide supply chain, supporting the production of a leading regional aircraft;
- StandardAero - a leading Canadian maintenance, repair and overhaul firm with a valuable partnership with the Department of National Defence / Canadian Forces; and
- Composites Atlantic - illustrates the potential growth of the Canadian aerospace industry across all regions of Canada, with the support of strategic government investment.

7.1 The Canadarm: Canadian capabilities in the space market

The Canadarm is considered Canada's most famous robotic and technological achievement in aerospace. The Canadarm refers to the Shuttle Remote Manipulator System ("RMS"), Canada's contribution to the US space shuttle program. Essentially, the Canadarm is a remote-controlled manipulator attached to the space shuttle and used in space for deploying, capturing and repairing satellites, positioning astronauts, maintaining equipment and transporting cargo.

7.1.1 Background

The first arm cost approximately $110.0 million to develop, and was largely carried out by the Canadian aerospace industry under the direction of the National Research Council of Canada, after the National Aeronautics and Space Administration ("NASA") invited Canada to contribute to the space shuttle program.

Five Canadarms were built and delivered to NASA between April 1981 and August 1993. The arms on the three shuttles in service (Discovery, Atlantis and Endeavour) continue to be used.

The arm first flew in November 1981 on the second space shuttle flight and performed well, exceeding all design goals. It was declared operational one year later after three successful test flights. Since it first flew, the Canadarm has become an important symbol of Canadian expertise in technological fields. In the first 80 flights of the shuttle between 1981 and 1997, Canadarms have flown 47 times. To date, the Canadarms have been used on 88 missions.

Key achievements carried out with Canadarm have included:

- the capture, repair and deployment of several satellites (a total of 70 different payloads have been handled by the Canadarm, including five missions to the upgrade and repair the Hubble Space Telescope);
- the docking of the space shuttle to the Russian Mir space station; and
- the removal of ice growths that were causing a blockage to a waste exit on the shuttle.

Export-oriented, industrial returns achieved to date associated with the Canadarm include:

- the sale and maintenance of four additional Canadarm systems to NASA totaling roughly $900 million, along with the contribution of the original system;
- the sale and maintenance of multiple grapple fixtures that are affixed to payloads that are handled by Canadarm and Canadarn2;
- support of robotic operations, including hardware maintenance, operations planning, risk management, and real-time operations support;
- the sale of robotic components to Japan and Europe;
- the upgrade of Canadarm simulators; and
- the development of robotic systems associated with other industries (medical, nuclear, etc.).

Given the success of the Canadarm, NASA initiated a contract with MDA Space Missions, headquartered in Vancouver, to produce three Robotic Workstations. Subsequently, Canada contributed robotics for the International Space Station, which included Canadarm2, a Mobile Base System and the Special Purpose Dexterous Manipulator known as “Dextre”.

The Canadarm and subsequent programs and resulting innovation and development has allowed the establishment in Canada of an industrial capability in the high-technology fields of advanced manipulator systems and robotics.

Figure 30: Canadarm Images - Canadarm, Canadarm2 and Inspection Boom[51]

7.1.2 History

NASA first invited Canada to participate in the shuttle program in 1969, when Canada and the Canadian aerospace industry were developing a national space policy for Canada. At the time, NASA was seeking to broaden support for their shuttle program while defraying its direct cost with international participation.

An industry team was formed which included Spar Aerospace (now MDA Space Missions) from Toronto, DSMA Atcon Ltd. from Toronto, CAE Electronics from Montreal and RCA from Montreal, who proposed that Canada build the shuttle manipulator and simulation facility.

[51] Source: MDA Space Missions

With the support of National Research Council ("NRC"), the Government of Canada earmarked $1.0 million for studies on the shuttle manipulator program that would help foster the space industry and showcase Canada's ability to manage large space projects.

A memorandum of understanding between the Canadian government and NASA was signed in July 1975 and the legislation was passed in 1976. The NRC was assigned to manage the project and Spar (now MDA Robotics Group) was named prime contractor, with DSMA, CAE and RCA as subcontractors.

Figure 31: Canadarm and Inspection Boom[52]

7.1.3 Arm specifications

The basic Canadarm configuration consists of a manipulator arm, a Canadarm display and control panel, including rotational and translational hand controllers at the orbiter aft flight deck flight crew station and a manipulator controller interface unit that interfaces with the orbiter computer.

The arm is constructed with materials such as titanium, stainless steel, and ultra-high modulus graphite epoxy, with attention to thermal design, lubrication and thermostatically controlled electric heaters. The Canadarm was designed to have a minimum lifetime of 10 years and to be used for up to 100 missions.

[52] Source : MDA Space Missions

7.1.4 Economic impacts

7.1.4.1 Overview

The development and utilization of the Canadarm and subsequent technology development has involved a number of economic / quantitative impacts, including:

- ***Initial Investment*** – Canada's initial investment in the Canadarm program is estimated at $110.0 million;
- ***Additional Spending / Investment*** – additional spending and investment on the Canadarm (through a contract developed with NASA) is estimated at $786.0 million;
- ***Export Activity*** – it is estimated that the Canadarm has resulted in excess of $700.0 million in export sales to the United States, Europe and Japan;
- ***Employment Impacts*** – a multi-organizational team based out of Toronto and Montreal developed the Canadarm; MDA Space Missions alone has over 100 employees (23% of the company's Brampton office headcount) involved in the Canadarm program from 1990 and 2009; and
- ***Spin-off Spending / Investment*** – there has been a significant amount of spending associated with the commercialization of spin-off research, development and innovation associated with the Canadarm;
  - MDA Space Missions has been under contract to NASA since the early 1980's, to provide on-going support of its shuttle robotic systems; revenue has averaged approximately $20.0 million annually over the last 40 years;
  - MDA is also under contract to the Canadian Space Agency to support space station robotic systems, with annual revenue averages estimated at $37.0 million.

7.1.4.2 Nationwide employment / contractors

The Mobile Servicing System Program (including Canadarm2, Mobile Base System and the SPDM or Dextre), has utilized contractors from across the country, with regional contributions varying by phase. The initial phase alone had a wide spread distribution of contractors, with a large amount of contribution from Ontario (62%) and Quebec (21%).

- Atlantic Canada - 3.2%
- Quebec - 20.6%
- Ontario - 62.4%
- Western Canada - 7.2%
- British Columbia - 6.6%

7.1.5 Associated and spin-off impacts

7.1.5.1 Space mission achievements / contributions

Through Canada's contribution to the US space shuttle program, it was given the opportunity to build its profile in the aerospace industry on a global scale, and as a result, positively influence national pride. Not only did Canada contribute a significant technology to NASA through the development and provision of the Canadarm, but in doing so it was given the opportunity to send its Canadian astronauts on space missions with NASA.

According to the Canadian Space Agency, from 1981 to 2010 total there have been approximately 30 space missions carrying Canadian astronauts and various Canadian produced technologies.

Since the Canadian Space Agency's (CSA) Canadian Astronaut Program was established in 1983, twelve Canadians have been selected to become astronauts. CSA astronauts that remain active include Chris Hadfield, Jeremy Hansen, Julie Payette, David Saint-Jacques and Robert Thirsk. Major Jeremy Hansen and Dr. David Saint-Jacques were selected in May 2009 and are currently in training at NASA's Johnson Space Center.

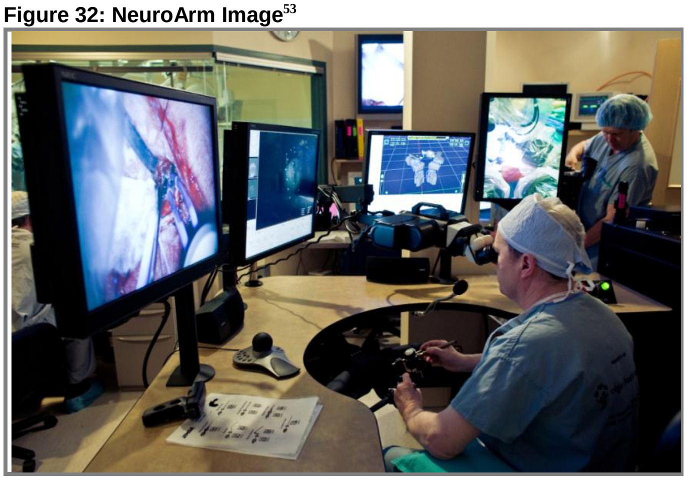
7.1.5.2 Technology deployment and spin-off technology

Canadarm technology has been utilized in a number of capacities. As described above, in addition to the initial Canadarm, NASA purchased four additional Canadarms to outfit their shuttle fleet and two inspection booms to inspect the space shuttle.

The success of the Canadarm program for NASA positioned Canada and MDA to take a leading robotics role on the International Space Station program, through Canadarm2. Canadarm2 is a major part of the Canadian space robotics system, and completed its first official construction job on the International Space Station ("ISS") in July 2001. The Canadarm2 plays a key role in station assembly and maintenance, including moving equipment and supplies around the station, supporting astronauts working in space, and servicing instruments and other payloads attached to the space station. Astronauts receive specialized training to enable them to perform these functions with the various systems.

On February 1, 2003 Space Shuttle Columbia disintegrated over Texas during re-entry into the earth's atmosphere, resulting in the death of all seven crew members, shortly before it was scheduled to conclude its 28th mission, STS-107. Following this tragedy, MDA provided NASA with an inspection boom, based on the original Canadarm, to allow NASA to inspect the shuttle for damage. This technology enabled NASA to resume flights following the space shuttle Columbia accident.

Figure 32: NeuroArm Image[53]



Canadarm based technology also includes various terrestrial applications. For example, the $10.0 million NeuroArm comprises advanced robotic systems that enable surgeons to plan and execute complex surgical procedures such as microsurgery and stereotaxy. The NeuroArm was developed for Calgary Foothills Hospital, with close collaboration between MDA space robotic engineers and University of Calgary physicians, nurses and scientists.

In addition, the Ontario Power Generation has a remotely operated robotic arm similar to the Canadarm, capable of performing detailed movement to allow inspections in critical locations where a person cannot go. Similar technologies are also utilized in the mining industry, in autonomous vehicle control and underground GPS and traffic management.

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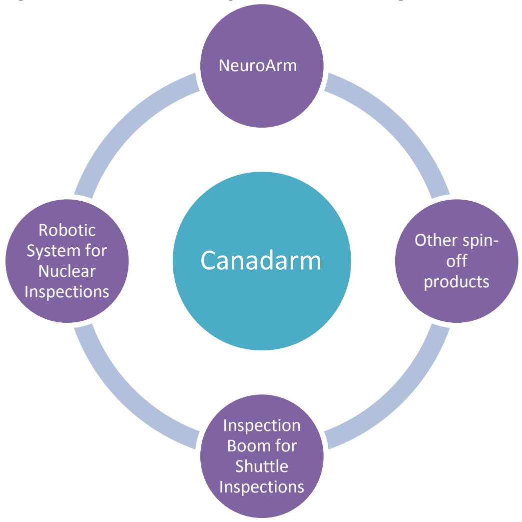
53 Source : MDA Space Missions

The shuttle and space station robotic programs also opened the market in Japan for products such as end effectors, grapple fixtures, cameras, and lights for Japanese robotics and Japanese transfer vehicles.

Figure 33: Canadarm Spin-off Technologies[54]



The Next Generation Canadarm program is expected to generate over 125 person years of employment through the term of the contract. MDA has committed to achieving a minimum of 80% Canadian content on the overall project, with an estimated contract value of $46.0 million.

7.1.6 Utilizing university partnerships in technology development

The development of the Canadarm and subsequent technologies has prompted a great deal of innovation, including the involvement of university research, application and education.

For example, MDA Space Missions, the lead team for the Canadarm, has engaged in extensive research and development to maintain and advance its position in space robotics, while partnering with universities worldwide to advance innovation in aerospace.

Some of these partnerships include:

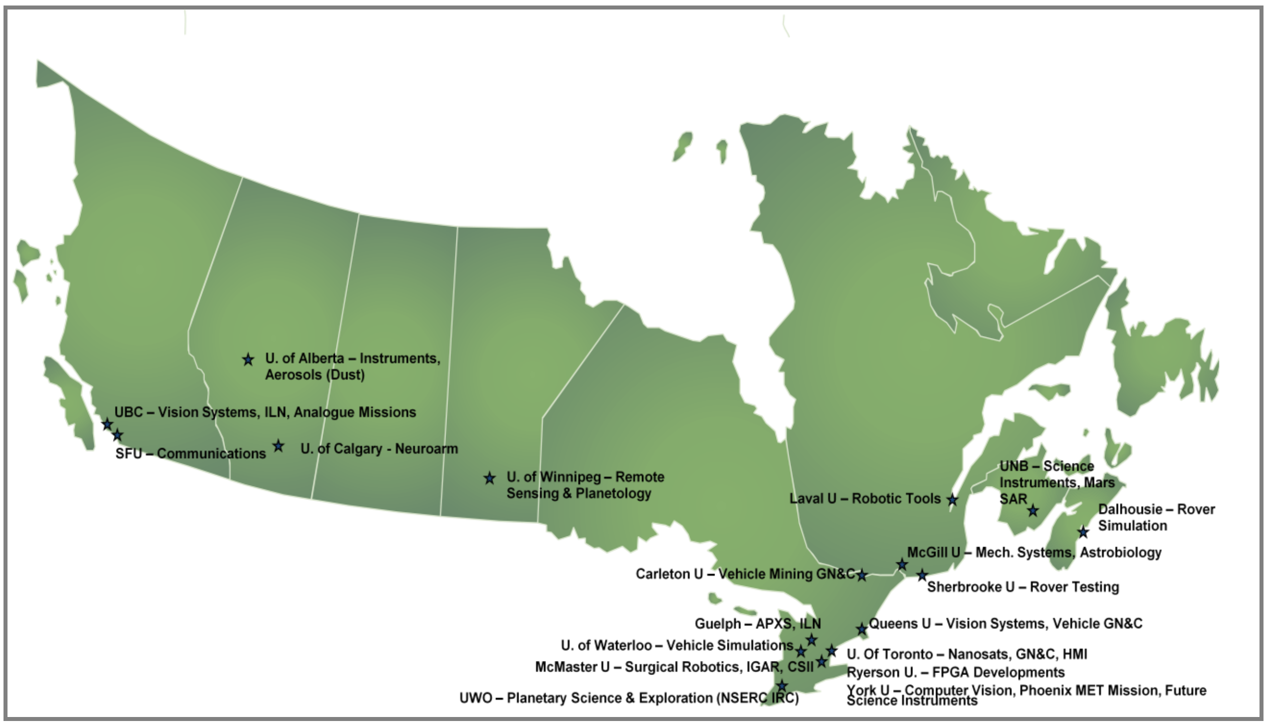
- offering post-graduate scholarships in the field of aerospace;
- collaborating with a network of universities to help advance new enabling technologies and research capabilities, i.e. through training and career opportunities for the next generation of engineers and scientists;
- utilizing a regular complement of professional experience year students on staff via internships;
- conducting an annual forum for collaborative university research and development since 2003;
- conducting a spacecraft design course at the University of Toronto Institute for Aerospace Studies for more than 20 years;
- establishing a partnership with McMaster University in the Centre for Surgical Innovation and Invention ("CSII"), a federally funded Centre of Excellence for the Commercialization of Research ("CECR");

[54] Source : MDA Space Missions

- direct funding of university technology development for projects that are applicable to robotics business areas include:
  - Manipulator & Rover Simulations - $113,000;
  - Vision Systems - $101,000;
  - Science Instruments - $60,000;
  - Medical Robotics - $450,000;
  - Guidance, Navigation & Control - $33,000;
  - Radiation Susceptibility - $40,000; and
  - Nanosat Formation Flight - $75,000.

The following diagram shows the geographic distribution of MDA's universities collaborations, ranging across Canada.

Figure 34: MDA University Collaborations (2003 – 2010)[55]



7.1.7 Summary

Canada's commitment to participate as an international partner on both the shuttle and space station programs has provided long-term access to space missions and related technology development for Canadian astronauts and researchers. The Canadarm is now recognized as one of Canada's greatest technological achievements, and a great source of national pride.

[55] Source MDA Space Missions

The Canadarm has resulted in a number of significant benefits, including economic impacts, such as major investment, employment and exports, as well a number of associated qualitative impacts such as contributions to space missions, spin-off technology development, continued Canadarm technology advancement and growing / utilizing university research and development resources.

7.2 Bombardier’s Q400: An Ongoing Canadian Aerospace Success

7.2.1 Overview

The Q400 is a member of Bombardier’s *Q-Series* “Aerospace Dash 8” family of regional airliners. This aircraft is the pre-eminent example of a Canadian manufactured aircraft which has utilized a variety of national suppliers, and implemented numerous advanced technologies, resulting in significant impacts with respect to demand, investment, cost savings, employment, environmental sustainability and innovation development in Canada.

Manufactured in Toronto, the Q400 was developed by Bombardier to meet the requirements of regional airlines for larger aircrafts on high-density, short-haul routes; the aircraft was launched in 1995 as a stretched 70 to 80 passenger version of the Q300 series.

The Q400 introduced a number of technological advancements through its design. The Q400 is considered among the “greenest” and quietest regional aircrafts in service around the world. On short-haul flights (approximately 500 nautical miles), its speed is comparable to the speed of a jet, with 30% better fuel efficiency, less noise and the same level of comfort. The Q400’s speed and 2,519 kilometre range also provide airlines with the capability to service markets beyond conventional turboprop aircraft distances.

The Q400 had its first flight in 1998, and entered commercial service in February 2000. Over 1,000 Dash 8 family aircraft have been ordered, with 385 of these being Q400 models. As of July 31, 2010, 312 Q400’s had been delivered.

7.2.2 Q400 NextGen

The subsequent Q400 model, the Q400 NextGen turboprop airliner, is considered the next step in the continuing evolution of the Q400 aircraft series. Along with updated interiors, operating costs of the Q400 NextGen airliner (which were previously among the lowest of any regional aircraft), will be made lower by increasing the scheduled maintenance intervals and further optimizing maintenance tasks to reduce downtime during the aircraft’s life cycle. According to Bombardier, while the Q400 aircraft is the most technologically advanced turboprop airliner and the NextGen features will make it even more so.

7.2.3 Technology specifications and performance strengths

The Q400’s advanced technologies enable the aircraft to excel in areas such as speed, fuel efficiency, noise control and comfort. The Q400 can reach cruise speeds quickly, resulting in climb distances and climb times far more efficient than previous turboprops; Q400’s require 40% less time to climb compared to turboprops. Additionally, on short-haul flights, a Q400’s speed is similar to that of a jet, with 30% better fuel efficiency, enhanced noise control through the aircraft’s noise and vibration suppression system, and with similar comfort.

The Q400 aircraft implements a variety of additional modern technologies in its design. For example, the aircraft’s Pratt & Whitney PW150A engine is the advanced turboprop engine currently in production; the PW150A produces nearly twice the take-off power of older turboprop engines and is nearly 50% more fuel-efficient.

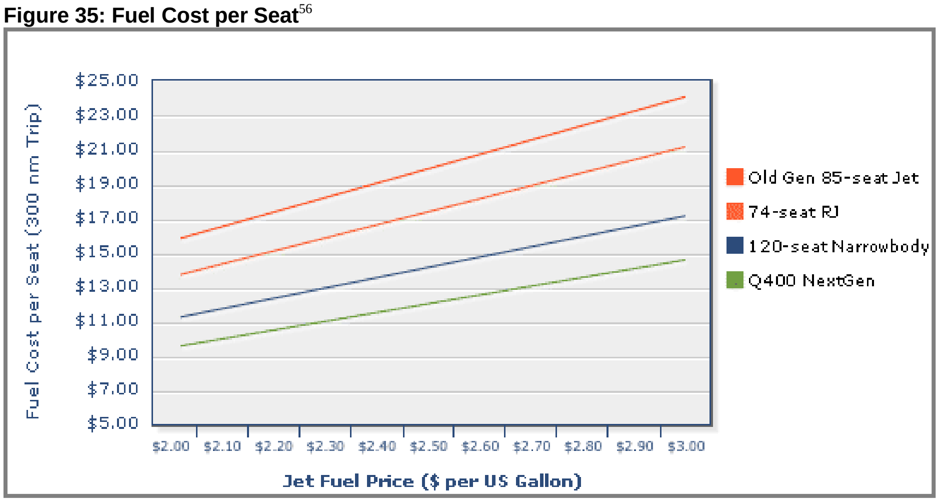
7.2.4 Operating costs and savings

Compared to older generation turboprops the Q400 utilizes more modern technology, resulting in lower cabin noise, lower vibration and higher speeds. An additional important differentiator between jets and turboprops involves economics; according to Bombardier, Q400 operators find a great economical advantage over jets, with the ability to generate greater profits.

Significantly lower fuel burns, especially during shorter distances, help to give the Q400 the lowest operating costs per seat in the regional aircraft market. Additionally, the flexibility of the Q400 allows it to operate profitably in a wide range of markets, from full service regional feeder routes to the ultra low fare markets.

At a jet fuel cost of roughly $3.00, the fuel cost per seat is nearly $15.00 for a Q400, much lower than comparable regional aircrafts. At a jet fuel cost of roughly $3.00, the Q400 annual fuel savings is potentially as high as $2.7 million (over an Old Gen 85-seat jet) given average use. Figure 35, following, compares various regional aircrafts with the Q400 NextGen with respect to fuel cost per seat and annual fuel savings.

Figure 35: Fuel Cost per Seat[56]



7.2.5 Environmental benefits

The global aviation industry is coming under increased pressure to reduce its environmental footprint. As such, the long term trend in aircraft design is expected to shift towards a more fuel efficient aircraft.

With its use of new technologies, the Q400 aircraft is considered one of the greenest regional aircrafts in service around the world. As a result of less fuel usage, the Q400 reduces the environmental impact of typical regional flights. Specific efficiencies include:

- Fuel utilization – the Q400 turboprop uses 30% to 40% less fuel compared to similar capacity older generation and / or 50-seat jet aircrafts;
- Emissions – each Bombardier Q400 aircraft produces 30% to 40% less emissions, or 6,000 to 8,000 fewer tons of emissions annually compared to similar capacity older generation and / or 50-seat jet aircrafts; and
- Noise – the Q400 is one of the quietest aircrafts in the world, as a result of Bombardier's internal Active Noise and Vibration Suppression ("ANVS") system.

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56 Source: Bombardier

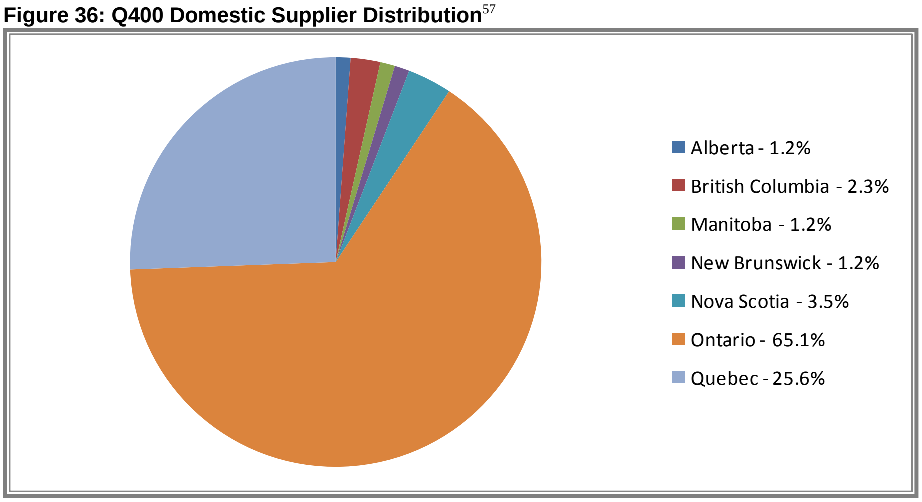
7.2.6 Q400's domestic based supply chain

While manufactured in Toronto, the production of the Q400 utilizes parts and services from approximately 86 different suppliers from across Canada. These suppliers include manufacturers of engines, hardware, interiors, equipment, and insulation materials. As noted in Figure 36, following, suppliers are distributed across seven provinces, and are primarily based in Ontario (65%) and Quebec (26%).

7.2.7 Employment impacts

There are an estimated 1,500 employees at Bombardier who are engaged in the manufacturing and support of the Q400. Bombardier further estimates that when considering all of the suppliers involved in the manufacturing of the Q400, there are four to six additional employees for every one employee directly employed by Bombardier. In total, there are potentially over 10,000 individuals employed throughout Canada in the production of the Q400.

Figure 36: Q400 Domestic Supplier Distribution[57]



7.2.8 Global demand for the Q400

The Q400 has experienced strong demand worldwide, and has been particularly significant to the operations of Canadian based airlines such as Porter Airlines and Air Canada's Jazz.

- ***Porter Airlines*** – Based in Toronto, Porter Airlines is Canada's third largest carrier with regularly scheduled flights between Toronto and a number of locations in Canada and the US. Its fleet is exclusively comprised of Q400 aircrafts. Currently, Porter has approximately 25 Q400 aircrafts, including new orders, with an additional six options. Since 2006, Porter has grown significantly, adding more destinations and aircrafts to its operations. According to Robert Deluce, president and CEO of Porter Airlines, "the Q400 aircraft is a foundation of Porter's operation and growth…Its reliability, performance and efficiency have helped Porter grow to over twenty aircraft from two over the last four years."[58]

[57] Source: Bombardier
[58] Porter Airlines New Releases – August 6, 2010.

- ***Air Canada's Jazz Air*** – With 64 Q-Series turboprops, Air Canada's Jazz Air ("Jazz") is the world's largest operator of the Q-Series. Based in Halifax, Jazz flies to more Canadian destinations than any other carrier (all 10 provinces and three territories), and is the second largest airline in Canada with respect to fleet size and number of routes flown. According to Air Canada, Jazz forms an integral part of Air Canada's domestic and Canada-US trans-border market presence and strategy. Joseph Randell, President and Chief Executive Officer of Jazz notes that, "the introduction of the Q400 NextGen aircraft is a perfect complement to our fleet of Canadian-built Bombardier aircrafts. This aircraft offers superior passenger comfort, fuel efficiency and improved environmental performance."[59]

With respect to global demand, there are approximately 30 different airline operators around the world who currently use Q400 aircrafts. Orders for the Q400 and Q400 NextGen have increased rapidly among a variety of global operators in recent years. Q400 operators are identified in Figure 37, following.

Figure 37: Air Carriers Utilizing Q400 aircrafts[60]

Q400 Airline Operators	Country	Q400 Airline Operators	Country
Air Baltic	Latvia	Jeju Air	South Korea
Air Nippon Network	Japan	LAM Mozambique Airlines	Mozambique
Arik Air	Nigeria	Luxair	Luxembourg
Austrian Arrows	Austria	Malév Hungarian Airlines	Hungary
Augsburg Airways	Germany	Olympic Air	Greece
Colgan Air	U.S.	PAL Express	Philippines
Croatia Airlines	Croatia	Porter Airlines	Canada
Ethiopian Airlines	Ethiopia	Qantas	Australia
Flybaboo	Switzerland	Royal Jordanian	Jordan
Flybe	U.K.	SATA Air Acores	Portugal
Frontier Airlines	U.S.	Sky Work	Switzerland
Horizon Air	U.S.	South African Express	South Africa
Island Air	U.S.	Tassili	Algeria
Japan Air Commuter (JAC)	Japan	Wideroe	Norway
Jazz	Canada	Wings Air	Indonesia

7.2.9 Innovation and technology development

Bombardier is currently considering the development of a stretch version of the Q400, which may potentially be titled the "Q400X". According to Bombardier, the Q400X could have strong potential, given a steady and increasing market for turboprops, anticipated increased demand for higher-density Q400's, as well as the potential for lower operating costs and technological enhancements in such a development.

Additionally, in 2010, it was announced that for the first time, a Bombardier Q400 aircraft would be flown using fuel from camelina, an oilseed crop, as part of a new biofuel test program. A six-partner Canadian consortium, led by Saskatchewan-based Targeted Growth Canada ("TGC"), expects to demonstrate this emerging biofuel produced from camelina in a Porter Airlines Q400 turboprop by early 2012. Renewable fuel from camelina offers the opportunity to reduce the environmental impact of commercial aviation by significantly reducing carbon lifecycle emissions, potentially by up to 80%.

Funding for the project is being provided by the six partners, as well as by Sustainable Development Technology Canada ("SDTC"), an arms-length, not-for-profit corporation created by the Government of Canada and Green Aviation Research & Development Network ("GARDN").

[59] Jazz Air LP Investor Relations – Press Release, February 9, 2010.
[60] Source: Bombardier

According to Bombardier, it continues towards developing and implementing cutting-edge green technologies for the future, and is committed to testing alternative fuels, including second and third-generation biofuels, in an effort to reduce the environmental impact of its products. This investment in environmental innovation provides Bombardier and its partners an opportunity to further the industry's biofuel efforts and ultimately help it reach its overall emissions reduction targets.

7.2.10 Summary

Bombardier's Q400 is considered a globally successful, Canadian-produced, technologically-advanced regional aircraft. On short-haul flights, the Q400's speed is comparable to that of a jet, with 30% better fuel efficiency, less noise and with the same comfort.

With 86 different Canadian suppliers, up to 10,500 Canadians employed through its production and support, and with two major Canadian airlines as customers, in addition to a large global consumer base, the Q400 constitutes a national achievement within the aerospace industry.

Additionally, the Q400 has the potential for further technological advancement, through the development of Bombardier's Q400 NextGen airliner, which utilizes enhanced technologies and reduces operating costs further. The Q400 will also be utilized in a significant biofuel test program in 2012, funded through various Canadian government agencies. Such a test will potentially emphasize Canada as a leader in developing green technology in the aviation industry, and is critical to achieving the environmental efficiency targets that the aviation industry is working towards on a global scale.

7.3 StandardAero: National MRO Leadership, Leveraging Government Support

7.3.1 Introduction

Manitoba is home to the largest aerospace sector in Western Canada and is the third largest provider of aerospace goods and services in Canada. The four world-class firms that anchor the sector are Aveos Fleet Performance Inc., Bristol Aerospace Limited, Boeing Canada and StandardAero.

StandardAero is a Dubai Aerospace Enterprise ("DAE") company, specializing in engine MRO, and nose-to-tail services that include airframe, interior refurbishments and paint for business and general aviation, air transport, and military aircraft. StandardAero services Pratt & Whitney Canada, Rolls-Royce, Honeywell, General Electric, Vericor, and Turbomeca engines used in these various markets.

Founded in 1911 in Winnipeg, StandardAero is one of the largest independent MRO and aviation service businesses in the world, providing comprehensive services to commercial, military, business aviation, helicopters and industrial operators. StandardAero recently joined forces with three other long-established companies – Landmark Aviation's MRO services (formerly Garrett Aviation), Associated Air Center and TSS Aviation, to form one of the largest independent MRO businesses in the world.

With its Canadian executive offices based in Winnipeg, Manitoba, StandardAero has an estimated 2.0 million square feet of plant facility space, 4,000 employees working out of facilities located in the US, Canada, Europe, Asia and Australia, and serves customers in over 80 different countries. Some examples of StandardAero's significant customers include the Department of National Defence / Canadian Forces, GE Aviation, WestJet and GoJet Airlines.

7.3.2 StandardAero Services

7.3.2.1 Maintenance, repair and overhaul (MRO) in Canada

In Canada, over 1,100 certified Aircraft Maintenance Organizations generate over $3 billion in annual revenues and employ 17,000 highly skilled workers. Canadian firms have developed a comprehensive array of MRO service capabilities for rotary wing aircraft spanning virtually all models of helicopters produced in North America and Europe.

7.3.3 Technical services

StandardAero's primary technical services include the following:

- ***Engines*** – main supplier of major maintenance for various Honeywell, Rolls-Royce, Pratt & Whitney and Boeing engines, among others.
- ***Auxiliary power units*** – main supplier of major maintenance for Honeywell and Hamilton Sundstrand auxiliary power units ("APU").
- ***Airframe*** – performs airframe work ranging from standard inspections to major alterations for Airbus Industries, Boeing Business Jet, Bombardier, Cessna, Dassault, Hawker, Learjet and other popular business jets.
- ***Avionics*** – capabilities include authorizations such as FAA Organization Designation Authorization ("ODA"), FAA Delegated Engineering Representatives ("DER") and Class 1, 2 & 3 Radio and Class 2 & 3 instrument ratings.
- ***Completions and paint*** – offers interior and exterior design services, including interior refurbishments, as well as exterior paint capabilities for a wide range of business aircraft.
- ***Mobile service teams*** – Mobile Service Teams are designed to provide customers with greater flexibility, while reducing costs and downtime; teams are equipped to handle troubleshooting for engines and airframes, minor discrepancy work, routine maintenance, engine removals / reinstallations, and engine maintenance.
- ***Associated air center*** – provides custom-designed and crafted interior completions, MRO services, engineering and certification; a major leader in the maintenance and modification of large transport category aircraft, clients include corporations and heads of state.
- ***Energy and industrial*** – provides total package solutions of turbine engine overhaul, component repair and field service to the power generating market all over the world.
- ***Component repair and overhaul*** – optimizes engine performance and minimizes operating costs, including the repair and overhaul for Rolls Royce, General Electric, Pratt & Whitney and Honeywell.
- ***Engineering services*** – services include re-engineering / redesigning an operation to maximize its productivity, workflow and efficiency.

7.3.4 Innovation and technology

StandardAero continues to focus on the advancement of repair processes through the application of new technologies. Some of their research and development achievements include:

- development of new repair schemes for engine components;
- application of engine monitoring and diagnostic tools such as "Trend Check Advanced" test cell diagnostics;
- performance enhancements, through the building of standardized management;
- development of new coatings.

StandardAero believes that by developing new processes to repair parts, they are able to achieve the following three critical objectives:

- repair costs are lowered;
- turn-around-time on serviced engines is drastically reduced; and
- quality of work is greatly improved.

7.3.5 Market leadership

7.3.5.1 Overview

2009 was considered a strong year for StandardAero, as a result of the company's diversity in providing services to airlines, the military, and helicopter and business jet operators. As airlines reduced their capacity in large aircraft fleets, they offloaded some flying to the regional carriers, which meant more airframe and engine inspections for the regional jets. Additionally, business jet operators that were holding off on inspections in 2009 will require service in 2010. 2009 sales totaled approximately $1.4 billion globally, with over $50.0 million resulting from export sales.

According to StandardAero's Vice President of Business Aviation, the company is on schedule for its 2010 business targets, with continued growth and expected additional work in the third quarter.

7.3.5.2 Servicing the Department of National Defence / Canadian Forces

Overview

StandardAero was contracted by the Department of National Defence / Canadian Forces ("DND / CF") to support their military operations in 1962, providing continued service since that time. Specifically, StandardAero has provided propulsion maintenance to Canadian Forces C-130 and CP140 aircraft fleet, as well as T-56 engine repair and overhaul, and technical publication and electronic manual services. As part of this contract, StandardAero also performs Technical Investigation and Engineering Support ("TIES") work and supports technical publications for the T56 engine. According to StandardAero, it was DND / CF's industrial policy and StandardAero's service to DND / CF in the areas of T56 and TIES that led to StandardAero's growth and global success in T56 MRO and TIES.

StandardAero has also been recognized by the Technical Airworthiness Authority ("TAA"), which is responsible for the regulation of the technical airworthiness aspects of design, manufacture, maintenance and material support of aeronautical products and the determination of the airworthiness acceptability of those products prior to operational service. The TAA ensures that the management of the DND / CF Airworthiness Program, from a technical perspective, is adequate to achieve an acceptable level of aviation safety for Canadian military aviation and for foreign military aircraft within Canada.

As a result of a successful initial contract, StandardAero was retained for additional services; StandardAero currently performs approximately $5.0 million in work annually for DND / CF, with approximately 10 to 15 individuals employed in the TIES and technical publications aspects of their work on the T56 engine. These services are largely conducted in Winnipeg, while subcontractors are also utilized from Vancouver and Toronto.

In mid 2010, StandardAero's Winnipeg operation won a 20-year contract to handle French language translation of technical publications for the Canadian Forces' new CC-130J Hercules heavy-lift aircraft. The contract was awarded by Lockheed Martin, with whom StandardAero is partnering on the CC-130J project. Earlier in 2010, StandardAero's Winnipeg facility was announced as one of five firms sharing more than $600 million in service contracts on the Canadian Forces' 17 new Hercules heavy-lift aircraft.

Supporting world class technologies

According to StandardAero, the spin-off technologies resulting from its contract work with DND / CF is potentially one of the greatest benefits resulting from this relationship. For example, DND / CF has funded the development of several new technologies to improve its support of aging C130 / T56 fleet, including the development of Performance Support Systems ("PSS"). PSSs are multi-media tools that are inserted into technical publications to provide technicians detailed information needed to perform technical tasks immediately before the task is to be performed. These PSSs are considered among the most advanced of systems in the world today.

Additionally, DND / CF has strategically invested in electronic technical manuals, making them among the most advanced worldwide. These electronic manuals allow technicians to see animations of procedures using 3D models and to conduct advanced searches of information. More recently, DND / CF tasked StandardAero to develop a user-friendly module to teach technicians how to improve their troubleshooting skills.

In 2009, StandardAero negotiated and obtained a license from Canada to market these technologies around the world in exchange for paying Canada a royalty. StandardAero is currently marketing these technologies, and is expected to realize sales in the near future, growing its Canadian operations further while also providing a healthy return on investment to Canada.

Sponsorship value

StandardAero's successful contract and relationship with DND / CF has helped to build its worldwide profile and contribute to company growth. According to StandardAero, its T56 maintenance repair and overhaul, as well as TIES capabilities were initially developed as a consequence of Canadian Defense / Industrial Policy. As a result of such policies StandardAero entered the T56 MRO business and has since taken that initial capability, developed it further and become a global leader in aerospace MRO.

Additionally, StandardAero considers DND / CF to be both imaginative and motivated to improve the support of their aircraft and engines. Consequently, DND / CF has supported StandardAero to develop new technologies with very practical applications, and their sponsorship has proven to be instrumental to StandardAero's success as an emerging engineering services company.

7.3.6 Regional coverage

7.3.6.1 Global presence

StandardAero has developed a global services network of 12 primary facilities in the US, Canada, Europe, Singapore and Australia, with an additional 14 regionally located service and support facility locations. StandardAero's 4,000 employees are distributed across the globe, with approximately 1,400 people located in Canada, 2,200 located in the US, and 200 individuals based in international locations.

StandardAero's Canada operations has experienced continuous growth worldwide in recent years, some significant select achievements include:

- In 2006, StandardAero signed a multimillion-dollar deal to repair and overhaul Rolls Royce T56 engines from NATO countries; the contract includes a buying agreement that allows all NATO member countries to obtain engine maintenance services from StandardAero at competitive rates and cost certainty, while reducing administrative red tape.
- In 2008, StandardAero completed a $1.6 million transformation of its Pratt & Whitney Canada PT6A facility in Winnipeg, Canada, aimed at improving its work flow; this transformation resulted in a 30% increase in PT6A engine overhaul capacity.
- In 2009, StandardAero signed a 12-year, $850 million contract with WestJet to care for 167 engines and spares that power the carrier's fleet of 81 Boeing 737-600/-700/-800s. This contract is a three-way deal that includes GE Aviation, which has designated Winnipeg as its only CFM56 Fulfillment Center for North American operators outside its own facility in the US.
- In 2010, StandardAero landed its first contract with a Russian airline (Moscow-based Region Avia Airline) to conduct the engine maintenance work on a fleet of Embraer 120 turbo-prop planes; the work will be performed at StandardAero's Winnipeg plant. Avia plans to carry approximately 2.0 million passengers a year on distances up to 1,500 kilometres between five Russian hubs -- Moscow, Samara, Yekaterinburg, Sochi and Novosibirsk by 2012.

7.3.6.2 Growing export market

StandardAero exports to a number of international markets worldwide, with clients in over 75 different countries, across a number of continents. According to Industry Canada, in 2009 StandardAero had over $50.0 million in export sales. Additionally, StandardAero is currently actively pursuing approximately 40 other international markets.

7.3.7 Summary

StandardAero is one of the largest independent maintenance, repair and overhaul, and aviation service businesses in the world, and one of Manitoba's largest aerospace firms. StandardAero has experienced continued, significant success, and has consistently been recognized as one of the top growing companies in Western Canada in recent years. With the help of its longstanding direct relationship with the Department of National Defence / Canadian Forces, StandardAero has been able to grow significantly and build its international profile, as well as facilitate technological advancements in aerospace that may potentially provide significant financial returns to Canada.

7.4 Composites Atlantic Limited: A Fast Growing SME Leader in Aerospace

7.4.1 Overview

Based in Nova Scotia, Composites Atlantic Limited ("CAL") has earned a reputation as a fast growing, leader in the design, testing, certification and manufacturing of advanced composites for the aerospace, space, defence, and commercial industries.

CAL is a Canadian company developed and supported in partnership with EADS Sogerma and the Province of Nova Scotia. The company was initially started with eight employees in 1987 as Cellpack Aerospace Limited, a subsidiary of Cellpack AG of Switzerland. CAL has been present in both the national and international market since 1988.

Today, CAL has a team of over 400 personnel, with experience in project management, systems engineering, design, testing, certification, procurement, quality assurance and manufacturing. CAL provides approximately 8,000 different parts for the industries noted above. Its major clients include Boeing, Airbus, Bombardier, Northrop Grumman, Honeywell, Goodrich, Cessna, MDA Space and Lockheed Martin.

In addition to its manufacturing plant and head office in Lunenburg, CAL has offices in Dartmouth and Mill Cove Nova Scotia, as well as other facilities in Montreal and Seattle Washington. The company also has representation in Wichita Kansas and Brazil to address critical areas of the aerospace market. It has strong links to Europe through EADS Sogerma. The company's expanded facility consists of 150,000 square feet dedicated to manufacturing, and 30,000 square feet for engineering and project management.

CAL has experienced rapid growth in recent years. According to Progress Magazine, in 2010, CAL was noted as one of Atlantic Canada's fastest growing companies (ranking 18th), and in 2007 CAL was ranked as the #1 Company in Atlantic Canada among top 101 companies.

7.4.2 Composites Atlantic Limited Technologies

7.4.2.1 Advanced Composites

CAL specializes in the design, testing, certification and manufacturing of advanced composites, with application in aerospace, space, defence, and commercial industries. A composite is a product made with a minimum of two materials – one being a solid material and the other a binding material (or matrix) which holds both materials together. There are many composite products with more than two raw materials which are not miscible together and are of a different nature.

Historically, composites were invented by mixing straw and clay to make bricks, where straw was the fiber reinforcement and the clay was the matrix. Today, in some parts of the world homes are made with similar material, using straw and vegetable fiber for reinforcement. Reinforcement of concrete with steel bars for construction has also been used for many years in bridge and building construction.

The position of the reinforcement and orientation of the fiber in such products is very important to how they are engineered and developed. Today, the state of the art in composites is the selection of the right fibers with the right matrix, calculating the position and the orientation of the fiber to optimize the product. New fibers and new resins are in continuous mode of development, and significant advancement and development in composite products is being experienced.

7.4.2.2 Technological Capabilities

CAL's services include providing a range of aircraft panels, space antennas, pressure vessels, aircraft accumulator tanks, struts, thermoplastic-injected components, solar panels and satellite components, to name a few.

In addition, CAL offers system engineering, product design services, project management, product procurement services, compression molding, laser machining, and product assembly and delivery services. It owns and operates a manufacturing facility and operates a laboratory for material testing purposes.

7.4.2.3 Continued Innovation and Technology Development

Launched in 2001, the Atlantic Innovation Fund ("AIF") is geared towards helping Atlantic Canadians compete in a global knowledge-based economy through the development of new ideas, technologies, products and markets. Under the AIF, $1.9 million in Nova Scotia commercial organization funding was granted to CAL in early 2010, to support its research and development in advanced composite struts.

Through this project, CAL is conducting research and development to combine two existing technologies in order to create a cost-efficient hollow core, all-composite strut for the airline industry. This strut will initially be targeted towards commercial aircraft with future applications for the space and defence sectors. The proposed composite struts will provide weight savings of 40% compared to existing struts. With this project, CAL will be able to remain competitive through better control of the manufacturing process and will offer customers a high quality product.

7.4.3 Client Scope

For nearly twenty years, CAL's strategy has focused on the development of the international market. Partnership agreements have been developed in order to divide the risk and increase understanding and knowledge; each partner benefits from cost reduction, project management, and program support.

CAL currently has over 50 clients, including the federal government, as well as a number of global defence market leaders such as Lockheed Martin, Boeing, Northrop Grumman, Raytheon, and EADS. According to AIAC, CAL's top ten customers include Bombardier, EADS Sogerma, Spirit Aerosystems, Boeing Winnipeg, Boeing USA, Honeywell-Grimes, Goodrich, Vought, and Short Brothers.

Additionally, CAL has export customers based in the following locations:

- France;
- United Kingdom; and
- United States (California, Kansas, Massachusetts and Washington; CAL is also pursuing new clients in additional US states).

Figure 38: Composites Atlantic Limited Customers[61]

Aec-Able	Capy Machine	Falcon Jet	Neptec
Airbus	Cessna	Fisher Advanced Composites	Potez Aeronautique
Augusta Westland	Comdev	Goodrich	The Aerostructures
ATR	Composites Aquitaine	GKN	Thiokol
ARC	EMS	Hexcel Structures	Trinity Fly Wheel
ARDE	Dassault	Honeywell Grimes	Raytheon
Beacon Power	DeepSea Engineering	IMP	Rolls Royce
Bell	DeHavilland	Lockheed Martin	Satlantic
BFG	DND	MDA Space	Short Brothers
Boeing	EADS	Martec Limited	Sogerma
Bombardier	East West	Mitsubishi	Spar
Bristol Aerospace	EDO Marine	Northrop Grumman	Sperry Marine
Canadair	Embraer	Odim Spectrum	Vought
Canadian Marconi	Eurocopter	O'Hare Airport	Wescam

7.4.4 The Joint Strike Fighter Program

7.4.4.1 Overview

DND / CF' Joint Strike Fighter ("JSF") program is a multinational effort to build and sustain an affordable, multi-role, next generation stealth fighter aircraft. JSF is the single largest fighter aircraft program in history. Partners in the program include the United States, Canada, the United Kingdom, the Netherlands, Italy, Turkey, Denmark, Norway, and Australia. Canada joined the JSF program in 1997.

In July 2010, the Government of Canada announced it would be acquiring the JSF F-35, a fifth generation fighter jet, to replace its fourth generation fleet of CF-18s, which are expected to reach the end of their operational life in the 2017-2020 timeframe. Delivery of the new aircraft is expected to start in 2016.

The F-35 is the only available fifth generation aircraft that meets the Canadian Forces' need for a next-generation fighter.

The total value of the program is expected to exceed US$383 billion, with production expected to top 5,000 aircraft; JSF partners are anticipated to acquire more than 3,000 aircraft, and export sales are estimated by Lockheed Martin at more than 2,000 aircraft. Based on these predictions, royalties from the export sales amounting to approximately $130 million will accrue to the Government of Canada's Consolidated Revenue Fund.

Participation in the JSF program has already provided Canadian industry with long-term, high technology industrial opportunities, such as advanced composite manufacturing, mission systems and high speed machining. To date, Canada has invested approximately $168 million in the JSF program. Since 2002, the Government's participation in the JSF program has led to more than $350 million in contracts for more than 85 Canadian companies, research laboratories, and universities—meaning that Canada has already seen a two-to-one return on its investment.

61 Source: Composites Atlantic Limited

7.4.4.2 A Key Contributor: Composites Atlantic Limited

With Canada committed to purchasing the F-35, Canadian industrial opportunities are estimated to potentially exceed $12 billion for the production of the aircraft. Sustainment and follow-up opportunities are emerging and will be available over the 40-year life of the program. For instance, as noted by Industry Canada, the JSF program provides an unprecedented opportunity for Canadian firms such as CAL to take part in the global supply chains that will define the aerospace and defence sectors for the next 40 years.

The development of the F-35 is the largest cooperative program of its kind since World War II. As a partner nation in the program, Canada is in a position to secure high-value work, such as the manufacturing of composite panels at CAL, on the entire JSF program. "This contract is significant, and the world-class composite fuselage panel manufacturing that is being done for the F-35s, right here at Lunenburg, will reinforce Composites Atlantic's place in the global aerospace industry," said Maurice Guitton, CAL's President and CEO. "We are proud to be working on this contract and look forward to future opportunities that the Joint Strike Fighter program will present over the next 40 years."

7.4.5 Summary

CAL is a leading aerospace company in Atlantic Canada, and is recognized as a fast growing leader in the design, testing, certification and manufacturing of advanced composites for the aerospace, space, defence, and commercial industries.

Through the support of various strategic investments from the Government of Canada, CAL continues to advance its technologies and extend its market breadth in the aerospace and defence industries. Programs such as AIF provide CAL the opportunity to further its advanced composites innovation and technology development. Through DND / CF's significant, multi-national JSF program participation, CAL is contributing its skills and technologies to a major national defence initiative, while expanding its own knowledge, innovation and future business growth potential.

Statement of responsibility

Deloitte prepared this report for the Aerospace Industries Association of Canada (“AIAC”) to provide an economic analysis of and outlook for the Canadian aerospace industry. Our report is general in nature and is not intended to be applied to address or reflect specific matters or circumstances as they may apply to a particular company or organization.

In preparing our report we have relied on the accuracy and completeness of information provided to us by AIAC and from publicly available sources. Deloitte has not audited or otherwise verified the accuracy or completeness of the information supplied to us. Events may have occurred since we prepared this report which may impact on the information therein and our conclusions.

While we discussed our draft report with AIAC the content of the final report, including any opinions, assessments and conclusions, is ours.