New Brunswick Sector Profile:
Aerospace and Defence

June 2013 – Revision

New Brunswick Career Development Action Group

(Funded by the Government of Canada and the Province of New Brunswick through the Canada-New Brunswick Labour Market Development Agreements)

Prepared by: InPro Solutions

Revision (March 31, 2014) Summary:

The methodology in which the full-time equivalent (FTE) of aerospace and defence (A&D) employment was allocated to specific occupations has been revised. Total reported employment numbers are not affected, only how they have been allocated amongst the individual occupations. The original methodology distributed A&D FTE employment amongst individual occupations based on the percentage of employment attributed to the A&D sector for industry group averages (ex. engineering, technologists, trades, operators, etc.). The revised methodology allocates A&D FTE employment based on the percentage of employment attributed to the A&D sector for each occupation in each company. It is believed that this revised methodology more closely reflects the actual situation.

List of revisions:

Section	**Page**	**Paragraph, or Table/Figure**	**Details**
6.1.3	44	Second paragraph	List of Top ten core occupations modified
6.1.3	45	Figure 24	New figure
6.1.4	46	Entire section including Table 14	Revisions to occupations representing significant percentage of total NB employment
6.7.3	56	Table 20	Total two-year hiring projections did not change, however estimated A&D FTE two-year hiring projections were modified.
Executive Summary	2	Fourth and fifth paragraph	The list of top ten occupations, as well as the list of six occupations that make up a significant percentage of total NB employment, were modified.

Table of Contents

1 Executive Summary 1

2 Introduction 4
2.1 Purpose and Scope 4
2.2 Objectives 4

3 Methodology 5
3.1 Primary Research 5
3.1.1 Contact List 5
3.1.2 Interviews 5
3.2 Secondary Research 6

4 Sector Definition 7
4.1 Challenges in Defining the Sector 7
4.2 The New Brunswick Aerospace and Defence Sector Definition 8
4.2.1 Primary Sector Segments 8
4.2.2 Non-Sector-Specific Segments 10
4.2.3 Core Occupations Associated with the Sector 10

5 Sector Profile 13
5.1 The Global Context 13
5.2 The Canadian Context 13
5.2.1 Market Opportunities 14
5.3 The New Brunswick Context 17
5.3.1 New Brunswick's Labour Force 17
5.3.2 Significance of the Sector 18
5.4 Company Size 21
5.5 Segmentation 21
5.6 Products and Services 23
5.7 Revenue 24
5.8 Certifications 26
5.8.1 Management Systems 26
5.8.2 Manufacturing Processes 27
5.9 Regional Distribution 28
5.10 Markets 30
5.10.1 Market Segments 30
5.10.2 Geographic Reach 34
5.10.3 Outlook 35
5.10.4 Market Barriers and Challenges 37
5.11 Infrastructure 38
5.11.1 CFB Gagetown 38
5.11.2 Airports 39
5.11.3 Seaports 39
5.11.4 Research and Development 40

6 Human Resources Profile 41
6.1 Workforce Composition 41
6.1.1 Core Occupational Groups within the Sector 41
6.1.2 Workforce Composition of Companies Preparing to Enter the Sector 41

6.1.3 New Brunswick A&D Sector Workforce Composition 42
6.1.4 A&D Sector's Share of NB Total Employment of Core Occupations 45
6.1.5 The Use of Contractors in the NB A&D Sector 46
6.2 Human Resources Practices 47
6.2.1 Human Resources - Dedicated Staff 47
6.2.2 Human Resources Plan 48
6.2.3 Succession Planning 48
6.2.4 Recruitment Methods 49
6.3 Unionization 49
6.4 Wages 50
6.5 Demographics 51
6.5.1 Age of A&D Sector Workforce 51
6.5.2 Gender 52
6.5.3 Permanent Residents and Temporary Workers 53
6.6 Staffing and Hiring Issues 53
6.7 Hiring Plans 54
6.7.1 Strategic Announcements 54
6.7.2 Current Vacancies 55
6.7.3 Hiring Projections for the Next Two to Five years 56
6.8 Employer Perceptions Regarding Crucial Occupations 59
6.8.1 Crucial Occupations for Current Work 59
6.8.2 Occupations Critical for Future Targeted Work 60
6.9 Challenges in Recruiting (n=32) 61
6.10 Needed Skills for the Future 62

7 Educational Capacity and Capability to Support the Sector 64
7.1 Challenges in Determining Educational Capacity 64
7.1.1 A Shared Labour Market with other Sectors 64
7.1.2 The Present Size of the Sector 64
7.1.3 Unique Skills Requirements 64
7.1.4 Varying Educational Approaches 65
7.2 Educational Capacity to Support Core Sector Occupations 65
7.2.1 Engineers 66
7.2.2 Technologists/Technicians 66
7.2.3 Key Trades within the Sector 67
7.2.4 Training Development and Delivery 71
7.2.5 Information Systems Developers 73
7.3 Skills Gaps 75
7.3.1 Project Management 75
7.3.2 Supervisors – Strong Leaders 75
7.3.3 Quality Assurance Management 76
7.4 Educational Capacity and Capability Conclusions 76

Appendix A: Acronyms 1

Appendix B: Education Matrix – A&D Core Occupations 1

Appendix C: New Brunswick Educational Programs in Support of A&D Sector 1

Appendix D: Bibliography 1

List of Tables

Table 1: Summary of Company Interviews 6
Table 2: Primary Segments within the Aerospace and Defence Sector 9
Table 3: Non-Sector-Specific Support Service Segments 10
Table 4: NB Aerospace and Defence Sector Occupations 11
Table 5: Characteristics of the Canadian Aerospace and Defence Subsectors 14
Table 6: Global Aerospace Forecast Summary (US$ billion) 15
Table 7: Selected Recent and Future Defence Procurement Projects 16
Table 8: Distribution of Establishments by Segment (n=50, 36, 12) 22
Table 9: Sampling of the Products/Services Supplied to the A&D Sector 23
Table 10: Revenue Estimates of New Brunswick A&D Sector 25
Table 11: Analysis of Segment Served by Active A&D Companies (n=36) 32
Table 12: Workforce Composition of Companies Not Yet Participating in Sector (n=14) 41
Table 13: NB Aerospace and Defence Workforce Composition 42
Table 14: A&D Occupations Representing a Significant Percentage of NB Total Employment 46
Table 15: NB A&D Companies' Use of Contractors 47
Table 16: Total NB A&D Sector Workforce Composition, Including Contractors 47
Table 17: Dedicated HR Staff (n=47) 48
Table 18: Average Wages Reported for Representative Occupations 50
Table 19: Current Vacancies 55
Table 20: Two-Year Hiring Projections 56
Table 21: Most Crucial Occupations Identified by A&D Employers (n=26) 59
Table 22: NB Educational Capacity - Trades 68

List of Figures

Figure 1: Conceptual Relationship of A&D Subsectors in Canada 7
Figure 2: Supply-Chain Tier Model 7
Figure 3: Conceptual Size and Overlap of the Canadian A&D Subsectors 14
Figure 4: Regional Distribution of the New Brunswick Labour Force 17
Figure 5: Total and A&D FTE Employment as a Percentage of A&D Business 18
Figure 6: Ratio of Participating Companies Above and Below 50% of Business in Sector 19
Figure 7: A&D FTE Employment by Company Count 19
Figure 8: Categorization of Companies that Make Up NB A&D Sector (n=50) 20
Figure 9: Make up of A&D Sector by Establishment Size Categories (n=36) 21
Figure 10: Gross Annual Revenue Ranges (n=33) 24
Figure 11: Management System Certifications (n=50) 26
Figure 12: Manufacturing Certifications (n=50) 27
Figure 13: Location of A&D Companies in New Brunswick 28
Figure 14: Regional Distribution of Establishments and Total Company Employment (n=50) 29
Figure 15: Regional Distribution of Establishments and A&D FTE Employment (n=36) 30
Figure 16: Aerospace and Defence Market Segments Currently Served (n=36) 31
Figure 17: Aerospace and Defence Market Segments Currently being Pursued (n=36) . 33
Figure 18: Segments Pursued by Companies Not Currently Supplying the Sector (n=14) 34
Figure 19: Source of Revenue by Geographic Region (n=32) 35
Figure 20: Perception of Sector Opportunities over Last Two Years (n=45) 36

Figure 21: Perception of Sector Opportunities over Next Two to Five Years (n=45) 37
Figure 22: Breakdown of A&D FTE Employment by Occupational Category (n=32) 43
Figure 23: Canadian Aerospace Employment by Job Category 44
Figure 24: A&D FTE Employment by Occupation (n=32) 45
Figure 25: Age Profile Comparison of A&D Workforce to Provincial Average 52
Figure 26: Reasons for Hiring over Last Five Years 54

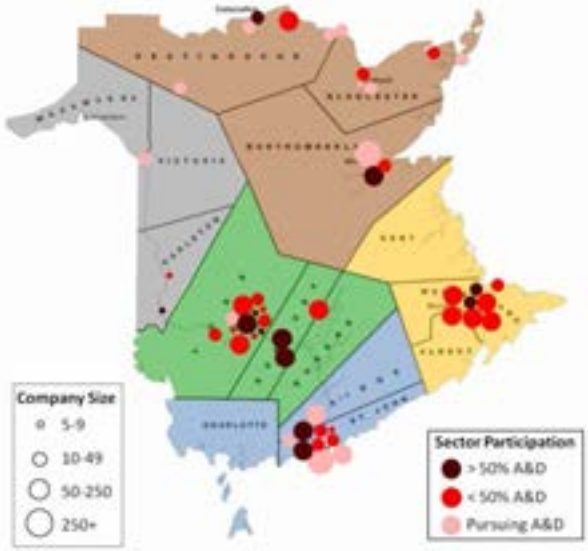
1 Executive Summary

The trillion dollar global aerospace and defence (A&D) sector represents a tremendous opportunity for New Brunswick (NB) companies. In fact, the New Brunswick government has identified aerospace and defence as one of six strategic sectors in its economic development action plan.

The mandate of this study was to develop a detailed profile of the aerospace and defence sector in the Province of New Brunswick (the Province) with a focus on the labour market. It must be clearly stated that this is not a strategy document, but rather a snapshot of the current state of the sector.

In 2012 the New Brunswick A&D sector was made up of approximately 36 companies which generated $155 million in revenue, and directly employed 724 full-time equivalents (FTEs) as well as 15 contract workers dedicated to serving the sector. In total, these same 36 companies generated an estimated $394 million in revenue and employed a total of 1850 people. On average, a NB company supplying to the A&D sector generated $11 million in annual revenue with over $4 million directly attributed to the sector, and employed 52 people where 20 FTEs were dedicated to serving the sector.

Approximately two thirds of participating companies were classified in industry segments not specific to aerospace and defence, and over half of these were in the metalworking and electronic component manufacturing segments. No concentration of companies was evident in any of the segments dedicated and specific to the sector.



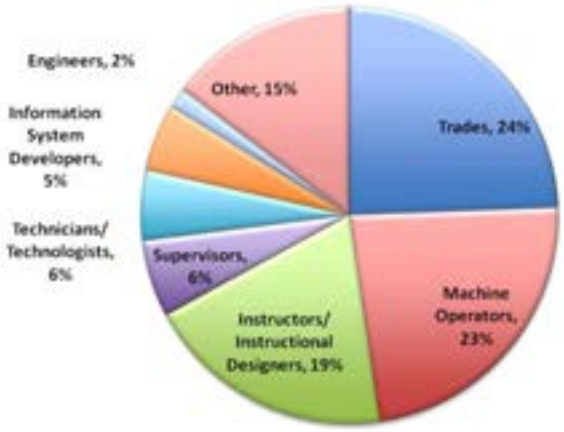
While NB A&D companies operated throughout the Province, there was a concentration in the urban centres of Fredericton, Moncton and Saint John. A&D FTE employment was concentrated (37%) in the Fredericton-Oromocto economic region, 23% in Campbellton-Miramichi, 22% in Saint John-St Stephen, 18% Moncton-Richibucto, and only 1% in Edmundston-Woodstock.

All NB A&D companies were small- to medium-sized enterprises with less than 200 employees. There were a relatively small number of players that contribute significantly to the sector. Just three (3) companies represented 50% of all employment attributed to the sector, while seven (19%) represented 81%. A significant portion (44%) of participating companies attributed less than 10% of their business to the sector.

The Defence Land segment was the most frequently cited market segment being served (cited by 44% of companies). The Defence and Civil Aviation segments were each cited by 36% of companies, and the Defence Marine segment was cited by 28% of companies. The Defence Marine segment was also the most frequently cited new market segment being pursued (cited by 31% of companies). This is not surprising given the timing, proximity, and relevance of the Irving Shipbuilding contracts. Approximately 42% of sector business came from within the Province, primarily from Canadian Forces Base (CFB) Gagetown. Approximately 28% was estimated to have been generated from international exports with the balance coming from other parts of Canada.

Perceptions regarding market outlook tended to be more positive among companies that derived a greater portion of their business from the sector. Companies with 50% or more of their business attributed to the sector viewed opportunities over the last two years as "somewhat strong", yet see a brighter future in the next two to five years, rating opportunities as "very strong". Companies with less than 50% of business derived from the sector held a somewhat more pessimistic view of opportunities over the last two years, viewing opportunities as "somewhat weak", but saw the next two to five years as "somewhat strong". Companies not currently serving, but actively pursuing the sector, saw the last two year as "very weak" in terms of opportunities, but see the next two to five years as "somewhat strong".

Of the 60 occupations chosen to help define the sector, New Brunswick A&D companies employed individuals in 49 of them. The chart shows the breakdown according to occupational grouping.



The Top 10 occupations by size were:

1. Metalworking Machine Operators (9514[1]);
2. Instructional Designers (4131);
3. Machinists (7231);
4. Flying Instructors (2271);
5. Supervisors[2];
6. Aircraft Mechanics (7315);
7. Welders (7265);
8. Plate-work Fabricators and Fitters (7263);
9. Electronics Assemblers, Fabricators, Inspectors (9483); and
10. Other Labourers in Manufacturing (NOC 9619).

Despite the small size of the NB A&D sector, it significantly contributed, as a percentage of total NB employment, to six occupations:

1. Metalworking Machine Operators (9514) = 73%;
2. Air Pilots, Flying Instructors (2271) = 67%;
3. Aircraft Mechanics and Aircraft Inspectors (7315) = 22%;

[1] National Occupational Code (NOC).
[2] Aggregate of Supervisors in various functional areas and disciplines.

4. Electronics Assemblers, Inspectors (9483) = 16%;
5. Machinists and Machining and Tooling Inspectors (7231) = 11%;
6. Plate-work Fitters/Fabrication (7263) = 8%

The New Brunswick aerospace and defence sector workforce was reported to be predominantly male (82%) compared to the provincial average of all sectors (54%). It was also seen to be generally younger, with a greater percentage (53%) of the workforce in the 25-44 year age category, in contrast to the provincial average (44%). The 55-64 year age category represented 8% of employment compared to the provincial average of 17%. All other age groups were comparable. Permanent Residents in the sector were slightly under-represented (2.6%) when compared to the provincial average for all sectors (3.8%).

In general, wages for sampled occupations in the sector (i.e. Engineer, Technician, Technologist, Welder, Machinist, Industrial Electrician, Instructional Designer, Programmer, and Mechanic) were reported to be above provincial averages.

Total two-year hiring projections for companies participating in, and those purusing the sector, was 571 positions. Based on employer expectations, 174 new workers were projected to be hired over the next two years to directly support work in the A&D sector. Other job growth within the sector may also come from A&D companies establishing operations within the Province. At time of writing, two announcements predicting 100 new jobs in the sector had recently been released.

An analysis was undertaken to examine if any education and training gaps existed in terms of capacity and capability based on the total two-year hiring projections for all related companies (those currently supplying, and those actively pursuing the sector). In general, with a few exceptions, the educational system appears to have ample capacity to support key occupations within the aerospace and defence sector at this time.

While companies did identify a number of skills needed for the future, the responses given were as varied as the sector's segments, and as specific as a particular company's focus. However, three common skills areas repeatedly came up during interviews: Project Management, Supervisory, and Quality Management. While these skill sets have historically been, and continue to be, taught through continuing education and professional development means, university and college institutions have begun to embed such training into some of their programs.

The New Brunswick aerospace and defence sector has companies such as Dew Engineering, Apex Industries, Moncton Flight College, and a number of others that are prominent players in their respective spheres. However, the sector is still small. Any significant change such as the landing of a new major project, the establishment of a new A&D company wishing to locate in the Province, or even the closure of one of the prominent players has the potential to significantly impact the sector. The scope of such change can be broad and can affect the economic profile, the employment profile, as well as training demand load in terms of both capacity and capability. In short, it can alter the picture of the sector captured in this study.

2 Introduction

2.1 Purpose and Scope

Aerospace and defence (A&D) has been identified as a strategic sector in the Province of New Brunswick.[3] Through the New Brunswick Career Development Action Group (NBCDAG), InPro Solutions was commissioned to study and develop a fact-based profile of the aerospace and defence sector with a focus on the labour force.

This is not a strategy document. A strategy can only be formulated by first understanding the current state - before undertaking steps to achieve a future vision. This study represents that first step: to define the current state. As such, it is intended to provide information to stakeholders, policy makers, and training institutions to formulate strategy in pursuit of their respective goals and objectives.

The scope of the study was limited to companies participating in the aerospace and defence sector as explicitly defined in Section 4. In addition, analysis is confined to the geography and issues faced by the sector in the Province of New Brunswick.

2.2 Objectives

The overall objective of the study was to develop a detailed profile of the aerospace and defence sector in New Brunswick with a focus on the labour market. Specific sub-objectives included:

1. To develop a clear definition of the sector, including subsector groupings and occupational classifications;
2. To develop a concise profile of the sector which includes both an economic profile as well as a human resources profile;
3. To identify the post-secondary educational capacity for skills related to this sector in the Province, and in a less comprehensive manner, the rest of Canada; and
4. To determine if gaps exist between education/skills demand and supply within the New Brunswick sector.

[3] "Growing Together - Economic Development Action Plan 2012-2016", Province of New Brunswick, May 2012

3 Methodology

Study methodology was based on a combination of both primary and secondary research activities as described below. The focus, however, was on primary research efforts where a census survey of New Brunswick aerospace and defence companies was intended.

3.1 Primary Research

3.1.1 Contact List

Following establishment of a sector definition (see Section 4) the development of a reliable contact list was undertaken. Because a census survey was intended, great efforts were made in an attempt to ensure that all "in-scope" companies were captured. To achieve this, a wide net was cast which began with:

1. Organizations listed in the "New Brunswick Aerospace & Defence Capabilities Guide 2012";
2. Members of the "New Brunswick Aerospace and Defence Association (NBADA)"; and
3. An employer list provided by the Labour Market Analysis Branch (LMAB) of the Department of Post-Secondary Education, Training and Labour (PETL).

These sources were synthesized into a single repository and supplemented with secondary sources which included: web searches and directory listings, as well as insight regarding other potential companies gained by the authors though other sector and labour market analysis studies.

A master contact list of 76 companies was ultimately created by filtering for companies determined to be "in-scope".

3.1.2 Interviews

To support and help guide interview activities, two discussion guides, designed for telephone interview purposes, were drafted and submitted for review and approval by the project Steering Committee. They included:

1. Employer Survey (72 questions); and
2. Economic Development Organizations (EDO)/Association Survey (22 questions).

Interviews were conducted by two interviewers, in English and French as required, during the period of December 2012 to February 2013. In total, 58 interviews were completed, 50 with A&D Companies, and eight with Economic Development Organizations (EDO) and Industry Associations. A tally of the completed company interviews is shown in Table 1.

Table 1: Summary of Company Interviews

MASTER CONTACT LIST/IDENTIFIED FOR STUDY	**76**
Self-identified, or otherwise determined, as not supplying and not pursuing the A&D sector	21
Unavailable to complete interview	4
Unable to locate valid contact information (out of business)	1
SURVEY INFORMATION COLLECTED FROM	**50**
Detailed survey completed, but self-identified as not currently supplying the A&D Sector, yet taking steps to actively pursue it	14
INTERVIEWED AND PARTICIPATING IN SECTOR	**36**
Provided only high-level data	4
COMPLETED DETAILED SURVEY[4]	**32**

Of the four companies that were unavailable, despite numerous contact attempts, only two were believed to have any meaningful participation in the sector. Secondary sources suggest that combined, these two companies may employ up to 90 staff, with potentially 25 to 35 Full-time Equivalents (FTEs) employed as a direct result of sales to the A&D sector. However, since these are unconfirmed numbers, they have not been included in the study. In addition, it is possible that a few additional companies do generate sales in the sector unbeknownst to stakeholders[5]; however if they do, they are likely very small and would have a minimal impact on study data.

Based on these assumptions, the companies that provided primary data to this study are estimated to represent at least 90% of the New Brunswick aerospace and defence sector.

3.2 Secondary Research

Secondary research efforts contributed significantly to the study. Numerous sources were accessed and are appropriately referenced throughout this document. Research activities included:

- A literature search of related studies;
- General internet searches for sector information, industry directories, etc.;
- A review of A&D company websites;
- Reviews of Statistics Canada data sources; and
- Reviews of Industry Canada data sources.

[4] Some respondents declined to answer certain questions.
[5] Labour Market Analysis Branch of the NB Department of Post-Secondary Education, Training and Labour, the NB Department of Economic Development, Invest NB, and the New Brunswick Aerospace and Defence Association.

4 Sector Definition

4.1 Challenges in Defining the Sector

Aerospace, defence, security and space each contribute significantly to the economy. However, clearly defining and delineating this contribution can be a challenge. This is because each of these subsectors[6] is typically reported independently, yet each can significantly overlap with others.

Figure 1 illustrates this concept. Note that the shape, size, and overlap of each subsector can vary depending upon regional circumstances[7].

Figure 1: Conceptual Relationship of A&D Subsectors in Canada

A paradigm commonly used to define the aerospace and defence sector is a tiered structure representing the various parts of the supply chain on major projects.

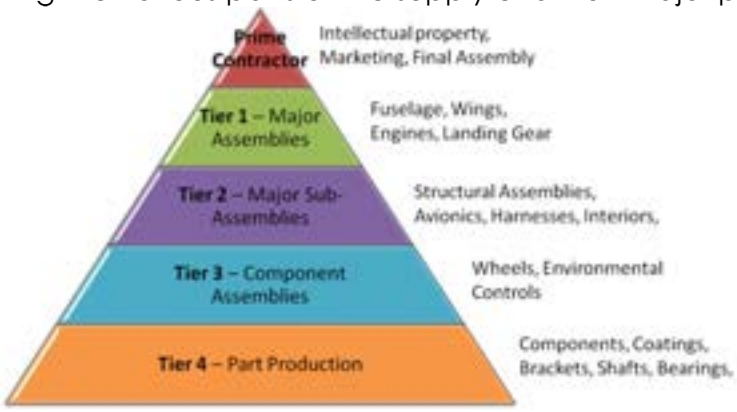


Figure 2: Supply-Chain Tier Model

"Primes" include companies that own the intellectual property of the system being built, such as an airplane. This would include companies like Boeing, Bombardier and Airbus.

[6] In the context of this study, these are referred to as the subsectors that make up the New Brunswick aerospace and defence (A&D) sector.

[7] For example, in Canada the commercial aerospace industry is larger than the entire defence industry, whereas the opposite is true in the United States.

These companies then engage a supply-chain to provide everything from major assemblies, for example, engines from "Tier 1" companies like Pratt & Whitney or Rolls Royce, to various sub-assemblies, components and parts.

For physical products, the concept is very intuitive and useful. Unfortunately, it does not eloquently accommodate the service segments within the sector such as Maintenance, Repair and Overhaul (MRO) and Training and Simulation.

4.2 The New Brunswick Aerospace and Defence Sector Definition

The "Rebuilding New Brunswick: New Brunswick Aerospace and Defence Sector Strategy 2012-2016" defines the aerospace and defence sector as follows:

> The aerospace and defence (A&D) sector in New Brunswick includes businesses and institutions whose products and services are used for civil aviation and national defence and security. Products include vehicle systems, aircraft components, and electronic assemblies and services related to maintenance, repair and overhaul; system support and training; and training simulation for military and commercial aviation. The sector includes companies involved in the industry's high technology infrastructure such as air traffic systems, mission systems and ground equipment of various kinds, as well as the space industry and security-related capabilities.

Flowing from that definition, and for the purposes of this study, the sector is divided into the aerospace, national defence and security subsectors. These subsectors can be further broken down into major segment groups that include the supply and maintenance of: aircraft, spacecraft, and associated systems; military land, marine, C4ISR[8], and weapons systems; and products and services that address both traditional and modern threats to national security. The aerospace and defence sector is also supported by enterprises that supply a number of products and services critical for, but not specific to, the sector.

Specifically excluded are:

- End users such as airlines, national defence agencies, national space agencies, and public security agencies;
- Infrastructure providers such as: airports, seaports, and military bases; and
- Suppliers of commodities, such as fasteners, linens, tableware, etc.

4.2.1 Primary Sector Segments

Table 2 provides a breakdown of the primary A&D segments, grouped into their major segment groups. They have been chosen to align with definitions adopted by national institutions, namely: the Aerospace Industries Association of Canada (AIAC), the Canadian Association of Defence and Security Industries (CADSI), and the Canadian Space Agency (CSA). The left side of the table shows how each of the three subsectors: aerospace, defence and security, relate to the various segments.

[8] Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance

Table 2: Primary Segments within the Aerospace and Defence Sector

			Segments	Associated Infrastructure
Subsectors	Defence	Aerospace	**Aviation Systems: Civil and Military**	
			Aircraft, Missiles, Unmanned Aerial Vehicles (UAVs) Major Structural Sections and Components Aircraft Engines and Engine Parts Avionics and Electro Systems Maintenance, Repair and Overhaul – Aviation	Airports Air Force Bases
			Space Systems: Civil and Military	
			Space(Platform) Systems Ground Systems Application and Services Space Research	
			Military Land Systems	
			Armoured and Specialized Military Vehicle Systems Other Military Land Equipment Clothe the Soldier (example: Uniforms, Body Armour, etc.) Maintenance Repair and Overhaul – Land	Army Bases
			Military Marine Systems	
			Shipbuilding and Repairing Navigation and Electronics Maintenance Repair and Overhaul –Navy	Naval Bases Shipyards
			Military C4ISR Systems	
			Air Mission Systems Land Mission Systems Maritime Mission Systems Joint & Common Equipment Mission Systems	Distant Early Warning (DEW) Line
			Military Other	
			Military Human Resource Augmentation	
			Weapons Systems: Military and Civil	
			Ordnance/Explosives Firearms Ammunition	
		Security	**Security Products and Services**	
			Manpower-Related Security Services Information/Cyber Security Solutions Security Products and Equipment Integrated Security Systems Security Consultancy	Border Crossings Sea Ports Public and Private Buildings Critical Infrastructure

4.2.2 Non-Sector-Specific Segments

Table 3 provides a breakdown of non-sector-specific segments critical to the sector. Companies classified under these segments provide goods and services that are not specific to the sector. Typical examples would be metal fabrication and advanced learning technologies.

Table 3: Non-Sector-Specific Support Service Segments

Manufacturing Services
Metal Fabrication
Machining
Fabrication
Sheet Metal
Casting/Forging
Heat Treatment, Finishing and Coatings
Plastic, Rubber, and Resin-based Composites
Fabrication
Repair
Electronic/Electrical Product Fabrication
Electronic Equipment Research and Development and Design
Electronic Power Systems
Wire Harnesses and Cables
Motion Control Systems
Assembly
Specialized Vehicle Systems
Training and Simulation
Training Delivery Services
Training Content, Equipment and Systems
Simulators
eLearning/CBT
Technical Services
Design and Engineering
Inspection and Testing
Business Services
Consulting and Business Services
Human Resource Augmentation
Project Management
Translation Services

4.2.3 Core Occupations Associated with the Sector

Table 4 lists the 60 occupations, based on National Occupational Classification (NOC) definitions, selected to be within the scope of the study[9]. The diversity and quantity of occupations reflects the broad definition of the sector that includes the aerospace, defence, and security subsectors. Occupations that did not have any practitioners in

[9] The list was developed with input from the Labour Market Analysis Branch of the Department of Post-Secondary Education, Training and Labour and approved by the New Brunswick Aerospace and Defence Association and Government of New Brunswick representatives.

New Brunswick, as reported by the Canadian Occupational Projection System (COPS) in 2009, were excluded from the study.[10]

Table 4: NB Aerospace and Defence Sector Occupations

NOC	Occupation
2131	Civil Engineers
2133	Electrical and Electronics Engineers
2147	Computer Engineers (Except Software Engineers and Designers)
2132	Mechanical Engineers
2141	Industrial and Manufacturing Engineers
2142	Metallurgical and Materials Engineers
2171	Information Systems Analysts and Consultants (Includes Quality Assurance)
2172	Database Analysts and Data Administrators
2173	Software Engineers and Designers
2174	Computer Programmers and Interactive Media Developers
2175	Web Designers and Developers
2253	Drafting Technologists and Technicians
2271	Air Pilots, Flight Engineers and Flying Instructors
2231	Civil Engineering Technologists
2241	Electrical and Electronics Engineering Technologists and Technicians
2281	Computer Network Technicians
2283	Systems Testing Technicians
2232	Mechanical Engineering Technologists and Technicians
2233	Industrial Engineering and Manufacturing Technologists and Technicians
2243	Industrial Instrument Technicians and Mechanics
2252	Industrial Designers
2261	Non-Destructive Testers and Inspectors
2262	Engineering Inspectors and Regulatory Officers
2255	Mapping and Related Technologists and Technicians
4131	College and Other Vocational Instructors (Includes Instructional Designers)
5241	Graphic Designers and Illustrators
7231	Machinists and Machining and Tooling Inspectors
7232	Tool and Die Makers
7263	Structural Metal and Plate-work Fabricators and Fitters
7265	Welders and Related Machine Operators
7311	Millwright/Industrial Mechanic
7315	Aircraft Mechanics and Aircraft Inspectors
7242	Industrial Electricians
7243	Power System Electricians
7333	Electrical Mechanics
7252	Steamfitters, Pipefitters and Sprinkler System Installers
7262	Boilermakers
7293	Insulators
7316	Machine Fitters
7341	Upholsterers
7443	Automotive Mechanical Installers and Servicers
7312	Heavy-Duty Equipment Mechanics

[10] One such example is that of Aerospace Engineer.

NOC	Occupation
7321	Automotive Service Technicians, Truck and Bus Mechanics and Mechanical Repairers
7322	Motor Vehicle Body Repairers (includes Painters)
7383	Other Trades and Related Occupations
7231	Machinists and Machining and Tooling Inspectors
9481	Aircraft Assemblers and Aircraft Assembly Inspectors
9496	Painters and Coaters - Industrial
9483	Electronics Assemblers, Fabricators, Inspectors and Testers
9485	Assemblers, Fabricators and Inspectors, Industrial Electrical Motors and Transformers
9482	Motor Vehicle Assemblers, Inspectors and Testers
9486	Mechanical Assemblers and Inspectors
9619	Other Labourers in Processing, Manufacturing and Utilities
9511	Machining Tool Operators
9514	Metalworking Machine Operators
9516	Other Metal Products Machine Operators
9612	Labourers in Metal Fabrication
9422	Plastics Processing Machine Operators
9423	Rubber Processing Machine Operators and Related Workers
9495	Plastic Products Assemblers, Finishers and Inspectors

5 Sector Profile

5.1 The Global Context

According to Research and Markets, the industry had total revenue of US$1,070 billion in 2010 with the defence segment accounting for US$791 billion (74%), and the civil aerospace segment US$279 billion (26%)[11]. The industry is global in nature, and dominated by large multinational players where the top 100 aerospace and defence companies alone accounted for US$677 billion in 2011[12].

Defence: Worldwide defence spending, which includes personnel and operations, was estimated to be in excess of US$1.7 trillion[13] in 2011. The US was by far the largest defence spender at US$711 billion accounting for over 40% of all global defence expenditures. US military spending was five times greater than second ranked China (US$143 billion). Canada's National Defence budget was approximately US$20 billion in 2011 which ranked the country 14th on the global stage. Canada's military spending as a percentage of GDP is 1.4%, which is below the world average of 2.5%.

Aerospace: Deloitte estimated the 2010 global aerospace market to be valued at over US$404 billion, almost evenly split between the civil and military segments[14]. The Emerson Report on Canada's aerospace industry[15] cites Canada among the leading aerospace nations in the world. Valued at $22 billion it is the fifth largest, and the second largest relative to the size of the economy. Canada's aerospace subsector is somewhat unique in that it derives 77% of its revenue from civil sales compared to the global average of roughly 50%.

5.2 The Canadian Context

As introduced in Section 4.1 there is a significant amount of overlap among the various subsectors of the aerospace and defence industry. For example, the Aerospace Industry Association of Canada (AIAC) is the national association representing the interests of organizations with a vested interest in aviation and space applications – both civil and military. Its counterpart, the Canadian Association of Defence and Security Industries (CADSI) is the national association representing companies with interests in the defence (including aerospace) and security markets. There is no industry association representing the space segment in Canada, but the Canadian Space Agency (CSA) regularly publishes on the 'state of the sector'. Shown in Table 5 are some of the high-level industry characteristics reported by these organizations.

[11] http://www.businesswire.com/news/home/20120106005088/en/Research-Markets-Global-Aerospace-Defense-Industry-Expected

[12] "Aerospace & Defence 2011 year in review and 2012 forecast", PricewaterhouseCoopers (PwC), 2012

[13] "2013 Global aerospace and defense industry outlook - Expect defense to shrink while commercial aerospace sets new records", Deloitte, 2013

[14] "Global Aerospace Market Outlook and Forecast – AIAC Phase 3 Report", Deloitte, October 2010

[15] "Beyond the Horizon: Canada's Interests and Future in Aerospace – Aerospace Review Volume 1", Government of Canada, November 2012

Table 5: Characteristics of the Canadian Aerospace and Defence Subsectors

	Aerospace[16]	Space[17]	Defence/ Security[18]
Revenue (billion)	**$22.4**	**$3.4**	**$12.6**
Domestic	27%	50%	49%
Export	73%	50%	51%
Employment	**87,231**	**8,256**	**71,000**
Quebec	53%	18%	---
Ontario	28%	55%	---
Western Canada	13%	23%	---
Atlantic Canada	5%	4%	---

However, as previously implied, these values are not mutually exclusive and therefore cannot be summed. Figure 3 attempts to conceptualize the magnitude and overlap of the subsectors.

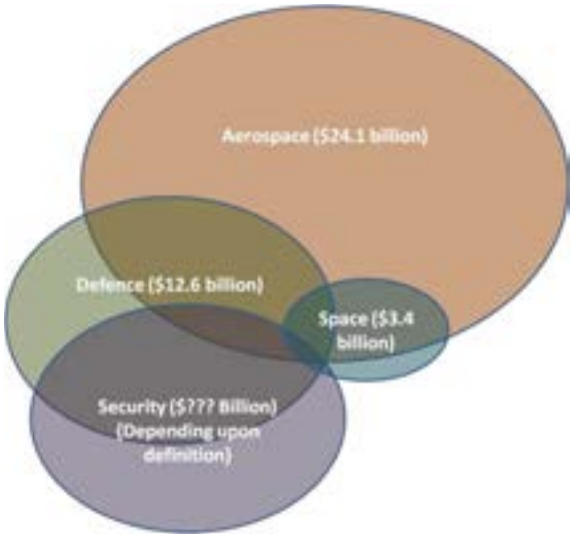


Figure 3: Conceptual Size and Overlap of the Canadian A&D Subsectors

5.2.1 Market Opportunities

This section is presented simply to provide context regarding the magnitude of opportunity available in the sector[19].

[16] "The state of the Canadian Aerospace Industry – Performance 2011", Aerospace Industry Association of Canada (AIAC), July 2012
[17] "State of the Canadian Space Sector 2010", Canadian Space Agency, 2011
[18] "Economic Impact of the Defence and Security Industry in Canada", KPMG, May 2012. (Employment data by region not available).
[19] A market strategy is a separate exercise well beyond the scope of this study.

Canada's aerospace industry is biased toward the civil and export markets - 77% and 73% of total industry sales respectively. According to Boeing's forecasts, approximately 34,000 new commercial planes worth US$4.5 trillion will be required by global airlines over the next two decades[15]. Table 6 shows projected annual revenue for both commercial and military segments in 2015 and 2020[14].

Table 6: Global Aerospace Forecast Summary (US$ billion)

Subsector	Sector	2010	2015	2020
A&AP	CAS	$99.67	$119.74	$143.48
	MAS	$106.16	$116.61	$128.43
E&EP	CAS	$29.03	$38.09	$43.44
	MAS	$23.30	$26.50	$28.19
MR&O	CAS	$37.95	$47.28	$56.88
	MAS	$62.37	$66.86	$71.68
T&S	CAS	$1.01	$1.86	$2.64
	MAS	$0.77	$1.57	$3.12
S&GM	CAS	$26.42	$26.42	$15.39
	MAS	$17.65	$19.39	$21.36
CAS Total:		**$194.08**	**$233.39**	**$261.83**
MAS Total:		**$210.25**	**$230.93**	**$252.78**
Global Total:		**$404.33**	**$464.32**	**$514.61**

CAS – Civil Aerospace Sector
MAS – Military Aerospace Sector
A&AP – Aircraft and Aircraft Parts
E&EP – Engines and Engine Parts
MR&O – Maintenance, Repair, and Overhaul
T&S – Training and Simulation
S&GM – Space and Guided Missiles

The defence area offers unique opportunities for Canadian companies where the Canadian government, as the primary customer, has flexibility under international trade agreements to favour domestic suppliers. In addition, recent strategic activities undertaken by the government have further improved opportunities for Canadian companies. In 2008/9, the release of the Canada First Defence Strategy[20] outlined a $240 billion re-equipping of all three branches of the Canadian Forces between 2008 and 2027. The key element was the $60 billion allocated for "Equipment" – where 20% had already been allocated by the end of 2012/13. In addition, the recently released Jenkins Report[21] outlined a change in approach to defence procurement intended to better engage Canada's defence industry players and maximize the economic benefit to Canada. While the report is focussed on strategies surrounding key industry capabilities (KIC), it also makes empirical observations such as: "evidence indicates that primarily all successful Canadian-based defence suppliers of scale got their start

[20] "Canada First Defence Strategy", Government of Canada, 2008/9
[21] "Canada First: Leveraging Defence Procurement Through Key Industrial Capabilities", Public Works and Government Services Canada, February 2013.

with a Department of National Defence (DND) contract," - an insight not likely overlooked by New Brunswick's economic development stakeholders.

To highlight some of the opportunities for Canadian, and New Brunswick, companies, Table 7 presents a selection of recent and future defence projects.

Table 7: Selected Recent and Future Defence Procurement Projects

Sector	Project	Description	Est. Value (millions)	Approval	Work Period	Primes & Major Subcontractors
Sea	Frigate Life Extension (FELEX)	Upgrade 12 modernized Halifax-Class ships	$549	2005	2010-2019	Halifax Shipyards, Victoria Shipyards, Fleetway Inc., DRS Flight Safety, Boeing, Lockheed Martin
	Arctic/Offshore Patrol Ships (AOPS)	6-8 ships, plus 25 yr in service support (ISS) contract	$3,074	2007	2015-2024	Irving Shipbuilding Inc.
	Joint Support Ship (JSS)	2 ships with option for 1	$2,613	2010	2014-2019	Vancouver Shipyards
	Canadian Surface Combatant (CSC)	Replacement of Halifax and Iroquois class ships	TBD	2009	TBD	Still in definition phase
Land	Light Armoured Vehicle III Upgrade (LAV III UP) project	Upgrade 550 LAV III vehicles	$1,064	2009	2011-2019	General Dynamics Land Systems-Canada
	Close Combat Vehicle (CCV) project	108 vehicles with an option for 30	$2,000	2013	2015-2019	Past Bidders: Artec GmbH, BAE Systems Hägglunds AB, General Dynamics Land Systems – Canada, Nexter Systems, Rheinmetall Landsysteme GmbH
	Tactical Armoured Patrol Vehicle (TAPV) project	500 Vehicles plus 5 year in service support (ISS) contract	$709	2010	2012-2017	Textron Systems Canada Inc.
	Force Mobility Enhancement (FME) Project	13 Armoured Engineer Vehicles (AEV) with option for 5 plus 4 Armoured Recovery Vehicles (ARV) both on Leopard 2 Chassis	$250	2008	2012-2017	AEV= Flensburger Fahrzeugbau (FFG) Gesellschaft mit beschränkter Haftung (GmbH) ARV= Rheinmetall Land Systems (RLS) GmbH
	Logistic Vehicle Modernization (LVM)	Approx 4000 vehicles to replace HLVW, LSVW, HESV wheeled logistics fleet (not MSVS)	$1,000	2013?	2016-2020?	TBD

Sector	Project	Description	Est. Value (millions)	Approval	Work Period	Primes & Major Subcontractors
Air	Next Generation Fighter Capability (NGFC)	Replace 65 CF-18 fighter aircraft	$9,000	2012	2017-2020?	TBD
	Fixed-Wing Search and Rescue Aircraft Replacement (FWSAR)	Replace 6 CC-115 Buffalo and 13 CC-130 Hercules aircraft, Plus ISS	$3,800	2013	2015-2020	TBD
	Joint Unmanned Aerial Vehicle Surveillance Target Acquisition System (JUSTAS)	Medium Altitude Long Endurance Unmanned Aerial Vehicle (UAV) System	$1,000	TBD	TBD	TBD
			$25,059			

5.3 The New Brunswick Context

5.3.1 New Brunswick's Labour Force

In order to gain an appreciation of the scope and impact of the aerospace and defence sector in New Brunswick, it is first useful to understand the size and composition of the New Brunswick labour force as a whole.

In 2012, New Brunswick's population was estimated to be 755,950[22] with 620,300[23] individuals aged 15 and older making up the working age population. The total labour force was comprised of 391,300 individuals with 351,300 employed and approximately 40,000 unemployed. The regional distribution of the entire New Brunswick labour force is shown in Figure 4.

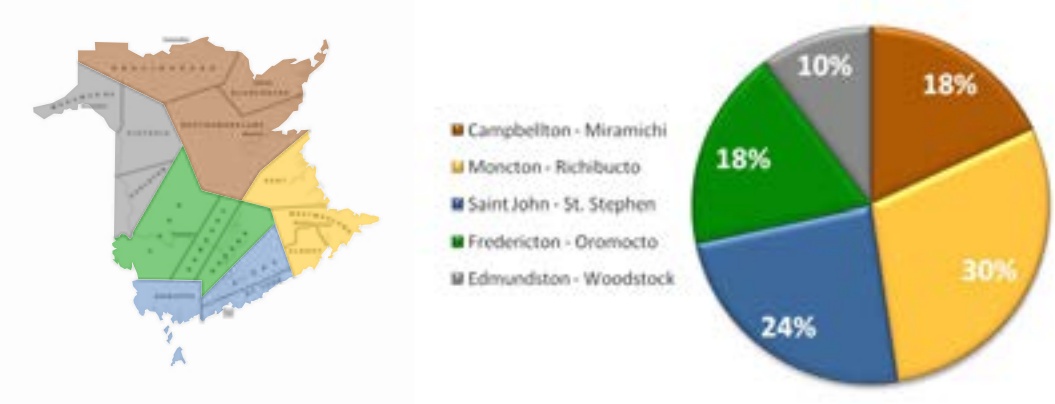


Figure 4: Regional Distribution of the New Brunswick Labour Force

[22] Source: Statistics Canada, CANSIM, table 051-0001, modified: 2012-09-26 (accessed: 2013-03-07).
[23] Source: Statistics Canada. Table 282-0055 - Labour Force Survey estimates (LFS), by provinces, territories and economic regions, modified 2012-01-04 (accessed: 2013-03-06).

5.3.2 Significance of the Sector

As described in Section 3.1, a wide net was cast in an effort to identify every New Brunswick company participating in the A&D sector. Of the 76 companies identified, 36 were confirmed to generate at least some revenue from the sector, and thus employ individuals as a result of that work.

Based on these numbers, one of the first conclusions to be drawn is that the New Brunswick aerospace and defence sector is relatively small. In total, the 36 active A&D companies employ an estimated 1856 people[24] , with approximately 724[25] (39%) full-time equivalents (FTEs) employed as a direct result of sales to the sector.

All of the companies currently active in the sector are small and medium-sized companies, each with less than 200 employees[26]. On average, New Brunswick A&D companies employ 52 employees per company with 20 FTEs dedicated to serving the sector.

To gain a sense of the intensity and significance that participating companies place on the A&D sector, a scatter plot was created to show two data points for each company. One data point represents total company employment (gold diamond), and the other shows FTE employment attributed to A&D business (blue circle). Both data points were plotted as a function of the company's percentage of business derived from the A&D sector. The results are shown in Figure 5.

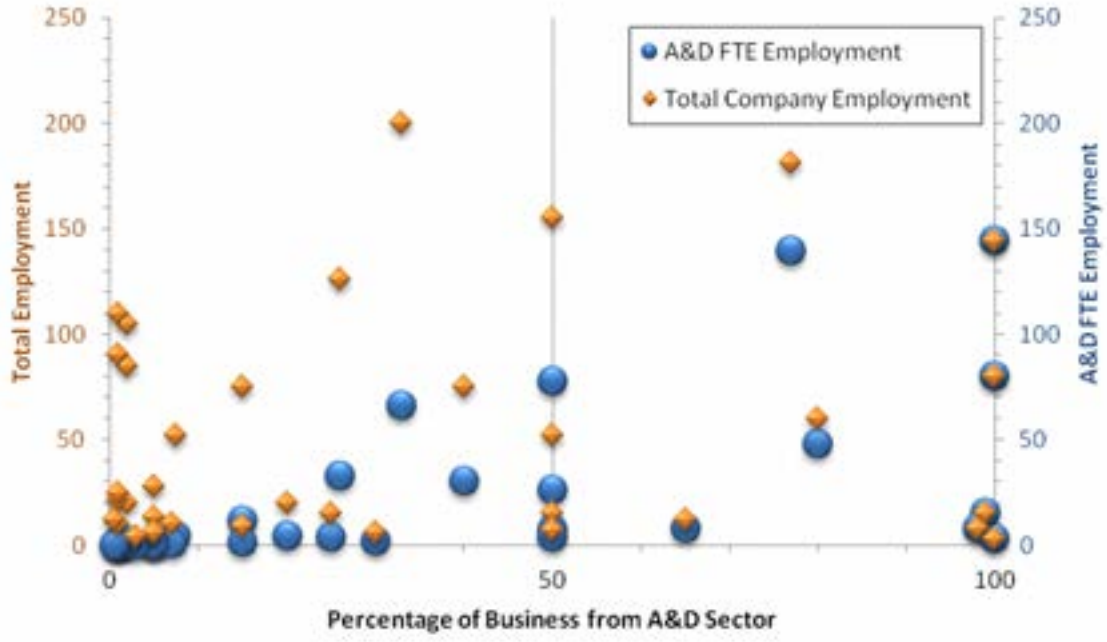


Figure 5: Total and A&D FTE Employment as a Percentage of A&D Business

[24] This represents only 0.5% of New Brunswick's total employment.
[25] This number grows marginally to 739 if contractors are included (see Section 6.1.5).
[26] Based on reported 2012 average employment (n=36).

To help understand the chart, consider the top-most gold diamond data point on the 50% grid line. This represents a company with 156 total employees (left vertical axis). Since 50% of the company's business is attributed to the A&D sector, it is estimated that 78 FTEs can be attributed to the A&D sector. A corresponding blue circle data point was therefore plotted on the 50% grid line at 78 A&D FTEs (right vertical axis).

What the plot demonstrates is that a significant portion of the 36 participating companies attribute less than 50% of their business to A&D sector. In fact it is a two-thirds split where only 12 companies derive 50% or more of their business from the sector, and 24 less than 50% (Figure 6).

Figure 6: Ratio of Participating Companies Above and Below 50% of Business in Sector

Figure 5 also shows that many companies (n=21) are small companies with less than 50 employees. The clustering of blue data points (A&D FTEs) at the left origin suggests that the sector is currently not a significant source of revenue for a large number of companies. In fact, 16 (44%) of the "participating" companies attribute less than 10% of their business to the sector. Conversely the blue data points (A&D FTEs) on the upper right of the chart suggest that relatively few companies are responsible for a significant portion of sector employment.

Figure 7 was created to provide greater clarity. The chart shows a number of interesting facts:

- Just three (3) companies represent 50% of all employment attributed to the sector [line 1];
- Seven (7) companies (19%) represent 81% of all employment attributed to the sector [the "80/20 rule"- line 2]; and
- Twenty-two (22) companies (60%) represent 99% of all employment attributed to the sector [line 3].

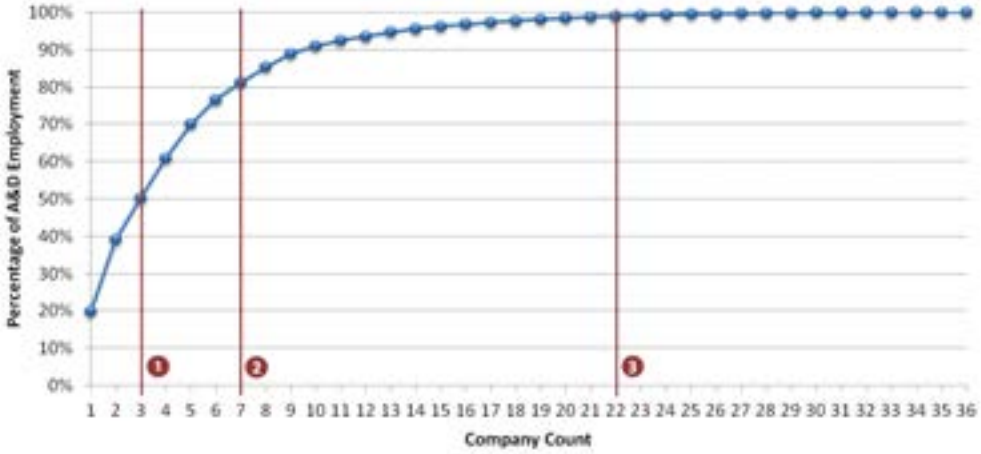


Figure 7: A&D FTE Employment by Company Count

A tempting first reaction may be to "dismiss" the contribution and significance of companies currently playing only a minor role in the sector. However, these companies represent a pool of organic growth opportunities where the first significant barrier, preparing for and achieving sales in the sector, has been overcome. These companies are one step ahead of others wishing to enter the sector. In fact, the study has determined that there are an additional 14 companies that, at time of writing, have yet to penetrate the sector, but are taking active steps to pursue it[27].

While there are undoubtedly shades of grey involved in defining the New Brunswick aerospace and defence sector, this study has adopted the following categorization for companies:

- Participating with 50% or more of business derived from A&D (>= 50%);
- Participating with less than 50% of business derived from A&D (< 50%); and
- Pursuing – Not currently participating but taking active steps to pursue.

Viewed from this perspective, Figure 8 shows the relative intensity with which the 50 interviewed companies participate in the New Brunswick aerospace and defence sector.

Figure 8: Categorization of Companies that Make Up NB A&D Sector (n=50)

Approximately 40% of New Brunswick companies that make up the A&D sector also make up other strategic sectors in the Province. Twenty five percent (n=9) of participating companies (n=36) are also part of the industrial fabrication (IF) sector[28]. Another 14% are estimated to be part of the information and communications technology (ICT) sector[29]. When companies not currently supplying, but taking steps to actively pursuing the A&D sector are considered, the number expands to 30% and 18% for IF and ICT respectively.

[27] A number of other companies within the Province possess capability to supply to the sector, however their intentions to pursue at time of writing were unknown to the authors and provincial stakeholders (i.e. New Brunswick Aerospace and Defence Association and Provincial Government officials).

[28] "New Brunswick Sector Profile: Industrial Fabrication," InPro Solutions, April 2012

[29] A list of New Brunswick companies based on a particular information technology sector definition is not available; the number is therefore estimated.

5.4 Company Size

Figure 9 shows the breakdown of the 36 participating companies by total company employment, where categories are:

- Very Small = 1 to 9 employees;
- Small = 10 to 49 employees;
- Medium = 50 to 249 employees;
- Large = 250-499 employees; and
- Very Large = 500 and over employees[30].

The blue bars in the figure represent the number of companies per category (dark blue shows companies deriving 50% or more of their business from the sector, and light blue shows those with less than 50%). The burgundy bars represent the total employment by company size category (the darkest shade shows A&D FTE employment only for companies deriving 50% or more of their business in the sector, the medium shade shows A&D FTE employment only for companies with less than 50%, and the lightest shade shows the balance of employment not attributed to the A&D sector).

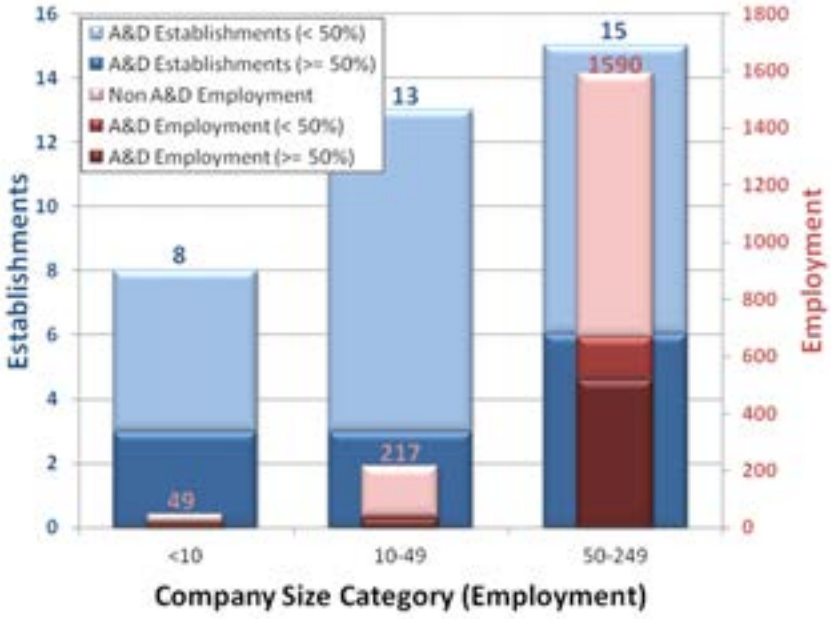


Figure 9: Make up of A&D Sector by Establishment Size Categories (n=36)

Fifty-eight percent (58%) of companies (n=21) have fewer than 50 employees. However, the 15 companies (42%) with 50-249 employees represent 86% of total employment and 92% of FTEs dedicated to the A&D sector.

5.5 Segmentation

Based on the responses provided to a series of survey questions, interviewers classified companies based on the segmentation scheme originally presented in Sections 4.2.1 and 4.2.2. Classification/segmentation was based on 'what a company does' and not

[30] As previously noted, there currently are no Large or Very Large companies active in the sector.

'what markets they supply' (which is discussed in Section 5.10.1). For example, a shop that machines metals may supply the aerospace and defence sector as well as other sectors, but it is still classified as a "machine shop" (metal fabrication – machining).

As can be seen in Table 8, when all 50 interviewed companies (which includes those participating in as well as those pursuing the sector) are considered, almost 80% are classified into "non-sector-specific" segments. When only those companies active in the sector (All Participating) are considered, a slight shift is evident where 28% are classified as "sector-specific", and 72% "non-sector-specific". When companies with 50% or more of their business derived from the aerospace and defence sector are consider (A&D >= 50%), the shift is significant (as expected) where over 83% were classified as "sector-specific".

The reason why not all "A&D >= 50%" were categorized as "sector-specific" was a judgement call made by the authors based on overall responses to survey questions. If a machine shop or an advanced learning technology (ALT) company reported that exactly 50% of their business was attributed to the sector, but still actively pursued other sectors, they were considered to be a machine shop and an ALT company and thus classified (i.e. they were not considered an aerospace parts manufacturer, or an aviation training company).

Table 8: Distribution of Establishments by Segment (n=50, 36, 12)

Segment		Participating & Pursuing (n=50)		All Participating (>= 50% and < 50%) (n=36)		Participating (>= 50% Only) (n=12)	
Aviation: Aircraft Engines & Engine Parts		1	10 [665]	1	10 [665]	1	10 [665]
Aviation: Navigation ground systems		1		1		1	
Aviation: Training		1		1		1	
Military C4SIR Systems: Air Mission Systems		1		1		1	
Military Land Systems: Armoured and Specialized Vehicle Systems		1		1		1	
Military Marine Systems: Shipbuilding and Repairing		1		1		1	
Military: Resource Augmentation		2		2		2	
Security Products & Services: Information/Cyber Security Solutions		1		1		1	
Security Products & Services: Security Products & Equipment		1		1		1	
Non-Sector Specific	Computer Programming & IT Services	5	40 [2314]	2	26 [1191]	0	2 [67]
	Electronic/Electrical Product Fabrication, or Assembly	7		6		0	
	Metal Fabrication	12		8		0	
	Metal Machining	5		2		1	
	Maintenance, Repair and Overhaul (MRO)	2		2		0	
	Plastic, Rubber, and Composites Fabrication & Repair	2		1		0	
	Specialized Vehicle Systems	1		1		0	
	Training Content and System Development	3		2		1	
	Other	3		2		0	
Total		**50 [2979]**		**36 [1856]**		**12 [732]**	

*numbers in "[ ]" indicate total company employment

5.6 Products and Services

New Brunswick companies produce and supply a diverse array of products and services to the A&D sector. Table 9 provides a description of some of the products and services offered by survey respondents categorized according to the segmentation previously presented in Table 8.

Table 9: Sampling of the Products/Services Supplied to the A&D Sector

Segment	Products/Service
Aviation: Aircraft Engines and Engine Parts	Tooling gauges and fixtures for landing gear and engine assemblies
	Design, manufacture, prototyping, precision machining, laser cutting, and heat treating, of airframe components
Aviation: Navigation ground systems	Visual and electronic navigation systems
	Airfield lighting and automated weather systems
	Communication towers
Aviation: Training	Flight training for: airlines, private, universities, military cadets
Military C4SIR Systems: Air Mission Systems	Design, manufacture, maintenance, launch, and recovery of UAVs
Military Land Systems: Armoured and Specialized Military Vehicle Systems	Add-on armour for crew protection
	Vehicle re-role programs
	Other defence solutions
Military Marine Systems: Shipbuilding and Repairing	Heavy fabrication and machining of ship components
	Non-Destructive Testing (inspection of welds, etc..)
Military: Resource Augmentation	Instructor-led training (provision of experienced instructors)
	Systems administration and operational support
	Courseware development
	Civilians in battle support
Security Products & Services: Information/Cyber Security Solutions	Cyber security for USA FART NERT - for protecting critical electrical infrastructure
	Other software security solutions
Security Products and Services: Security Products & Equipment	Unattended ground sensors for border security
	Covert cameras and transmission devices
	Robotics (hostage negotiation, checking buildings or explosives)
	Covert tracking devices
Non-Sector Specific: Computer Programming & IT Services	Secure cloud-based servers, storage and related IT services (includes physical and network security)
Non-Sector Specific: Electronic/Electrical Product Research, Design, Fabrication, or Assembly	Wireless aircraft refuelling controls
	Emergency shutdown for jetways
	Remote controls for ground support equipment
	Printed Circuit Board Assembly
	Software Systems Design
	Cable harness design and manufacturing
	"Box Build" solutions (ex. control panels and ground support units)
	Conformal coating and potting
	Custom battery packs - DC Power
	Thermal measuring instruments for coatings, explosives, etc.

Segment	Products/Service
	Power distribution centres for ships
Non-Sector Specific: Metal Fabrication	Components and integrated small structures for fixed and rotary wing airframes
	Power distribution systems
	Fabrication of parts and sub-assemblies from multiple metal processing methods –ex. cutting, machining, forming, welding
	Piping – modularized
	Containers for weapons systems
	Tanks for: water, fuel, oil, contaminated products, etc.
Non-Sector Specific: Metal Machining	CNC Machined components
	Bushings, retainers, valve seats, piston valves, threaded, washers - all metals
Non-Sector Specific: MRO	Powertrain MRO of heavy equipment
	Repair of hydraulic cylinders (incl. re-plating, etc..)
Non-Sector Specific: Plastic, Rubber, and Resin-based Composites Fabrication & Repair	Rubber Molded Track Pads and Wheels
Non-Sector Specific: Specialized Vehicle Systems	Bomb disposal trailers
	Vehicles systems for military, police and security
Non-Sector Specific: Training Content and System Development	Training & Simulation Products
	Curriculum, Courseware Development
	Compliance based training
Other	Technical manuals and translation of technical documents
	Paper static protected products

5.7 Revenue

Companies participating in the survey were asked to indicate average annual gross sales for 2012 based on revenue ranges[31]. The results for the 33 respondents are shown in Figure 10.

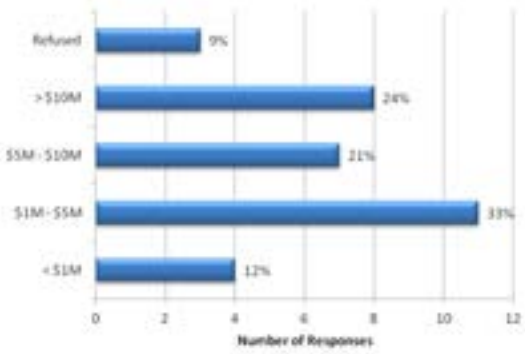


Figure 10: Gross Annual Revenue Ranges (n=33)

While these responses help to paint a picture of the New Brunswick sector, they do not provide a specific answer to the most sought after question – What is the value of the sector?[32]

[31] Revenue ranges were used due to the sensitivity that many companies have in sharing exact revenue numbers.

To answer that question, an approach was taken based on estimates of total revenue generated per employee. Values for revenue per employee published by Industry Canada/Statistics Canada[33] were used as a proxy to calculate total company revenue based on the total employment numbers reported by respondents.

It must be strongly emphasized that these revenue estimates are highly speculative and are open to numerous sources of error[34]. However, as a means of assessing the validity of the estimates, the calculated estimates for each company were compared to the respective revenue range reported by survey respondents (when available). The approach resulted in over 60% of the estimations falling within the reported ranges, 25% being over, and the balance being under. These results suggest that the revenue estimates may serve as a reasonable indicator, however they may be slightly overstated. They are provided only to gauge magnitude and are not to be considered statistically valid.

As shown in Table 10, the total corporate revenue calculated by proxy for the 36 companies participating in the sector was approximately $394 million. Of this amount, approximately $155 million (39%) is attributed directly to sales in the A&D sector. The average company generated $11 million per year, with just over $4 million from the A&D sector.

Table 10: Revenue Estimates of New Brunswick A&D Sector

		Revenue from all sectors (000s)	Revenue from A&D only (000s)
Combined Revenue of:	All participating companies (n=36)	$393,532	$155,294
	Companies with >= 50% from A&D (n=12)	$153,457	$119,946
	Companies with < 50% from A&D (n=24)	$240,075	$35,348
Average Revenue of:	All participating companies (n=36)	$10,931	$4,314
	Companies with >= 50% from A&D (n=12)	$12,788	$9,995
	Companies with < 50% from A&D (n=24)	$10,003	$1,473

[32] Despite using revenue ranges, almost 10% of companies still declined to provide a response. In addition, the total value of the sector cannot be drawn out using such data. For example, does a company that reported revenue over $10 million actually generate revenue of $11 million or $60 million? For these reasons a proxy was used.

[33] The two primary sources used were: 1) Canadian Industry Statistics, Industry Canada (http://www.ic.gc.ca/eic/site/cis-sic.nsf/eng/h_00006.html), Last updated November 2011, and 2) Canadian ICT Sector Profile, Industry Canada (http://www.ic.gc.ca/eic/site/ict-tic.nsf/eng/h_it07229.html), Last updated May 2012.

[34] Errors include but are not limited to: errors in total employment reported by respondents, errors in estimated percentage of business attributed to the A&D sector, errors in classifying companies to the 4-digit NAICS level, and errors due to Industry Canada data being based on national averages.

5.8 Certifications

This section highlights some of the prominent certifications achieved by New Brunswick companies actively serving, as well as pursuing, the sector. It is not intended to be exhaustive, but rather provide insight into the types of certifications held and being sought by companies.

5.8.1 Management Systems

Management system certifications are very relevant in the A&D sector. Shown in Figure 11[35] are the third-party certifications and approvals reported by survey respondents. ISO 9001 (quality management) and Controlled Goods (security management) are the most prominent certifications achieved. Over three-quarters of companies currently selling to the sector possessed at least one of the certifications listed in Figure 11.

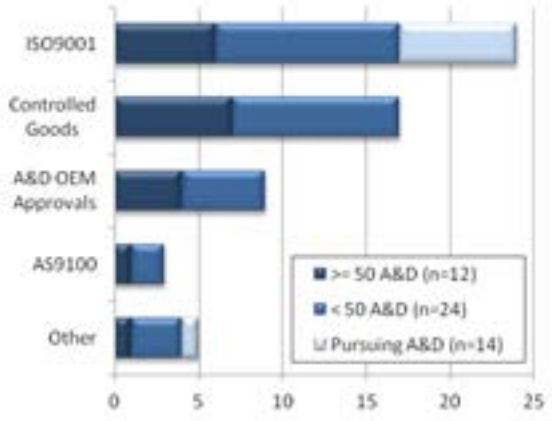


Figure 11: Management System Certifications (n=50)

Half of the companies reported having an externally certified quality management program. ISO 9001 was almost the exclusive standard (96%) achieved. The three companies reporting certification to AS9100 were also certified to ISO 9001. Three additional companies indicated that they expect to achieve certification in the first or second quarter of 2013.

Only companies participating in the sector reported successful registration with the Controlled Goods Directorate[36]. This is because Controlled Goods registration is granted only when a specific need is identified. Therefore if a company had not required access to controlled goods over a particular period, they may be deregistered by the Controlled Goods Directorate. In fact, this situation was the case cited by a few respondents. In addition, a number of companies pursuing the sector reported

[35] AS9100 is an international quality management standard for the aerospace and defence industry based on ISO9001; OEM approvals refer to quality management standards set and measured by Prime or tier manufacturers such as Boeing, Bombardier, etc. for their supply-chain partners, also known as Approved Supplier Status.

[36] The Controlled Goods Program (CGP) is a federally managed program with legally enforceable requirements related to the examination, possession or transfer of controlled goods in Canada (as defined in the Export Control List). Registration is mandatory for any companies/individual requiring access to Controlled Goods.

undertaking steps in preparation for Controlled Goods registration, but are waiting for a requirement to trigger registration (i.e. a contract)[37]. It should be noted that a company can still be actively supplying the A&D sector without a requirement for Controlled Goods registration (i.e. not all A&D products are considered controlled goods).

Types of certifications categorized as "other" include:

- Other industrial security clearances;
- ASME[38] quality assurance program certification (welding); and
- Lean Manufacturing[39].

5.8.2 Manufacturing Processes

New Brunswick companies serving, and wishing to serve, the A&D sector possess a multitude of manufacturing certifications. Figure 12 shows the relative ranking of certifications cited. It should be noted that many companies hold multiple manufacturing certifications. Figure 12 presents total certification counts.

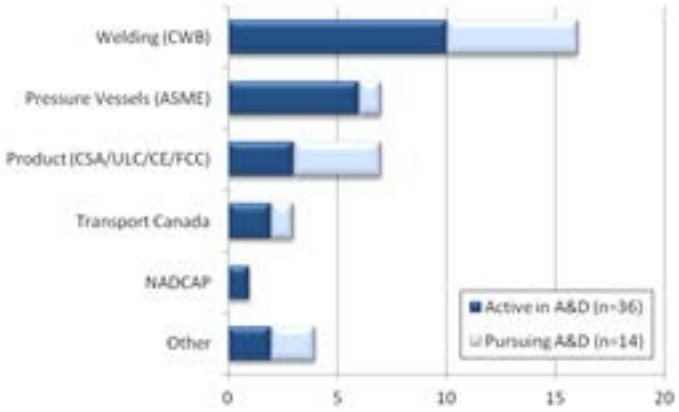


Figure 12: Manufacturing Certifications[40] (n=50)

It is not surprising, given the relative concentration of metal fabrication companies (n=12 (24%), see Table 8), that welding tops the list. Almost all welding certifications (94%) were to one or more CWB standards.

[37] Some companies surveyed indicated that, in some cases, they have had difficulty bidding on OEM contracts, because Controlled Goods Registration was required in order to bid, but they could not obtain registration without a contract.

[38] American Society of Mechanical Engineers

[39] Lean manufacturing is a practice that involves never ending efforts to eliminate or reduce 'muda' (Japanese for waste or any activity that consumes resources without adding value). Developed by the Toyota executive Taiichi Ohno during post-Second World War reconstruction period in Japan, and popularized by James P. Womack and Daniel T. Jones in their 1996 book 'Lean Thinking.', BusinessDictionary.com

[40] CWB (Canadian Welding Bureau); CSA (Canadian Standards Association); ULC (Underwriters Laboratory Canada); the CE (Conformité Européenne) Mark, the European equivalent of CSA and ULC; FCC (U.S.A. Federal Communications Commission); NADCAP National Aerospace and Defense Contractors Accreditation Program)

Closely aligned to welding were certifications reported for pressure vessels – primarily ASME. Product certifications such as CSA, ULC, CE, and FCC typically related to specific products produced by the company. These can vary widely, from electrical components to nuclear products. Similarly, Transport Canada certifications vary from vehicle-related certifications to the only pilot approved training organization in Canada.

Only one company had achieved the aerospace and defence industry-specific NADCAP certification for a number of their processes.

Some of the "other" manufacturing certifications reported were typically very unique to the type of business (ex. emergency management, explosion proof certification, etc.).

5.9 Regional Distribution

Figure 13 shows the regional distribution of the 36 companies currently supplying the A&D sector, as well as the 14 that are currently not supplying the sector, but are taking active steps to pursue it.

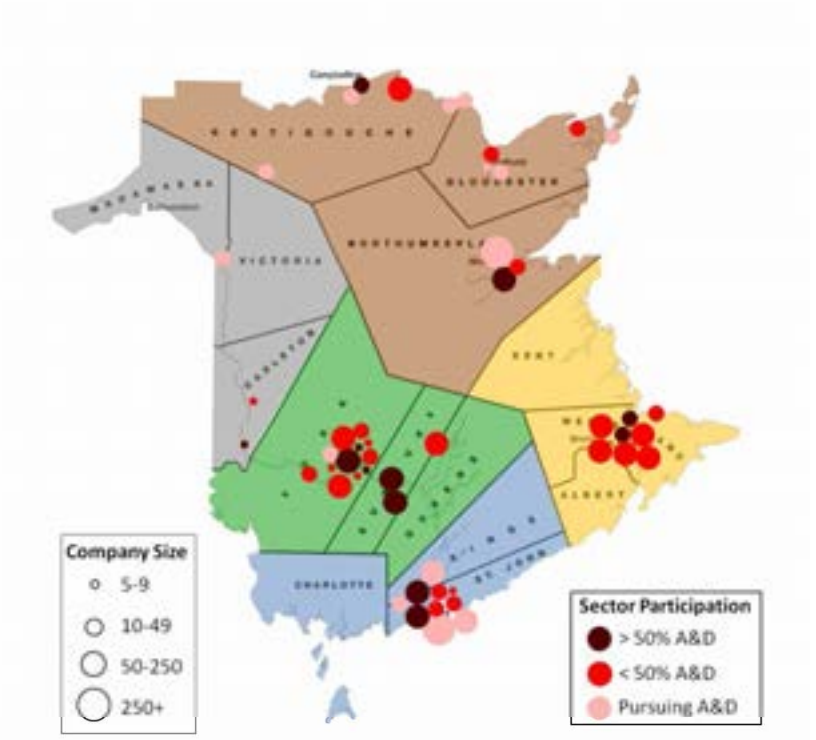


Figure 13: Location of A&D Companies in New Brunswick

Clusters around the urban areas of Fredericton, Moncton, and Saint John are evident.

Figure 14 shows the breakdown of company count and employment by region. The three shades of blue bars show establishment count (bottom axis) by region where: the dark-blue represents establishments deriving 50% or more of their revenue from the A&D sector; the mid-blue shows those with less than 50%; and the light-blue shows those not

currently selling to the sector, but actively pursuing. The three shades of brown show employment count (top axis) by region where: the dark-brown represents total company employment by companies deriving 50% or more of their revenue from the A&D sector; the mid-brown shows total company employment of companies with less than 50%; and the light-brown shows total company employment of companies not currently selling to the sector, but actively pursuing.

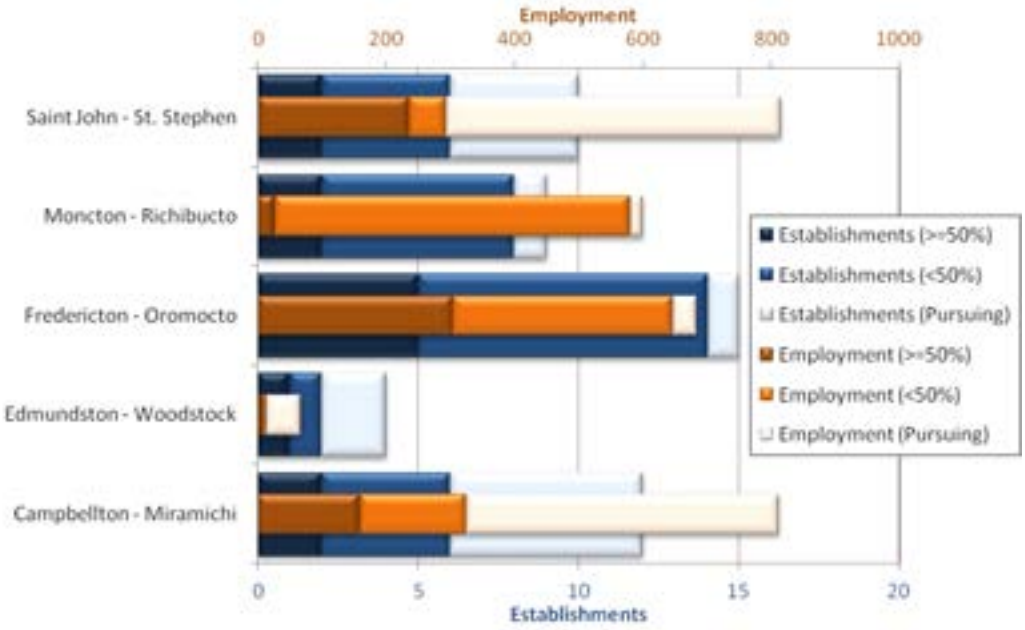


Figure 14: Regional Distribution of Establishments and Total Company Employment (n=50)

Viewed with this lens, the Fredericton-Oromocto and Moncton-Richibucto regions show the strongest presence of active companies. The significant showing of employment attributed to companies not currently serving, but actively pursuing, the sector in the Campbellton-Miramichi and Saint John-St. Stephen regions is due to two large companies (over 250 employees), one in each respective region.

When only A&D FTE employment is considered, the picture changes slightly as shown in Figure 15.

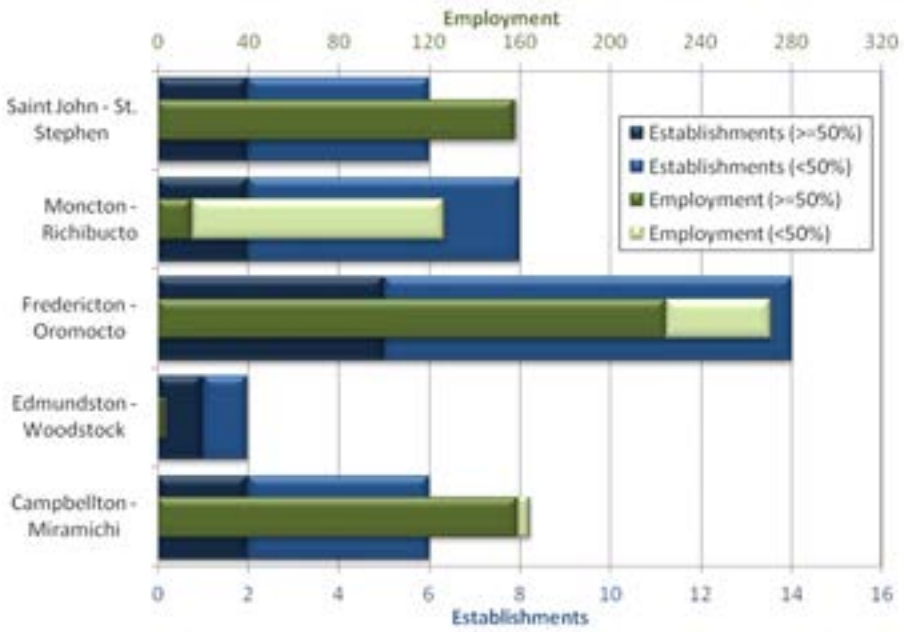


Figure 15: Regional Distribution of Establishments and A&D FTE Employment (n=36)

Viewed with this lens, the Fredericton-Oromocto region accounts for the greatest portion of A&D FTE employment. The strong showing for companies deriving over 50% of revenue directly from the A&D sector in the Fredericton-Oromocto region is primarily due to two resident companies providing services to CFB Gagetown in Oromocto. Similarly the Saint John - St. Stephen region numbers are strongly skewed by two companies, and the Campbellton – Miramichi region is significantly skewed by one company.

5.10 Markets

5.10.1 Market Segments

When discussing market segments it is useful to envision a supply chain model, or even the tier model discussed in Section. 4.1. What a company "does" identifies what segment they belong to, who they "sell to" identifies what market segment they serve. Using a turbine engine manufacture as an example, such a company would be classified in the "Aircraft Engines & Engine Parts" segment of Table 2, but they could serve both the "civil aviation" and the "defence aviation" market segments.

The intent of this section is to gain a sense of the market segments served by New Brunswick companies. The following categories were used to poll respondents:

- Commercial/Civil Aviation
- Space: Commercial/Civil
- Space: Military/Defence
- Defence: Aviation
- Defence: Land
- Defence: Marine
- Defence: C4ISR
- Defence: Weapons
- Security

5.10.1.1 Segments Served

When asked to identify which A&D market segments they serve[41], the Defence Land segment was the most frequent response received at 44% (n=16) of the participating companies. The Defence and Civil Aviation segments were cited by 36% (n=13 each) of companies. The third most frequent response was the Defence Marine segment, cited by 28% (n=10) of companies. The results are shown in Figure 16.

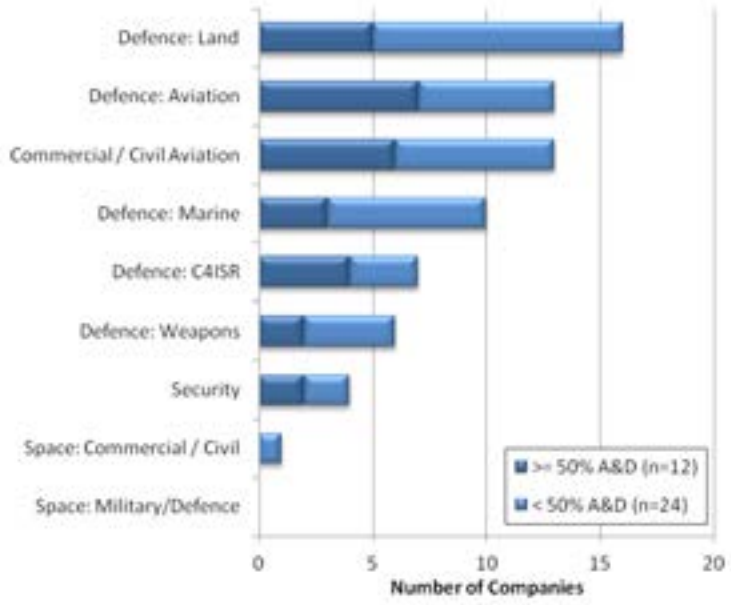


Figure 16: Aerospace and Defence Market Segments Currently Served (n=36)

It is critically important to recognize that these results simply identify the segments being served by NB companies and not the magnitude[42].

Table 11 provides greater insight into the markets served by New Brunswick companies based on their relative concentration in the A&D sector (i.e. those deriving 50% or more of their revenue from the sector, and those with less than 50%).

To help interpret the table, consider the first row "Defence: Land". It was the most frequently cited market segment served (23% of 70 citations). It was reported as being served by 44% of all companies in the sector, yet only cited by 42% of companies deriving more than 50% of their business from the sector.

[41] Companies can serve more than one segment, and therefore counts add to more than 36
[42] To illustrate by way of example: A company may derive 40% of its business from the A&D sector in three segments where segment 1 would represented 80% of their A&D business, segment 2 - 15%, and segment 3 - 5%. Figure 16 would simply capture that 3 segments were identified and which segments they were.

Table 11: Analysis of Segment Served by Active A&D Companies (n=36)

Segment	% of Segment Citations	% of Companies Serving		
		All Combined (n=36)	>= 50% A&D (n=12)	< 50% A&D (n=24)
Defence: Land	23%	44%	42%	46%
Defence: Aviation	19%	36%	58%	25%
Commercial/Civil Aviation	19%	36%	50%	29%
Defence: Marine	14%	28%	25%	29%
Defence: C4ISR	10%	19%	33%	13%
Defence: Weapons	9%	17%	17%	17%
Security	6%	11%	17%	8%
Space: Commercial/Civil	1%	3%	0%	4%
Space: Military/Defence	0%	0%	0%	0%

On average, companies deriving 50% or more of their revenue from the A&D sector reported supplying to 2.4 segments, compared to 1.7 segments for companies with less than 50% of their revenue derived from the sector.

Companies were also asked if they would be willing to share specific supply chain contracts that they were supporting. While many declined to answer, those that provided a response helped make responses to questions regarding market segments served more tangible. Some of the responses, in no particular order, included:

- Irving Shipbuilding (mid-life re-fit of frigates);
- Lockheed Martin (naval);
- Pump overhauls for Navy;
- CAE;
- Boeing;
- Huskie Helicopter;
- BJ Composites;
- IMP Aerospace;
- CanLink Aviation;
- Municipal Police Department;
- WestJet;
- United Airlines;
- Rolls Royce (naval); and
- DND (Department of National Defence).

5.10.1.2 Segments Pursuing

When companies already supplying to the sector were asked to identify which markets they are actively pursuing (in addition to those they are currently serving), the Defence Marine segment topped the list. This is not surprising given the pending start of the $25 billion Irving Shipbuilding contract[43] to build the next generation of combat ships. Rounding off the top three were the Defence Land, and the Defence Aviation segments. Figure 17 summarizes all of the segments identified.

[43] http://www.cbc.ca/news/canada/nova-scotia/story/2011/10/19/ns-shipbuilding-contract-reaction.html

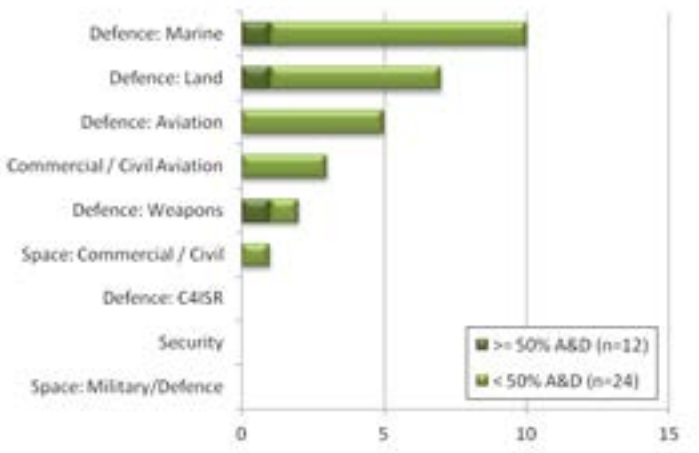


Figure 17: Aerospace and Defence Market Segments Currently being Pursued (n=36)

It is not surprising that companies with less than 50% of their revenue derived from the sector (< 50% A&D) have identified the majority of segments being pursued. This is likely because their more established counterparts had already penetrated selected segments.

To substantiate claims of pursuing market segments, companies were asked what kind of steps they were taking to support their pursuit. Responses varied, but in general companies proved they were being proactive in their approach. Responses include (paraphrased):

- Attending supply chain information sessions;
- Joining industry associations;
- Pursuing/upgrading certifications (i.e. ISO 9001, AS9100, Controlled Goods, etc.);
- Tasking sales representatives to pursue the sector;
- Applying for Approved Supplier status to Primes and Tier companies;
- Initiating discussions with Irving Shipbuilding;
- Trying to leverage previous work in shipbuilding;
- Leveraging local relationships to gain entry into the sector; and
- Working with government officials to help gain access to markets.

Companies pursuing the sector identified the segments shown in Figure 18 as those being actively pursued. The Defence Marine and Defence Land segments were most prominent, being cited by over 40% of the 14 companies.

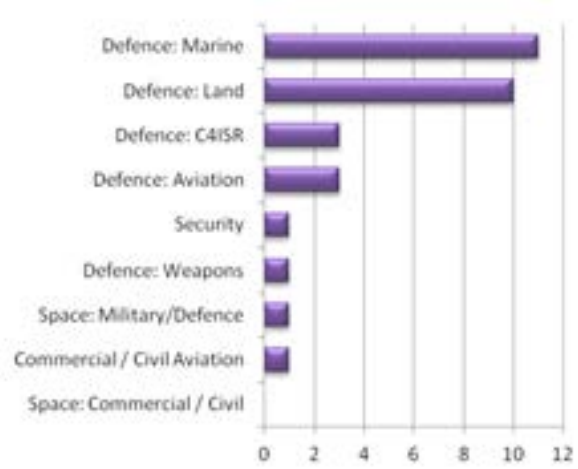


Figure 18: Segments Pursued by Companies Not Currently Supplying the Sector (n=14)

Similar to their participating counterparts, these companies have taken tangible steps to pursue the market segments. Examples include (paraphrased):

- Completed questionnaires;
- Attended shows/conferences/seminars;
- Gaining certifications (ex. ISO 9001, Controlled Goods);
- Completed vendor questionnaire for Irving Shipbuilding; and
- Participated in a regional group pursuing the sector.

5.10.2 Geographic Reach

Figure 19 shows the proportional allocation of A&D revenue[44] originating from defined geographic regions. The chart was created by combining data provided by willing survey respondents (n=30) plus source location assumptions for two of the larger A&D companies where data was not otherwise provided[45]. The chart therefore corresponds to n=32 companies which represents approximately 80% of A&D sector revenue. Unfortunately, data from one of the Province's largest A&D companies was not available, which could possibly skew the results.

[44] Based on the approach for estimating company revenue described in Section 5.7.
[45] Given the known nature and location of these companies, the assumptions are provided with a degree of confidence.

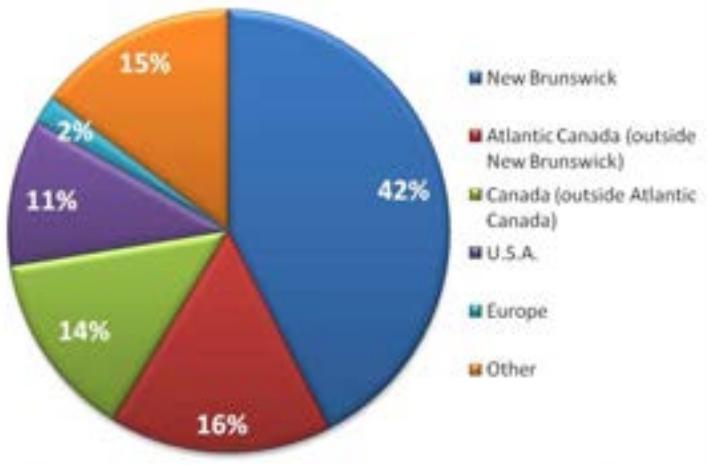


Figure 19: Source of Revenue by Geographic Region (n=32)

Most of the revenue (90%) originating from New Brunswick can be attributed to business from CFB Gagetown.

Approximately 28% of revenue was estimated to have been generated from international exports. Asia represented the greatest portion of the "Other" category, and was heavily skewed by one large company with significant revenue attributed to this region.

5.10.3 Outlook

When asked to characterize the opportunities for their company over the last two years, responses seemed to vary significantly depending upon the company's participation rate in the sector. A scale from one to nine was used, with one being extremely weak and nine being extremely strong, four being somewhat weak and six being somewhat strong. Participating companies with 50% or more of their revenue derived from the A&D sector collectively viewed the last two years as a six out of nine, or as "somewhat strong". Participating companies with less than 50% of their revenue derived from the sector collectively viewed the last two years more pessimistically as a four out of nine, or as "somewhat weak". However, companies not participating in but pursuing the sector had a negative perception of opportunities over the last two years, collectively averaging a three out of nine rating, or as "very weak". All results are shown in Figure 20.

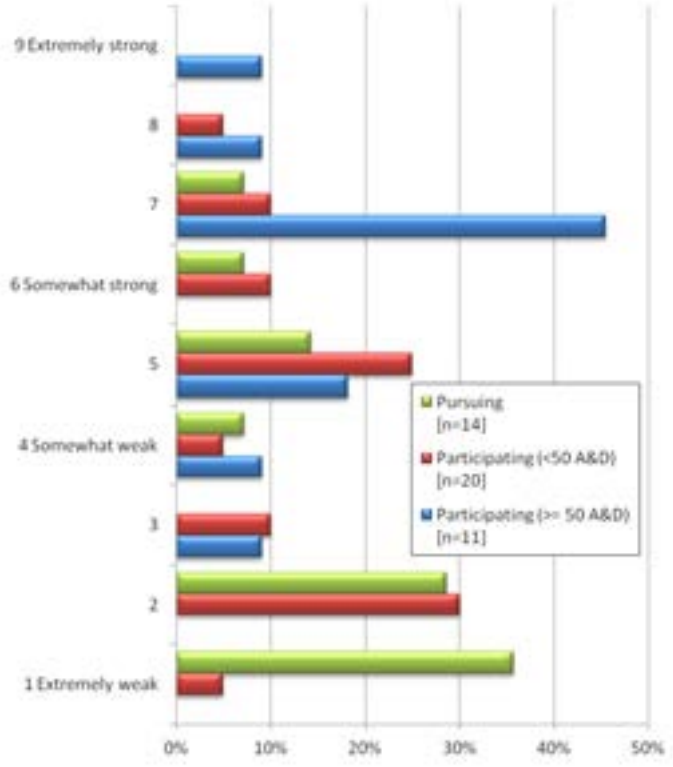


Figure 20: Perception of Sector Opportunities over Last Two Years (n=45)

When asked to characterize opportunities in the sector over the next two to five years, views were generally more aligned, and slightly more optimistic. Participating companies with 50% or more of their revenue derived from the sector collectively viewed opportunities in the future as a seven out of nine, or as "very strong". While there was a significant spread reported amongst participating companies with less than 50% of their revenue derived from the sector, they collectively aligned with companies pursuing the sector. Both groups rated future opportunities as a six out of nine, or as "somewhat strong". All results are shown in Figure 21.

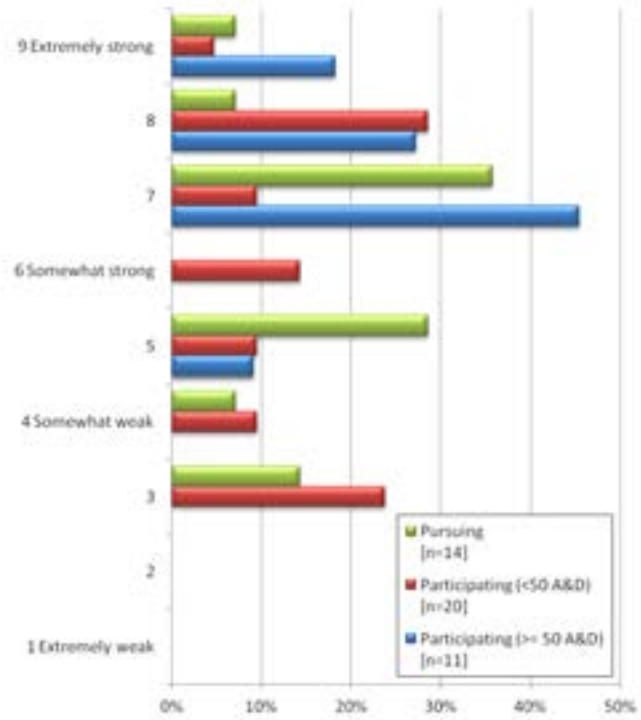


Figure 21: Perception of Sector Opportunities over Next Two to Five Years (n=45)

5.10.4 Market Barriers and Challenges

Two prominent themes emerged regarding market barriers and challenges, particularly from companies pursuing the sector and those relatively new to participating in the sector. The first challenge related to business development in the sector, and the second to certification.

Compared to many industries, certification requirements in the aerospace and defence sector can seem rather intimidating for some suppliers. The degree can vary depending upon the segment being pursued. Many new entrants to the sector viewed this as a challenge. In fact, certifications were referenced in over 30% of comments received regarding challenges. Security, Controlled Goods, and ISO9001 were the most commonly referenced by name. See Section 5.8 for more information on certifications.

Of the over 20 comments received regarding challenges, almost 40% related to business development. Lack of contacts and general lack of knowledge and understanding of the sector were the essence of the challenges reported. While most of these comments originate from new or potential entrants into the sector, it demonstrates some of the principal characteristic of the market: it can be complex, it is relationship-based, it is project/platform-based, and it requires long term consistent commitment. One active company, now with 50% or more of its business derived from the sector, summed it up best: they stated that it "… took a long time to get in (five years)", but "everything is taking off this year".

Other business development challenges cited included that the process "is too political" or it "takes too long". Companies expecting to simply hand out business cards

and brochures and obtain work will surely be disappointed. However, there is evidence to suggest that many companies have not adopted this attitude. For example, a recent entrant into the sector recognized that: "… we needed a management system first (ISO 9001), then the tools (CWB welding capabilities), then needed to know where we were going and what we were doing before jumping in."

Challenges relating to human resources are discussed in Section 6.

5.11 Infrastructure

New Brunswick has excellent infrastructure in place to support the aerospace and defence sector. Of primary significance are CFB Gagetown, airports, and seaports infrastructure. This focus is not intended to diminish the excellent infrastructure components such as roadway, railways, and telecommunications, but rather highlight what is uniquely important to the A&D sector.

5.11.1 CFB Gagetown

CFB Gagetown is the second largest military base in Canada and the largest military facility in Eastern Canada[46]. The Base directly employs approximately 4,900 people (approximately 3,800 regular military, 342 reservists, and 780 civilian workers). It has a direct local spending impact of approximately $256 million.[47]

The primary functions of CFB Gagetown are to provide:

- Training for both Canadian and U.S. Forces;
- Army individual training; and
- Administration and logistical support for all units in New Brunswick and Prince Edward Island.

Operational and support Units located on the base include:

- 2nd Battalion, The Royal Canadian Regiment;
- 4th Air Defence Regiment;
- Land Force Atlantic Training Centre;
- 403 Helicopter Operational Training Squadron;
- 4 Engineer Support Regiment;
- Land Force Trials and Evaluation Unit;
- 3 Area Support Group Signal Squadron;
- Armour School;
- Artillery School;
- Canadian Forces School of Military Engineering;
- Infantry School;
- Tactics School;
- Atlantic Cadet Support Training Centre; and
- Canadian Forces Recruiting Centre Atlantic.

[46] http://www.army.forces.gc.ca/cfb_gagetown/home-accueil-eng.asp, Updated 2012-10-09
[47] http://www.forces.gc.ca/site/pri/first-premier/bases/gagetown-eng.asp#content, Updated 2012-01-13.

5.11.2 Airports

A number of airports are in operation throughout the Province, including three international airports:

- Greater Moncton International Airport;
- Fredericton International Airport; and
- Saint John Airport.

Collectively these three airports generate in excess of $370 million in revenue from operations, and directly employ over 1,000 people[48]. Unique to the A&D sector, the Fredericton Airport has development plans in place for an Aerospace and Defence Park[49].

Also worthy of mention is the 10,000 foot runway at the Miramichi Airport capable of landing practically any aircraft[50].

5.11.3 Seaports

Being a coastal Province, New Brunswick is gifted with ample coastal access and five ports that permit inexpensive and convenient shipping of raw materials and finished goods to the United States, Europe, and beyond. Seaports are located in:

- Dalhousie;
- Belledune;
- Miramichi;
- Saint John; and
- St. Andrews/Bayside.

In addition to the seaport, the Province is home to the NB Naval Center[51] - a three-building complex dedicated to naval construction, repair and manufacturing. It is located in the Bas-Caraquet industrial park, in Northern New Brunswick. The two boatyards and equipment are available for rent.

[48] Roughly estimated from economic impact data reported in various publications including: http://www.saintjohnairport.com/assets/Uploads/Fast-Facts.pdf, http://74.209.241.69/index/todaynews_0529b, http://lanemacintosh.com/uploads//Website_Assets/FIAA-2011-GLEANER_INSERT.pdf

[49] http://www.frederictonairport.ca/en/yfc-info/aerospace-and-defence-park

[50] "Newly-extended runway at Miramichi Airport now open for cargo service", Government of New Brunswick press release, 19 October 2012

[51] http://www.nbnaval.ca/

5.11.4 Research and Development

New Brunswick's A&D sector is supported by R&D infrastructure at all levels of government, academia and the private sector. Combined with one of the lowest after-tax R&D costs in the world, this creates an ideal environment for A&D companies wishing to conduct R&D in New Brunswick.

Academia:

University of New Brunswick (UNB) hosts over 800 faculty and research staff with strong links to government laboratories, the community, the private sector, and more than sixty international institutions. UNB researchers are spread over 13 facilities in two campuses (Fredericton and Saint John). Over 75 per cent of the federally-funded research in the Province is conducted by UNB where millions of dollars of research is conducted each year. A&D areas of research include, but are not limited to: unmanned aerial vehicles, computational fluid dynamics for the Navy, composite materials for the CF-18, and high speed impact testing for NASA.

L'Université de Moncton (UdeM) is Canada's largest French language university outside Québec, with campuses located in Moncton, Edmundston, and Shippagan. Fields of expertise include: mechanical, electrical, civil and industrial engineering, physics, photonics, composite materials, ergonomy, mathematics and statistics, chemistry and biochemistry, biology, energy conservation, environmental sciences, information technology, translation, distance education (e-learning), and information management.

New Brunswick Community College (NBCC) / Collège communautaire du Nouveau-Brunswick (CCNB) are separate provincial Crown Corporations, each directed by a board of governors and headed by a President and CEO. NBCC and CCNB together offer more than 80 programs, as well as apprenticeship and continuing education opportunities. In 2012, both organizations were eligible to support research under the Natural Sciences and Engineering Research Council of Canada (NSERC) College and Community Innovation (CCI) program.

Governments Institutes:

National Research Council Institute for Information Technology (NRC-IIT) is situated on the campus of the University of New Brunswick (UNB). The Institute's research areas include: 3D Imaging, Modeling and Visualization; Interactive Information; Knowledge Discovery; Natural Language Processing; Human Computer Interaction; Intelligent Internet Applications; and Learning & Collaborative Technologies. The business accelerator offers companies state-of-the-art technical facilities and the chance to interact with NRC researchers.

Research and Productivity Council (RPC) in Fredericton is an independent contract R&D and technical services organization located in Fredericton, NB. RPC's complement of 100 scientists, engineers and technologists are supported by a 13,000 sq. meter facility housing world-class analytical chemistry and material-testing laboratories, extensive prototype design, manufacture and testing services and a wide variety of pilot facilities for the development and improvement of industrial processes and products.

6 Human Resources Profile

6.1 Workforce Composition

Many of the companies interviewed experienced significant fluctuations in employment levels throughout the year, based on projects. It should be kept in mind, therefore, that company reporting of average employment data in many cases involved estimation. In addition, the stating of the percentage of time spent by each occupational group involved educated estimations by the employers. As a result, this workforce data is presented as approximations and estimations[52].

6.1.1 Core Occupational Groups within the Sector

The 60 occupations core to the A&D sector have been grouped according to:

- Engineers;
- Technicians/Technologists;
- Supervisors;
- Trades;
- Machine Operators;
- Instructors/Instructional Designers; and
- Information System Developers.

Based on the above groupings, participating companies were asked to report average full-time equivalents (FTE) of employees working for the company/NB business unit during their last fiscal year.

In the case of the four companies that provided only partial data (number of employees / what percentage of their work is for A&D), this input was used to approximate their contribution to FTE employment, but without a breakdown into occupational groupings.

6.1.2 Workforce Composition of Companies Preparing to Enter the Sector

Table 12 summarizes the findings of the workforce composition of companies yet to enter, but actively pursuing the sector. The employment levels of these companies are noteworthy, and indicate significant potential.

Table 12: Workforce Composition of Companies Not Yet Participating in Sector (n=14)

Occupational Categories	# of Employees
Engineers	30
Technicians/Technologists	245
Supervisors	54
Trades	192
Machine Operators	71
Instructors/Instructional Designers	14
Information System Developers	103
Total Core Occupations	**709**
Total Other Occupations (Admin, Sales, etc.)	414
Total from all Occupations	**1123**

[52] The data should be considered as sufficiently reliable for the purposes of this study.

When compared to the employment levels of those companies active in the aerospace and defence sector (see Table 13), there are significant differences in every occupational grouping except Engineers. This is due to some large information and communications technology (ICT) companies working towards entering the sector. Their employee counts skew the numbers toward a greater number of ICT roles.

6.1.3 New Brunswick A&D Sector Workforce Composition

Table 13 presents a breakdown of the composition of the workforce of companies currently participating in the A&D sector.

Table 13: NB Aerospace and Defence Workforce Composition

Occupational Categories (Companies n=32)	Total # of Employees	Estimated A&D FTE Employment
Engineers	35	9
Technicians/Technologists	112	30
Supervisors	115	33
Trades	510	135
Machine Operators	291	128
Instructors/Instructional Designers[53]	107	107
Information System Developers	48	29
Total Core Occupations	**1218**	**471**
Total Other Occupations (Admin, Sales, etc.)	296	81
Total from all Occupations	**1514**	**551**
Percentage of Core Occupations out of Total Occupations[54]	80%	85%
Other Participating Companies (n=4)	**Total # of Employees**	**Estimated A&D FTE Employment**
Employee count	342	173
Totals for A&D Participating Companies (n=36)	**1856**	**724**

The primary research determined that the companies in this sector that provided employment counts (n=36) retain approximately 1856 total staff.

Of the 1514 employees reported by the 32 companies that gave detailed information, approximately 80% work in the core occupations that are the focus of this study. These companies provide an estimated 551 FTE jobs in aerospace and defence, 471 of which are in the core occupations within the sector. Taking into account the employees of the four companies that provided only high-level data, there are an estimated 724 FTE jobs allocated to the A&D sector (n=36).

[53] It should be noted that some training development companies utilize Interactive Media Developers (NOC 2174) that also have skills in instructional design for e-learning development. These have been classified under the Information System Developers group.
[54] The percentage of total core occupations and the percentage of core full-time equivalents are not identical, as each employer's reporting of percentage of time spent on aerospace and defence work varied between occupational categories.

Figure 22 represents the breakdown of A&D FTE employment by job category. Eighty-five per cent of the total A&D FTE jobs are in the core occupations chosen for the focus of this study.

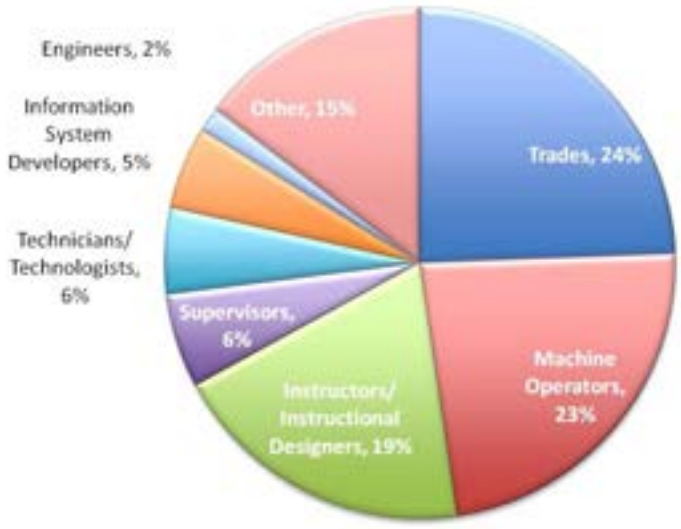


Figure 22: Breakdown of A&D FTE Employment by Occupational Category (n=32)

Manufacturing staff (trades, machine operators and supervisors) make up just over half (53%) of the total. This is not surprising in the New Brunswick A&D sector where the majority of the participating companies are production-driven.

Relatively few engineers are engaged in the NB A&D sector (2%), when compared to the Canada-wide aerospace industry (22.1%). See Figure 23. This is explained in part by the fact that companies supplying within the lower tiers of supply chains most often are provided with engineered specifications, rather than needing to develop them.

The New Brunswick aerospace and defence sector has a significant Advanced Learning Technologies (ALT) component, as evident from the significant percentage of instructional designers engaged in the sector.

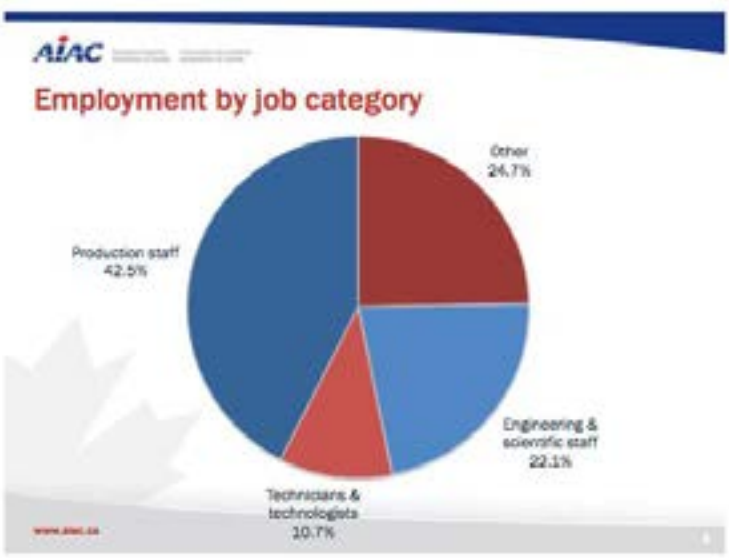


Figure 23: Canadian Aerospace Employment by Job Category[55]

Out of the 60 core occupations (NOCs) chosen as the focus for this study (see Section 4.2.3), companies reported having employees in 49 of these vocations. Figure 24 provides a breakdown of the numbers of A&D FTE employment in these 49 occupations.

The top ten core occupations in the New Brunswick aerospace and defence sector by size are:

1. Metalworking Machine Operators (NOC 9514);
2. Instructional Designers (4131);
3. Machinists (7231);
4. Flying Instructors (2271);
5. Supervisors[56];
6. Aircraft Mechanics (7315);
7. Welders (7265);
8. Plate-work Fabricators and Fitters (7263);
9. Electronics Assemblers, Fabricators, Inspectors (9483); and
10. Other Labourers in Manufacturing (9619).

These ten occupations, representing 20% of the 49 core A&D occupations, comprise over 80% (387) of the total FTE core occupation employment in the sector (470)[57].

[55] http://aiac.ca/uploadedFiles/Canadas_Aerospace_Industry/Industry_Statistics/2011%20Statistics%20-%20State%20of%20the%20Canadian%20Aerospace%20Industry.pdf

[56] Data was collected on Supervisors from various functional areas and disciplines.

[57] "Other Technicians and Technologists" and "Other Information System Developers" shown in Figure 24 represent employees that fell into these occupational categories, but were not among the specific 60 occupations within scope of the study definition (See Section 4.2.3).

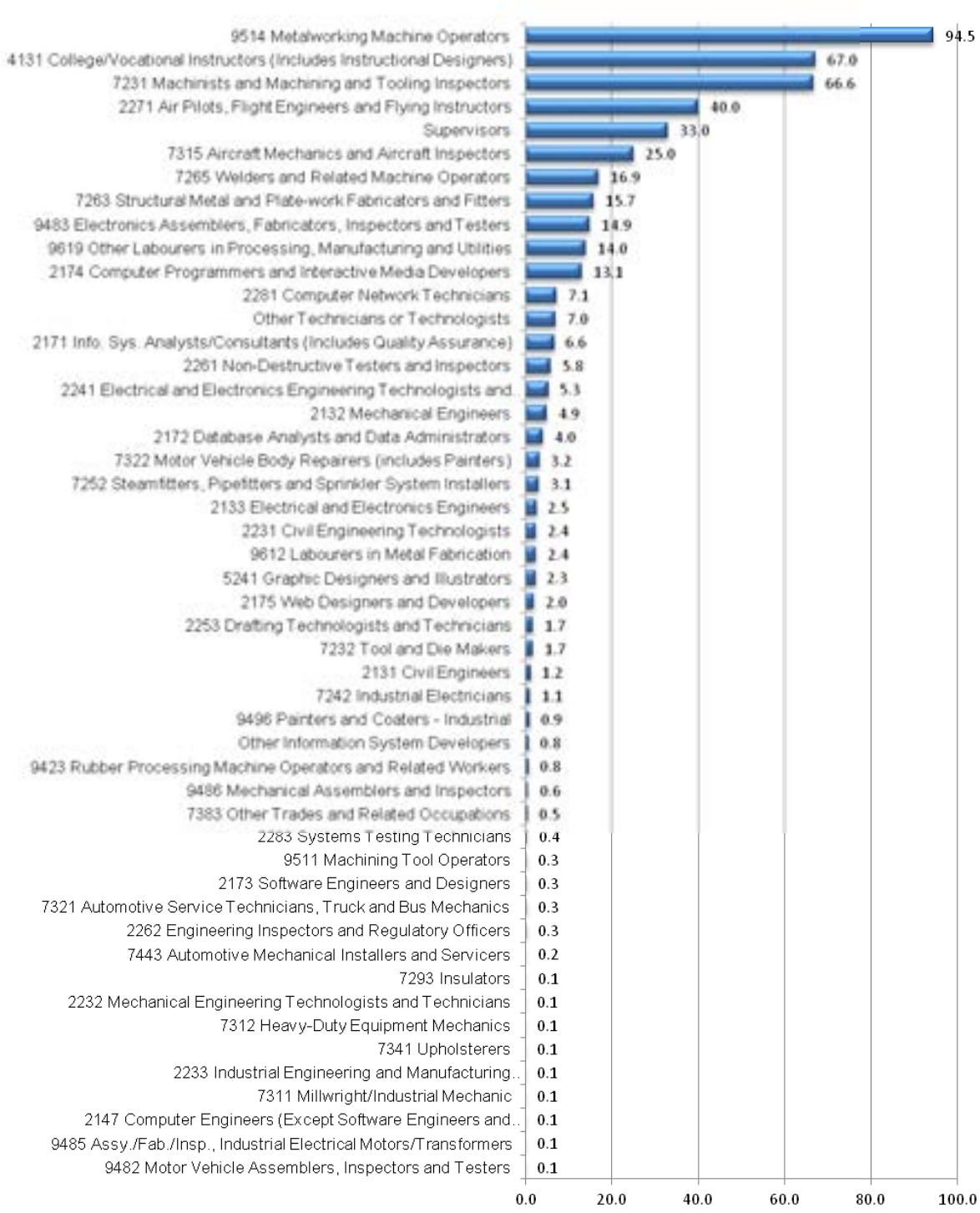


Figure 24: A&D FTE Employment by Occupation (n=32)

6.1.4 A&D Sector's Share of NB Total Employment of Core Occupations

The majority of the 49 core A&D occupations with New Brunswick employees represent a very small percentage of the NB total employment for these occupations. Of the 49 occupations represented in the A&D sector:

- 40 (82%) encompass less than 5% of the NB total employment in each occupation;
- 35 (71%) encompass less than 2%; and
- 33 (67%) encompass less than 1%.

However, certain aerospace and defence sector core occupations represent a significant share of total employment for those occupations across all industries in New Brunswick. Table 14 presents six of these occupations.

Table 14: A&D Occupations Representing a Significant Percentage of NB Total Employment

Occupation	NB A&D FTE Employment	Total Estimated NB Employment for Occupation[58]	A&D Estimated % of Total NB Employment for Occupation
9514 Metalworking Machine Operators	95	130	73%
2271 Air Pilots, Flying Instructors	40	60	67%
7315 Aircraft Mechanics and Aircraft Inspectors	25	113	22%
9483 Electronics Assemblers, Inspectors	15	95	16%
7231 Machinists and Machining and Tooling Inspectors	67	596	11%
7263 Plate-work Fitters/Fabrication	16	213	8%

The A&D sector workforce is currently a small portion of the New Brunswick labour market. It should be kept in mind, however, that if there is major growth in the sector, the human resources profile, including workforce composition, wages and demographics, could shift significantly, depending on which segments within the sector grow.

6.1.5 The Use of Contractors in the NB A&D Sector

Companies (n=32) were polled about their use of contractors in the sector. Specifically they were asked to report which occupations, if any, were contracted out and what the annual FTE head count would represent. The companies' previous responses to the percentage of time spent by the various occupational groups under their employ for work within the A&D sector were utilized to estimate FTE A&D employment for contractors. This data is useful in gaining a more complete picture of total employment generated by the A&D sector. Table 15 presents the FTEs for contractors[59] utilized by New Brunswick aerospace and defence sector companies.

[58] Stokes Occupational Forecast Estimates (SOFE), Winter 2012, Provided by LMAB
[59] Typically self-employed

Table 15: NB A&D Companies' Use of Contractors

Occupational Categories (Companies n=32)	Total FTE for Contractors Utilized	Estimated FTE for Contractors Utilized for A&D Work
Engineers	6	1
Technicians/Technologists	9	2
Trades	11	1
Machine Operators	2	0
Instructors/Instructional Designers	3	1
Information System Developers	13	10
Totals	**44**	**15**

Table 16 shows the revised totals for the sector's workforce composition, including employees and individuals contracted by A&D sector companies.

Table 16: Total NB A&D Sector Workforce Composition, Including Contractors

Occupational Categories (Companies n=32)	Total FTEs, Including Contractors	Estimated FTE for A&D Work, Including Contractors
Engineers	41	10
Technicians/Technologists	121	32
Supervisors	115	33
Trades	521	135
Machine Operators	293	129
Instructors/Instructional Designers	110	108
Information System Developers	61	39
Total Core Occupations	**1262**	**486**
Total Other Occupations (Admin, Sales, etc.)	296	81
Total from all Occupations	**1558**	**567**
Other Participating Companies (n=4)		**Estimated A&D FTE**
Employee count	342	173
Totals Including Contractors (Companies n=36)	**1900**	**739**

With contractors included, the total number of FTE employees (n=36) is 1900. The revised estimation for FTE employment attributable to the New Brunswick aerospace and defence sector is 739.

6.2 Human Resources Practices

6.2.1 Human Resources - Dedicated Staff

Each company (n=47[60]) was asked: Does your company have a human resources person or department that helps manage this part of your business? The answers were categorized into 3 practices:

[60] Companies not yet participating in the sector are included in this portion of the report's data.

- No dedicated HR staff;
- One full-time or a part-time dedicated HR staff person; or
- An HR department with two or more staff.

Forty-seven companies answered this question, including 33 companies active in the sector and 14 companies pursuing the sector, but not yet supplying the sector. The breakdown for all forty-seven companies is given in Table 17.

Table 17: Dedicated HR Staff (n=47)

HR	% of Companies	Average Employee Count	Largest # of Employees
No dedicated HR staff	40% (n=19)	15	52
One or part-time HR person	30% (n=14)	63	140
HR dept. with 2 or more staff	30% (n=14)	118	400

The ratios are similar when considering active A&D companies only (n=33): no dedicated HR staff (42%); one or a part-time (30%) HR person; HR department with two or more staff (27%).

As expected, there is a correlation between the size of the company and the number of human resources dedicated to HR functions. On average, the larger the number of employees, the greater is the likelihood that the company will dedicate resources to HR. Ninety-four per cent of companies with over 50 employees have resources dedicated in full or in part to HR, as compared to 38% of companies with 49 or less employees. The smallest company headquartered in New Brunswick to have an HR department with two or more staff had 30 employees.

6.2.2 Human Resources Plan

When asked about human resources plans that address labour force planning, recruitment, training, performance management, and exit interviews, 46 companies responded:

- 41% (n=19) had no HR plan in place;
- 20% (n=9) had a partial HR plan in place; and
- 39% (n=18) had a comprehensive HR plan in place.

The size of the company, again, seems to bear a correlation to whether or not the development of an HR plan has taken place. Eighty-four per cent of companies with over 50 employees have either a partial or comprehensive HR plan, while 42% of companies with 49 or less employees have some type of HR plan in place. Of the companies with 25 or less employees, the percentage of those having HR plans, whether partial or comprehensive, drops to 28%.

6.2.3 Succession Planning

When questioned regarding succession planning for the ownership and / or management of the company, 38% (n=18) indicated that they had a formal plan in place, while 26% (n=12) indicated they did not have a formal plan, but were mentoring employees for management roles. The remaining 36% (n=17) did not have a plan, or declined to say.

Although some correlation can be drawn between size of company and the likelihood that succession planning has taken place, it is clearly not the only factor. Fifty-five per cent of the companies that had a formal succession plan in place had 25 or less employees. Conversely, 33% of the companies that had no plan in place at all had over 50 employees. Anecdotally, other factors influencing succession planning, which came out during the interviews, were family ownership, and the age of senior management. In addition, two companies mentioned that they had put a succession plan in place, because it was either required or desirable for companies who wished to enter certain aerospace supply chains, where stability in supply partners is sought after.

6.2.4 Recruitment Methods

The companies were asked: What method(s) does your company use to find employees to fill vacant positions? Most use multiple methods to find new employees. Forty-five companies responded. Of those:

- 60% find new employees by word of mouth, resumes on file, or other informal means;
- 49% use specialized third-party websites, such as Career Beacon and Monster.com;
- 33% advertise in newspapers;
- 20% advertise new positions on their own company website;
- 18% use professional recruiters;
- 18% utilize government job bank database and referrals;
- 2% use trade journals or trade-specific websites;
- 2% contact student employment centres; and
- 2% utilize foreign worker recruitment processes.

Other methods that were mentioned include:

- 18% have built strong relationships with local colleges, universities, and even high schools. Some companies are showing great initiative in this regard, for example, encouraging job fairs and co-op programs with high schools, and offering bursary contests leading to job placement among colleges;
- 7% use social media. LinkedIn and resumes through Facebook were both mentioned; and
- 4% have hired full-time recruiters on staff while another 2% are considering the same.

6.3 Unionization

Only one of the 33 active A&D companies responding to this question indicated that they have unionized workers on staff. This company's employees represent approximately 8% of the human resources of companies currently active in the sector. Only a portion of this company's employees is unionized. Although we do not have the breakdown of how many of this company's employees are unionized, it is apparent

that unionization within the sector is currently well below the provincial average of 29%[61].

Canada-wide, the Canadian Auto Workers union (CAW) states the unionization rate within aerospace to be 50%. The majority (61%) of CAW's members within aerospace are employed by three Primes: Bombardier, Pratt & Whitney and Boeing.[62]

CAW also represents workers in shipbuilding, including the Halifax shipyard. However, it is not evident that unionization is required throughout the defence marine systems supply chain in the same way that we observe in large industrial construction projects. It is, therefore, doubtful that the entry of New Brunswick companies into supporting roles in the shipyard's defence contracts will, in itself, change the level of labour organization within the New Brunswick sector.

It is impossible to predict to what extent unionization rates may change as the sector grows in New Brunswick. If large Primes, especially within aerospace, are drawn to the Province, this profile may change. Similar to defence shipbuilding, however, it is not apparent that unionization is required by Primes within their supply chains. Thus, external constraints are unlikely to change the level of labour organization.

6.4 Wages

Enquiry was made into the average wage that could be expected within each company participating in the sector (n=32) for the following occupations:

- Engineer
- Technician
- Technologist
- Welder
- Machinist
- Industrial Electrician
- Instructional Designer
- Programmer
- Mechanic

Table 18 presents these findings.

Table 18: Average Wages Reported for Representative Occupations

	Lowest Reported (from Survey)	Highest Reported (from Survey)	Average Reported (from Survey)	NB Average[63]
Engineer (n=12)	$46,355	$197,000	**$80,363**	$58,103

[61] Source: HRSDC calculations based on Statistics Canada. Labour Force Survey estimates (LFS), employees by union coverage, North American Industry Classification System (NAICS), sex and age group, annual (CANSIM Table 282-0078). Ottawa: Statistics Canada, 2012.
[62] http://www.caw.ca/assets/pdf/582-Aerospace.pdf
[63] workingincanada.gc.ca

Technician (n=8)	$25,000	$80,000	**$46,302**	$34,607
Technologist (n=17)	$33,376	$114,000	**$52,986**	$34,607
Welder (n=11)	$25,032	$70,000	**$42,831**	$29,667
Machinist (n=12)	$30,594	$55,000	**$42,548**	$40,495
Industrial Electrician (n=5)	$30,000	$114,000	**$47,700**	$44,964
Instructional Designer (n=3)	$45,000	$65,000	**$48,687**	$46,355
Programmer (n=4)	$39,865	$80,000	**$49,966**	$52,400
Mechanic (n=5)	$39,865	$50,063	**$42,673**	$33,376

As there was a large variance in occupation types, some employers reported in yearly salary, and some in hourly wage. The data has been calculated to present all wages as yearly income. The hourly to yearly income conversions were based on the following calculations:[64]

- 254 working days in 2012 in NB
- 36.6 hour average work week in NB, 2011
- 7.3 hours per average workday in NB
- Equals 1854.2 working hours per year

Sample sizes reported are very small, and therefore, the results may be unduly influenced by extreme high or low values. This makes drawing any conclusions from the data difficult (such as determining any wage trends as compared to other sectors employing the same occupations). However, as the majority of companies operating within the sector were canvassed, the wages, as reported, give a rough approximation of the current state of remuneration within the sector. In general, wages for the occupations sampled within the sector appear to be above the provincial averages.

Reasons for some of the very high wages reported include:

- A combined role of engineer and executive within a corporation;
- Occupations where there appears to be a small labour pool, especially for the most experienced workers;[65] and
- Companies that must draw highly skilled tradespersons to rural or small urban regions, which the potential employees may perceive as places with less opportunities for working spouses or family.

6.5 Demographics

6.5.1 Age of A&D Sector Workforce

Figure 25 shows the age profile of the total workforce (including both core and non-core occupations) of companies participating in the A&D sector (n=32) against the provincial average.

[64] http://www.workingdays.ca

[65] For example, one training development company mentioned that they no longer seek Instructional Designers within the Province, due to a finite, limited labour pool that has driven wages up. They are able to find individuals to work remotely who are more highly experienced and available for lower wages in other parts of Canada.

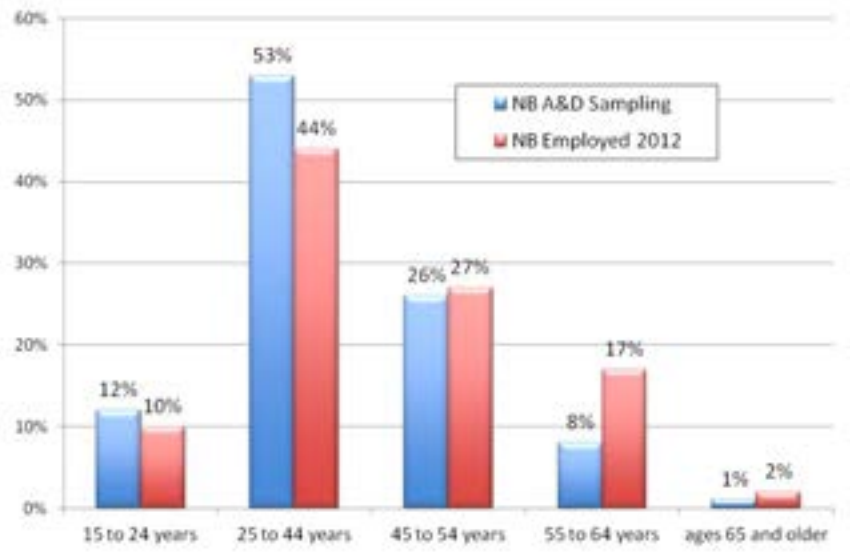


Figure 25: Age Profile Comparison of A&D Workforce to Provincial Average[66]

Just over half of the sector employees were 25 to 44 years of age. The workforce aged 45 to 54 was the second largest group (26%), followed by those aged 24 and under (12%).

The aerospace and defence sector workforce is younger than the provincial average. Ninety-one per cent of the A&D workforce is between 15 and 54 years of age, in comparison to the provincial average of 81%. While retirements within the aerospace sector Canada-wide, and in Atlantic Canada in particular[67], has been identified as an issue over the next several years, the data suggests that, currently, it is not as big an issue within the A&D sector in New Brunswick.

6.5.2 Gender

Among all companies currently active in the sector, the average percentage of female employees was 12%. This is well below the provincial average of 46% across all industries. The New Brunswick A&D sector, on average, shows a strong gender-bias.

There were some notable exceptions. The Electronic/Electrical Product Research, Design, Fabrication, or Assembly segment workforce averaged 53% females, with the largest of the companies in the segment (75 employees) reporting 65% females. The Training Content and System Development segment averaged 43% females.

[66] Source: Statistics Canada. Table 282-0002 - Labour Force Survey estimates (LFS), by sex and detailed age group, annual (persons unless otherwise noted).
[67] "The demographic tsunami will hit Atlantic Canada first," by David Campbell, The Globe and Mail, November 8, 2011.

6.5.3 Permanent Residents[68] and Temporary Workers

Twenty-five percent of the 32 active A&D companies that provided detailed data reported having permanent residents on staff. A total of 39 permanent resident workers were reported. This represents 2.6% of the total workforce reported, compared to a provincial rate of 3.8% across the workforce of all industries.[69]

As the sector grows in New Brunswick, the percentage of permanent residents working in the sector may grow as well. One company mentioned that they expect to recruit internationally for some of the specialized experience they will need to be competitive in the sector. In addition, it is likely that International firms locating within the Province will bring some specialized staff with them.

Two companies (6%) of the 32 respondents stated that they have temporary foreign workers currently on staff. A total of four temporary foreign workers (0.3%) were reported. As larger influxes and exits of temporary foreign workers usually comes with substantive short-falls in the labour force due to large projects, especially in highly mobile workforces such as in construction, it is unlikely that these employment rates for temporary foreign workers will oscillate greatly as the companies in the sector grow systemically. It is expected that foreign companies that establish a presence in New Brunswick will have foreign workers on staff during start-up. It is also expected that some companies will utilize temporary foreign workers to gain expertise quickly that is scarce within the Province.

Over the past five years, three employers reported the hiring of seven temporary foreign workers. Fifteen of the 32 responding employers hired a total of 52 permanent residents in the same time period.

6.6 Staffing and Hiring Issues

Respondents (n=46) were asked about their reasons for hiring of staff over the past five years: 65% of hires were due to organic growth, 35% were replacements for employees who were terminated or quit, and only 1% was for replacement of workers who retired.

[68] The term "permanent resident" has replaced "landed immigrant" to reference a person who is not a Canadian citizen but who has been granted permission to live and work in Canada without any time limit on his or her stay. en.wikipedia.org

[69] Statistics Canada. Table 282-0102 - Labour Force Survey estimates (LFS), by immigrant status, age group, Canada, regions, provinces and Montreal, Toronto, Vancouver census metropolitan areas, annual (persons unless otherwise noted)

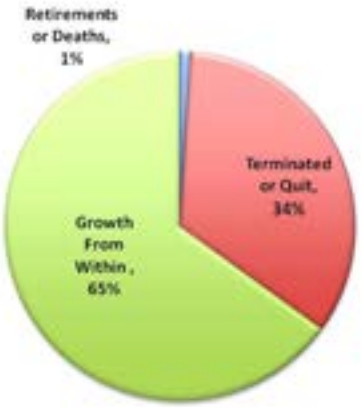


Figure 26: Reasons for Hiring over Last Five Years

6.7 Hiring Plans

6.7.1 Strategic Announcements

At time of writing, Economic Development, Invest NB and the Office of the Premier had recently announced that two new aerospace and defence companies will be establishing a presence in New Brunswick.

1. **FFG Canada**, an international joint-venture company between Industrial Rubber Company Ltd., and German defence firm FFG Flensburger Fahrzeugbau Gesellschaft mbH (FFG), will create 26 new jobs in Bathurst. The company will begin its operations with the $135-million contract awarded to the German defence firm to supply 13 WISENT 2 Armoured Engineer Vehicles (AEV) to the Department of Defence through the conversion of Leopard 2 main battle tanks into armoured engineer vehicles. The Province is investing $1.2 million in payroll rebates and a conditional contribution with the expectation that the venture will contribute $2.6 million annually to the province's gross domestic product once all the jobs have been filled. [70]

2. **"Cormer Defense**, part of Cormer Group Industries, will expand operations into a new facility located in Miramichi. The venture is purported to create 80 jobs. As part of a 10-year agreement with the company, the provincial government will provide financial support of up to $5.2 million through conditional contributions, forgivable loans and payroll rebates. The investment is anticipated to contribute up to $73 million over 10 years to New Brunswick's gross domestic product once all 80 jobs have been filled. Cormer provides integration of all sub-contracting processes, with expertise in precision high-speed machining, integration, assembly, and driver train repair and overhaul for the Canadian Armed Forces."[71]

[70] Government of New Brunswick News Release, 18 July 2012, http://www2.gnb.ca/content/gnb/en/news/news_release.2012.07.0659.html, and information from Invest NB staff.
[71] Government of New Brunswick News Release, 25 January 2013, http://www2.gnb.ca/content/gnb/en/news/news_release.2013.01.0061.html .

At time of writing, neither company was able to provide additional detail regarding future human resource needs and plans[72]. Any potential new jobs arising from these two companies have not been included with the projections provided by other companies interviewed during the primary research of this study.

6.7.2 Current Vacancies

Twenty companies (n=20) responded to questions on current vacancies relating to their work within the aerospace and defence sector. The responses were varied. In a few instances, companies have either been looking to fill a position for quite some time, or they were not actively looking but would hire someone to fill a position if the right person came along. In these cases, the employers did not give specific numbers for those occupations. These cases have been marked "Open Call". A summary of responses is shown in Table 19.

Table 19: Current Vacancies

Occupations	Vacancies
Electrical/Electronics Technology:	**4**
Electronics Technologist	1
Electrical Mechanical Service Technician (experienced)	1
Power Electrician	2
Information, Computers, and Training:	**26+**
User Support Technician	1
Information Systems Testing Technician	1
Learning Management Administrator	1
Instructional Designer	1
Project Managers	21
Chief Security Officer (executive position)	1
Technical Writers	Open Call
Solutions Software Architect	Open Call
Computer Programmers	Open Call
Metalworking:	**22+**
Steel Fabricator/Fitter	1
CNC Programmer/Setup (only)	1
Industrial Painter (not automotive – different skills)	1
Supervisor	1
Millwrights	4
Machinists (CNC/Traditional) – majority CNC	14
Welders	Open Call
Pipe Fitters	Open Call
Sales:	**3**
Sales	1
Senior Sales	1
Senior VP, Sales (executive position)	1
Aerospace Maintenance, Repair and Overhaud (MRO):	**2**
Aircraft Maintenance Engineers	2
Total	**57+**

[72] Both companies were contacted, but no new information was provided.

Machinists, especially CNC Machinists, were reported to be in demand. In particular, the requirements for tight tolerances and large part volume in the aerospace subsector required CNC capability for companies to be competitive.

Project Managers were also in demand; a single company reported 20 of the 21 vacancies.

Even though they were not included as one of the A&D occupations for this study, the sales positions have been included because during the interviews, companies expressed that they had a need for sales people with established contacts in order to break into the sector.

6.7.3 Hiring Projections for the Next Two to Five years

Table 20 shows two-year hiring projections for occupations selected to represent a cross-section of job roles for the various A&D sector segments. For comparison, the table includes, for each occupation, current A&D FTE employment as well as two-year Stokes Occupational Forecast Estimates (SOFE) employment net-hire projections.

The 11 occupations shown in Table 20 will form the focus for the consideration of educational capacity in Section 7.

Two major factors should be kept in mind regarding SOFE projections shown in Table 20:

1. The SOFE projections look at the occupations listed across all industry sectors in NB, not just the A&D sector; and
2. Because of this, the SOFE projections are expressed as net-hires, whereby one industry may contract in a given occupation while another industry may expand.

Table 20: Two-Year Hiring Projections

Occupation	A&D Companies (n=32)					All Companies (n=46)			SOFE 2-yr Hiring
	Total Employment	Total 2-yr Hiring	% Increase	A&D FTE Employment	A&D FTE 2-yr Hiring	Total Employment	2-yr Hiring	% Increase	
CNC Machinists/ Machinists (7231)	186	49	26%	67	18	229	60	26%	47 to 63
Flight Instructors (2271)	40	49	123%	40	49	40	49	123%	2 to 4
Technologists/ Technicians (all types)	112	45	40%	30	12	357	76	21%	148 to 216
Welders (7265)	102	45	44%	17	8	183	53	29%	94 to 114
Steel Fabricators/ Fitters (7263)	97	39	40%	16	6	130	48	37%	11 to 19
Mechanics (7312, 7315, 7321, 7443)	39	35	90%	26	23	39	35	90%	308 to 376

Instructional Designers (4131)	67	33	49%	67	33	81	38	47%	151 to 177
Programmers/ Media Designers (2174)	21	30	143%	13	19	56	45	80%	23 to 27
Engineers (all types)	35	17	49%	9	4	65	35	54%	146 to 200
Industrial Electricians (7242)	12	5	42%	1	0	13	17	131%	49 to 67
Software Engineers and Designers (2173)	2	2	100%	1	1	34	31	91%	7 to 11
Subtotal	**713**	**349**	**49%**	**287**	173	**1227**	**487**	**40%**	**---**
Other	801	36	4%	264	12	1410	84	6%	---
Total	**1514**	**385**	**25%**	**551**	**185**	**2637**	**571**	**21%**	**---**

6.7.3.1 A&D FTE Projected Two-year Hiring

The two-year projections for A&D FTE hires for each occupation were calculated assuming a similar ratio of A&D work being performed by future hires as for current A&D company employees.

For example: the current employment level among A&D companies of Engineers is 35. Because most of these A&D employers are involved in other sectors as well, the full-time equivalent employment of Engineers involved in aerospace and defence work is nine, or 25.7% of the total number of Engineers employed. There is an expectation among these same companies to hire an additional 17 Engineers over the next two years; representing a 49% increase. If it is assumed that a similar ratio of A&D work is maintained among the Engineering staff, approximately four full-time equivalent Engineers are projected to be added for aerospace and defence work over the next two years. (9 FTE ÷ 35 total Engineers employed = 25.7%; 25.7% of 17 Engineer new hires = 4 projected FTE Engineers to be hired).

If the expansion in employment is accompanied by a higher percentage of work done within aerospace and defence within any of these occupations, the corresponding A&D FTE projections could be higher.

6.7.3.2 Observations on Employer Hiring Projections

There appears to be relative optimism present among the employers with regard to the A&D sector (and their businesses as a whole). Employment projections represent a significant increase in their employee base (a 22% increase as compared to their current core occupation employment levels). It should be noted that these projections reference only a selection of occupations and not all companies provided forecasts.

Technicians/Technologists and Traditional and CNC Machinists continue to be in significant demand as employers look to enter into or expand their business within the sector. The same may be said of Welders and Steel Fitters/Fabricators. The relatively high projections for Fitters/Fabricators (as compared to SOFE projections) are consistent with what was found in the industrial fabrication sector, of which some of the employers

of this occupation are a part. In the IF sector, 156 Fitters/Fabricators and 175 Welders were estimated to be hired within two years[28].

Within the A&D sector segments served by the ICT sector (for example, simulation training development and software development), Instructional Designers, Media Designers, Programmers and Software Engineers and Designers are also in demand.

The requirement for Flight Instructors is also expected to be very strong. Aircraft Mechanics[73] make up 28.5% of the expected new hires among Mechanics. This represents a 40% increase over current employment among A&D companies for this occupation.

6.7.3.3 Employment Projection Considerations

Employer projections: It is important to note that employer projections are based on the labour needs for their entire business portfolios, and are not estimations of full-time equivalent employees associated with their work in the A&D sector only. Also, these estimates are based on each employer's current understanding and assumptions regarding their business and the market. Factors that may have an impact on these projections include:

- The awarding of future, as of yet unknown contracts;
- A choice by company executives to move in a new direction or create a new product or service; and
- The level of optimism with which employers view their prospects.

Economic modeling projections: The SOFE model takes a macro view of the economy, based on expectations and assumptions regarding what will transpire in the economy over a span of time (10 years). The projections are based on current known inputs that will shape all or part of the economy, as well as historic trends. Employment share and labour demand changes are estimated based on those assumptions.

While overall these models provide a helpful, statistically sound view of the labour market, it is always possible that reality will play out differently than projected. Reasons may include:

- The economic outlook and factors used as inputs at the time of developing the model may change in unexpected or unpredictable ways;
- The model cannot account for decisions at the micro level, for example the decision of a CEO to create a new product or move the company into a new direction, significantly changing the profile of the company's labour resources; and
- Simple under- or over-estimation can take place for a particular occupation.

[73] These numbers only include employers that satisfy the sector definition (Section 4.2), excluded are Aircraft Mechanics employed by "operators".

6.8 Employer Perceptions Regarding Crucial Occupations

6.8.1 Crucial Occupations for Current Work

Thirty-two (32) of the actively participating A&D employers taking part in the study were asked, "What occupations do you perceive to be essential to your current work within the aerospace and defence sector?" Twenty-six (n=26) companies responded. Table 21 presents the responses.

Table 21: Most Crucial Occupations Identified by A&D Employers (n=26)

Crucial Occupation	No. of Mentions
CNC Machinist/Traditional Machinist	9
Steel Fitter/Fabricator	6
Quality Controller	6
Welder[74]	5
Electronics/Electrical Technologist[75]	5
Engineers – Mechanical or Manufacturing	4
Project Managers	3
Electronics Assembler[76]	2
Field Service Representative[77]	2
Auto. and Heavy Equip. Mechanic	2
Graphic Artists and Media Developers[78]	2
Software Systems Designer	2
Subject Matter Experts (in A&D)	2
Instructional Designer / Courseware Developer	2
Industrial Painter, Coater, Finisher	2
Translator	1
Supervisor (strong leaders)	1
Sales	1
Aircraft Mechanic	1
Aircraft Pilot Instructor	1
Upholsterer	1
Skilled Labourers	1
IT Technical Support (help desk)	1
Mechanical Technologist	1
Database Analyst	1
Admin roles: HR and procurement	1

The metalworking roles of Machinist, Fitter/Fabricator and Welder are at the top of the list, along with Quality Controller, a role that these employers indicated was critical to delivering products that meet the demanding standards of aerospace and defence. It is not surprising that metalworking occupations are at the top of the list, as 42% of the

[74] Skills mentioned: aluminum welding; highly skilled in producing quality welds – crucial for sector
[75] Skills mentioned: prototyping; design and manufacture box build solutions, for example: control panels, ground support units; cable harness, cable assembly design and manufacturing.
[76] Skills mentioned: printed circuit board assembly; conformal coating, potting capability.
[77] Skills mentioned: maintain and train in the use of specialized equipment.
[78] Graphic Artists, Animators, Audio/Video Producers.

companies responding to the question were involved in metal fabrication and machining.

Engineers and Engineering Technologists are seen as crucial as well. The remainder of the roles are representative of the broad and various segments that make up the New Brunswick aerospace and defence sector.

When the Canadian Council for Aviation and Aerospace (CCAA) vetted its list of key occupations[79] (as viewed by the industry) for the aerospace manufacturing sector (a subset of aerospace and defence), they put forward:

- Assembler
- Composites/Fabricator
- Electrical/Electronic Assembler
- Engineer
- Machinist
- Non-Destructive Testing (NDT) Technician
- Quality Assurance Manager/Quality Assurance Inspector
- Sheet Metal Worker
- Technicians
- Technologists

Most of these were also mentioned in this survey of New Brunswick A&D companies.

6.8.2 Occupations Critical for Future Targeted Work

All 46 employers that provided detailed survey information, including those that have not yet entered the sector, were asked, "What occupations do you see as being critical for your work, or targeted work, in the sector moving forward?" Forty-three (43) companies responded.

Respondents currently operating in the A&D sector (n=26), responded with the same list of occupations presented in Table 21. However, they also added some new occupations based on future requirements:

- Instructional Designer;
- Senior Information System Analyst and Consultant (no junior level);
- Chemical Engineer;
- Sales and Senior Management to take the company further into the sector;
- Experienced CNC (two companies) and Traditional Machinist (one company); and
- Engineers and Technologists in Composites – Research and Development.

For those companies not currently participating in the sector (n=14), Engineering Technician/Technologists of various specialties were among the most mentioned.[80] Also at the top of the list were Steel Fitter/Fabricator, CNC Machinist, and Welders. The rest

[79] "Skilled Labour in the Canadian Aerospace Manufacturing Sector", Canadian Council for Aviation and Aerospace (CCAA), March 2012

[80] Specializations included: drafting, composites, instrumentation, power electrical, and electrical

of the occupations perceived as critical were similar to those mentioned by the companies already serving the sector, and represent the various segments in which these companies operate. Roles mentioned included Programmers, Instructional Designers, Technical Writers, Project Managers, Multimedia Designers, Painters, etc.

6.9 Challenges in Recruiting (n=32)

Thirty-two companies (68% of the 46 that provided complete information) indicated that they had experienced difficulty filling occupations for work in the A&D sector. In many cases, the employers found that trained workers were available, but not with the advanced experience or skill sets required.

Twenty-eight per cent (28%) of the employers reported difficulty finding qualified traditional Machinists, 12.5% finding CNC Machinists. Nineteen per cent (19%) mentioned problems hiring Steel Fitter/Fabricators. Twelve and one-half per cent (12.5%) experienced difficulty in finding experienced Supervisors and Project Managers. Two of the companies reported finding Quality Managers to be difficult. ICT companies reported the local labour market for Technical Writers and Instructional Designers to be "exhausted," and the competition for experienced Project Managers and Salespeople in ICT to be intensive.

The rest of the occupations where difficulty in hiring was mentioned (by one company each) include qualified Translators, experienced Consultants, Senior Software Architects, Power Electricians, and Aircraft Maintenance Engineers. In most cases, the issue was in finding the necessary skills or experience needed. One example was a company needing Engineers with a very specific mix of experience, radio frequency (RF)and Petrochemical metering. In another case, a company was only hiring programmers with a minimum of five years of experience.

When asked for their opinion on why the local labour market was not able to meet their needs, a wide variety of answers were given. The most common answer was out-migration of young people to other parts of Canada.

In the case of two occupations, Steel Fitter/Fabricator and CNC/Traditional Machinist, 22.5% of the employers stated that they do not believe enough are being trained in the Province's colleges. In one case, an employer hired an entire class of graduates for one of these trades. Another company has utilized foreign recruiters to find CNC and Traditional Machinists, but have not found the quality needed. They mentioned that some aerospace Primes will not allow workers from certain countries into these occupations, and that contracts can be lost if in breach of these guidelines.

One large employer mentioned that obtaining the level of skills needed to meet the rigorous standards within the sector for welding has been a challenge. A&D projects require weld tests that are far more demanding than CWB tests. These will require either automation, or taking their very best Welders and giving them time to practice. This is a case where the level of experience needed is well beyond that which can be imparted in a trade program.

In some cases, employers are aware that the skill sets and experience they require cannot be addressed by the local educational system. In one case, an employer mentioned that, in North America, only Chicago and Vancouver have companies doing the same type of development work as they do. In these cases, employers understand that there is no justification for creating an educational program to meet their very specific needs. Similarly, another company that utilizes (only) Senior Information Systems Consultants stated that, in years past, software development was done locally while, now, the bulk is done in India. The next generation, in this employer's estimation, are not able to learn "from the ground floor," gaining the kind of pervasive knowledge they need to be effective consultants. This company believes the next generation of senior IT consultants will come from India.

Sixteen per cent (16%) of the respondents noted their company's geographical location as an impediment to drawing the skills they need into their company.

6.10 Needed Skills for the Future

Exactly half (n=23) of the companies interviewed in detail indicated they had difficulty, or expect to have difficulty, finding employees with specific skills. Forty-one percent (41%) indicated they did not, and 9% said that they were unsure. The following is a breakdown of new skills, or skills employers have found difficult to find, grouped by associated occupation category. These skills are those that employers identified as necessary to compete and grow their business in the sector.

Engineer, Engineering Technologist/Technician

- Composites
- RF (radio frequency) and petrochemical metering
- Satellite communications
- Photonics
- Non-contact methods of measurement
- Instrumentation
- Quality Control, including quality documentation
- Project management

Trades

- Certified composites assemblers
- Hydraulics
- Industrial Electricians
- Welders with experience and certifications related to work for DND

Programming and Media Development

- Mobile App Development (IOS, Android, etc.)
- 3D modeling for advanced learning products
- ActionScript, MySQL, PHP, and HTML5

Security

- Chief Security Officer
- Security of IP – one manufacturer indicated that A&D Primes are requiring more from them – a firewall is not enough

Marketing/Sales

- Background (and contacts) in A&D

The responses given are as varied as the sector's segments, and as specific as particular companies' technological focus.

One theme that was referenced by several employers was the need for persons with prior experience in the aerospace and defence sector. This is seen as a necessary means for entry into the sector (for example in sales and marketing), and also is recognition of specialized skill sets needed to consult or produce goods for the sector. One company indicated that the level of quality required in welding, for example, is of an order of magnitude higher than for the other industries they serve. Similarly, the CCAA notes that the college sheet metal training for general industry is very different from aviation and aerospace sheet metal training[79]. The same is true for CNC Machinist training.

Another theme, among some of the companies who are not yet participating in the sector, along with those currently generating little revenue from aerospace and defence, was that they are not yet sure of the new skills they will need in order to expand into the sector. Some of these companies are looking for help to understand what they will need to compete in and supply various sector supply chains. The Halifax shipyard project is one example; the defence land systems to be built or modified in the Province is another. A number of these companies have begun to meet with the Primes on these projects as a first step to understand and enter the supply chains.

7 Educational Capacity and Capability to Support the Sector

Capacity refers to the number of new entrants that the educational system is able to supply for the given occupations. Capability refers to the educational system's ability to respond to and support the sector's needs for specific skill-sets.

7.1 Challenges in Determining Educational Capacity

7.1.1 A Shared Labour Market with other Sectors

Most employers interviewed supply more than one sector of the economy (recall 67% of active companies interviewed derive less than 50% of their revenue from the A&D sector). Therefore, any impact on the educational system from projected new hires and identified skills gaps must be weighed in the wider context of the various sectors that utilize these shared occupations. For example, the employers in this study are projecting to hire 53 Welders over the next two years (see Table 20). This must be considered in the context of demand for Welders in other sectors such as industrial fabrication,[81] construction[82], and others. The same can be said of all shared occupations, such as Software Designers, Programmers/Media Developers, Machinists, etc.

7.1.2 The Present Size of the Sector

Current employment within the sector is relatively small, yet the number of job roles and related skills are broad and diverse. This breadth and variety is observable in the 49 core occupations for which employers reported employment (see Figure 24). This makes the task of assessing educational capacity more challenging.

At the sector's current size, the projections for new hires are not large (see Table 20). Therefore, educational capacity for most of these occupations will not likely be an issue. There are a few exceptions, which are explored in Sections 7.2.3.2, 7.2.4.2 and 7.2.5.1.

However, it should be noted that because of the small size of the sector, any awarding of major contracts, or entry of new A&D companies, could dramatically shift the profile of skills and occupations needed. It is likely that any sudden and substantial change in the sector requiring new skills or greater numbers of new entrants into sector occupations would likely need to be filled by in-migration from other parts of Canada or internationally to meet the initial requirements. Adaptation of educational programs to support any long-term shift in HR needs could then be planned for and implemented.

7.1.3 Unique Skills Requirements

In contrast to measuring capacity, the capability of the educational system to support A&D-specific skills is an even more complicated matter. The aerospace and defence sector often requires a different set of competencies for similar occupations in other

[81] 175 new hires of Welders were projected by IF establishments (n=49) over two years (2012-2013) in the 2012 IF sector study. *Ibid;* page 42

[82] The Construction Sector Council (CSC) estimated a net change of 71 in employment for Welders in the New Brunswick construction sector from 2010 to 2014. "Construction Looking Forward, An Assessment of Construction Labour Markets from 2011 to 2019 for Atlantic Canada"

sectors. Within the sector itself, skills are more segment-specific, even project or platform-specific. For example, materials to be welded and the level of quality control can vary significantly from marine, to land, to air defence systems, differing in turn to that needed for the mining or value-added wood sectors.

The critical mass needed to form an A&D cluster within the Province has not yet been achieved. As a result, there is no clear direction to guide employers or educators regarding new skills profiles needed to support specific sector segments.

New Brunswick companies have an opportunity to become part of a manufacturing cluster likely to form in support of the shipbuilding projects awarded to the Halifax shipyard. As the supply chains to support this project begin to form, any distinctive competencies required should become clearer, and allow for long-term planning by the colleges and universities on how best to enable New Brunswick firms to adapt their skills and compete.

Similarly, if additional defence land systems contracts are won by New Brunswick companies, or if additional defence contractors choose to establish a presence in the Province, new and specific skill sets and/or occupations may be required.

The primary research indicated that some companies, especially those most engaged in the sector, know what skills they will need going forward;[83] for others it is still unclear. This makes determining potential gaps in educational capability a more general exercise. The research did bring up some information regarding reported skills gaps, which is worthy of consideration. These are examined in Section 7.3.

7.1.4 Varying Educational Approaches

When examining educational capacity, it should be noted that there is not always a one-to-one relationship between an occupation and the programs that can help prepare an individual to perform that job role. In cases where professional, technical or trade certifications are involved there is a much more direct relationship, as the programs must be approved by the certifying bodies. In other cases, when comparing programs from different institutions there can be very different approaches. In other words, determining seat capacity or graduation rates in support of a particular occupation is not always straightforward.

7.2 Educational Capacity to Support Core Sector Occupations

The focus of this study is on New Brunswick educational institutions. It is neither reasonable nor practicable to explore the educational capacity of institutions throughout Canada for the following reasons:

- The sheer number of occupations based on the definition of the sector;
- the relatively low number of new entrants required;
- the variance in skills required by the sector in different regions of Canada; and
- the diverse educational approaches in support of these occupations.

[83] It should be noted, however, that even some of the most engaged, were not able to specify their up-coming skills needs because they are contingent on contracts yet to be awarded (often a multi-year process).

This section therefore explores the capacity within the New Brunswick educational system to support the 11 occupations for which new-hire projections were provided by employers (See Table 20).

For reference, Appendix C contains a fuller list of New Brunswick educational programs, public and private, that relates to the aerospace and defence sector.

7.2.1 Engineers

The current profile of engineers within New Brunswick A&D companies includes primarily Mechanical Engineers, Electrical and Electronics Engineers, and Computer Engineers. The University of New Brunswick and the Université de Moncton average 110 graduates a year, taking the various engineering disciplines collectively.[84]

Respondents (n=46) indicated that their expectation is to hire 35 engineers over the next two years. The two-year projections for Engineers dedicated to A&D work (A&D FTEs) is four (See Table 20). The SOFE projections for net-hires of Engineers across all industries in New Brunswick over the next two years are between a low of 146 to a high of 200. If these projections hold true, it appears that New Brunswick universities have adequate capacity to meet the needs of the sector.

Ontario and Quebec are the only provinces where there are engineering programs specializing in aerospace. In most cases, these are masters-level engineering degrees. These specialized engineering skills in aerospace do not appear to be needed within the New Brunswick A&D sector at this time.

7.2.2 Technologists/Technicians

Currently, companies active in the sector utilize several types of technicians and technologists. These include: Drafting Technicians, Civil Engineering Technologists, Electrical/Electronics Engineering Technologists, Computer Network Technicians, Mechanical Engineering Technologists, Industrial and Manufacturing Engineering Technologists, and Non-Destructive Testers and Inspectors. While many Civil Engineering Technologists are employed by A&D companies, analysis and information from the interviews indicate that few of these are involved in A&D work. It should also be noted that there are only two Industrial and Manufacturing Engineering Technologists currently employed by the companies interviewed.

Companies surveyed (n=46) projected the hiring of 76 Technologists/Technicians over the next two years. The two-year hiring projections for A&D FTE Technologists and Technicians is 12 (See Table 20). The SOFE projections estimate a low of 144 and a high of 206 net-hires of these types of technologists and technicians combined over the next two years. NBCC (New Brunswick Community College) and CCNB (Collège communautaire du Nouveau-Brunswick) appear, in general, to have ample seat capacity to support the sector's current need for engineering technologists and

[84] Data regarding average graduates per year in the various engineering programs was provided by the Department of Post-Secondary Education, Training and Labour (PETL). (See Appendix C for a detailed list of college programs related to these occupations).

technicians. See Appendix C: Engineering Technology for a detailed list of college programs related to these occupations.

In some cases, the colleges do not have a program expressly designed for a specific occupation, for example Non-Destructive Testers (NDT) and Inspectors (NOC 2261), or Drafting Technician. However, these occupations are in part or wholly covered by other college programs.

For instance, non-destructive testing (NDT) is part of the practices associated with the Welding Technologist, Mechanical Technician and in some specializations of the Electrical/Electronics Engineering Technologist – again, each within the scope of their respective occupational focus. Certainly, non-destructive testing has an essential role within the aerospace and defence sector. Within the context of aerospace, the CCAA has identified non-destructive testing as one of the areas experiencing the greatest labour and skills shortages (of interest, one of the others mentioned was quality assurance personnel)[79].

7.2.3 Key Trades within the Sector

The primary research for this study asked sector employers to estimate the number of new hires that they would require over the next two years for five trades:

- Machinist/CNC Machinist;
- Steel Fitter/Fabricator;
- Welder;
- Mechanic (both Automotive, Heavy Equipment and Aircraft Service Technicians); and
- Industrial Electrician.

NBCC and CCNB offer courses in many trades. Successful completion generally allows the graduate the opportunity to challenge Apprenticeship exams, and apply course time against the required work hours for advancement through the New Brunswick Apprenticeship block program. See Appendix B for an indication of all the A&D trades for which there are apprenticeship programs in New Brunswick. Except for CNC Machinist, all the relevant trades carry "Red Seal" endorsements.[85]

In addition to the programs available from NBCC and CCNB, there are a variety of trade programs available from private schools within the Province. These include:

- Eastern College, Saint John
  - Steel Fabricator/Welder
  - Industrial Electrician
- BayTech College, Moncton
  - Welding
  - Contract Training – Welding specializations
- ReadyArc Welding, Saint John
  - Welding
  - Contract Training – Welding specializations

[85] Red Seal endorsement allows a journeyperson to work throughout Canada.

See Appendix C: Trades and Technology for a detailed list of college programs related to these occupations.

Table 22 presents the length of courses, and number of seats available[86] as compared to the two-year projections for each of the five trades.

Table 22: NB Educational Capacity - Trades

Trade	Apprenticeable in NB (Red Seal△)	NBCC		CCNB		Private Colleges[87]		Employer 2-year Hiring Projections	SOFE 2-year Net-hire Projections	Total 2-year Educational Capacity in NB
		Length of Program in weeks	# of Seats Annually	Length of Program in weeks	# of Seats Annually	Length of Programs in weeks	# of Seats Annually			
CNC Machinist	Yes	80	12	40	8	NA	NA	**60**	47 to 63	**128**
Machinist	Yes△	40	30	40	14	NA	NA			
Steel Fitter / Fabricators	Yes△	40	14	40	14	28*	36*[88]	**48**	11 to 19	**128**
Welders	Yes△	40	95	40	55	16** 24***	100** 72***	**53**	94 to 114	**716**
Mechanics -Auto -Heavy Eq. - Aircraft	Yes△ Yes△ No	40 40 N/A	82 18 N/A	40 40 N/A	28 28 N/A	NA	NA	**35**	237 to 275	**312**
Industrial Electrician	Yes△	40	20	NA	NA	28*	36*	**17**	49 to 67	**112**

7.2.3.1 CNC Machinist/traditional Machinist

The hiring projections indicated by employers (n=46) for the occupation of Machinist (CNC and Traditional) were 60 over the next two years. If only the companies currently active in the A&D sector are considered, the projection is 49 over the same period. Bearing in mind that the companies interviewed do not include all the machine shops in the Province (although the sample did include the largest shops), these are large numbers for new employment expectations. The employer estimates are roughly equivalent to the SOFE projections for all industries in the Province for this time period (low of 47 to high of 63).

[86] Note that total seat capacity theoretically represents the number of new entrants that could enter the workforce; however, in reality the number of graduates is usually smaller, due to classes not being filled, students switching programs, dropping out or failing to graduate.
[87] Eastern College*; BayTech College**; ReadyArc Welding***. Note that classes may be made up of longer days in order to finish the program more quickly, with the intention of getting graduates into the workforce and apprenticeship as soon as possible.
[88] This program from Eastern College is designed so that graduates may choose either the Steel Fabrication trade or the Welding trade.

With a two-year capacity of 128 seats within the Province, it appears that supply is currently able to meet demand. However, 28% of employers stated that they had difficulty in finding Traditional Machinists in the past five years, and 12.5% stated that they had challenges in finding CNC Machinists over the same time period. It should be noted that employers indicated that the trouble they have had in finding Traditional Machinists is due to the fact that they are often looking for Machinists with deep experience, versus new entrants.

The growth of the A&D sector in New Brunswick may create further labour demand for CNC Machinists. NBCC and CCNB's employer advisory mechanisms will continue to be crucial to keep pace with employer needs.

7.2.3.2 Steel Fitter/Fabricator

Nineteen per cent (19%) of the companies interviewed indicated that they have had problems finding Steel Fitter/Fabricators over the last five years. Employers estimated the need for 48 new Fitter/Fabricators over the next two years, 10 of which are projected as FTEs for A&D work. These employers represent a sub-set of the total number of employers utilizing Fitter/Fabricators in the Province. The IF sector study reported employer expectations to hire 156 Steel Fitter/Fabricators over the two year period 2012 to 2013.[28]

The employers' projected need appears to be very large, especially when compared to the SOFE model's estimations of 11 to 19 net new hires for the trade over the next two years. The comments in the IF sector study and again in the A&D sector study regarding the difficulty in finding Steel Fitter/Fabricators, lends credibility to the assertion that the labour pool for this trade continues to be under constraint.

With the addition of a Steel Fitter/Fabricator pre-employment course by one of the private colleges,[89] the potential new-entrant supply (128 over two years) is getting closer to, but still falls short of employer's perceived labour demand (156 over two years within the IF sector).

Close communication with employers will be needed to make sure the labour supply of new entrants remains aligned with labour demand. Any growth within the sector as A&D supply lines are established could put further pressure on labour supply for this occupation.

7.2.3.3 Welder

To get a more accurate handle on labour demand for Welders in New Brunswick would require collecting and combining data from all other sectors in the Province. However examining the industrial fabrication sector, the construction sector and the aerospace and defence sector[90] can provide some insight.

[89] See Eastern College in Table 22. It should be noted that, as this course is designed so that graduates may choose either the occupation of Steel Fitter/Fabricator or Welder, not all graduates can be assumed to become Steel Fitter/Fabricators.
[90] Some of the companies interviewed for this study operate in all three of these sectors, therefore there is an overlap in the projections data coming from the three sectors.

The Construction Sector Council (CSC) estimated a net change of 71 Welders in the New Brunswick construction sector from 2010 to 2014[91]. The IF sector study indicated that 175 Welders were expected to be hired from 2012 to 2013[28]. This present study found that A&D companies expect to hire 53 Welders from 2013 to 2014, eleven of which are projected as A&D FTEs. Between public and private colleges, New Brunswick has a two-year seat capacity of 716[92]. Thus, there seems to be little internal constraint in the provincial labour supply for Welders. However, external pressure from other parts of Canada for Welders is on-going. Alberta and Newfoundland and Labrador both are in situations of labour demand far out-stripping the supply.

The challenge for this trade within the A&D sector may include a shift in needed skill sets. One employer stated that he has found that the standards for welding quality within aerospace and defence are far more stringent than the CWB (Canadian Welding Bureau) standards and testing, which have been one of the primary benchmarks for the welding trade.

In addition to pre-employment training in welding, BayTech College and ReadyArc Welding deliver contract courses in welding to companies on an as-needed basis. These can focus on bringing a group of Welders up to a new certification level, or training in areas of specialization. This permits some flexibility and agility in the educational system capability to respond to new requirements for skills for work in new industries or sectors. Welding of exotic metals would be a possible example for upgraded skills needed.

As the needs within the various supply chains such as defence shipbuilding and defence land systems, become clearer, it will be necessary as part of the colleges' consultation process, to determine when particular practices move from being exotic to becoming long-term needs that might need to be met with program changes in pre-employment and apprenticeship training. Long-term contracts, such as that awarded to the Halifax shipyard, make such long-term planning possible, as well as necessary.

In the short-term, there appears to be both capability and capacity within the private colleges to respond to training in specific new areas of welding practice.

7.2.3.4 Mechanics – Automotive, Heavy Equipment and Aircraft

The employers interviewed projected the hiring of 35 Mechanics over the next two years, 10 of which are Aircraft Maintenance Technicians.

The community college program for Aircraft Maintenance has been discontinued as the class numbers were very low. The Nova Scotia Community College (NSCC) and the College of the North Atlantic (CNA) of Newfoundland and Labrador both offer programs in Aircraft Maintenance.

[91] "Construction Looking Forward, An Assessment of Construction Labour Markets from 2010 to 2019 for ATLANTIC CANADA," page 7.
[92] Of course, the seat capacity does not equal the actual number of graduates coming out of the programs each year. It simply gives a measure of maximum capacity for new students.

Without a picture of what other sectors draw upon the labour supply for Auto Service Technicians and Heavy Equipment Service Technicians, it is difficult to know whether there are any pressures on the labour supply for these two occupations. From the single perspective of the aerospace and defence sector, the demand is, at worst, 8% of the total seats available for Automotive and Heavy Equipment Maintenance programs. There may be somewhat greater constraints on the supply of Heavy Equipment Technicians, as less seats are available, and employers indicated a need for Mechanics with experience in heavy equipment for the type of work they are doing, or looking at doing, within the sector.

This trade may grow within the A&D sector, if defence land systems manufacturing and maintenance, repair and overhaul (MRO) continue to develop within the Province.

7.2.3.5 Industrial Electricians

Again, it is difficult to make conclusions regarding the labour demand for this trade, without having data from several other industrial sectors. SOFE predicts a relatively low amount of net new hiring of this trade over the next two years. In this context, there seems to be more than enough capacity within the educational system. The demand from the A&D sector is relatively small.

7.2.4 Training Development and Delivery

7.2.4.1 Flight Instructors

The Moncton Flight College is in the unique position of being both the developer of Flight Instructors, and the employer of them. Moncton Flight College is an Approved Training Organization (ATO) as certified by Transport Canada. The school is one of only two in Canada to have this designation.

The college offers four course programs:

- A Diploma in Aviation Technology (IATP – Integrated Airline Transport Pilot License);
- An Integrated Commercial Pilot Course (ICPC);
- A joint program with Mount Allison that offers a B.Sc. preparing for a career in the aviation industry and includes advanced pilot training, the graduate holding a Commercial Pilot's License; and
- A Modular Pilot Training (MPT) program. This program contains all levels of pilot training, including commercial and instructor. It is the only Flight Instructor program in the Maritimes. An average of 50+ students graduate per year from the Modular Pilot Training program.

The projected new hires for Flight Instructors in the Province is 49 over the next two years. While not all pilots graduating from the Modular Pilot Training program have trained as instructors, the Moncton Flight College is able to meet, on average, 90% of its needs from its own graduates; the remainder are hired from outside as needed.

7.2.4.2 Instructional Designers

It is of interest that the occupation of Instructional Designer is currently the job role with the most FTEs within the A&D sector in New Brunswick. This speaks to the fact that New Brunswick has significant strength in advanced learning technologies.

Not all those filling the role of Instructional Designer necessarily have an educational background in instructional design (of course, this can be said about many, if not most, roles filled within companies today). Depending on what learning modality is being used, companies may use writers, for example, for authoring instructor-led training courses.

Learning development companies utilize different people for the various competencies needed to develop advanced learning solutions – instructional designers to design and author content, multimedia developers and graphic artists to create the working courseware. Some companies have returned to a model of having persons with both skill sets, so that they author and package the whole course. This is all to say that different companies utilize and conceive of the occupation of instructional designers in different ways, and therefore look for people with various types of background, education and experience. Some would be classified as Instructional Designers, others may be called Courseware Developers and be classified under the Programmer / Multimedia Developer NOC. The tools and processes for developing learning solutions continue to evolve dramatically, which has a dynamic effect upon the practice of this occupation.

Persons with a true educational background in instructional design are valued among advanced learning technology (ALT) companies, as there has been much ineffective training developed in the past due to the lack of thoughtful and creative instructional design.

The University of New Brunswick (UNB), Fredericton campus, offers a Masters of Education in Instructional Design. The student is exposed to the theories and processes of instructional design and how to use them in the development of various types of instruction (classroom, web-based, simulation, job-role embedded learning, etc.). This program graduates on average of 12 students per year.

The estimate of Instructional Designers expected to be hired over the next two years by A&D sector employers is 38, greater than the current supply coming from the educational system.

The Instructional Designer labour market in New Brunswick appears to have been constrained for some time, as the Province has entered again into a growth phase in ALT opportunities. Learning companies in the Province have had to compete for a limited, finite labour pool, which has raised wages and created tensions between some companies. One company interviewed has ceased looking for instructional designers in New Brunswick for these very reasons, and instead contracts highly skilled individuals from other parts of Canada to work remotely at a lower wage. To see companies working and partnering together to obtain larger contracts is the kind of clustering that would be valuable within the Province. A constrained labour supply for this critical resource has created a level of mistrust among some companies that have tried to work together, and in the process have had key resources hired away by the partnering company. Growth in the local labour supply would help ease such situations and allow companies to better position themselves for potential large opportunities

ahead as the Department of Defence continues to invest in advanced learning solutions.

7.2.5 Information Systems Developers

7.2.5.1 Software Engineers and Designers

The primary research indicated that the employers that provided complete surveys (n=46) expect to hire 31 Software Engineers over the next two years[93]. This figure is very high in comparison to the SOFE projections of net-hires for this occupation over the same period: a low of seven to a high of 11. It should be remembered that SOFE projections take into account that other sectors may be shrinking at the same time as some are growing. It is impossible to get a true picture of the labour market demand for this occupation without data from the rest of New Brunswick ICT companies. The employers interviewed as part of this study represent only a small portion of the total ICT sector.

UNB Fredericton offers a Bachelor of Science in Software Engineering (BScSwE). There are on average nine graduates per year from this program. Because this is an engineering degree, graduates are able to register as a Professional Engineer, and as an Information Systems Professional.

UNB Saint John offers a Bachelor in Computer Science, Networking and Software Engineering. Students can specialize in networking as well as in software engineering. There are an average of 10 graduates per year from this program.

Depending on the number of Software Engineers graduating from each of the programs, it is possible that these programs could satisfy the needs of the ICT companies active in or seeking to enter the A&D Sector. However, the employer with the largest projected need indicated when interviewed that they have had to hire Software Engineers from Ontario and pay for their moving expenses to bring them to the Province. This comment, at least anecdotally, indicates that the labour market for Software Engineers may be constrained in New Brunswick.

7.2.5.2 Computer Programmers and Interactive Media Designers

HRSDC breaks NOC 2174 into two parts. NOC 2074.1, Computer Programmer, is defined in this manner: "Computer programmers write, modify, integrate and test computer code for microcomputer and mainframe software applications, data processing applications, operating systems-level software and communications software."[94] NOC 2174.2, Interactive Media Designers, is defined in this way: "Interactive media developers write, modify, integrate and test computer code for Internet applications, computer-based training software, computer games, film, video and other interactive media."[95]

---

[93] The majority of this projected need came from a single company that is one of the companies currently taking steps to enter the sector, but does not at this time supply aerospace and defence. The projected A&D FTE new hires for this occupation is only one over the next two years.

[94] http://www30.hrsdc.gc.ca/NOC/English/CH/2001/QuickProfile.aspx?v=2174.1

[95] http://www30.hrsdc.gc.ca/NOC/English/CH/2001/QuickProfile.aspx?v=2174.2

Interactive Media Developers are used extensively in the development of interactive learning, as well as other applications. Some, as mentioned previously, with the additional skills of instructional design, are used by at least one local training development company that is active in the A&D sector.

Computer Programmers are also used extensively in many types of applications – there are many uses for these skills within aerospace and defence. Employers are often looking for programmers with experience in specific programming languages and environments.

The employer survey indicated an expectation to hire 45 people in these categories over the next two years. This is much higher than the SOFE projections of 23 to 27 net-hires over the same time period. For reasons mentioned previously, it is impossible to measure the true load upon the education system to support these occupations without data from the rest of the ICT sector. Certainly, the Province has seen ICT companies grow and later shed jobs once the initial product set has been developed and/or the company is purchased and redundancies are eliminated. It could be that the SOFE estimates have taken into account such factors.

There are several educational paths available for computer programming or multimedia development. There are Computer Science degrees with focus on programming, and university adult education courses in software development. NBCC and CCNB each provide a program for IT: Programmer Analyst.

The programming of electronic games can be explored in NBCC's program in Electronic Game Design. Some of the simulation training being developed for defence is built on gaming platforms. Particular aspects of multimedia design can be learned in programs like NBCC's Electronic Games – 3D Graphics, or NBCC's Animation and Graphics course. NBCC Fredericton offers a program in partnership with CFB Gagetown: Advanced Skills in IT Multimedia. The description for the course is: "An internship program with CFB Gagetown where graduates from a college IT program become experts in developing simulation software for training purposes." Beyond the public schools, there are also private schools in the Province teaching programming, multimedia development, animation, game design, etc. Some of these also partner with CFB Gagetown for the internship of graduates.

As previously stated, it is not possible to measure educational capacity for these skill sets without a complete picture of the needs for these occupations within the whole of the ICT sector. Indeed, these two occupations are used widely in many sectors, both public and private. However, from the standpoint of the requirements of the A&D sector only, there is ample bandwidth within the education system, public and private, to meet its needs.

7.3 Skills Gaps

In addition to the specific occupational skills discussed in Section 6.10, there were three skills areas that came up repeatedly in different ways throughout the interviews with the employers.

7.3.1 Project Management

In the past, project management has not always been given rigorous treatment in academic programs, and has primarily been taught through adult continuing education. This is generally due to the fact that project managers normally need some vocational context upon which to add these skills, if they are to effectively manage projects in their field of expertise.

There is no doubt, however, that strong project management competency is an absolute prerequisite for working and thriving in the aerospace and defence sector. This need was something for which many of the companies showed keen self-awareness. It was mentioned in various contexts. Employers weren't always sure what occupations should be the focus for these skills. Both Engineers and Technologists were mentioned as possibilities.

This need is being addressed in various ways within the New Brunswick educational system. NBCC has embedded project management courses into several of its engineering technology programs. UNB, in addition to offering continuing education seminars in project management, also offers project management in some of its engineering programs. UNB's engineering faculty also offers a Diploma in Technology Management and Entrepreneurship, which includes courses on managing engineering and information technology projects, and quality management. UNB Saint John (UNBSJ) also has partnered with the Project Management Institute, New Brunswick chapter (PMI-NB) allowing "Masters of Business Administration (MBA) students at UNBSJ to participate in activities that will help them achieve project management credentials such as Certified Associate in Project Management (CAPM)®, Project Management Professional (PMP)®, and Program Management Professional (PgMP)®."[96]

Of interest, some colleges in other parts of Canada have begun to introduce Project Management full-time diploma or certificate programs.

7.3.2 Supervisors – Strong Leaders

This is a common area of need expressed by employers. Supervisors most often are workers who have gained experience in their field of expertise and are promoted to managing others. Some may have innate skills in supervising others, many do not.

Educators have begun to respond to these needs, often through contracted seminar training. In addition, some of the NBCC Engineering Technology programs have embedded courses related to these skills.

[96] http://blogs.unb.ca/newsroom/2011/11/04/unb-saint-john-partners-with-project-management-institute-nb-chapter/

7.3.3 Quality Assurance Management

It is not surprising that quality management came up repeatedly throughout the primary research. In the aerospace and defence sector the requirement for quality management is pervasive. The issue was brought up several times in an occupational context as a need for a Quality Manager or Quality Controller. Similar to project management, quality management is most often taught as continuing education, such as: ISO 9001 Lead Auditor, Six Sigma®, or LEAN Manufacturing training.

NBCC has embedded training in quality management into several of its engineering technology programs. They have recently made the switch to training in LEAN Manufacturing, previously having used Six Sigma® training.

The ASQ (American Society for Quality) is a certifying body for quality professionals. There are various designations such as Certified Quality Engineer (CQE), Certified Reliability Engineer (CRE) and Certified Quality Auditor (CQA).

Several colleges in Canada (many in Ontario) offer part-time quality management courses. Sheridan College is the only one to offer a one-year full-time certificate program: Quality Assurance – Manufacturing and Management. The program includes in-depth coverage of material that appears on the certification examinations for professional quality designations (CQE, CRE, CQA).

7.4 Educational Capacity and Capability Conclusions

In general, with few exceptions, the educational system appears to have ample capacity to support key occupations within the aerospace and defence sector at this time.

As stated earlier, due to the sector's size any changes within the sector (new contracts, new companies) can have a marked effect on occupational needs and skills. The public and private educational system exhibits the capability to respond to short-term and long-term needs. The close relationship of the colleges and universities with many sector companies will help these educational institutions to continue to respond to these needs appropriately.

Appendix A: Acronyms

A&D – Aerospace and Defence

ADIANS – Aerospace and Defence Industries Association of Nova Scotia

ADIANL – Aerospace and Defence Industries Association of Newfoundland and Labrador

AIAC – Aerospace Industry Association of Canada

ALT – Advanced Learning Technology

ASME - American Society of Mechanical Engineers

BNB – Business New Brunswick (former New Brunswick Government Department)

CADSI – Canadian Association of Defence and Security Industries

CCAA – Canadian Council for Aviation and Aerospace

CCNB - Collège communautaire du Nouveau-Brunswick

CGD/CGP – Controlled Goods Directorate / Controlled Goods Program

COPS – Canadian Occupational Projection System

CSA – Canadian Standards Association

CWB – Canadian Welding Bureau

FTE – Full-Time Equivalent

HRSDC – Human Resources and Skills Development Canada

ICT – Information and Communications Technology

IF – Industrial Fabrication

Invest NB – Invest New Brunswick (New Brunswick Government Crown Corporation)

LMAB – Labour Market Analysis Branch (Branch of PETL)

NAICS – North American Industry Classification System

NBCC – New Brunswick Community College

NBCDAG – New Brunswick Career Development Action Group

NOC – National Occupational Classification

NSCC - Nova Scotia Community College

OEM – Original Equipment Manufacturer

PETL – Post-Secondary Education, Training and Labour (New Brunswick Government Department)

SIC – Standard Industry Classification

SOFE - Stokes Occupational Forecast Estimates

Appendix B: Education Matrix – A&D Core Occupations

The following matrix indicates where New Brunswick educational programs exist that wholly, or in part, prepare individuals for aerospace and defence occupations found in the Province. The universities include all campuses of Mount Allison University, Université de Moncton (U de M) and the University of New Brunswick (UNB). The colleges include all campuses of the public colleges: Le Collège communautaire du Nouveau-Brunswick (CCNB) and New Brunswick Community College (NBCC); and all New Brunswick campuses of the private colleges: Atlantica Centre for the Arts, Baytech College, the Centre for Arts and Technology, Eastern College, the Gaming and Animation Institute of Fredericton (GAIF), Moncton Flight College (MFC), and ReadyArc Welding.

Occupations	Universities	Colleges	Apprenticeship NB	Employer Trained
2131 Civil Engineers	X			
2132 Mechanical Engineers	X			
2133 Electrical and Electronics Engineers	X			
2147 Computer Engineers (Except Software Engineers and Designers)	X			
2171 Information Systems Analysts and Consultants	X	X		
2172 Database Analysts and Data Administrators	X	X		
2173 Software Engineers and Designers	X	X		
2174 Computer Programmers and Interactive Media Developers	X	X		
2175 Web Designers and Developers	X	X		
2231 Civil Engineering Technologists		X		
2232 Mechanical Engineering Technologists and Technicians		X		
2233 Industrial Engineering and Manufacturing Technologists and Technicians				
2241 Electrical and Electronics Engineering Technologists and Technicians		X		
2253 Drafting Technologists and Technicians		X		
2261 Non-Destructive Testers and Inspectors		X		
2262 Engineering Inspectors and Regulatory Officers				
2271 Air Pilots, Flight Engineers and Flying Instructors	X	X		
2281 Computer Network Technicians		X		
2283 Systems Testing Technicians (Software Testing/Quality Assurance)				
4131 College and Other Vocational Instructors (Includes Instructional Designers)	X			
5241 Graphic Designers and Illustrators		X		

Occupations	Universities	Colleges	Apprenticeship NB	Employer Trained
7231 Machinists and Machining and Tooling Inspectors		X	X Red Seal	
7232 Tool and Die Makers				
7242 Industrial Electricians		X	X Red Seal	
7252 Steamfitters, Pipefitters and Sprinkler System Installers			X Red Seal	
7263 Structural Metal and Plate-work Fabricators and Fitters		X	X Red Seal	
7265 Welders and Related Machine Operators		X	X Red Seal	
7293 Insulators			X Red Seal	
7311 Millwright/Industrial Mechanic		X	X	
7312 Heavy-Duty Equipment Mechanics		X	X Red Seal	
7315 Aircraft Mechanics and Aircraft Inspectors				
7321 Automotive Service Technicians, Truck and Bus Mechanics and Mechanical		X	X Red Seal Compulsory	
7322 Motor Vehicle Body Repairers (includes Painters)		X	X Red Seal	
7341 Upholsterers				
9423 Rubber Processing Machine Operators and Related Workers				X
9482 Motor Vehicle Assemblers, Inspectors and Testers				X
9483 Electronics Assemblers, Fabricators, Inspectors and Testers				X
9485 Assemblers, Fabricators and Inspectors, Industrial Electrical Motors and Transformers				X
9486 Mechanical Assemblers and Inspectors				X
9496 Painters and Coaters - Industrial				X
9511 Machining Tool Operators				X
9514 Metalworking Machine Operators				X
9612 Labourers in Metal Fabrication				X
9619 Other Labourers in Processing, Manufacturing and Utilities				X

Appendix C: New Brunswick Educational Programs in Support of A&D Sector

Program information was gathered from institutional websites,[97] PETL, and institutional staff. Programs listed that are offered by Collège communautaire du Nouveau-Brunswick (CCNB) and Univeristé de Moncton (U de M) are delivered in French. All other programs listed are delivered in English.

Aviation

Moncton Flight College[98] (MFC)	
Program	**Diploma in Aviation Technology (IATP)**
Description	This innovative program allows students to receive professional flight training and acquire a recognized Diploma through MFC. This combination of extensive technical knowledge and academic concentration gives Diploma graduates the confidence needed in today's aviation environment. The program is divided into four terms and lasts 20 months.
Length	20 months
Avg. # of Graduates per year	15 to 20
Outcomes	Upon completion of this program, graduates receive a Commercial Pilot Licence, Multi-Engine Rating, Instrument Rating, "Frozen Airline Transport Pilot License" status, CRM Certification, Aviation Safety Management Certification, extensive exposure to advance turbine flying on the Beech King Air 200 Simulator, approximately 200 hours of flying time, and approximately 920 hours of instruction of academic training and labs. The Diploma Program exceeds the requirements the Integrated Airline Transport Pilot Course (IATP); therefore students also finish with an IATP certificate.
Program	**Integrated Airline Transport Pilot (IATP) and Integrated Commercial Pilot Course (ICPC)**
Description	MFC, in its ongoing effort to provide Professional Flight Training, has introduced these two courses as options for the career-orientated student. MFC is one of only a few flight training centers in Canada to be approved for such a course. The Integrated Pilot Courses are a structured curriculum where the ground school is integrated into the flight training. One of the ICPC options is the Integrated Airline Transport Pilot Course (IATP) which includes a "Frozen Airline Transport Pilot License" status, Instrument and Multi-Engine Ratings, and training on the Beech King Air 200 Simulator. Training also involves approximately 500 hours of ground school and 195 flight hours.
Length	1 year
Avg. # of Graduates per year	100 +
Outcomes	IATP or ICPC

[97] Information may have been edited for presentation purposes.
[98] Moncton Flight College is a Transport Canada Approved Training Organization (ATO), and is only one of two schools in Canada to have this designation.

Program	Modular Pilot Training
Description	The Modular Pilot Training Program is structured to meet the needs of a student wishing to either extend their pilot training or complete one or more Licences and/or Ratings at their own pave. For example, if a student already has a Commercial Licence and wishes to add a Multi and/or Instrument Rating, or if s/he holds a full-time job and require a flexible studying schedule, the modular program is ideal. This program contains all levels of pilot trailing including commercial and instructor, as well as modules on the various pilot upgrades and ratings such as Instrument Rating and Night Rating. The Instructor pilot program is offered on an ongoing basis and is the only instructor program in the Maritimes. The program also provides training for the Air Cadet Program.
Length	Varies according to modules taken
Avg. # of Graduates per year	50 +
Outcomes	Recreational Pilot Permit, Private Pilot License (PPL), Commercial Pilot License (CPL), Night Rating, Multi-engine Rating, VFR Over the Top Rating, Instrument Rating, Instructor Rating,
Moncton Flight College in partnership with **Mount Allison University**	
Program	**Bachelor of Science in Aviation (IATP)**
Description	In partnership with Mount Allison University, The B.Sc. (Aviation) major is a four year program for students wishing to obtain a university degree while preparing for a career in the aviation industry. The major is an interdisciplinary science program, featuring study in depth of subjects that are relevant to aviation, including geography, mathematics and physics, together with professional pilot training to an advanced level. Before graduation, students complete over 200 hours of flying, hundreds of hours of ground training, and hold a Commercial Pilots Licence (CPL) with Multi-Engine and Instrument Ratings. The option to complete the integrated Airline Transport Pilot (IATP) course is also available to students.
Length	4 years
Avg. # of Graduates per year	This is the first year to graduate students. Average expected to be 8 to 15 per year.
Outcomes	B.Sc., CPL, Optional: IATP

Applied and Media Arts

New Brunswick Community College (NBCC)	
Program	**Animation and Graphics**
Location	Miramichi
Description	The program prepares graduates for challenging careers in all aspects of animation and its applications, teaching them how to use strong artistic skills and a comprehensive knowledge of the latest computer animation technologies to turn creative thoughts into compelling images that communicate ideas and messages.
Length	Two years (80 weeks)
# of Seats Available per year[99]	20
Outcome	Diploma
Program	**Applied Studies Internship**
Location	CFB Gagetown, NBCC – Fredericton
Description	The Applied Studies Internship program is designed to provide graduates of technical programs with the opportunity to enhance their skills by participating in an experiential workplace internship program. Over 12 months, students take part in academic studies that complement their learning in an authentic workplace setting. Through a series of practicum courses, students participate in an internship at the Department of National Defence in one of the following fields: Graphic Arts, Imagery, Web Development, Game Programming, Programming, Audio and Video, Texture Artist, 3D Artist, 3D Animator, Administration, or Information Technology.
Length	12 Months
# of Seats Available per year	20 Interns are chosen per year from graduates of both private and public colleges.
Program	**Electronic Game Design**
Location	Miramichi
Description	Using sophisticated programming, students will learn how to design, script and develop various types of electronic games. Students learn applied computer programming languages such as C++, XNA and Java ME while working with 3D graphics students to create and program prototypes, electronic games and mobile applications in a simulated professional setting with qualified instructors.
Length	Two years (80 weeks)
# of Seats Available per year	20
Outcome	Diploma
Program	**Electronic Game - 3D graphics**

[99] The number of seats available per year, for each college program listed in this appendix, is the maximum number of new entrants that can be taken each year into the program. Theoretically, this represents the maximum number of graduates that can enter the labour force, however, often the number is less, due to some who drop out of the course, or those who change programs.

Location	Miramichi
Description	The program melds art, animation, graphics, audio, production, storytelling and portfolio development where students learn how to create inspiring computer graphics using sophisticated software tools for computer games, simulation, animation, and the gaming industry. Students learn to apply drawing skills, create model sheets and storyboards that feed into the graphics software pipeline process in order to develop conceptual art into interactive media productions.
Length	Two years (80 weeks)
# of Seats Available per year	20
Outcome	Diploma
Le Collège communautaire du Nouveau-Brunswick (CCNB)	
Program	**Conception graphique (Graphic Design)**
Location	Dieppe
Description	This program prepares students to design and carry out work related to the world of visual communication. Graphic design is the first step in the production chain graph and is based on communication, creativity and aesthetics. Although the main tool is the Macintosh computer, students start learning the basics of the traditional methods. In the first year, different exercises on composition, design, color, typography, creating symbols and layout can acquire the basics of graphic design and typography. In the second year, deepening knowledge of illustration software, layout and image processing complete technical training and introduces the student to prepress. In addition, the application of the concepts learned in the first year to more complex projects such as advertising, corporate image, editing, design three-dimensional, interactive presentation and production of complete websites the curriculum. An internship of eight weeks allows the person to quickly integrate the labor market and find employment within existing businesses, to work freelance or start their own business.
Length	Two years (80 weeks)
# of Seats Available per year	15
Outcomes	Diploma
Program	**Production et animation 3D (Production and 3D Animation)**
Location	Péninsule acadienne
Description	The Production and 3D animation program is designed to prepare the student to produce and combine content filmed and animations for 3D simulation in video games, animation, digital special effects and architectural visualization.
Length	Two years (80 weeks)
# of Seats Available per year	15 - new entrants may enter the program every second year.
Outcome	Diploma
Centre for Arts and Technology	
Program	**2D Animation and Digital Art**
Location	Fredericton
Description	The Fredericton 2D Animation Program aims to provide students with one year of extensive hands-on training. This gives students ample time to learn how to apply the applicable techniques to create original art and illustrations.
Length	One year

# of Seats Available per year	24
Outcome	Diploma
Program	**Animation for Game, Film, & Visual Effects**
Location	Fredericton
Description	It requires the skills of professional visual effects specialists to bring backdrops and characters to life. This program will teach students the techniques and skills needed in this in-demand field. This 3D Animation Program will teach the student everything they need to know from developing concepts, to storyboard creation to post production and special effects. This is a versatile training program that aims to develop and enhance the student's 3D animation skills. They will learn lighting, modeling, rendering, texturing, rigging, composing, life drawing, layout design, character design, 2D classical animation, storyboarding and game design.
Length	Two year
# of Seats Available per year	24
Outcome	Diploma
Program	**Graphic & Digital Design**
Location	Fredericton
Description	This diploma program focuses on training the student in graphic design, digital imaging, developing forms of visual communication and publishing digital arts. They will specialize in design flow, layout, aesthetics, overall design, corporate identities, advertising, website "front ends" and different types of visual design.
Length	12 months
# of Seats Available per year	24
Outcome	Diploma
Program	**Graphic Design & Web Development**
Location	Fredericton
Description	This program offers training that specializes in different forms of graphic design. Once the student completes the Web Design Program they will be a master of website design and development skills.
Length	18 Months
# of Seats Available per year	24
Outcome	Diploma
The Gaming and Animation Institute of Fredericton (GAIF)	
Program	**3D Animation and Modeling**
Location	Fredericton
Description	Students learn to create their own props, environments, and characters for games, apps, movies, and other digital mediums using the latest 3D modeling software. Using both key-framing techniques and motion capture technology, students learn animation skills to bring their characters to life.
Length	15 months

# of Seats Available per year	The maximum class size is normally 15 new entrants per year, but classes could be added to accommodate up to 30 students.
Outcome	Diploma
Program	**2D Gaming and Classical Animation**
Location	Fredericton
Description	Students learn the necessary techniques for simplified animation, drawing, life drawing and character animation. They will be able to use both traditional and digital animation skills to make short animated films, and create games for mobile and console platforms.
Length	15 months
# of Seats Available per year	The maximum class size is normally 15 new entrants per year, but classes could be added to accommodate up to 30 students.
Outcome	Diploma
Program	**Game Design Program – Scripting and Production**
Location	
Description	The program covers the entire design and development process needed to take a game from concept to completion. Students will explore game design fundamentals such as game balance, motivation, narrative, semiotics, and production strategies. This is combined with technical skills to program games using middleware, script missions, and design levels. To support this, the student also learns to produce basic assets using images, audio, text, 3D models, and animation.
Length	15 months
# of Seats Available per year	The maximum class size is normally 15 new entrants per year, but classes could be added to accommodate up to 30 students.
Outcome	Diploma
Atlantica Centre for the Arts	
Program	**3D Animation**
Location	Saint John
Description	This program is a complete course starting from the ground up where the basic fundamentals are covered and honed in drawing, story boarding, life drawing, story telling and of course, classical animation. Students will create the foundation needed to truly excel in the program, and learn the fundamentals of digital design and 3D software, including modeling, texturing and animation. The second semester begins with advanced techniques and ends in the simulated production experience of 3D film making. The student learns advanced techniques in design, script writing, story boarding, 3D modeling, animation, special effects, lighting, and rendering.
Length	80 weeks
# of Seats Available per year	12
Outcome	Diploma
Program	**Graphic Design**
Location	Saint John

Description	Students will be guided through the principles of design, its history, and processes. They will be provided with a thorough understanding of the creative process, idea development, the design process, and production methods. Students will also learn the fundamentals of colour theory, typography, drawing, sketching, and illustration. They will be designing for 2D, 3D, web, printing, packaging, TV and publishing.
Length	48 weeks
# of Seats Available per year	12
Outcome	Diploma

Trades and Technology

New Brunswick Community College (NBCC)	
Program	**Electrical / Industrial**
Location	St. Andrews
Description	Industrial Electricians install, maintain, test, troubleshoot and repair industrial electrical equipment and associated electrical and electronic controls. The Industrial Electrician must be willing to work in a hands-on environment, as well use software for troubleshooting and calibration of equipment. Considerable time will be spent programming and troubleshooting equipment using computer software.
Length	One year (40 weeks)
# of Seats Available per year	20
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**CNC Machining**
Location	Moncton
Description	This program is designed to provide students with the skills and knowledge required for employment as computerized numerically controlled (CNC) machine programmers and operators. Students will learn to program, set up, troubleshoot and run advanced machine tools. This hands-on training, combined with the associated technical theory, will make graduates a valuable team member in a variety of metal working industries.
Length	Two years (80 weeks)
# of Seats Available per year	12
Outcomes	Diploma. Upon successful completion of this program, graduates are eligible to challenge Block III of the CNC Machinist license.
Program	**Machinist**
Locations	Moncton, Saint John
Description	Machinists set up and operate a variety of machine and hand tools to measure, cut, drill, form, shape, grind and finish metal, plastic or similar materials to make or repair parts or products with precise dimensions used in the manufacture and repair of mechanical devices, machines and equipment. This program trains students in the range of machinery and tooling available, and the methodology employed in their use.
Length	One year (40 weeks)
# of Seats Available per year	16 + 14 = 30
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Automotive Service Technician**
Locations	Fredericton, Moncton, Saint John

Description	This program introduces the student to the tools, shop equipment and systems needed to work in the motor vehicle repair trade. Students will learn how to diagnose, test, repair and replace some of the major systems and components in automobiles and light trucks. The will learn steering, suspension, brakes, engines, fuel, exhaust and electronics. The extensive changes in technology have caused a shift to electronics in vehicles, which allows for the sharing of information between computers, as well as the use of alternate fuel and hybrid technology.
Length	One year (40 weeks)
# of Seats Available per year	20 + 42 + 20 = 82
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Heavy Equipment Service Technician**
Locations	Miramichi
Description	The student will learn to diagnose, repair, adjust, overhaul, maintain, operate and test mobile, heavy duty off-road equipment.
Length	One year (40 weeks)
# of Seats per year	18
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Motor Vehicle Body Repairer / Painter**
Locations	Saint John
Description	Students will learn how to repair and restore damaged motor vehicle body parts and interior finishing components, repaint body surfaces and repair and replace automotive glass.
Length	One Year (40 weeks)
# of Seats per year	20
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Industrial Mechanic**
Locations	Miramichi, Saint John
Description	The student is introduced to metal processing, basic welding and cutting, sheet metal work, machine shop practices, maintenance and troubleshooting. They will progress from simple hand and machine processes to more exacting operations such as machining, fitting and reassembly. The trade theory and practical work of this program are supported by instruction in trade-related mathematics, physics, communications, blueprint reading, shop safety and basic metallurgy.
Length	One year (40 weeks)
# of Seats per year	16 + 16 = 32
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Steel Fabrication**
Locations	Moncton

Description	This Steel Fabrication program introduces students to the skills they need to layout, fabricate, assemble and erect steel frameworks, structures, containers and components using the cutting, forming and welding required in the steel fabrication trade.
Length	One year (40 weeks)
# of Seats Available per year	14
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Welding**
Locations	Moncton, Miramichi, St. Andrews, Saint John, Woodstock
Description	This program trains students with a technical understanding of arc welding, welding safety, arc welding power sources, electrode classifications and selection. The Welding program is designed to train students for the job market and prepare them to continue development through apprenticeship.
Length	One year (40 weeks)
# of Seats per year	16 + 28 + 20 + 15 + 16 = 95
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements. Students may challenge up to 4 CWB tickets – most will challenge at least one; Students also challenge the Class B – F3 certification from the Dept of Labour.
Program	**Welding Technology**
Locations	Moncton
Description	This program trains students to be a specialist or supervisor in the welding field. Graduates' main areas of responsibility will be the effective communication and application of welding technology and quality control procedures developed by welding and design engineers. Graduates will have a sound background in welding inspection, quality control, production procedures and metallurgical principles. In the first year of the program, students are trained in the basics of welding and steel fabrication. In the second year of studies, students receive specialized training in robotics, metallurgy, weld inspection methods, and weld design. The program includes on-the-job training in both years of the program.
Length	Two years (80 weeks)
# of Seats per year	12
Outcomes	Diploma. Graduates may acquire the following certifications upon meeting the external agencies' certification requirements: - CWB: Level 1 Welding Inspection Examination - New Brunswick Society of Certified Engineering Technicians and Technologists (NBSCETT): certification with two years of acceptable work experience
Le Collège communautaire du Nouveau-Brunswick (CCNB)	
Program	**Usinage à commande numérique (CNC Machining)**
Locations	Bathurst

Description	This program prepares students to operate automated, numerically-controlled equipment for the manufacture of precision mechanical parts. Prerequisite: certificate or diploma in material processing, tooling, industrial engineering technology, industrial maintenance technical training program or equivalent.
Length	One year (40 weeks), including an internship
# of Seats per year	8
Outcomes	Upon successful completion of this program, graduates are eligible to challenge Block III of the CNC Machinist license.
Program	**Usinage de matériaux (Material Machining)**
Locations	Bathurst
Description	This program prepares students for employment in machining techniques.
Length	One year (40 weeks), including an internship
# of Seats per year	14
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Mécanique de l'automobile (Automotive Mechanics)**
Locations	Bathurst
Description	This program prepares students for employment in the field of maintenance and repair of cars and light trucks. They will learn how to check equipment, diagnose problems, understand the cause of a failure, install new parts and make necessary adjustments.
Length	One year (40 weeks), including an internship
# of Seats per year	28
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Mécanique d'équipement lourd (Heavy Equipment Mechanics)**
Locations	Bathurst
Description	This program prepares students to work in the repair and maintenance of heavy equipment used in construction sites, forestry and mining. They will learn how to check equipment, diagnose problems, understand the cause of a failure, install new parts and make necessary adjustments. The program teaches the dismantling and reassembly of mechanical , electrical, electronic, hydraulic and fuel components.
Length	One year (40 weeks), including an internship
# of Seats per year	28
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Débosselage et peinture de carrosserie (Auto Body Repair and Painting)**
Locations	Bathurst
Description	This program prepares the student to perform repair, body work and painting of car body and trucks. The student will use hand and power tools to straighten, sand, polish, remove and replace body panels and chassis parts. They will also learn the use of welding equipment, and to utilize fiberglass for body sealing and repair.
Length	One year (40 weeks), including an internship

# of Seats per year	15
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Mécanique industrielle (Industrial Mechanic (Millwright))**
Locations	Bathurst
Description	The program in Industrial Mechanics (Millwright) provides students with the skills to do machining and installation of parts in a manufacturing environment. The student will learn to interpret drawings, specifications and technical documentation. They will also carry out lubrication, do manual machining and perform the work of cutting and welding.
Length	One year (40 weeks), including an internship
# of Seats per year	14
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Façonnage et montage métalliques (Metal Fabrication)**
Locations	Bathurst
Description	This program prepares students for the field of metal fabrication and assembly. They will manufacture, assemble and install various metal structures made with different types of metals. The student may use welding techniques, riveting and bolting, as required, to manufacture quality products.
Length	One year (40 weeks), including an internship
# of Seats per year	14
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Assemblage des métaux et des composites (Metal and Composites Assembly)**
Locations	Péninsule acadienne
Description	This program prepares students to work in the field of the fabrication and erection of steel structures and welding - or in the manufacturing industry utilizing composite materials.
Length	One year (40 weeks), including an internship
# of Seats per year	12
Outcomes	Certificate
Program	**Soudage (Welding)**
Locations	Bathurst, Edmundston, Péninsule acadienne
Description	This program prepares students for employment in the field of welding. It will apply the different techniques used in the welding industry, and will teach the techniques for the preparation and finishing of materials.
Length	One year (40 weeks), including an internship
# of Seats per year	28 + 15 + 12 = 55
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
Program	**Tuyauterie (Pipefitting)**
Locations	Bathurst

Description	In this program the student will learn to assemble, build, maintain and repair piping systems carrying water, steam, chemicals and fuel in heating, cooling, lubrication or other industrial processes. At the end of this training, the graduate will be able to perform tasks such as drilling, grinding, winding pipe and welding.
Length	One year (40 weeks), including an internship
# of Seats per year	14
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 1200 hours toward Block I work requirements.
BayTech College	
Program	**Welder**
Location	Moncton
Description	This welding program includes safety, tools and weld faults, oxy-fuel/plasma cutting, trade math, shielded metal arc welding (SMAW), flux core arc welding, gas metal arc welding/GMAW pulse, blueprint reading, introduction to fabrication, distortion control/jigs and fixtures, overview of applicable standards, productivity/employability skills, workmanship/material finishing and a work term.
Length	16 weeks
# of Seats per year	100
Outcomes	Certificate. Graduates may challenge the Apprenticeship Block I exam; credited 640 hours toward Block I work requirements. Students challenge 4 CWB tickets: Shielded Metal Arc Welding in flat and horizontal positions; and Flux Core Arc Welding in flat and horizontal positions.
Eastern College	
Program	**Industrial Electrician**
Location	Saint John
Description	The Industrial Electrician Diploma program at Eastern College is an extremely practical approach to learning the extensive skills required for success in the electrical trades. Under your careful monitoring, motors, generators, pumps, lighting systems, and associated controls must be installed, tested, inspected, and serviced to support critical commercial and industrial operations.
Length	28 weeks
# of Seats per year	36
Outcomes	Certificate. Students may challenge the Apprenticeship Block I exam; credited 1120 hours toward Block I work requirements.
Program	**Steel Fabricator / Welder**
Location	Saint John
Description	Through a combination of classroom theory and shop application, students will graduate from Eastern College with the knowledge and ability to layout, cut, prepare, join, and repair various metals in manufacturing and construction. Includes: safety; oxyfuel cutting and welding, brazing and braze welding; materials handling / rigging; SMAW; arc cutting and gouging; GMAW; weld faults; FCAW; SAW; blueprint reading; mathematics; Metric and Imperial Measurement; metallurgy; and heat treatment.
Length	28 weeks
# of Seats per year	36
Outcomes	Certificate. Students may challenge the Apprenticeship Block I exam; credited 1120 hours toward Block I work requirements. They may choose to seek

	employment and enter apprenticeship in either the Steel Fabricator or Welder trade.
Program	**Steamfitter / Pipefitter**
Location	Saint John
Description	Students will learn planning, assembling, installing, and repairing of industrial, manufacturing, and water treatment piping systems. These systems are used to transport essential materials including steam, water, air, gases, chemicals, solids, and fuel.
Length	28 weeks
# of Seats per year	36
Outcomes	Certificate. Students may challenge the Apprenticeship Block I exam; credited 1120 hours toward Block I work requirements.
ReadyArc Welding	
Program	**Pressure Welding**
Location	Saint John
Description	This program offers the skills needed for a beginner to achieve successful completion of an approved F4 Pipe Ticket along with Math Blueprint and Welding theory related to the trade.
Length	24 weeks
# of Seats per year	72
Outcomes	Certificate. Students challenge ASME: F3B Plate Test (4 Position); F3 Pipe Test (6G Position); and F3/F4 pipe Test (6G Position)).

Engineering Technology

New Brunswick Community College (NBCC)	
Program	**Electronics Engineering Technology: Industrial Electronics**
Location	Moncton
Description	Students will learn to configure and operate electronic systems and machinery of all sizes. They will learn industrial electronic applications including motor controls, power control and conditioning, opto-electronics, sensors and signal conditioning, programmable logic controllers, power generation and distribution systems.
Length	Two years (80 weeks)
# of Seats per year	20
Outcomes	Diploma. Graduates may acquire the following certifications upon meeting the external agencies' certification requirements: New Brunswick Society of Certified Engineering Technicians and Technologists (NBSCETT): certification with two years of acceptable work experience.
Program	**Electronics Engineering Technology: Telecommunications**
Location	Moncton
Description	Students will explore the convergence of voice, video and data in modern telecommunication networks. They will investigate broadcast, landline, optical fibre, satellite and microwave transmission techniques, while building engineering design and project management skills.
Length	Two years (80 weeks)
# of Seats per year	20
Outcomes	Diploma. Graduates may acquire the following certifications upon meeting the external agencies' certification requirements: New Brunswick Society of Certified Engineering Technicians and Technologists (NBSCETT): certification with two years of acceptable work experience.
Program	**Electronics Engineering Technology: Computer Systems**
Location	Saint John
Description	Students will learn electrical, electronic and digital circuits and devices, printed circuit board rework and repair, local and wide area networks, programming, fibre optics and microprocessors. They will learn to design, build, test, document and maintain electronic computer networking systems. This program may involve paid co-op work terms, if placements are available.
Length	Two years (80 weeks). For Co-op students, this may be extended by up to 12 months.
# of Seats per year	18
Outcomes	Diploma. Graduates may acquire the following certifications upon meeting the external agencies' certification requirements: New Brunswick Society of Certified Engineering Technicians and Technologists (NBSCETT): certification with two years of acceptable work experience.
Program	**Electronics Engineering Technology: Electronic Communication Systems**
Location	Saint John

Description	The program combines classroom theory, hands-on lab work, and co-op placements that introduce students to the real world of electronic circuit analysis and design. Master wireless and computer controlled systems while learning to design, build, test, document and maintain electronic, computer and telecommunication systems.
Length	Two years (80 weeks). For Co-op students, this may be extended by up to 12 months.
# of Seats per year	14
Outcomes	Diploma. Graduates may acquire the following certifications upon meeting the external agencies' certification requirements: New Brunswick Society of Certified Engineering Technicians and Technologists (NBSCETT): certification with two years of acceptable work experience.
Program	**Electronics Engineering Technology: Electronic Communication Systems**
Location	Saint John
Description	The program trains the student to provide technical support and services in the design, development, maintenance and testing of machines, components, tools, heating and ventilation systems. In the first year, the student will learn the basics of mechanical engineering technology. In your second year, they will learn advanced machine design, computer-aided drawings and specifications, building systems including HVAC, and engineering manufacturing operations and processes.
Length	Two years (80 weeks). For Co-op students, this may be extended by up to 12 months.
# of Seats per year	40
Outcomes	Diploma. Graduates may acquire the following certifications upon meeting the external agencies' certification requirements: New Brunswick Society of Certified Engineering Technicians and Technologists (NBSCETT): certification with two years of acceptable work experience.
Program	**Mechanical Technician**
Location	Saint John
Description	The program prepares the student for work in the industrial mechanical maintenance field. They will learn the basic functions of pipefitting, welding, rigging, electrical and machining. A hands-on learning environment allows the student to learn to install, assemble, maintain and commission mechanical, hydraulic, pneumatic, lubrication, cooling and exhaust systems in industrial plants. By combining the skills of an Industrial Mechanic with some of those of a Mechanical Engineering Technologist, this program provides the student with a unique learning experience. They receive specialized training in vibration analysis, non-destructive evaluation and computers. In addition, students will learn to prepare both written and oral reports on technical subjects.
Length	Two years (80 weeks). For Co-op students, this may be extended by up to 12 months.
# of Seats per year	16
Outcomes	Diploma. Graduates may challenge the Apprenticeship Block I exam; include three four-month work terms, which may be added to the apprenticeship work requirements, at the discretion of the employer.

Le Collège communautaire du Nouveau-Brunswick (CCNB)	
Program	**Technologie du génie électronique (Electronics Engineering Technology: Telecommunications)**
Location	Bathurst
Description	This program prepares the student to work in the specialized field of electronics, networking and telecommunications. They will install and repair computers as well as their networks. The student will learn how to maintain electronic and telecommunications systems, ensuring that all systems and components needed for the transmission of information by backhaul, optical fiber, satellite and microwave links are working properly.
Length	Two years (80 weeks), including an internship
# of Seats per year	24
Outcomes	Certificate. Graduates may acquire the following certifications upon meeting the external agencies' certification requirements: New Brunswick Society of Certified Engineering Technicians and Technologists (NBSCETT): certification with two years of acceptable work experience.
Program	**Technologie de l'instrumentation et de l'automatisation (Instrumentation Technology and Automation**
Location	Bathurst
Description	This program prepares students to work in the field of instrumentation, automation and industrial electricity. They will learn how to develop new control systems or to expand existing ones. The students will develop expertise in the areas of PLCs, metrology, automation, electrical, electronics, drawing, networking and electrical machinery.
Length	Two years (80 weeks), including an internship
# of Seats per year	16
Outcomes	Diploma. Graduates leave the course having written Block I exams (Electrical, Instrumentation) and credited with 1800 hours Block II work experience. Once they are hired they may immediately write the Block II exams, and then begin the work requirements for Block III.

Engineering

University of New Brunswick	
Program	**Bachelor in Mechanical Engineering**
Location	Fredericton
Description	Mechanical engineers work with systems that transform energy and material to useful ends. Combining the principles of physics with engineering, mechanical engineers design, develop and analyze machines, including: aircraft, automobiles, ships, spacecraft, industrial equipment, robotics, medical devices, heating and cooling systems.
Length	Four years
Avg. # of Graduates per year	50
Outcomes	BScE
Program	**Bachelor in Computer and Electrical Engineering**
Location	Fredericton
Description	Emphasis in this discipline is on the application of computers to solve real-world problems in many areas, from consumer electronics to power systems.
Length	Four years
Avg. # of Graduates per year	40
Outcomes	BScE
Université de Moncton	
Program	**Bachelor in Mechanical Engineering**
Location	Edmundston (first year), Moncton (remainder of years)
Description	The program includes components of thermo-dynamics, fabrication, robotics, fluids, acoustic vibration, and metals.
Length	Five years
Avg. # of Graduates per year	10
Outcomes	B.Ing
Program	**Bachelor in Electrical Engineering**
Location	Edmundston (first year), Moncton (remainder of years)
Description	The program is divided into three principal domains: electronics, communications and electrical technology.
Length	
Avg. # of Graduates per year	10
Outcomes	B.Ing

Information Technology and Science

New Brunswick Community College (NBCC)	
Program	**Information Technology: Internet Application Development**
Location	Moncton
Description	This concentration is designed to provide students with the skills to design, build and deploy internet/intranet based applications that can be implemented in areas such as e-commerce, business management, client maintenance and employee support.
Length	Two years (80 weeks)
# of Seats Available per year	20
Outcome	Diploma. Graduates may write exams that can lead to industry credentials, such as MCPD (Microsoft Certified Professional Developer) and MCITP (Microsoft Certified IT Professional).
Program	**Information Technology: Business Analyst**
Location	Fredericton
Description	The Information Technology: Business Analysis program is designed to bridge the gap between the business and information technology (IT) operations within an organization. Graduates gain the skills needed to analyze, identify and document a business or stakeholder's needs as well as plan, manage and monitor the proposed solutions. Students are equipped with the ability to model data, processes and to write use cases. Graduates of the program will be able to assess the organization's readiness for change and plan a strategy to make that change happen. Prerequisite: any post-secondary degree
Length	One year (40 weeks)
# of Seats Available per year	16
Outcome	Diploma
Program	**Information Technology: Programmer Analyst**
Location	Fredericton, Saint John
Description	Students learn essential IT skills as well as strong business programming skills during their first year. In year two, students will work in small groups to develop a systems project that they will program in their final academic term. This project incorporates all of the programming and analysis skills developed over the two years. This program may involve paid co-op work terms through the Saint John location if placements are available. This will extend the length of the program.
Length	Two years (80 weeks)
# of Seats Available per year	20 + 30 = 50
Outcome	Diploma

Program	Information Technology: Network Support
Location	Moncton, St. Andrews
Description	The Network Support program has students building, maintaining and upgrading peer-to-peer and client-server networks; applying network security protocols, and learning how to support desktop and server computer systems.
Length	One year (40 weeks)
# of Seats Available per year	16 + 20 = 36
Outcome	Certificate
Program	**Information Technology: Network Administration**
Location	Moncton
Description	The Network Administration program builds on the foundation of the IT: Network Support program, offering training in advanced network operating systems, network infrastructure and administration and server systems. Students also prepare to achieve industry certification.
Length	Two years (80 weeks)
# of Seats Available per year	20
Outcome	Diploma
Le Collège communautaire du Nouveau-Brunswick (CCNB)	
Program	**Technologie de l'informatique : programmation et analyse (Information Technology: Programming and Analysis)**
Location	Bathurst
Description	This program focuses on the acquisition of technical knowledge and skills to develop software on various platforms such as microcomputers, networks, internet and mobile devices like smart phones. It teaches the skills needed to design and build efficient and secure solutions for business today. Training in a software development environment, computer equipment and state-of the-art operating systems will facilitate the rapid integration of the person at any team of developers.
Length	Two years (80 weeks), including an internship
# of Seats Available per year	30
Outcome	Diploma
Program	**Technologie de l'informatique: réseautique et sécurité (Networking and Security)**
Location	Bathurst
Description	This program teaches knowledge and skills in computer technology and focuses on expertise in installation and network management. It develops the skills necessary to adapt the technology to the needs of users, act as administrator, ensure the planning of communication systems in the enterprise, ensure the security of the information and take responsibility for establishing security policies. It also teaches the skills to repair and deal with software installation. Finally, it promotes rapid integration into the labour market by strongly emphasizing human relations skills in the provision of customer service, the ability to take on responsibilities and the ability to make decisions.
Length	Two years (80 weeks), including an internship
# of Seats	30

Available per year	
Outcome	Diploma
Centre for Arts and Technology	
Program	**Web Program Specialist**
Location	Fredericton
Description	The Web Programmer Program in Fredericton is a six month training program that is designed by professional web programmers. This program will provide the student with knowledge and skills to develop interactive content on the web as well as for mobile devices. The student will develop skills in Java, HTML, Python, Javascript, CSS, L.A.M. programming (server-side) and design sensibility, as well as PHP, Ruby on Rails, CSS and interface design.
Length	Six Months
# of Seats Available per year	24
Outcome	Certificate
Program	**Network Security Administrator**
Location	Fredericton
Description	The program offers training to all tech-savvy individuals who want to specialize in network security. The training program covers hardware, networking, desktop support, network systems, system administration, system automation, network architecture, network infrastructure and computing. Students who wish to continue training have the option to move on to the Advanced Network Security Specialist Program. The program offers several certification options for students. These include: Microsoft Certified IT Professional (MCITP) on Server Administration, CCNA, Microsoft Certified Technology Specialist (MCTS), MCITP on Enterprise Administration and Managing, Linux+, Security+, Network+, CEH, CPT and LPI. Graduates will be given vouchers allowing them to challenge the appropriate certification exams.
Length	9 months
# of Seats Available per year	24
Outcome	Certificate
Program	**Network Security Specialist Professional**
Location	Fredericton
Description	This program includes perimeter security, data communication and networks, hands-on network exploits, operating systems, computer forensics, vulnerabilities, penetration testing and encryption. Prerequisite: Network Security Administrator Certificate
Length	9 months
# of Seats Available per year	Not available
Outcome	Diploma
University of New Brunswick - Fredericton	
Program	**Bachelor in Computer Science**
Location	Fredericton
Description	The Bachelor of Computer Science (BCS) degree will teach students the

	fundamentals of Computer Science. They will learn how to design and build innovative computer applications, helping to solve problems in all areas of life. The students will develop their creativity, teamwork, and leadership skills, and dream up new ways for connected computing to improve the way we live.
Length	Four years (Five years for Co-op students)
Avg. # of Graduates per year	25
Outcome	B.CS
Program	**Bachelor of Information Services**
Location	
Description	The program will teach the student how to develop and manage the technology and information systems required to support a modern business. They will also learn key business skills such as marketing, finance, accounting and management. The program will teach the student information technology fundamentals in hardware, software, networking and databases as well as information systems design and development methodologies and practice.
Length	Four years (Five years for Co-op students)
Avg. # of Graduates per year	3 (newer program)
Outcome	B.ISys
Program	**Bachelor of Science in Software Engineering**
Location	Fredericton
Description	The Bachelor of Science in Software Engineering (BScSwE) will teach students to develop and maintain reliable, safe and efficient software systems, enabling them to work on complex projects with safety-critical applications, such as those found in the aviation, medical and energy industries.
Length	Four years (Five years for Co-op students)
Avg. # of Graduates per year	9
Outcome	B.Sc.SwE
Program	**Certificate in Software Development**
Location	Fredericton
Description	Designed especially for working adults, the Certificate in Software Development will provide the student with the formal background necessary to become a more effective participant in the Information and Communication Technology industry.
Length	16 months (part-time); An optional four month work term for students in the certificate program is available, subject to certain regulations.
Avg. # of Graduates per year	5
Outcome	Certificate
Program	**Bachelor of Science in Software Engineering**
Location	Fredericton
Description	A relatively new field, software engineers perform a number of tasks including design, development (or construction), testing, maintenance, systems management and the adaptation of software to address regional and language differences, also known as software localization.

Length	Four years
Avg. # of Graduates per year	3
Outcome	B.Sc.SwE. students graduating from the program will be eligible for registration as a Professional Engineer and an Information Systems Professional.
University of New Brunswick – Saint John	
Program	**Bachelor in Computer Science, Networking and Software Engineering**
Location	Saint John
Description	This program is accredited by the Canadian Information Processing Society (CIPS), leading to a Bachelor of Science in Computer Science (BScCS). Students can specialize in networking as well as software engineering.
Length	Four years
Avg. # of Graduates per year	10
Outcome	B.Sc.CS
Program	**Certificate in Computing**
Location	Saint John
Description	This certificate program is designed to provide individuals, especially working adults, with an opportunity to acquire the formal background necessary to become effective participants in the Information Technology Industry.
Length	16 months (part-time)
Avg. # of Graduates per year	0
Outcome	Certificate
Program	**Bachelor of Information Services**
Location	Saint John
Description	The Bachelor of Information Sciences (BISc) program is by design an interdisciplinary program involving core courses taken primarily from Business Administration, Computer Science, Economics, Mathematics and Statistics. The core subjects are particularly relevant to the collection, treatment, understanding and management of data (information) encountered in other academic disciplines. Emphasis is placed on the statistical methods and modern computing techniques of handling these data, the design and application of mathematical models, and the management of information within organizations.
Length	Four year
Avg. # of Graduates per year	0
Outcome	B.ISc
Mount Allison University	
Program	**Bachelor of Science, Computer Science**
Location	Sackville
Description	This program offers a broad variety of courses and programs in Computer Science. Introductory courses may teach programming and theories of computing or offer a general overview of the use and application of popular microcomputer software; more advanced courses deal with topics ranging from artificial intelligence and the role of computers in society to the design and implementation of advanced hardware or software systems.

Length	Four years
Avg. # of Graduates per year	5
Outcome	B.Sc.CS
Université de Moncton	
Program	**Baccalauréat en gestion de l'information (Bachelor in Information Management)**
Location	Shippagan
Description	This program includes system management, communication/information management, knowledge-based systems, etc. Coursework includes: information security, multi-media, client-server applications, simulation technologies, and architecture.
Length	Four years
Avg. # of Graduates per year	11
Outcome	B.GI

Appendix D: Bibliography

Aerospace and Defence

Arizona State University. *The Arizona Aerospace and Defence Database Glossary.* Apr. 2012

Atlantic Canada Opportunities Agency (ACOA). *Aerospace and Defence Industry in Atlantic Canada.* Nov. 2012

Atlantic Canada Opportunities Agency (ACOA) and the Aerospace and Defence Industries Association of Nova Scotia (ADIANS). *Sector Trade Study for: The Aerospace and Defence Industries of Nova Scotia.* Jan. 2002

Canadian Defence Review. *Ontario's Aerospace & Defence Industry.* June 2010

Greater Halifax Partnership. *Aerospace and Defence.* Sep. 2012

Industry Canada. *National Aerospace and Defence Strategic Framework: 2005-2025.* 2005

New Brunswick Aerospace and Defence Association (NBADA). *New Brunswick Aerospace & Defence Capabilities Guide: 2012.* 2012

PriceWaterhouseCoopers (PWC). *Aerospace & Defence 2011 year in review and 2012 forecast.* 2012

Defence and Security

KPMG. *Economic Impact of the Defence and Security Industry in Canada*. May 2012

Aerospace

Aéro Montreal. *Profile of the Aerospace Industry.* Sep. 2002

Aerospace Industries Association of Canada (AIAC). *Guide to Canada's Aerospace Industry: 2012-2013.* 2012

Aerospace Industries Association of Canada (AIAC). *The State of the Canadian Aerospace Industry: Performance 2011.* July 2012

Canada 2020. Conference Report: *Taking Flight: Making an Ontario Aerospace Cluster a Reality.* June 2012.

Canadian Aerospace Associations Human Resources Alliance (CAAHRA). *Canadian Aerospace Human Resources Strategy.* Mar. 2008

Canadian Aviation Maintenance Council (CAMC). *A Human Resources Study of the Canadian Aviation Manufacturing and Maintenance Industry*. Nov. 2002

Canadian Centre for Policy Alternatives (CCPA). *Search and Replace: The Case for a Made-in-Canada Fixed-Wing Search and Rescue Fleet.* June 2012

Canadian Council for Aviation & Aerospace (CCAA). *Skilled Labour in the Canadian Aerospace Manufacturing Sector*. Mar. 2012

Canadian Council for Aviation & Aerospace (CCAA). *CCAA 2012 Forum Presentation: Robert Donald.* Oct. 2012

CAW-Canada. *Aerospace Sector Profile.* 2012. www.caw.ca

Deloitte. *AIAC Report Executive Summary: The Strategic and Economic Impact of the Canadian Aerospace Industry*. Oct. 2010

Deloitte. *AIAC Report Phase 1: Profile of the Canadian Aerospace Industry*. Oct. 2010

Deloitte. *AIAC Report Phase 2: Impact of the Canadian Aerospace Industry*. Oct. 2010

Deloitte. *AIAC Report Phase 3: Global Aerospace Market Outlook and Forecast*. Oct. 2010

Industry Canada. *Aerospace Review, Vol. 1: Beyond the Horizon: Canada's Interests and Future in Aerospace.* Nov. 2012. Review Head: the Hon. David L. Emerson. www.aerospacereview.ca[100]

Industry Canada. *Aerospace Review, Vol. 2: Reaching Higher: Canada's Interests and Future in Space.* Nov. 2012. Review Head: the Hon. David L. Emerson. www.aerospacereview.ca

Nova Scotia Dept. of Labour and Workforce Development. *Labour Market Analysis for the Nova Scotia Aerospace and Defence Industry.* April 2009

Province of New Brunswick. *New Brunswick Aerospace and Defence Sector Strategy: 2012-2016.* 2012

Sherwood, Blair and Prentice, Barry. *Airship Logistics Centres: The 6th Mode of Transport.* June 2010, presented at the Canadian Transportation Research Forum

Ryerson Institute for Aerospace Design and Innovation. *A Research Assessment Report on Integrated Technology Demonstration & the Role of Public Policy.* July 2012

Defence

Berkok, Ugurhan; Penney, Christopher; and Skogstad, Karl. *Defence Industrial Policy Approaches and Instruments.* July 2012

Department of National Defence, Canada. *Canada First Defence Strategy.* June 2008

Jenkins, Tom; Special Adviser to the Minister of Public Works and Government Services. *Canada First: Leveraging Defence Procurement Through Key Industrial Capabilities.* Feb. 2013

Public Works and Government Services Canada. *Canada First: Leveraging Defence Procurement Through Key Industrial Capabilities*. Feb. 2013

Security

Canadian Association of Defence and Security Industries (CADSI). *A Primer: Learn More about the Canadian Public Safety and National Security Market.* 2012

[100] Many excellent background and working group reports can be found at www.aerospacereview.ca.

Ecorys Research and Consulting. *Study on the Competiveness of the EU Security Industry.* Nov. 2009

U.S. Department of Justice. *The Private Security Industry: A Review of the Definitions, Available Data Sources, and Paths Moving Forward*. Dec. 2010

Space

Canadian Space Agency. *State of the Canadian Space Sector 2011: Policy and External Relations*. 2012

Canadian Nanosatellite Workshop 2012 (CNW 2012) Organizing Committee. *Small is Beautiful: Report from the 1st Canadian Nanosatellite Workshop (CNW 2012).* Apr. 2012

General

Labour Market Analysis Branch (LMAB); Post-secondary Education, Training and Labour (PETL). *Profile of the New Brunswick Labour Force.* Nov. 2012

Labour Market Information (LMI) Division, New Brunswick; Human Resources and Skills Development Canada (HRSDC). *Labour Market Bulletin – New Brunswick, Annual Edition 2012.* 2012

Websites

Aerospace Association of Prince Edward Island (APEI). www.apei.ca

Aerospace and Defence Industry Association of Newfoundland and Labrador (ADIANL). www.adianl.ca

Aerospace and Defence Industries Association of Nova Scotia (ADIANS). www.adians.ca

Aerospace Review. www.aerospacereview.ca

Aerospace Industries Association of Canada. http://www.aiac.ca

Atlantic Alliance of Aerospace and Defence Associations. www.aaada.ca

Canadian Aeronautics and Space Institute (CASI). www.casi.ca

Canadian Aerospace Industry Capabilities Directory. www.aero-canada.ca

Canadian Association of Defence and Security Industries (CADSI). www.defenceandsecurity.ca

Canadian Council for Aviation & Aerospace (CCAA). www.avaerocouncil.ca

Canadian Defence Review (CDR). www.canadiandefencereview.com

Canadian Space Agency. www.asc-csa.gc.ca

Canadian Space Commerce Association (CSCA). spacecommerce.ca

New Brunswick Aerospace and Defence Association (NBADA). www.nbada.ca

The Security Industry Association (SIA). www.siaonline.org