Education and Training Supply for the Aviation and Aerospace Sectors in Ontario: A Strategic View

April 2003

Ontario Aerospace Council

The Ontario Aerospace Council (OAC) is an incorporated, not for profit organization established in 1993 as a mechanism to enable Ontario aerospace companies to come together to identify issues, opportunities, and challenges for the industry, and to work collaboratively in developing and implementing strategic initiatives that respond to these, for the betterment of all Ontario aerospace companies and employees, and of the Ontario aerospace industry. OAC has approximately 110 member companies, representing all sub-sectors of the industry and firms of all sizes, who collectively employ approximately 2/3 of the 26,000 aerospace employees in Ontario.

OAC has worked with CON*NECT and several colleges since 1995 to develop and deliver training initiatives to many Ontario aerospace employees, and partnered with CON*NECT to sponsor and direct this project.

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CON*NECT

The Colleges of Ontario Network for Education and Training (CON*NECT) was established in 1994 by the Presidents and governors of Ontario's community colleges to provide industry and government with convenient access to the educational resources of the Colleges through strategic alliances. CON*NECT operates as a division of the Association of Colleges of Applied Arts and Technology of Ontario (ACAATO) representing the 24 colleges which offer programs in 200 communities across the province.

CON*NECT staff have worked with the Ontario Aerospace Council (OAC) and other representatives of the aerospace industry since 1995 on a number of research and training initiatives, and partnered with OAC to sponsor and manage this project.

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About this report

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Executive Summary

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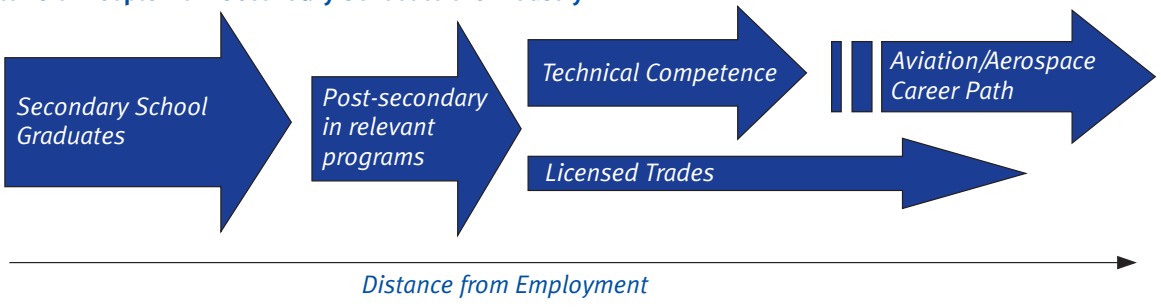
- This study is designed to suggest practical actions that can be taken by the provincial education system and aviation/aerospace industry to bridge skill gaps. As the terms of reference say: "success...will be gauged by subsequent actions taken by the Ontario aerospace industry and Ontario educational institutions to bridge the gaps."
- Because the human resource issues facing the aviation and aerospace sectors are often shared with other industries, anyone interested in understanding these issues and ways to address gaps may find the report instructive.
- This report takes a *strategic approach*. With modification, this approach is applicable to many industries.
- Previous studies in this area have tended to focus specifically on shortages as defined by the manufacturing and maintenance sub-sectors. In these studies, gaps emerge because the human resource pipeline under certain growth scenarios is not large enough.
- The current study recognizes that the size of the human resource pipeline is actually a function of a broader range of factors and the actions of a variety of stakeholders. Therefore, in this study we try to define a strategic framework that considers the motivations and constraints of these players, which include industry, students/employees, educational institutions, regulators and accreditors.
- Each of these stakeholder groups has its own dynamics, motivations and strategies for getting what it wants out of the labour market. Where there are common interests, there is room for co-operation to deal with gaps. But it is important to be aware of the underlying forces that drive gaps and to be realistic about the context in which co-operation can work.
- Gaps will emerge because it is difficult to co-ordinate the dynamics of stakeholders with the industry demands. Economists call this problem "asynchronous information" — all the players do not have the same information to act upon or even the same motivations for acting.
- We have identified three kinds of gaps:
  - people
  - competencies
  - capacity of the education and training system
- In a nutshell, the main strategic thrust of the report is to increase the number of people emerging from secondary school that might pursue educational and career pathways within the aerospace sector. Once this base of people is established, the role of the higher education and training system is to organize capacity to develop competencies in line with career paths (Exhibit 1).

Exhibit 1
Flows of People from Secondary School to the Industry



- A key methodological feature of this study was the active engagement of its steering committee in the research process (see Acknowledgements). While the committee was instrumental in facilitating the interview process, its members were also actively engaged in discussing and adding to the key findings emerging from the research.
- At the steering committee meeting of April 3, 2003, members reviewed and discussed the findings of this report.
- Members were asked what specific actions they would be willing to take to support the strategy of developing career pathways that would attract more people to the aviation/aerospace sectors.
- The steering committee came up with a number of suggestions for action. These actions were grouped based on their common strategic thrust. Members then volunteered to serve on teams to advance the strategic agenda. The result of this exercise is captured in Exhibit 2.

Exhibit 9
Steering Committee's Ideas for Action

Main Action	Sub-Actions
Bridge the Gaps Between • Customer needs • Industry needs • Education and training	• Competencies – General vs. Specific • Refine understanding of demand • Provide training and education for management • Produce more Transport Canada inspectors • Expand partnerships between education and industry to produce new programs • Improve global perspective of learning and develop capacity to reach global markets • Create a laddering mechanism
Create education and training capacity	• Create capacity through co-operation among companies on shared competencies • Refine understanding of demand • Provide training and education for management • Produce more Transport Canada inspectors
Build Strategic Alliances	• Build alliances between aviation/aerospace and other sectors • Work with Canadian Aviation Maintenance Council (CAMC), HRDC and industry to facilitate federal/provincial linkages • Build alliances between educational organizations across Canada
Improve the policy and regulatory environment	• Work with federal and provincial governments to ensure effective industry policies • As specific initiatives emerge, make sure that government policies support these initiatives • Draw on government assistance to resource initiatives
Communicate more effectively with all stakeholders	• Promote career paths to students • Communicate ways in which immigrants and re-entry workers can get into the industry • Develop communication to support strategic alliances and other initiatives
Improve recognition of learning	• Create a laddering mechanism • Reach out to immigrants and improve global perspective of both education and industry • Work on standards and make them transparent

Chapter 3
Overview of the Report

- The study uses a broad definition of the aviation and aerospace industry. Going beyond the traditional definition of aircraft manufacturing and maintenance sector, this study includes six industry sub-sectors:
  1. aircraft and aircraft systems design, development and manufacture
  2. maintenance, repair and overhaul (MRO)
  3. air navigation systems, air traffic control systems operation
  4. air carrier operations
  5. airport operations
  6. air regulatory functions

- The main methodology comprised personal interviews with representatives of educational institutions and the portion of the aviation and aerospace industry that undertakes training. There were four streams of interviews:
  1. educational institutions
  2. aviation/aerospace companies
  3. Transport Canada
  4. experts on other jurisdictions

- A second aspect of the methodology was a review of existing data and literature. This review was used to determine areas of demand and the underlying factors contributing to growth in the demand for skilled labour. It was also used to ascertain best practices in other jurisdictions.
- The emphasis of this study is on *skilled* labour, as it creates a demand for higher education and training. Pilots are not included in the study.
- Ontario students have some leeway to select the skill sets that they will develop.
- Although most young people will not be in a position to decide what career they want to pursue in secondary school, many will tend toward accumulating skills and credentials that give them maximum flexibility to respond to a changing labour market.
- The tendency, therefore, is to pursue more generalized credentials — in the arts, business, and computer sciences — that are widely applicable to many different work settings and have a certain level of social acceptance.
- Men overwhelmingly dominate trades and technical careers in the manufacturing and MRO parts of the industry. As such, women may not see a future for themselves in aviation and aerospace — a fact that effectively cuts the manufacturing and MRO side off from half of the potential labour force.
- The trend in recent years has been for young people to accumulate more education but less work experience up to the age of 24. This means that employers do not have an opportunity to gauge and develop the soft (or employability) skills of young workers, and young workers do not have chance to experience the world of work that would help them decide which careers to pursue.
- Once individuals have made a commitment to pursuing industry-specific credentials, they have also effectively made a choice about the job that they will take and, indeed, the career that they will develop.
- A big part of the human resource challenge is to develop a pool of people who are inclined to develop the core technical skills relevant to parts of the industry. This, then, is about presenting people with a career pathway as opposed to an end point.

- The human resource challenge is somewhat different for those who have already secured work experience in the industry. These people will have accumulated applied skills while on the job.
- In the new *secondary school* curriculum, technical education is given a broader scope beyond "shops." Expanded technical programming provides a solid basis for reaching secondary school students.
- Ontario's Ministry of Education estimates that some 300 thousand students will be enrolled in technical courses in 2002-2003. One stream now deals specifically with transportation technology.
- Interestingly, secondary schools are also being given the option to add additional semesters in technical streams where a case can be made for responding to local demand.
- Industry has typically relied on *colleges of applied arts and technology* to develop its skilled entry-level employees, especially in the trades and technical occupations. Colleges are motivated to provide students with job skills.
- Colleges are given a financial incentive that is largely driven by short-term success in the labour market, as measured by employment rates and the satisfaction of employers and graduates.
- Colleges will only expand capacity if students are applying for existing programs. They have shown themselves willing to expand programs when student demand is high.
- The *universities* tend to focus on highly skilled employees and managers.
- In professional disciplines like engineering, there is relatively little need to worry about the employment prospects of graduates, as there is plenty of evidence that these graduates are in high demand.
- Both colleges and universities operate in a highly regulated and publicly funded environment. As such, governmental decisions on education policy (e.g., access) and financing have major implications for what individual institutions decide to do.
- Colleges and universities have attempted to shield themselves somewhat from government funding decisions by developing non-subsidized programs.
- Another key part of the learning infrastructure in aviation is NAV CANADA in its role as educator, employer and trainer. Its challenge is to ensure that it manages the need for newly accredited air traffic controllers, flight service specialists and technicians to its own needs.
- The public continues to demand a transportation sector that is among the safest in the world.
- Transport Canada has made the strategic decision to manage the new safety challenges through a performance-based model.
- Transport Canada is recognized as a world leader in aviation regulation and safety management.
- Transport Canada has moved from owner-operator-regulator to a regulatory agency that inspects and audits facilities owned and operated by others.

  Many previous functions have been devolved to outside entities.

- Increased commitment to safety has obvious implications for the organization of education and training. It is far more likely that a safety module will have to be incorporated into the training regimen of virtually every employee in the industry.
- For Transport Canada employees, increased attention to safety means that the core staff has to be educated to manage regulation within the new paradigm.
- Many parts of the industry are also organized around quality management systems in which it is more important to produce a consistent, customer-defined quality than it is to produce cheaply on a large scale. As technology and customer needs change, it is vital to be able to adjust the workforce to meet these needs.
- These trends in the management of safety and quality have potentially profound implications for the nature of accreditation, credentials and licenses.
- The vast majority of workers in the aviation and aerospace industry do not require licenses to perform their jobs. Indeed, the manufacturing side makes most of their annual hires from non-certified technicians.
- Parts of the industry, however, will continue to require licenses to either perform certain tasks or be allowed to effectively sign off on safety standards set by Transport Canada.
- What is the role of accreditation and credentials in this system?
  - Employers will be increasingly interested in employees who have a good core set of *technical skills* and the adaptability to adjust to new circumstances as work processes change to manage new products and services.
  - Employers are likely to be equally interested in so-called employability skills that speak to a person's ability to learn on the job and work well with fellow employees and customers. There is currently no system in place for credentialing these skills, other than employers' human resource systems.
  - Established employees will demand learning opportunities to improve their long-term career prospects. Some of this learning will be credentialed, while some will be on-the-job training that is not. Either way, the employee will want to demonstrate to current and prospective employers a certain level of technical proficiency and adaptability to new circumstances.
- The above-mentioned employer and employee expectations have implications for the relative weight between *macro and micro* credentials. A macro credential is a certificate, diploma or degree that typically takes a long time to complete (eight months or more). Micro credentials are certificates of learning that respond to short-term needs for skill upgrading. Completed in as little as a week up to eight months, these certificate programs typically focus on specific competencies to do specific tasks.
- When well designed, a competency-based micro credentialing system is entirely consistent with a macro credentialing system. But for organizational reasons, these systems may not mesh.
- The mix between micro and macro credentialing is being changed by the need for more flexibility by both employers and employees. Employees want the freedom to move between jobs with an employer, or even between employers. Employers want employees who can adapt to changes in customer needs.

- The rather broad definition of employers used in this study makes it difficult to generalize about their approach to human resources. Each sub-sector has very different industry dynamics that affect which issues the industry is likely to face in the labour market and how it views the education and training system. Sub-sectors have different issues with respect to skills but also in terms of replacement rates due to aging and retirement.
- Based on our survey, retirements would appear to be the biggest issue for Transport Canada, airports and, to a lesser extent, manufacturing/MRO (maintenance, repair and overhaul).
- The labour market of the *aircraft and aircraft systems design development and manufacturing sub-sector* is typical of a globally integrated, heavy capital goods industry.
- The manufacturing industry structure means that employment flexibility is at a premium and that relatively few employers will be of sufficient scale to undertake significant in-house training.
- The *maintenance, repair and overhaul* sub-sector differs somewhat from the manufacturing side. Its business cycle is more akin to a capital service business.
- *Air carrier operations* also have a reputation for instability. This is primarily because scheduled airlines have typically operated on a knife-edge of profitability.
- *Airports* are more a pure service business that relies on aircraft movements and passenger volumes.
- The *air traffic and navigation sub-sector* is tightly managed by NAV CANADA, which runs the air traffic system and also trains to Transport Canada specifications for air traffic controllers and flight service specialists. NAV CANADA's human resources are geared toward aircraft movements at airports: it is effectively the monopoly supplier of air traffic controllers and air navigation system personnel in Canada. Graduates of NAV CANADA training are virtually assured of secure, albeit stressful, employment.
- Ontario's *air transport regulatory system* runs in a manner very similar to other regulatory services in Canada. Like NAV CANADA, it offers stable employment and has a significant in-house training capacity. Although the employment environment of the public sector is stable and offers excellent pension benefits, these characteristics make the looming retirement of the baby boom generation somewhat more problematic for the regulatory system.
- To summarize, five factors distinguish the dynamics of the sub-sectors:
  1. nature and conditions of employment
  2. risk of retirements that will require replacement
  3. need for formal credentials and licenses
  4. capacity to invest in training
  5. reliance on outside providers for education and training versus provision of in-house training

Chapter 4
Demand Outlook

- The study generates order of magnitude estimates of the size and distribution of the skilled workforce for each sub-sector. It then undertakes a situational analysis as to the factors that will affect these top-line estimates over time, focusing on the risk of gaps forming.
- The main driver of long-term performance in the industry is overall economic growth — in particular, personal disposable income.
- After two years of lacklustre growth, Ontario should resume medium-term growth of about 3 per cent per annum.
- About 55 per cent of the entire aviation and aerospace workforce requires higher education. We found roughly 14,824 positions in the six industry sub-sectors for a coverage of about half of all skilled (non-pilot) positions. These occupations are also organized by major sub-sector.
- Our survey asked whether industry saw its skilled workforce as expanding, contracting or staying the same. Most industry employers expect to hold steady in the next year.
- Applying projected growth rates to employment levels generates a flat outlook for all aspects of the industry. Expansions and contractions are of roughly the same magnitude and the majority of employers expect a holding pattern on employment levels.
- Companies that are recruiting concentrate in the manufacturing/MRO sub-sector. Within this, aircraft maintenance engineers (AMEs), component technicians and aviation machinists received the most mentions for recruitment. The high number of AMEs suggests that even beyond Air Canada there are plans for expanding the maintenance part of the industry.
- Both the review of the literature and the survey of the industry point to the same trend: an essentially flat short-term outlook and an uncertain medium- to long-term outlook. This longer-term outlook is somewhat more predictable for those parts of the industry that are primarily dependent on provincial economic growth — airport operations, air carrier operations (outside of maintenance) and air traffic control and navigation services. These industries' long-term growth trends will tend to mirror overall provincial growth. In the longer term, they will also have to deal with structural issues like technological change and an aging workforce.

- Supply is created through three mechanisms (Table 1):
  - companies upgrading their employees to respond to emerging demands
  - new recruits, either from other companies or graduates of post-secondary educational institutions
  - immigration
- Each of the three sources of supply has its own implications for the education and training system.

Table 1
Survey Findings
What percentage of new entrants to this position comes from...?
(Selected Aviation and Aerospace Occupations, n=45)

	New Graduates		Experienced		New Ontarians
Occupation	**Community College**	**University**	**Within Company**	**Another Company**	**Immigrants**
Aerospace Engineer	1	24	16	58	1
Manufacturing Technician	10	1	40	46	3
Aviation Machinist	22	3	17	51	7
Aircraft Maintenance Engineer	26	0	1	73	0
Avionics Technician	30	0	4	62	4
Maintenance Technician	28	0	4	65	3
Aviation Machinist	19	2	5	69	5
Air Carrier Manager					
Airport Operations Manager	5	15	73	7	0
Assembler	5	0	7	63	25

Source: Survey Findings

- The education and training system creates supply by developing knowledge and competencies. Some of these competencies are developed through formal education and others through workplace training.
- At the *university* level, there are some advanced engineering courses geared toward the design part of the industry.
- *Colleges of applied arts and technology* offer two types of programs that relate to the industry:
- Programs closely aligned to specific occupations: this is the tendency in aerospace and aviation trades and licensed trades, most of which are formally supplemented by additional work experience.
- Programs where aviation is added as an option: these tend to be arts or management programs with optional pilot training.
- The vast majority of university and college programs produce highly skilled people who are likely to be in demand by the industry. On average, it takes five semesters to complete a program, with most college programs taking four semesters and most university programs taking eight semesters.

- Courses of interest to Transport Canada for safety management systems and inspections were assessed separately. This survey found that 12 colleges offer the sort of base training required for safety inspectors, including courses on communication skills, office technology and basic risk assessment. Colleges also offer more specialized training in areas such as safety management evaluation (8 colleges), safety management systems (10 colleges) and organizational awareness (12 colleges). These courses are not specifically geared to Transport Canada requirements, as they are components of programs targeted to different occupations.
- The majority of programs do, indeed, prepare people to go to work in the industry — but other paths are also possible. For instance, people with degrees who are qualified to work in the engineering and design part of the industry may actually choose to work in another industry.
- Colleges, in particular, plan to aggressively expand many areas that are directly relevant to the needs of the industry. Most noteworthy are planned expansions in programs for various types of managers,
  AMEs and maintenance technicians.
- Overall industry demand is actually more variable than the outflows of people from educational institutions. As such, graduates who enter the labour market during a downturn end up doing something else — either continuing their education or working outside the industry.
- Whether graduates find immediate work or have to wait, they will still require some company-specific training.
- Surveyed employers plan to spend about $14 million a year on training. To put this into context, this annual training effort is about the same as that made by the college system. The difference is that the training is applied to fewer people than is college education. Also, this training is focused on specific competencies needed to perform jobs. At least five thousand aviation and aerospace employees in Ontario benefit from this type of training annually.
- The study clearly supports other research that pinpoints learning on the job as a very important element to employers when considering employee development. Indeed, the employer findings can be interpreted thus: the further the source of supply is located from the workplace, the less valuable the training is.
- Employers place a very high premium on programs that they design to address workplace needs.

Chapter 6
How Does Mobility Affect Supply?

An oft-heard complaint from the industry is that companies have difficulty finding and retaining skilled employees. The mobility of skilled people has a direct impact on this question. We are interested in two types of movement:

1. inter-firm mobility
2. geographic mobility

- The aviation/aerospace sector is not especially unique in terms of turnover. In a typical year, millions of Canadians are recruited outside of their organizations. The overall turnover rate for Canada is about 7 per cent. The rate for the manufacturing sector as a whole is around 4.5 per cent. Studies from the US suggest that the aerospace industry has a turnover rate of around 5 per cent. The recent downturn in the industry will likely increase these rates.
- Although these top-line turnover rates are no cause for alarm, there are several structural factors that may impact particular firms hiring for certain jobs.
- First, there has been a tendency for parts of the industry to move toward highly specialized ways of credentialing and licensing skills.
- A second source of structural shortages occurs between small and large firms. Larger companies are generally in a financial position to bid talent away from smaller firms.
- It is easy to underestimate the role of immigrants because the number of skilled immigrants is relatively small in relation to the total skilled workforce. However, it is well known that immigrants tend to concentrate in a few major urban areas, the most important of which is the GTA. This, coincidently, is where most of the aviation and aerospace industry is located in Ontario.
- Ontario immigrants accounted for 60 per cent of the total number of immigrants with skills of interest to the aviation sector: about one thousand every year.
- The skilled aviation and aerospace workforce is about 25 thousand people. If there is 5 per cent attrition, immigrants could almost fill the entire need for additional people.
- However, to this point, immigrants tend to work in less-skilled positions in the manufacturing sub-sector.
- The majority of *emigration* is in managerial occupations. These employees are likely older people, many of whom are working in global companies with Canadian operations.
- Canada does lose some highly skilled people to the US in fields such as engineering, computer science and, to a lesser extent, skilled trades. Some of these people may be new graduates and others will have work experience. But the numbers are not large in relation to the Canadian labour force. The entire US aircraft and aircraft manufacturing sector employed just over three thousand Canadians in 2002.
- Although there is plenty of anecdotal evidence about Canadians moving to the US for better opportunities, it is doubtful that this is a major issue for the Ontario aviation and aerospace industry.
- The data presented in the report seems to lead to two conclusions:
  1. The “brain drain” is probably not as big an issue some people think. Turnover is more likely due to people moving between employers within Canada than emigrating
  2. Immigrants are an under-appreciated source of skilled labour. They may, however, present special training issues, most notably with language skills.

- The study collected a considerable amount of qualitative data from employers and educational institutions through in-person interviews.
- Employers want graduates who have been exposed to basic mechanical, technical and professional skills and have good work habits.
- In summary, employers have expressed demand in the following key areas and sub-areas:

Employability Skills

- teamwork
- ethics
- leadership

Technical skills

- good set of core technical skills
  - ability to read engineering diagrams
  - facility in computer-based technologies and communications
- specific skills in demand
  - non-destructive testing
  - wiring
  - machining
  - composite materials processing

Other skills

- regulatory training for non-regulatory employees
- first aid, CPR, St. John's Ambulance

- The lack of co-operative education led to a concern about a shortage of practical skills. Interviewees generally feel that too much time is spent on "book learning" and too little on developing technical skills.
  - As the college system works with employers to design an effective system, there will inevitably be some frustration that the college is not “doing enough.”
  - Although this may not speak to a general unwillingness of colleges to listen to industry, it does demonstrate the need to develop effective channels of communication. Also, it emphasizes the need for both the industry and the PSEs (post-secondary educational institutions) to recognize each other’s constraints and to be innovative in the way they overcome these constraints.

- It was difficult to interpret findings on where skills should be developed. Few of the interviewees admit to hiring graduates, and those who do make it clear that they are trained extensively after hiring or have worked at the plant already in an apprenticeship or co-op role.
  - These interviewees see the PSEs as places where prospective job market entrants can learn the basic technical skills that will allow them to pursue further training in any number of sectors.
  - PSEs see themselves as the developers of fully trained and employable graduates whose training is directly related to a career path.
  - Frequent mention is made of the benefits of graduates working in a plant environment before finishing their studies, to get the "real world" exposure employers find lacking in recent graduates.
  - On the other hand, PSEs want to respond to employer demand for more highly trained graduates by putting their own capacity in place.

- Almost all employers make it clear that new aerospace employees are subject to a minimum of 40 hours of training when they are first hired. As most new recruits come from other companies and very few from PSEs, it is apparent that employers see industrial training as a requirement for their staff.
  - Many employers mention that they would rather train new hires in the specific skills needed for their jobs themselves, leaving PSEs to inculcate the basic mechanical and technical skills and "good work habits."

- Some employers see distance learning as a shortcut to filling gaps.

- Industry accepts and values the role of Transport Canada as the third-party accreditor. For the most part, no dissatisfaction with Transport Canada or its role is expressed.
  - PSEs value Transport Canada accreditation of their programs. Courses or programs which result in a Transport Canada-approved diploma are seen to be more job-oriented and of a more serious nature than programs that result in a college diploma or certificate.

- Geographic location of skills training resources was not raised as an issue among industry respondents.
  - However, one manufacturer who is located in Eastern Ontario uses a local college for some of its contract training.
  - For the most part, though, industry is willing to send its employees wherever the best courses are offered, and will pay associated living expenses.

- As colleges attempt to build new capacity to meet employer demands, they are faced with a fundamental challenge in financing new capacity.
  - Not surprisingly, the interviews uncovered a good deal of frustration among the colleges with respect to their financing constraints.

- Universities acknowledge that they are less fleet of foot than colleges in responding to changing market demands, due to the complex dynamics of university funding and their joint teaching/research mandate.

- Most colleges continue to predict steady growth for enrollment based on "student and industry demand," despite the fact that market is in a cyclical downturn.

- Numerous employers cite having used co-op placements and apprenticeship programs successfully in the past and all agree that on-the-job training is very desirable in a new employee.
- Colleges also provide some continuing education services to industry.

- Another practice that appears successful is one-to-one relationships between specific employers and specific PSEs.

- There are essentially three perspectives on gaps that need to be considered:
  1. *People gaps* refer to whether there are sufficient applicants with the right basic level of education entering the labour force to account for growth and attrition.
  2. *Competency gaps* emerge if employees do not have the right competencies to do the work.
  3. Often, people gaps and competency gaps are directly related to the organization of education and training *capacity*. If capacity is insufficient, there may not be enough people to meet employment demand. If capacity is not organized where it should be, it may not be developing the right competencies.
- The exhibit titled *Risk of Gaps* takes into consideration each of these factors in assessing the flows of people emerging from Ontario's PSEs. This exhibit outlines the likelihood of gaps for key occupations by industry sub-sector.

Exhibit
Risk of Gaps
(Selected Occupations by Industry Sub-sector)

Sub-sector/Occupation	Graduate Replacement Rate	Demand	Competition	Other Supply	Gap Risk
Manufacturing, Maintenance, Repair and Overhaul					
Management	1.9%	low	high	high	**low**
Engineering Design	12.9%	low	high	medium	**medium**
Manufacturing Technician	0.5%	medium	high	medium	**medium**
Aviation Machinist	1.5%	medium	medium	low	**medium**
Aircraft Maintenance Engineer (AME)	9.5%	high	high	low	**high**
Aircraft Maintenance Technician	5.6%	high	high	low	**high**
Air Carriers					
Air Carrier Manager	2.4%	medium	low	high	**low**
Airport Ramp Attendant	1.8%	medium	low	high	**low**
Airport Operations					
Airport Operations Manager	4.6%	medium	high	medium	**medium**
Air Traffic Control and Navigation					
Flight Service Specialist	69.9%	low	low	low	**low**
Air Traffic Controller	40.7%	medium	low	low	**low**
Air Regulatory Functions					
Transport Canada	NA	medium	low	low	**medium**

- This analysis suggests that AMEs and technicians face the greatest threat of having *people gaps* emerge. This potential gap exists in spite of the fact that colleges are doing a very good job of expanding capacity to train people in these areas

- Shortages may also arise among various types of manufacturing trades and technicians.
- Other occupational areas are less likely to experience gaps, either because they have a very broad labour market from which to draw or because they have low competition for employees.
- Manufacturing managers are often developed within companies after accumulating years of work experience. The Ontario Aerospace Council has focused its continuing education curriculum on these people, who will often have a sound technical background but require management training.
- On the air traffic control front, NAV CANADA appears to have things in hand and does not face stiff competition for its graduates. Although NAV CANADA faces the challenge of maintaining high staffing levels and has a high turnover rate, its programs are oversubscribed. The demand for flight service specialists is likely to fall because of technological innovation.
- There are two major challenges in developing *competencies*. On the technical front, there is an inevitable gap between the technical competencies developed in the PSE system and the technical competencies needed in the workplace.
- A second type of *competency gap* exists with respect to employability skills.
- In this study, we view the education and training system as an integrated system of lifelong learning. That system is probably not, in reality, integrated.
- On the classroom front, there are two capacity issues:
  - management of growth
  - spatial organization of capacity
- New capacity is clearly required if AME programs are to deliver the 70 per cent growth that is anticipated in enrollments between now and 2008.
- The location of capacity is probably of greatest interest to students who are effectively taking an investment risk when they apply to post-secondary schools.
- A bigger issue than geographic distribution of programs would seem to be the balance between classroom and workplace education.

- In dealing with potential gaps, Ontario can reflect on experience in other jurisdictions.
- Best practices were organized by recruitment, selection and improvement.

Recruitment

- Launchpad for Learning is a UK initiative led by the Society of British Aerospace Companies. Its primary purpose is to connect school children (9 years and older) with the aviation industry, thus encouraging them to consider aerospace/aviation as a career path.
- MentorNet is a US-based not-for-profit e-mentoring network supported primarily by grants and donations from industry, government and foundations. Its specific mission is to further women's progress in science and technology, but its principles and objective could have wider application.

Selection

- In May, 2002, the General Accounting Office in the US published a report titled *A Model of Strategic Human Capital Management* that includes "recommendations to help the Federal Aviation Administration (FAA) meet its impending need to hire and train thousands of air traffic controllers." However, it is not clear whether FAA has adopted these recommendations, in part or in total.
- A European research initiative named *Consequences of Future ATM Systems for Air Traffic Controller Selection and Training (CAST)* attempted to relate the future changes in air traffic control equipment and procedures to selection and training needs. CAST was a relatively exhaustive study carried out by six European Union representatives.
- A Web-based selector system used by Air New Zealand provides information to potential air traffic control program applicants. The intent of this system, which includes a self-assessment module, is to help potential candidates determine whether or not they are suited to the occupation. The goal of this system is to increase the percentage of applicants who will succeed.

Improvement

- Competency-based training was identified in the literature as a priority issue to be researched. The UK and Australia are the leading jurisdictions in using competency-based vocational qualifications.
- Competency-based standards now have relatively wide application.
- The key implementation issues appear to be exactly how to define and measure competence, and how to determine the degree to which "generic attributes" or "core skills" should be included in measurement.
- The distinctive aspect of the UK's National Vocational Qualifications (NVQ) appears to be the creation of the General National Vocational Qualifications (GNVQ), a blend of competency-based and "core" qualifications.
- Australia appears to have followed a similar path with respect to creating a blended academic and occupational standard like the GNVQ. In Australia, the National Training Board (NTB) uses the expression "key competencies."
- The distinctive aspect of Australia's approach appears to be its attempt to combine e-learning distribution initiatives with its vocational education and training structure.
- One example of education/government/industry partnerships has been selected for review here: *Centre d'adaptation de la main d'œuvre aérospatiale du Québec (CAMAQ)*. CAMAQ appears to be one of the earliest attempts to formalize this dialogue, and the model has survived the test of time.
- A range of *simulation technologies* has the potential for more extensive use in the education and training system.
- The expression "*corporate universities*" encompasses a wide variety of concepts and levels of commitment. The idea originated in the US but has now been adopted relatively aggressively by many of the larger European companies, especially German ones. Two notable examples are:
  - BAE Systems Corporate University in the UK
  - Lufthansa School of Business in Germany

- The way forward is for the aviation/aerospace industry and the education/training system to work together in managing the gaps between supply and demand. There are two aspects to this process:
  1. *shared understanding of the strategic issues* — specifically, common understanding of the underlying markets and drivers of change
  2. *joint program* for action based on shared interests
- Between the findings of the research and the ongoing discussions of the steering committee, members have begun to develop a shared understanding of the strategic issues. This is a prerequisite to effective action.
- People gaps, competency gaps and capacity gaps are likely to persist, but can be managed with concerted effort.
- The main strategic issue that has emerged from this study is the need to increase the number of people who want to pursue a career (as opposed to "job") in aviation/aerospace. If people see the aviation/aerospace sector as a good environment in which to develop a career, they are likely to invest in education to that end.
- In the early stages of education, industry may work with PSEs to enhance students' confidence that they have access to an effective school-to-work transition system.
- Special issues of immigrant and re-entry workers also need to be addressed.
- Integration may also be an issue for workers who have been recently laid off — especially if they lack educational credentials, yet have developed useful competencies through work experience.
- Finally, there is the case of career development for employees within the industry. Even employees who maintain their employment throughout the business cycle may choose to leave the industry if there are no opportunities for career advancement. From a retention-of-human-capital perspective, it is important that the industry take a "lifelong learning" approach to the development of its people.
- Part of the employee development challenge is within the capacity of organizations to control, either through their hiring practices or the way they work with the education system.
- In some cases, smaller organizations can achieve the same economies of scale by collaborating with others outside the aviation/aerospace industry.
- The challenge of economies of scale can also be addressed on the supply side.
- PSEs are most likely to respond where there is sufficient and sustainable demand for programming. Variability in demand has implications for PSE capacity.
- All parts of the industry face a similar challenge in ensuring that school-developed competencies align with work-required competencies.
- As capacity gaps are addressed, there is a need to revisit how capacity should be organized through industry and colleges.
- More attention should be paid to enhancing the flexibility of the system and constructing "bridges" and "ladders."
- Stakeholders can control creative solutions to the inherent differences in outlook and motivations. Resolving these juxtapositions will move the system towards greater flexibility.
- The Colleges of Ontario Network for Education and Training (CON*NECT) and the Ontario Aerospace Council (OAC) are committed to working together to find effective ways of linking industry demand with education/training supply, thereby bridging skill gaps.

Full Report

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Chapter 1
Introduction

In recent years, there has been heightened interest in the human resource issues facing Canada's aviation and aerospace industry. One reason is that the industry provides the sort of high-skilled jobs that are emblematic of the so-called "knowledge economy." Moreover, geographic clusters characterize the industry. Policymakers increasingly favour industrial clusters as incubators for innovation and economic growth.[1] The success of clusters is clearly tied to the availability of skilled human resources. Hence, there is a need to understand human resource issues in strategic industries like aviation and aerospace.

The industry faces serious human resource challenges. The domestic value-added component of Canada's aerospace industry has fallen sharply and significantly over the past several years, dropping from a peak of 66 per cent in 1995 to 53 per cent in 1998. This key measure is expected to remain at these lower levels for the foreseeable future, or decline even further.

Canadian aerospace suppliers are losing their market share on the domestic front. In the aerospace sector globally, dramatic changes in supply chain relationships — as risk and investment are pushed down the supply chain and companies at all levels are obliged to "move up the value chain" — are now requiring all aerospace employees, from the executive offices to the design/development departments to the shop floor, to enhance their knowledge, skills and abilities.

Interest in the industry's human resource issues has resulted in a number of excellent studies that point to shortages of critical skills. Noteworthy examples include *A Human Resources Study of the Canadian Aviation Manufacturing and Maintenance Industry* (2002) and the *Canadian Aerospace Labour Market Survey and Employment Forecast for 2001-04* (2001).[2] These industry-sponsored, national studies focus on the aircraft manufacturing and maintenance sub-sectors of the industry.

Although manufacturing and maintenance are significant focal points for the aerospace sector, it is important to broaden the parameters when analyzing education and training needs. Airport operations, both on the ground and in the air, and the regulatory sector also need to be considered. Education and training for such functions as airport management and air traffic control are important components of maintaining a viable aerospace sector.

The need for a broader perspective is especially apparent in the aftermath of the September 11 terrorist attacks in the US. The serious excess capacity problems already evident in the industry have been exacerbated by the uncertain political climate. This means that the industry will likely undergo significant structural change as it adjusts to the new realities. Human resource issues are a key component of this structural change.

Although previous studies provide a number of important messages for stakeholders, many of the issues they identify are managed at the provincial level or within industry clusters at the sub-provincial level. It is true that aviation and aerospace have a national regulatory framework, but the actual decisions about skill investments tend to be made by individuals, provincially regulated post-secondary educational (PSE) institutions, and by companies through their training budgets. It is a classic case of thinking globally, acting locally.

Consequently, there is a need for province-level studies focusing on the dynamics that create gaps and exploring ways to address those gaps. This is the purpose of the current study, which is designed to suggest practical actions that can be taken by the provincial education system and by industry to bridge skill gaps. On this point, the terms of reference for the study are clear: "Success…will be gauged by subsequent actions taken by the Ontario aerospace industry and Ontario educational institutions to bridge the gaps."

What is the Contribution of this Study?

Previous studies in this field have tended to focus specifically on shortages as defined by the manufacturing and maintenance parts of the industry. They detail the occupational structure of the industry and they model attrition and replacement rates under various growth scenarios. In these studies, gaps emerge because the human resource pipeline under certain growth scenarios is not large enough.

But the size of the human resource pipeline is actually a function of a broader range of factors and the actions of a variety of stakeholders. So, the current study attempts to define a framework that takes into consideration the motivations and constraints of these players, which include industry, students/employees, educational institutions, regulators and accreditors. The current study will attempt to understand the gaps in terms of this broader framework.

A second unique aspect is the study's broad definition of the industry. This study goes beyond the traditional definition of aircraft manufacturing and maintenance, and includes six industry sub-sectors:

1. aircraft and aircraft systems design, development and manufacture
2. maintenance and repair and overhaul
3. air navigation systems, air traffic control systems operation
4. air carrier operations
5. airport operations
6. air regulatory functions

A third distinguishing feature of the study is that it concentrates on the industry-specific education and training system in Ontario. Although there is also an analysis of demand, the major original research for this study is a survey of industry and educational institutions. As such, the study goes into considerable detail on how industry and education view the organization and effectiveness of training capacity in Ontario.

Who Should Read This Study?

Various readers will find the current study of interest. The keenest interest is likely to be exhibited by industry (and related associations), the educational institutions and government bodies whose actions shape the industry's education and training infrastructure. The report contains specific recommendations for action by these stakeholders.

The human resource issues facing the aviation and aerospace industry are often shared with other industries, so anyone interested in understanding the issues and ways to address gaps may find the report instructive. Moreover, policymakers who are interested in pursuing cluster strategies would do well to take into consideration the human resource issues in industries like aviation and aerospace. This pertains especially to Ontario, which is one of two major centres (along with Québec) where clusters are currently a reality rather than a desired state.

Methodology

A number of methodologies were employed in producing this report. This study is primarily about the way the education and training infrastructure responds to industry demand. As such, the main methodology comprised personal interviews with representatives of educational institutions and the portion of the aviation and aerospace industry that undertakes training. Forum Research Inc. conducted these interviews between August and December, 2002. In addition, Allan Martel Consulting conducted a separate stream of interviews that considered the demand and supply issues for the regulatory system. Allan Martel Consulting also conducted interviews and a literature review that looked at the practices of other jurisdictions. (The specifics of these methodologies are covered in the technical report in Appendix C).

There were four streams of interviews:

- educational institutions
- aviation/aerospace companies
- regulators
- experts on other jurisdictions

In total, over 100 interviews were conducted, including 44 from the education stream and 47 with companies that conduct training.

Data collection in the education stream was focused on post-secondary institutions with aviation and aerospace programs. (Although these institutions also provide skilled labour through other programs, the share of aviation and industry demand in these areas is too small to justify an industry-specific response by post-secondary institutions). The industry stream included most of the large aviation and aerospace companies that conduct training.

The regulatory survey was sent to 27 Ontario colleges and universities in late September, 2002. Follow-up phone calls were made to each institution to ensure that the questionnaires were received and to answer any initial questions related to the purpose of the study. Twenty-seven institutions responded. Most of the responding institutions were also interviewed by phone. The survey package outlined important characteristics of the demand such as modular delivery, distance learning, and Transport Canada marketing support.

A second aspect of the methodology was a review of existing data and literature. This review was used to determine areas of demand and the underlying factors contributing to growth in the demand for skilled labour. It was also used to ascertain best practices in other jurisdictions (see Chapter 8).

The emphasis of this study is on *skilled* labour, as it creates a demand for higher education and training. One way of thinking about the skilled labour force is through the four categories used in the aforementioned *Canadian Aerospace Labour Market Survey and Employment Forecast for 2001-04*:

- trades
- technical
- scientific
- managerial

Although undoubtedly highly skilled, pilots are expressly excluded from the current study.[3]

A final methodological feature was the active engagement of the steering committee for this study in the research process (see Acknowledgements). While the steering committee was instrumental in facilitating the interview process, its members were also actively engaged discussing and adding to the key findings emerging from the research. This report particularly reflects the insights offered by steering committee members at their meeting at Humber College on December 20, 2002.

A Guide to the Report

The report begins by outlining an analytical framework that will form the basis for interpretation of data and literature (Chapter 2). This is followed by an overview of current demand conditions in each industry sub-sector (Chapter 3). The study then analyzes the original data that we have collected, which shows the education and training system's plans for adjusting to the future demand (Chapter 4). The report then includes an analysis of how mobility may affect gaps (Chapter 5). Qualitative data in the form of the findings of in-person interviews is presented in Chapter 6. All this sets the stage for the gap analysis of Chapter 7.

In Chapter 8, promising practices from other jurisdictions are considered. The concluding chapter (Chapter 9) distills the main findings and develops recommendations for action.

It is common for human resource studies to identify gaps based on employers' (or an industry's) understanding of the issue. This is natural, given that employers are ultimately the ones responsible for defining which skills are relevant to their workplaces.

Yet, analyzing skill gaps purely on the basis of employer considerations may lead to an incomplete understanding as to why gaps emerge. Employers are best at understanding their own needs within the context of their strategies, management processes and time frames.

Aviation and aerospace employers are not alone — they are participants in the wider labour market. That market also includes individuals who potentially have a variety of options for pursuing skills acquisition and employment. It includes employers from outside the industry who are competing for people. It includes an education and training system that develops those skills based partly on industry demand but also on broader labour market conditions. It also includes government regulators and accreditors who codify and regulate quality and issue licenses that allow regulated tradespeople to practice.

Exhibit 1:
Framework: Four Players + Four Motivations = Gaps

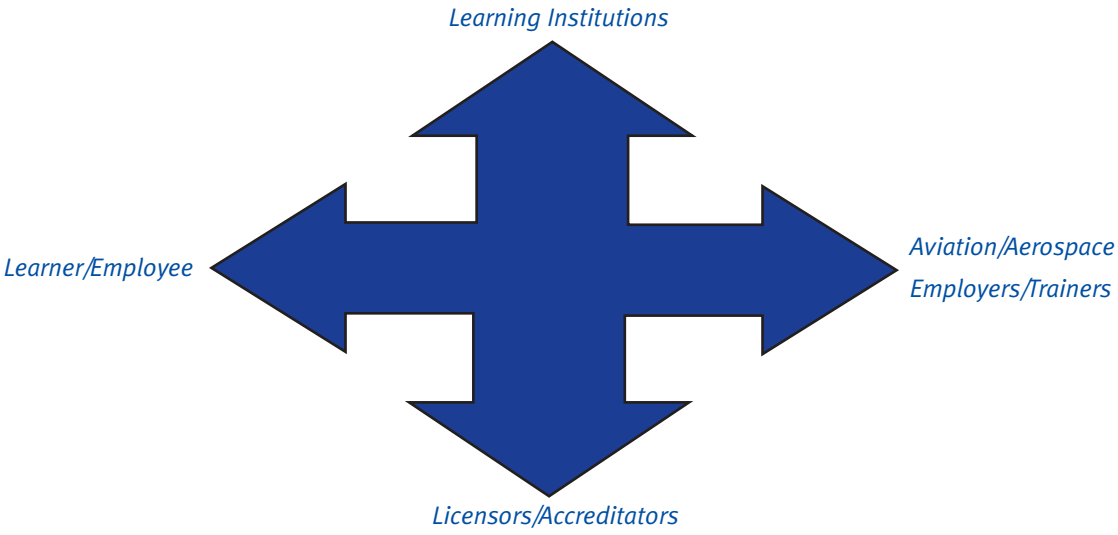
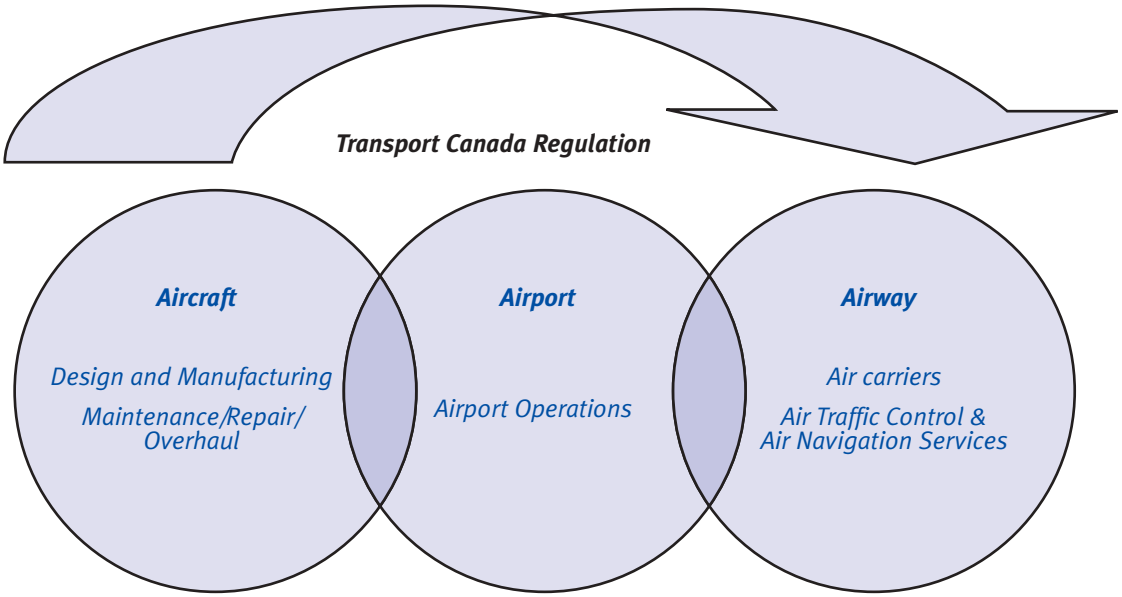


Exhibit 1 sets out these four different players using a simple diagram. Each of these groups has its own dynamics, motivations and strategies for getting what it wants out of the labour market. Where there are common interests, there is room for co-operation to deal with gaps. But it is important to be aware of the underlying forces that drive gaps and to be realistic about the context in which co-operation can work.

The motivations of each group interact with the realities of the industry. It is helpful to think about the industry using a diagram developed by the Ontario Aerospace Council (Exhibit 2).

Exhibit 2:
The Aviation and Aerospace Industry in a Nutshell



Source: Ontario Aerospace Council

Exhibit 2 shows the aviation and aerospace industry as an integrated system with an overarching regulatory structure. The five sub-sectors of industry are slotted into the regulation-aircraft-airport-airway configuration. Exhibit 2 is essentially a detailed way of looking at the industry quadrant of Exhibit 1.

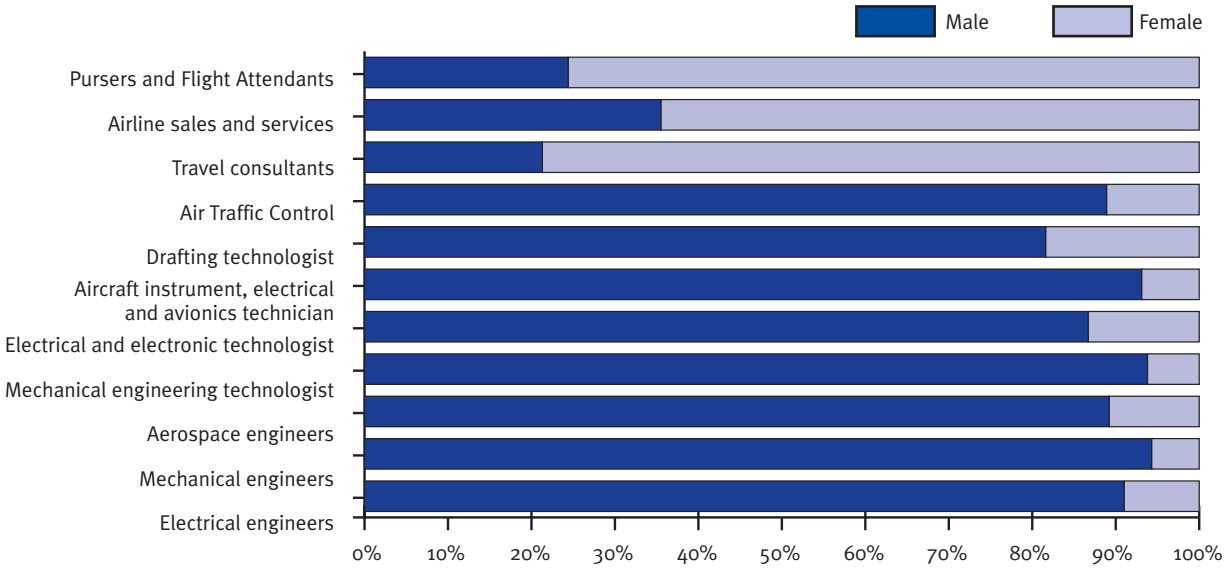
Gaps will emerge because it is difficult to co-ordinate the dynamics of Exhibit 1 with the industry demands of Exhibit 2. Economists call this problem "asynchronous information," which is jargon for saying that all the players do not have the same information to act upon or even the same motivations for acting. Let's consider first the motivations of the players in Exhibit 1 and then the specific situation of the sub-sectors in Exhibit 2.

Ontario students have some leeway to select the skill sets that they will develop. This choice starts as early as Grade 10 when students decide which optional streams of the curriculum they will pursue. Obviously, family and, to some extent, friends will influence students' decisions. A common complaint heard from the industry is that parents and students are biased against technical streams and tend to favour academic streams.

The basis for this bias may originally have had something to do with the way that technical skills were introduced at the secondary level. Technical education was usually based on auto shop or woodworking shop. This stream of education developed the well-deserved reputation of developing (primarily) males for blue-collar jobs. As many of these skills were applicable to the manufacturing and repair side of aviation, this part of the industry attracted people from the high school technical stream.

To this day, men overwhelmingly dominate trades and technical careers in the manufacturing and repair parts of the aviation and aerospace industry (Chart 1). As such, women may not see a future for themselves in aviation and aerospace — a fact that effectively cuts the manufacturing and repair side off from half of the potential labour force.

Chart 1:
Ontario Aerospace Gender Distribution
(Selected Occupations Relevant to the Industry)



Source: Statistics Canada, 1996 Census

This situation was further exacerbated by the system for credentialing skills that is used by the industry. Credentials are very important to individuals because they act as a sort of passport, especially for early school-to-work transition. They are a communication device that informs employers about the likelihood that an individual possesses certain knowledge and skills. Individuals are likely to demand the credentials that are best aligned with their interests, abilities and views about long-term success.

However, the trend in recent years has been for young people to accumulate more education but less work experience up to the age of 24.[4] This exacerbates the problems of career paths— employers do not have an opportunity to gauge and develop the soft (or employability) skills of young workers, and young workers do not have chance to experience the world of work that would help them decide which careers to pursue. The tendency, therefore, is to pursue more generalized credentials — in the arts, business, and computer sciences — that are widely applicable to many different work settings and have a certain level of social acceptance.

Compulsory trades and licensed professions such as aircraft maintenance engineers (AME) not only have a blue-collar reputation but also require a considerable amount of schooling and applied work experience. It can take as long to become a qualified AME as it does to complete a bachelor's degree. Once individuals have made a commitment to pursuing these licenses, they have also effectively made a choice about the job that they will take and, indeed, the career that they will develop. Although most young people will not be in a position to decide what career they want to pursue in secondary school, many will tend toward accumulating skills and credentials that give them maximum flexibility to respond to a changing labour market.

There is a relationship between stability of employment and an individual's inclination to develop skills that are unique to an industry. If an industry has a reputation for instability, people are unlikely to want to narrowcast the acquisition of skills (and the credentialing of these skills) toward one particular industry.

People who have a "love of flying" may be more determined to pursue careers in aviation. Also, there are various ways that people can manage the risk associated with certain career paths. They may, for instance, use family or social networks to introduce them into employment. But for the vast majority of students, the main drivers will be good jobs with desirable social standing and the flexibility to manage employment instability.

So, a big part of the human resource challenge is to develop a pool of people who are inclined to develop the core technical skills relevant to parts of the industry. This, then, is about presenting people with a career pathway as opposed to an end point.

This challenge is somewhat different for those who have already secured work experience in the industry. These people will have accumulated applied skills while on the job. They will also have a certain level of security, especially if they are working in a unionized environment. Even for employees with limited tenure, their applied experience is valued both within and outside the industry, which puts them in a somewhat better position than the entry-level person with little work experience. For example, people working in airport management will accumulate management skills that are also applicable to other transportation industries and even non-transportation industries. Although these people, too, will want to develop their careers, they have a better line of sight to career paths and are in a better position to make incremental decisions about accumulating skills and credentials to enhance their career prospects.

A positive trend in developing a pool of people who may consider entering the industry has been the introduction of the new Ontario *secondary school* curriculum. In the new curriculum, technical education is given a broader scope beyond auto shop. The idea is to introduce students in Grade 10 to the technical foundations for a wide variety of careers in which these competencies are applied.

The Ministry of Education estimates that some 300 thousand students in Ontario will be enrolled in these courses in 2002-2003. One stream now deals specifically with transportation technology. This forms a considerable target population that the aviation and aerospace industry can appeal to in its desire to develop trades, and technical and scientific occupations. Ontario also has improved its youth apprenticeship system (through Ontario Youth Apprenticeships), and school boards are specifically requested to work with industries in developing these.

Interestingly, secondary schools are also being given the option to add additional semesters in technical streams where a case can be made for responding to local demand. The industry's dialogue with the secondary school system has typically been about trying to improve the industry's image with youth or providing work placements that may or may not be linked to the curriculum. The new curriculum theoretically creates an opportunity for the industry to work with secondary school educators on a variety of initiatives that demonstrate to learners the connections between classroom education and the world of work. In this context, local schools should have the motivation and a more effective mechanism for working with both industry and colleges.

Industry has typically relied on *colleges of applied arts and technology* to develop its skilled entry-level employees, especially in the trades and technical occupations. Colleges are motivated to provide students with job skills. Indeed, under Ministry of Training, Colleges and Universities' Key Performance Indicators (KPI) funding, colleges are given a financial incentive that is largely driven by short-term success in the labour market, as measured by employment rates and the satisfaction of employers and graduates. In 2002, the Ministry paid over $16 million to colleges based on these criteria.[5] Obviously, this system places a premium on turning out students who will find employment soon after graduation. There is little incentive for colleges, on their own account, to undertake major program expansions based on medium-term industry growth forecasts.

Colleges work with local employers where there is a clear demand for new entrants. Colleges also provide adult continuing education programs. But should they expand capacity to deal with structural changes in the demand for employees that are being driven by issues like retirement and export growth? In the final analysis, colleges will only expand capacity if students are applying for existing programs. When student demand is high, they have shown themselves willing to expand programs. But as students may not always be aware of areas of increasingly demand, colleges play an important intermediary role in shaping demand.

Another issue with colleges, and indeed universities, is their independence and pride as centres of learning excellence. This can create friction when adopting standards and curricula that are developed outside of their institution. They will certainly be motivated to adopt these where there is a clearly stated employer and student demand. However, colleges will not generally want to submit to cumbersome industry accreditation, especially if this is seen as overlapping with existing accreditation through Transport Canada.

The *universities* tend to focus on highly skilled employees and managers. Universities do not tend to define their mission in terms of vocational training. Rather, they see themselves first and foremost as high-quality educators and researchers. In professional disciplines like engineering, there is relatively little need to worry about the employment prospects of graduates, as there is plenty of evidence that these graduates are in high demand. Moreover, engineers can apply their knowledge and skills in many work environments. Indeed, our interviews found that aerospace graduates are often recruited into the auto sector.

Both colleges and universities operate in a highly regulated and publicly funded environment. As such, governmental decisions on education policy (e.g., access) and financing have major implications for what individual institutions decide to do. This government role largely explains the organization of capacity in the current system. Institutions of higher learning tend to view their capacity through government funding lenses. Through the allocation of capital funding, the Ministry of Training, Colleges and Universities and the Ministry of Enterprise, Opportunity and Innovation have a powerful effect on the location and shape of education capacity. Some of these decisions around capacity are inevitably influenced through the political process; this may mean that some parts of the system have excess capacity, while others at capacity are unable to expand.

Colleges and universities have attempted to shield themselves somewhat from government funding decisions by developing non-subsidized programs. This trend has been most apparent in the entry of colleges into the customized training market and the development of high-level management programs like the Ontario Aerospace Council/Rotman School of Management program in executive education.

Another key part of the learning infrastructure in aviation is NAV CANADA. A private, non-profit and non-governmental organization that manages Canada's air navigation and air traffic control system, NAV CANADA is a fully integrated operation that effectively manages the entire school-to-work transition process. NAV CANADA is educator, employer and trainer. Its challenge is to ensure that it manages the need for newly accredited air traffic controllers, flight service specialists and technicians to its own needs. As these jobs are high technology/high stress, it also has to manage a process of continual training and early retirement rates. As the NAV CANADA system is relatively small and self-contained, it doesn't face the same issues as the post-secondary institutions regarding the hand-off between education and the world of work.

The public continues to demand a transportation sector that is among the safest in the world. Safety is affected by factors such as the growth of the transportation sector, rapid technology developments in the industry, and demographic trends. There will be continuing pressures to manage the safety risks in a more integrated and systematic manner. While the number of accidents per 100 thousand flights has been lowered, the number of flights has grown rapidly. Without further improvements, the accident rate will rise beyond publicly acceptable levels.

Transport Canada has made the strategic decision to manage the new safety challenges through a performance-based model. This agency is now a world leader in moving to performance-based regulatory inspection and auditing, which is the best way to achieve "order of magnitude" safety improvements.

Transport Canada is also a recognized world leader in aviation regulation and safety management. Organizations such as IATA and ICAO often develop their international regulations based on Canadian models. This leads to the prospect of attracting foreign demand for Canadian safety regulation, inspection and auditing programs.

Transport Canada has moved from owner-operator-regulator to a regulatory agency that inspects and audits facilities owned and operated by others. Many functions previously performed by the department have been devolved to outside entities (e.g., the Motor Vehicle Test Centre, Canadian Coast Guard, NAV CANADA, the Canadian Air Transport Security Agency, and airports and ports).

Since the tragic events of September 11, 2001, the possibility of terrorist attacks on aircraft and airport facilities has added a new threat to safety. Airports, air carriers, air navigation and even maintenance operations work with Transport Canada and law enforcement agencies to manage this threat. The danger of terrorist attack has added new demands on the training of personnel in the airport/airways part of the system. Security around the maintenance end of the system has also been enhanced.

This change in approach has major implications for the supply and demand for education and training. To begin with, it means that safety employment and management is moving away from Transport Canada to the operators in the airways/airports/air traffic control systems. As an indication of this, Transport Canada now employs about 4,200 people nationally, whereas under the old model it employed over 20 thousand people. This does not mean that Canada's commitment to safety has been reduced — quite the contrary. Rather, many more people are probably involved in safety in some capacity, although safety is not the only function of their job.

This increased commitment to safety has obvious implications for the organization of education and training. It is far more likely that a safety module will have to be incorporated into the training regimen of virtually every employee in the industry. Moreover, increased involvement in safety means that ongoing training will be required to ensure that the aviation/aerospace workforce is current with Transport Canada standards.

As for Transport Canada employees, it means that the core staff has to be educated to manage regulation within the new paradigm. This affects not only the technical competencies of Transport Canada employees but also the employability skills (communication skills and the like) that determine their effectiveness in interacting with the regulated community. Transport Canada now designs its regulations in concert with the regulated community. It recognizes process technology leadership as residing in the private sector. It prefers to design training requirements in performance-based terms and supports outside delivery.

Risk management techniques are used to strike the appropriate balance between 100 per cent monitoring (with presumably zero failures but at a prohibitive cost) to 0 per cent monitoring (with unacceptable failure levels but at zero cost). Transport Canada will be challenged to find new ways to ensure high safety standards, instill a safety culture in the transportation sector, consider further delegation of responsibilities, and focus resources on the greatest risk abatement.

Although there is a safety rationale for licensing and accreditation emerging from Transport Canada, accreditation has also grown out of the tradition of guilds where skills were passed along from generation to generation. Guilds acted as both a school-to-work transition system and a quality-control mechanism. Eventually, trades also became an organizing structure for workforce management. This dovetailed with the command and control scientific management systems that developed in the post-war period. Trades also became the basis for unionization of the workforce and collective bargaining.

But several factors have undermined this way of organizing the workforce. To begin with, the economy has gradually moved toward more of a service orientation. The manufacturing parts of the industry are now less labour intensive and more capital intensive. They are also organized around quality management systems in which it is more important to produce a consistent customer-defined quality than it is to produce cheaply on a large scale. As technology and customer needs change, it is vital to be able to adjust the workforce to the new customer need. Quality is therefore built into the management system rather than the occupation. Although there is still a need to know whether a person has knowledge and can perform tasks, these competencies are not necessarily strictly aligned to specific occupations.

These trends in the management of safety and quality have potentially profound implications for the nature of accreditation, credentials and licenses. The main players in accreditation for the industry in Ontario are Transport Canada, the Canadian Aviation Maintenance Council (CAMC) and the Ontario Aerospace Council (OAC). There are also out-of-province organizations that play a role in training airport managers (IAAE, the International Association of Airport Executives; AAAE, the American Association of Airport Executives). The Air Transport Association of Canada (ATAC) is in the process of finalizing a program with the Ontario Student Assistance Program (OSAP) for training school accreditation. A companion project, in partnership with CAMC/HRDC National, has started to further examine the issue of accreditation.

To be sure, there are still parts of the industry that will require licenses to either perform certain tasks or be allowed to effectively sign off on safety standards set by Transport Canada. So, occupations such as air traffic controller and aircraft maintenance engineer (AME) will continue to rely on licensing at the individual level. This is because people in these occupations have to respond quickly to particular circumstances in the course of doing the job. Much of the management of safety is therefore at the individual level. But the vast majority of workers in the aviation and aerospace industry do not require licenses to perform their jobs. Indeed, the manufacturing side makes most of their annual hires from non-certified technicians.[6]

What is the role of accreditation and credentials in this system? Employers will be increasingly interested in employees who have a good core set of technical skills and the adaptability to adjust to new circumstances as work processes change to manage new products and services. For the entry-level employee, a credential is testament to a core set of skills that has been accredited by an institution of learning. These tend to focus on technical skills to do particular jobs. But employers are likely to be equally interested in so-called *employability skills* that speak to a person's ability to learn on the job and work well with fellow employees and customers. There is currently no system for credentialing these skills, other than employers' human resource systems.

Each industry association is taking a different approach to accreditation. For example, CAMC has developed a very structured and detailed system of classroom curriculum based on the traditional trades model. Focused on the many non-certified technicians in the manufacturing and maintenance parts of the industry, CAMC's approach will extend the amount of certification. CAMC does not deliver training but accredits learning institutions that wish to use its curriculum and to have its students eligible for CAMC credentials. CAMC audits learning institutions to ensure that their teaching facilities meet their standards.

The OAC, on the other hand, has tended toward developing curricula with learning institutions and leaving the processes for delivering learning to the institution. The OAC curricula are focused on managing quality in an aerospace manufacturing setting.

Established employees will demand learning to improve their long-term career prospects. Some of this learning will be credentialed, while some will be on-the-job training that is not. Either way, the employee will want to demonstrate to current and prospective employers a certain level of technical proficiency and adaptability to new circumstances.

All this has implications for the relative weight between *macro* and *micro credentials*. A macro credential is a certificate, diploma or degree that typically takes a long time to complete (eight months or more). Micro credentials are certificates of learning that respond to short-term needs for skill upgrading. Completed in as little as a week up to eight months, these certificate programs typically focus on specific competencies to do specific tasks. According to Alain Bussiere, senior director of training and planning for Airbus, the biggest trend in training these days centres around the requirement for shorter training cycles that are available on-site. "Airlines are not going to send batches of trainees outside to get trained. It is a trend that has been developing for the last couple of years in the States and I think it's going to reach the other side of the Atlantic."[7]

When well designed, a competency-based micro credentialing system is entirely consistent with a macro credentialing system. But for organizational reasons, these systems may not mesh. For instance, other institutions may not recognize micro credentials because they cannot, or will not, attest to their veracity. Or, the programs offered by these institutions may be organized around macro credentials where incremental learning has to be accumulated before it is recognized, often in the form of a well-defined occupation.

The mix between micro and macro credentialing is being changed by the need for more flexibility by both employers and employees. Employees want the freedom to move between jobs with an employer, or even between employers. Employers want employees who can adapt to changes in customer needs.

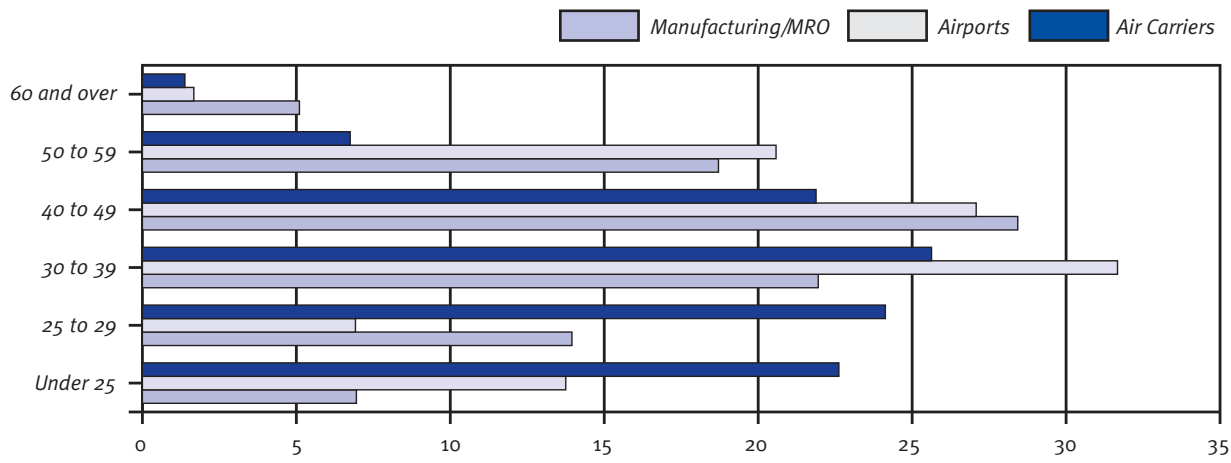
The traditional approach has been to codify all the particular tasks of an occupation and to award a macro credential when a person has demonstrated the ability to do those tasks. But this type of system may prove too cumbersome and, at any rate, undesirable from the perspectives of both employer and employee. Employers may increasingly be interested in a core set of common technical competencies that are shared by groups of occupations. Employees may not be interested in narrowcasting their macro credential except for occupations for which there are clearly good career prospects and long-term job stability.

Employers / Trainers

The rather broad definition of employers used in this study makes it difficult to generalize about their approach to human resources. Each sub-sector has very different industry dynamics that affect which issues the industry is likely to face in the labour market and how it views the education and training system. Sub-sectors have different issues with respect to skills but also in terms of replacement rates due to aging and retirement (see Chart 2).

Based on our survey, retirements would appear to be the biggest issue for Transport Canada, airports and, to a lesser extent, manufacturing/MRO (maintenance, repair and overhaul).

Chart 2
Age Structure of Ontario Aviation/Aerospace Sub-sectors



Source: Survey Findings

The labour market of the *aircraft and aircraft systems design development and manufacturing* sub-sector is typical a globally integrated, heavy capital goods industry. These industries are typically characterized by periods of stock building and lulls, which can be reflected in significant swings in employment from year to year. Moreover, employment is not dominated by a single large employer; rather, it is widely dispersed among many small employers. Small employers are well known as a major source of job creation...and job destruction![8]

This industry structure means that employment flexibility is at a premium and that relatively few employers will be of sufficient scale to undertake significant in-house training. Training will tend to be focused on employees who have some tenure, but are still at the early stages of their careers. This is because employers want some assurance that they are investing their training dollars in good people, and they also want to recoup their investment through higher productivity over time.

The *maintenance, repair and overhaul* sub-sector differs somewhat from the manufacturing side. Its business cycle is more akin to a capital service business. This means it is mildly countercyclical (with lags) to the aircraft manufacturing part of the industry. As the average age of aircraft increases, there is greater need for maintenance (and visa versa).

Although it is true that there are almost 300 approved maintenance organizations (AMOs) in Ontario, the market is dominated by the in-house maintenance of carrier operations, especially Air Canada. By one estimate, Air Canada accounts for about 37 per cent of aircraft maintenance employment in Canada. Air Canada is a large, unionized employer. For these reasons, employment on the maintenance side of industry is not as cyclical as it is on the manufacturing side of the business (for more on Air Canada, see Box 1). The allocation of training is also likely to be skewed, with Air Canada doing most of it and smaller AMOs relying on the education system for most of it.

Air carrier operations also have a reputation for instability. This is primarily because scheduled airlines have typically operated on a knife-edge of profitability. Changes in demand therefore have a huge impact on scheduled airlines that are often forced to discount seats to maintain loads. Airlines operate in essentially a national market, as regulation prohibits cabotage. This makes it difficult to spread out business cycle risk. As such, various Canadian airlines have had difficulty maintaining profitability, and the industry is subject to periodic restructuring. The economics for small, non-scheduled air carriers is somewhat different, primarily because they have greater flexibility in their operations. However, their small scale does present particular challenges in attracting and retaining skilled employees like AMOs.

Airports are more a pure service business that relies on aircraft movements and passenger volumes. Employment growth tends to be steady, in line with overall income and employment growth in the economy. The concentration of scheduled air traffic at a few airports means that airport employment is fairly stable and concentrated in a few large units. The major airports have sufficient scale to have significant training budgets. However, the transition from public to private management challenges them to develop content that is relevant to their new world.

The air traffic and navigation sub-sector is tightly managed by NAV CANADA, which runs the air traffic system and also trains to Transport Canada specifications for air traffic controllers and flight service specialists. NAV CANADA's human resources are geared toward aircraft movements at airports: it is effectively the monopoly supplier of air traffic controllers and air navigation system personnel in Canada. Graduates of NAV CANADA training are virtually assured of secure, albeit stressful, employment.

Box 1
The Significance of Air Canada

Air Canada deserves special attention in any analysis of education and training in aerospace and aviation in Ontario.

As in other industrialized countries, Canada's transportation policy restricts competition on domestic routes to national carriers. Air Canada effectively controls over 70 per cent of the domestic air market and also has a dominant position in the international travel originating from Canadian airports. As such, Air Canada's activities have a huge impact on virtually all aspects of the industry, with the possible exception of the manufacturing sub-sector, which is globally integrated.

Not only is Air Canada a dominant player in the air carrier sub-sector, but its operations also straddle other sub-sectors and indeed the training system itself. Air Canada has announced its intention to aggressively pursue maintenance activity, particularly for US carriers that are looking for cost-effective, high-quality maintenance. Air Canada Tech Services currently has about one-third of their work from other carriers and intends on growing this.[9]

Moreover, in August, 2002, Air Canada announced the formation of Tracor as a separately organized training arm that is in the technical training business. Most of Tracor's initial work will emerge from Air Canada itself, but it intends on aggressively targeting the North America maintenance, repair and overhaul skills market.

In some ways, the market dominance of Air Canada makes the management of the education and training simpler. Transport Canada, NAV CANADA, colleges, and major airports can organize a significant amount of their human resources around Air Canada's activities and stated needs. But Air Canada's expansion into maintenance exports and into the training business presents some special challenges in determining the level of Air Canada's needs and the extent to which the company will rely on outside educators to meet these needs.

Finally, the *air transport regulatory system* runs in a manner very similar to other regulatory services in Canada. As with NAV CANADA, it too offers stable employment and has a significant in-house training capacity. Although the employment environment of the public sector is stable and offers excellent pension benefits, these characteristics make the looming retirement of the baby boom generation somewhat more problematic for the regulatory system.

In an ideal world, Transport Canada would continue its tradition of hiring experienced workers to replace an orderly, manageable outflow of exits and retirees. The incoming workers would have as much as 20 years of experience with an average of eight to ten years, rarely fewer than six. All would have some management experience. Transport Canada would be an employer of choice, able to compete with the private sector to attract the best and the brightest.

Given the new regulatory paradigm now developing within Transport Canada, candidates for employment would have sector and management experience as described above. As well, Transport Canada recruits would have a solid base in safety regulation, inspection and auditing as an entry requirement: they would have taken training courses of several weeks' duration at the community college and/or university level. Transport Canada would then train the new recruits further in several soft skills areas, in organizational awareness, in ethics and values in a regulatory environment, and in Transport Canada's approach to auditing and inspecting safety management systems.

For some branches of the Transport Canada Civil Aviation Directorate, this model is still the reality. In Commercial Aviation, for example, Transport Canada is still able to attract very experienced pilots with management experience, many of whom are willing to accept reduced salary so as to choose a different lifestyle in their later employment years. In most other branches, however, the feedstock of experienced workers is drying up or has already substantially disappeared.

Human resources forecasts for the aviation manufacturing and maintenance sub-sectors in Canada suggest that the shortfall will be exacerbated beginning in 2008 and beyond. Of 879 Transport Canada aviation safety inspectors, about 67 per cent are eligible for retirement within the next five years. Looking at Transport Canada more broadly, of the 1,359 inspectors, about 50 per cent are also eligible to retire over the same period. These are national numbers, so the impact within Ontario will be somewhat smaller.

Recruiting patterns for many branches of the Civil Aviation Directorate will have to change. This situation is not unlike that faced by several other regulated sectors, like health care and nuclear energy. If the supply of experienced workers simply isn't available, the only credible option seems to be to hire inexperienced staff and train them in a different manner.

Exhibit 3
Summary of Why Gaps Emerge
Three Perspectives of the Ontario Aerospace School-to-Work Transition

Issue	Student/Employee	Learning institutions
Enrollment into aerospace programs	Unlikely to have been exposed to aerospace in secondary school; unknown option Aerospace may be seen as "blue collar"; put off women and others with "white collar" aspirations Young people want to avoid narrowcasting skills unless there is a firm commitment of long-term job security Itinerant employees with tenure value want continuing education	Want to attract people where there is a demand for program Want to address both basic skills for young people and continuing education of current employees Political decisions around where program capacity resides Colleges judged according to employment outcomes
Design of educational programs	Little influence	Want to work with industry but control course design and pedagogy
Credentials	Want credentials that improve mobility and help develop career over time Relationship between credentials and long-term labour market performance in terms of job security and wages	Focus on awarding certificates, diplomas and degrees for entry level employees Willing to expand continuing education to address micro credential needs
Mobility	Want to maximize choice and options to develop a career	Want to offer base credentials that improve mobility and labour market outcomes Want to offer continuing education to upgrade skills

However, the upcoming wave of retirements is rather predictable and therefore entirely manageable if Transport Canada and the education and training community work together effectively to train replacements. A mitigating factor is that the baby boom echo will be increasing labour market supply around the time that Transport Canada will be requiring more people.

From the foregoing discussion, one can identify five factors that distinguish the dynamics of the sub-sectors:

- nature and conditions of employment
- risk of retirements that will require replacement
- need for formal credentials and licenses
- capacity to invest in training
- reliance on outside providers for education and training versus provision of in-house training

These factors have many implications for the human resource challenges that each sub-sector faces in terms of what people they will attract, what credentials they will use, and with whom they will work to develop skills. Some of the reasons for why gaps emerge are summarized in Exhibit 3. These are the issues that the remainder of the report will address, starting with consideration of demand factors.

Industry & their Associations	Possible Gaps
Want people with aerospace-specific skills as business opportunities arise	Gap between young student needs and industry ability to offer stable employment PSEs want to respond to both industry demand and student demand but may be caught in between Political decisions may develop capacity where it is not needed and underfund it where it is needed Difficult to co-ordinate cycles of enrollment and employment
In some instances, work well with PSEs on course design Auditing of course inputs and processes may create conflict with some institutions	Ontario colleges have not adopted industry-specific courses College courses may not mesh with industry accreditation
Want industry specific credentials Very small part of industry is subject to compulsory licensing	If industry credentials are the end point students may not want them
Offers some credentials that are specific to industry	Students desire for mobility may conflict with employers need for specific skills Employers want to recoup their investment in skills by investing in employees who are likely to stay

Approach

This chapter will develop an outlook for industry demand and supply by sub-sector. It will provide an overview of the factors that are shaping demand for skilled labour. These are the factors that must be taken into consideration by the education and training supply. The way the education and training supply adjusts will be partly in response to demand. But the argument developed to this point is that the different players are likely to respond in different ways based on their motivations and constraints within the current system. If these responses create gaps, then the solutions are partly about improving the responsiveness of the existing system and partly about changing the system.

The outlook is developed based on a review of existing data sources, the literature, and our survey of the industry. Existing data sources include the Canadian Occupational Projection system, Statistics Canada Labour Force Survey and census data, and recent industry studies. The main problem with existing data sources is that they present definitional problems and often do not offer reliable estimates at the occupation or sub-sector level. This problem becomes more acute when undertaking provincial analyses.

This study is interested in a subset of occupations for which post-secondary institutions have developed industry-specific education programs. The thinking here is that it will be easier for the post-secondary institutions to engineer a response to industry demand in the programs that are actually geared to the industry than it will be for occupations where aviation and aerospace demand is only a small portion of total demand.

For instance, colleges of applied arts and technology graduate tool and die makers. But according to one study, tool and die makers constitute only about 0.92 per cent of the total workforce in aerospace and aviation manufacturing and maintenance.[10] As such, changes in industry demand for tool and die makers are unlikely to be sufficient to bring forth a response from the education and training system.

A similar situation faces Transport Canada's demand in the face of looming retirements. There is probably not sufficient demand on Transport Canada's own account to justify major new programs at the post-secondary education (PSE) level. However, if Transport Canada defines its core competencies in relationship to the broader regulatory community, then there may very well be sufficient demand to bring forth a supply response.

Therefore, for some occupations, the aviation and aerospace industry needs to co-operate with other industries to have an impact on capacity. The same cannot be said for occupations such as aircraft maintenance engineers (AMEs), airport managers and air traffic controllers. In these cases, there is a very clear relationship between education and training supply and industry demand. These are the skilled occupations upon which this study will focus.

Given the fluidity of the industry's current situation, the quality of secondary source data, and the core methodology for this study, we eschew the approach of point estimates for particular occupations. Such forecasts have proved very unreliable, especially since the tragic events of September 11, 2001. Rather, the study generates order of magnitude estimates of the size and distribution of the skilled workforce for each sub-sector. It then undertakes a situational analysis as to the factors that will affect these top-line estimates over time, focusing on the risk of gaps forming.

The main driver of long-term performance in the industry is overall economic growth — in particular, personal disposable income. Within this, each sub-sector has its own dynamic, depending largely on the geographic scope of its market and whether it reflects a manufacturing business cycle or a service business cycle. Within these parameters, the industry can be thought of along a continuum that measures the extent to which global or provincial factors shape demand (Exhibit 4).

As it happens, the continuum also reflects the extent to which the sector is likely to be unionized. Large, unionized organizations in Ontario typically tend to have older, long-tenured employees with better pension benefits. As such, these organizations are at greater risk of experiencing replacement challenges emerging from the looming retirement of the baby boom generation.

Exhibit 4
Sub-sectors and Underlying Markets

Marketing		
Global Aircraft Market	Continental Aircraft Service	Ontario Originating and Destined Passenger and Cargo Movements
Manufacturing	Maintenance, Repair and Overhaul	**Air Carriers** **Air Traffic Control, Air Navigation** **Airports** **Air Regulatory Functions**
Industry Sub-sector		

Much of the industry depends on provincial economic growth to fuel demand. One structural factor that is important to demand is the tendency for much of the industry to locate in and around major airports, most notably Lester B. Pearson International Airport in Mississauga. By one study's estimate, the airport and its associated activities employ more than 138 thousand people, and generate a total annual output of over $14 billion.[11] Although Pearson acts as a hub for flights destined for other markets, the majority of activity at Pearson is driven by the demand for transportation into, and out of, the Golden Horseshoe. About seven out of 10 passengers are either residents of the Greater Toronto Area (GTA) or businesspeople and tourists visiting the Golden Horseshoe.[12] Thus, while expanding as an international gateway, Pearson Airport is primarily an airport driven by provincial (and GTA) income growth.

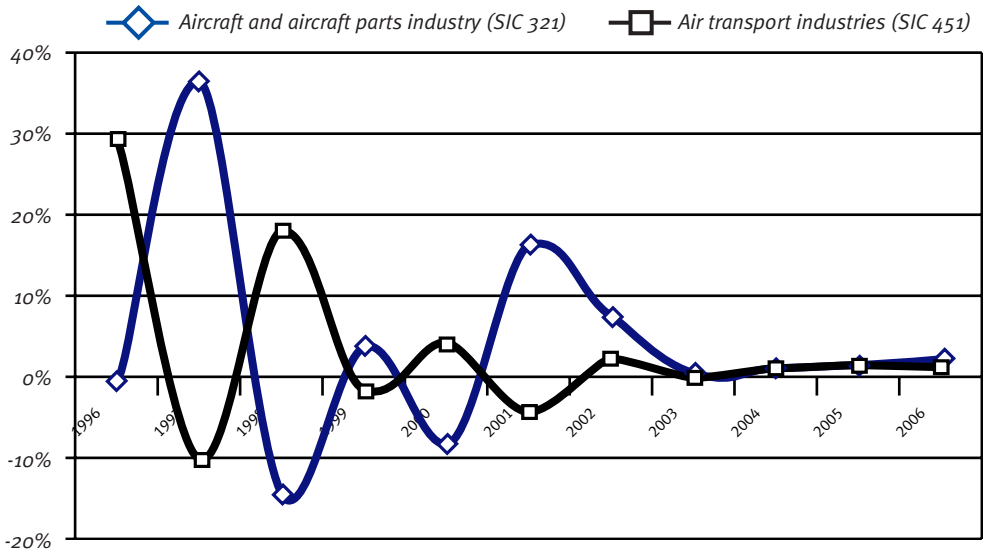
After two years of lacklustre growth, according to the Conference Board of Canada, Ontario should resume medium-term growth of about 3 per cent per annum. The passenger (both business and leisure) and cargo sides of aviation are services that directly co-relate with provincial personal disposable income. This drives the business for air carrier operations and maintenance, repair and overhaul (MRO). These, in turn, generate demand for airport operations, air traffic control, and navigation services and regulatory functions.

The manufacturing side of the industry tends to respond less to domestic growth and more to international demand for aircraft. Moreover, the manufacturing side reflects a business cycle of a capital goods industry, whereas all other aspects of the industry reflect a service sector business cycle. The main difference in these cycles is that the manufacturing cycle tends to be more cyclical in its employment (Chart 3).

These business cycles determine desired employment levels. Within this, each industry sub-sector may be undergoing structural changes that affect attrition rates and the desired mix of skills. The report now turns to an examination of how these factors come together for each of the four sub-sectors:

- aircraft and aircraft systems design, development and manufacturing
- maintenance, repair and overhaul (MRO)
- air carrier operations
- airports

Chart 3
Employment in Ontario Aircraft Manufacturing and Air Transport Industries
Per Cent Growth, Year over Year: 1996-2006



Source: Canadian Occupational Projection System (COPs) forecast for Ontario.

Aircraft and aircraft systems design, development and manufacturing: the key driver is the global market in new aircraft. This industry is organized in a hierarchy of suppliers. Most Ontario manufacturing employment is with aircraft and space systems and equipment. As such, its business cycle is ultimately determined by the order books of aircraft manufacturers.

Tier 1 producers are those that have major responsibility for the design of the finished product and main components. Canada's main Tier 1 producer is Bombardier, which specializes in business and regional jets. This market has seen strong growth over the last 20 years; however, it has also seen very strong competition that has reduced margins.

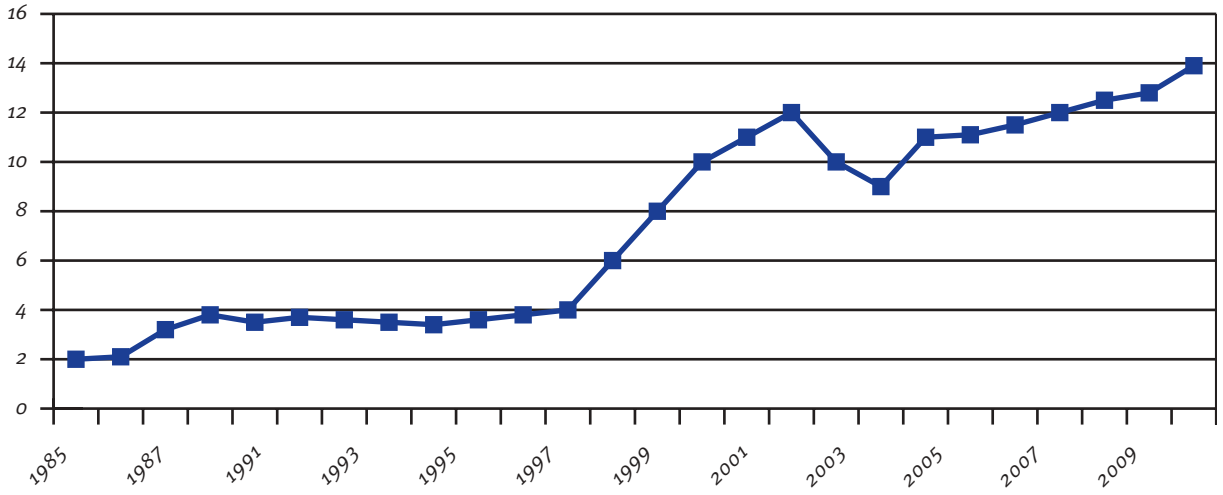
Although the business and regional jet market is important to Ontario producers, they are integrated into a global manufacturing market that is dominated by Tier 1 producers such as Boeing in North America and Airbus in Europe. (Québec also specializes in helicopter production through Bell Helicopters). The industry has gained a reputation for high-quality production that has made cost considerations less important.

Table 1
Commercial Aircraft Sales 2001-2005

	Units Produced		Value (Billions Constant $US, 2001)	
Year	Large Commercial Jets	Regional Aircraft	Large Commercial Jets	Regional Aircraft
2001	813	439	46.07	6.34
2002	723	383	42.31	5.64
2003	644	349	40.30	5.45
2004	547	363	38.15	5.67
2005	541	366	40.59	5.76

Source: Teal Group

Chart 4
Business Jet Sales 1985-2010 (2002 Constant $US billion)



Source: Honeywell Aerospace. 2002. Business Aviation Outlook 2002.
Presentation to National Business Aviation Association Conference. September. Orlando.

The short- to medium-term outlook for aircraft sales is flat. The main problem for the industry in the short term has been that structural issues impacting the profitability of major carriers have coincided with a downturn in the business cycle. Capital goods industries like aircraft manufacturing tend to lag the recovery, and so strong employment growth is unlikely to return until 2004-2010. This is reflected in Teal Group's medium-term outlook for commercial aircraft sales (Table 1) as well as Honeywell's long-term forecast for business jets (Chart 4).

The main structural issue facing the industry is agility and the ability to keep current with rapidly changing products and manufacturing technologies. Agility manifests itself in two ways:

- a need to manage significant fluctuations in employment levels
- a need to adjust the workforce competencies

Maintenance, repair and overhaul (MRO): The MRO side faces a similar challenge in ensuring that its workforce is current on the latest aircraft and aviation technology. This market is driven by a combination of the age of aircraft and their ongoing usage as measured by aircraft movements (both passenger and cargo). Initially, this activity was directly related to the aircraft movements of domestic carriers. However, in recent years, the maintenance sub-sector has become more export oriented. This development is transforming the industry into a continental supplier.

Export growth has been largely spearheaded by Air Canada's aggressive move into the $40 billion global maintenance market through Air Canada Technical Services. As an indication of the potential for growth, by early 2002, Air Canada had recalled about a thousand workers that it had laid off post-September 11, 2001. Air Canada now generates over $200 million in sales from this market. If it is successful in its plan to grow this business, it will effectively have transformed what was essentially a domestic-oriented maintenance sub-sector into a continental service provider.

The challenge is for other approved maintenance organizations (AMOs) to attract business. Many lack sufficient economies of scale and scope to service such a large and sophisticated market. The major carrier maintenance business requires sizable investments in specialized equipment and knowledge that many smaller AMOs simply lack.

Air Canada's dominance in the maintenance sub-sector (it employs a third of the workforce) also means that the sector tends to reflect the demographics of Air Canada's older, longer-tenured employees. It is therefore likely to experience a structural issue with retirements, particularly after around 2008. This is likely to especially affect aircraft maintenance engineers (AMEs).

Air carrier operations: As with airports, air carrier operations in Ontario tend to be influenced by provincial income. This drives the leisure, business and air cargo markets. Also, Ontario is home to the majority of Canada's immigrants, who disproportionately account for outbound and inbound leisure travel. This naturally has implications for airports and air carrier operations.

Notwithstanding the existence of a number of passenger and cargo competitors, Air Canada dominates the employment of air carriers, especially since it took over Canadian Airlines International in December, 1999. Although regional and charter carriers like WestJet, Royal, First Air, Air Transat and Skyservice will continue to challenge Air Canada at the margins, the fact remains that Air Canada accounts for over 70 per cent of the domestic market. Air Canada is on record as saying that it intends to reduce the average number of employees per aircraft from the current 148 to 136.[13] Even if other providers pick up part of the slack, the medium-term employment growth in the industry is likely to be modest.

A mitigating factor is the aforementioned aging of Air Canada's workforce. But with the intention of reducing its workforce, Air Canada is likely to encourage early retirements. The company has already reduced its workforce by seven thousand employees and could lose another eight thousand in the medium term. Many of these losses will undoubtedly come from early retirements.

For the purposes of this study, however, the main interest is in technical staff. Air Canada's strategy is clearly to see its maintenance arm less as an internal service and more as a separate business unit with its own revenue stream. So even if the overall workforce of Air Canada is stagnant, its technical service staff could grow.

Airports: Passenger and cargo movements through the airports drive employment. As with air carrier operations, the key economic driver is provincial income. The point has already been made that while Lester B. Pearson Airport serves as a hub, it is primarily a beginning and end point for GTA passengers. The steady growth in personal income will have the effect of increasing the size of Ontario airports, especially in Mississauga and Ottawa. The positive long-term view is a major factor in the Greater Toronto Airports Authority's expansion of Pearson Airport. Aircraft movements at Pearson are expected to increase by over 200 thousand to 650 thousand annually by 2020.

The main structural change has been the transfer of ownership from Transport Canada to local airport authorities and private operators. This means that airports are increasingly free to develop their commercial potential. Airports are a unique combination — part high-safety/high-security transportation facilities, part hotel and retail space. Although some managers will require a transportation background, many may very well emerge from the retail management field. Increasingly, hotels and entertainment will also be attached to airports. Airports are likely to continue the practice of leasing space to other businesses. But this requires managers who understand how to develop revenue streams out of passenger traffic and how to service retail tenants. Over the long term, Ontario airports are likely to require more "facility management," as this area of management is called.

Safety is also very important in the management of such airport functions as aircraft rescue and firefighting, handling and storage of hazardous substances and materials, airport emergency planning and wildlife hazard control. This will call forth a diverse set of management skills.

Air traffic control and air navigation: Air traffic controllers are employed in Area Control Centres, the Ottawa Terminal Control Unit (TCU) and in Ontario's 12 towered airports. In addition, there are 72 flight service stations across Canada at locations with fewer than 60 thousand aircraft movements.

NAV CANADA targets its employment levels to aircraft movements. As such, employment levels in the industry are likely to expand gradually over the long term. Employment levels will occasionally spike as new capacity is installed. For instance, flight information centres planned for London and North Bay will affect air navigation employment in these centres.

However, the nature of employment and technology will have counteracting impacts on the industry. NAV CANADA employees work in a unionized environment with good benefits. They also happen to work in a very high-stress part of the industry and therefore tend to retire early. This means that there will be a high demand for replacing workers earlier than in other sub-sectors.

However, technology counters this trend towards greater staffing needs. Air navigation technology in particular has reduced the number of people required to provide navigation services, especially flight service specialists. At the same time, rapid technology advancement means that NAV CANADA must overstaff positions so that employees can receive skills upgrading away from the job. These counteracting trends — some that increase the demand for labour and others that dampen it — will likely portend modest and manageable increases in the air traffic control and air navigation workforce over time.

Air regulatory functions: The main driver of employment for Transport Canada is the movement toward a performance-based regulatory structure. Over time, this has had an appreciable effect on the number of people required by Transport Canada and on the skills they require. Specifically, the characteristics of a regulatory inspector need to be redefined. Regulatory inspection needs to move from a traditional military thought process based on pilot experience to a recognition of other values, such as those of commercial air services managers and owners.

In the short term, the issue for Transport Canada will be to maintain a very high level of regulatory performance through its people working with others in the industry. But on the horizon looms a very significant challenge in replacing retiring workers. As with NAV CANADA, however, Transport Canada is the monopoly supplier of air regulations. Transport Canada does not have to compete with other regulators for people. Although it faces a significant staffing challenge, the retirements it faces are somewhat predictable, and new people will be attracted by the excellent work environment and good benefits it offers. Therefore, it is very likely within Transport Canada's capabilities to manage the change, working in concert with other regulatory functions, PSEs and the industry.

Table 2
Overview of Ontario's Skilled Aviation/Aerospace Workforce, 2002

Industry Sub-sector	Total	Skilled [a]	Distribution of Skilled Workforce
Aircraft and aircraft systems design, development and manufacture	20,000	16,000	Technicians: 20% (Non-certified: 15%) Trades: 55% Scientific: 15% (Non-certified 40%) Managers: 10%
Maintenance, repair and overhaul [b]	5,000	4,000	Scientific: 5% Trades: 50% Technicians: 45% (Licensed AMEs: 50%)
Airport operations [c]	1,500	500	Airport Operation Managers: 100%
Air carrier operations	18,000	4,000	Managers: 90% Technical Ground Staff: 10% (maintenance covered above)
Air traffic control and navigation	910	910	Flight Service Specialists (FSS) 19% Electronics Technicians 27% Air Traffic Controllers Visual Flight Rules 19% Instrument Flight Rules 36%
Air regulatory functions [d]	4,200	3,000	Aviation Safety Inspectors (20%)

[a] Scientific, technical, trades, managers that create demand for higher education. Pilots are excluded from consideration.

[b] Maintenance, repair and overhaul includes maintenance people in air carrier operations.

[c] Airports include 12 towered airports.

[d] National figures. Majority will be in Ontario because of Ottawa headquarters and major airports.

Sources: Authors' estimates based on following sources: A Human Resources Study of the Canadian Aviation Manufacturing and Maintenance Industry. 2002. Ottawa: Canadian Aviation Maintenance Council and Malatest and Associates Ltd. 2001. Final Survey Report Vol.2.2. Canadian Aerospace Labour Market Survey and Employment Forecast, 2001-2004. Canadian Urban Institute. 2001. Industrial Sector Study: Aerospace Industry. (Toronto: CUI). Data from the Canadian Occupational Projection System (COPS). Transport Canada. NAV CANADA data. Greater Toronto Airports Authority. 2001. Economic Briefing Paper. (Mississauga: GTAA). Airport websites. Industry survey stream.

Table 3
Ontario
Survey Results on Employment by Major Industry and Occupation
n=41

	Employees
Manufacturing, Maintenance, Repair and Overhaul	
Aircraft, Components, Systems or Process Designer	983
Aircraft Maintenance Engineer (AME)	
M License (General Maintenance)	2,209
S License (Structures)	732
E License (Electronics)	742
Aircraft Maintenance Technician (unlicensed)	852
Aircraft Reciprocating Engine Technician	203
Aircraft Simulator Technician	25
Assembler	1,473
Aviation Electrical/Electronics/Instrument Component Technician	812
Aviation Machinist (including CNC Programmer)	867
Aviation Maintenance Inspector	83
Aviation Mechanical Component Technician	253
Aviation Painter	483
Trim and Finish	550
Composites Fabricator	225
Dynamic Component Technician (including helicopter)	22
Gas Turbine Engine Repair and Overhaul Technician	373
Quality Assurance/Control Technician	299
Quality Assurance/Control Engineer	98
Air Carriers (Outside of MRO and Pilots)	
Air Carrier Radio Operator	375
Aviation Ground Support	640
Air Transport Ramp Attendant	404
Airports	
Airport Engineer	42
Airport Operations Manager	28
Apron Management Officer	20
Aviation Ground Support	16
Aviation Fueler	5
Air Traffic Control and Navigation	
Technician	245
Flight Service Specialist	173
Air Traffic Controller	492
Air Regulatory Functions	
Aviation Safety Inspector	500
Policy and Program Manager	600
GRAND TOTAL	**14,824**

Source: Estimate from Survey Findings

Table 2 uses the industry framework outlined in Chapter 2 to present estimates of the skilled workforce for each sub-sector. We tend toward using round number estimates, as these are as reliable as point estimates and focus on the order of magnitude. We supplement these top-level estimates with detail emerging from our survey of the industry.

Our initial estimate of the portion of the workforce that creates a demand for higher education is about 55 per cent. We found roughly 14,824 positions in the six industry sub-sectors for a coverage of about half of all skilled (non-pilot) positions. These occupations are also organized by major sub-sector. Table 3 looks at the distribution of employment across occupational categories based on our surveys.

Box 2
Key Risks to the Outlook

The outlook presented here is based on a small-scale survey of aerospace and aviation employers and institutions of higher learning. Because of the industry structure, a few large employers have a great impact on the overall outlook, especially Air Canada. Also, the manufacturing component of the industry is highly cyclical. Finally, the study focuses on the civil aviation sector: the military's demand for people was excluded. These factors add an element of risk to the outlook presented here.

The point has already been made that Air Canada plays a dominant role in several parts of the industry and the training and education system (Box 1). In Spring 2003, Air Canada filed for bankruptcy protection. As this report went to press it remained unclear how Air Canada's financial challenges would impact its demand for human resources. Indications are that Air Canada will continue to aggressively expanding its maintenance activities. The way the report deals with this is to discuss the trends outside of Air Canada's maintenance plans. Should these plans materialize, Air Canada may increase its demand for maintenance employees in Ontario over the next year. All reported findings may be adjusted upwards upon realization of this plan.

Aside from the dominance of Air Canada, another risk relates to the highly cyclical nature of demand in the manufacturing sub-sector. As the industry is currently in a mild cyclical downturn, it is very difficult to forecast employment levels based on an industry survey. In some ways, the challenge on the manufacturing side is similar to the risk posed by Air Canada. Specifically, industries that are more dependent on a closed national market are easier to forecast than those whose expansion depends on continental or global plans.

Finally, we have not considered military demand as a separate component of the industry. This has not been a problem lately because the military has not been expanding. However, all indications are that the military is about to face an immediate need for people through expansion and could potentially face large-scale retirements after 2010.

The Outlook from the Survey

Our survey asked whether industry saw its skilled workforce as expanding, contracting or staying the same. Table 4 presents the findings for those organizations that responded to this question. Most industry employers expect to hold steady in the next year. However, it is noteworthy that air carrier operations do intend to expand their operations.

Table 4
In the next year, do you see your aviation and aerospace workforce expanding, contracting or staying the same?
Selected Sub-sectors
n=41

Sub-sector	Expanding	Contracting	Staying the Same	Total
Manufacturing/MRO	5	5	11	21
Air Operations	2		10	12
Air Carriers	5	2	1	8
	12	**7**	**22**	**41**

Source: Survey Findings

Of course, these findings have to take into consideration the size of employer to be accurately translated into demand. The survey findings can be used to generate a top-level demand for skilled workers in aviation and aerospace in Ontario based on employers' responses to questions on levels of growth. Seventeen of the surveyed employers were able to provide specific estimates of how much they anticipated their employment to expand or contract (9 expanding and 8 contracting).

Table 5
Occupations that the Industry Plans on Expanding in the Next Year
n=41

Occupations	Mentions
Aircraft, Components, Systems or Process Designer	1
Aircraft Maintenance Engineer (AME)	
M License (General Maintenance)	8
S License (Structures)	3
E License (Electronics)	3
Aircraft Maintenance Technician (unlicensed)	2
Aviation Electrical/Electronics/Instrument Component Technician	4
Aviation Machinist (including CNC Programmer)	3
Quality Assurance/Control Technician	2
Aviation Fueler	3
Aviation Ground Support	2
Air Transport Ramp Attendant	2

Source: Survey Findings

Applying projected growth rates to employment levels generates a flat outlook for all aspects of the industry (with the proviso of Box 2). Expansions and contractions are of roughly the same magnitude and the majority of employers expect a holding pattern on employment levels.

In regard to companies that are expanding, Table 5 outlines the occupations they will be recruiting in the short term. In defining these occupations, we have taken care to align our definitions with those used in other industry studies, most notable the recent *Human Resources* study. Air Canada's expansion plan will primarily affect the recruitment of M-licensed (general maintenance) AMEs, some of whom will need to complement the classroom portion of their training with applied work experience before being licensed.

Companies that are recruiting concentrate in the manufacturing/MRO sub-sector. Within this, AMEs, component technicians and aviation machinists received the most mentions for recruitment. The high number of AMEs suggests that even beyond Air Canada there are plans for expanding the maintenance part of the industry.

Both the review of the literature and the survey of the industry point to the same trend: an essentially flat short-term outlook and an uncertain medium- to long-term outlook. This longer-term outlook is somewhat more predictable for those parts of the industry that are primarily dependent on provincial economic growth — airport operations, air carrier operations (outside of maintenance) and air traffic control and navigation services. These industries' long-term growth trends will tend to mirror overall provincial growth. In the longer term, they will also have to deal with structural issues like technological change and an aging workforce.

The same cannot be said for the manufacturing side — and increasingly, the maintenance side — of the industry. Manufacturing has a well-established history of cyclical employment. Although the industry is currently in a lull, past experience shows that it can grow very strongly during recovery periods.

There are preliminary indications that the maintenance side may be undergoing a structural change that may see it penetrate a broader market outside of Canada. If this materializes, it could change the dynamics of this sub-sector and the way the training and education system responds to its needs.

The report now turns to this response of the education and training system to industry demands.

Having considered some of the forces shaping demand over the course of the short and medium term, the study now turns to the supply response. This response is created through three general mechanisms. First, companies upgrade their employees to respond to emerging demands. Although often ignored, this source of new supply is critical. Companies attempt to manage this upgrading through their training programs. A second source of supply is new recruits, either from other companies or from the graduates of post-secondary educational institutions. A third source is through immigration.

Each of these sources of supply has its own implications for the education and training system. We begin by looking at major occupations within industries according to their source of new entrants. We streamline the occupations in Table 6, focusing on those that have significant volumes and draw on the supply of higher education and training. (Assemblers are included to illustrate a later point about immigrants).

Table 6
What percentage of new entrants to this position comes from...?
(Selected Aviation and Aerospace Occupations, n=45)

	New Graduates		Experienced		New Ontarians
	Community College	University	Within Company	Another Company	Immigrants
Occupation					
Aerospace Engineer	1	24	16	58	1
Manufacturing Technician	10	1	40	46	3
Aviation Machinist	22	3	17	51	7
Aircraft Maintenance Engineer	26	0	1	73	0
Avionics Technician	30	0	4	62	4
Maintenance Technician	28	0	4	65	3
Aviation Machinist	19	2	5	69	5
Air Carrier Manager					
Airport Operations Manager	5	15	73	7	0
Assemblers	5	0	7	63	25

Source: Survey Findings

Table 6 presents a neatly organized way of thinking about the labour market flows and the associated education and training challenges. The table segments the labour force into three categories:

- new graduates
- experienced movers
- new Ontarians

People in the labour market are distinguished primarily based on two attributes: work experience and education. One part of supply is simply about the movement of people with varying levels of these attributes. A second part of the labour supply is about the creation of new supply through the education and training system.

The education and training system creates supply by developing knowledge and competencies. Some of these competencies are developed through formal education and others through workplace training. Competencies are also developed through informal training and experience on the job. Although not well captured in training statistics, there is undoubtedly a market value associated with workplace experience; this was borne out by the interviews for this study. Moreover, many trades are organized around a model of classroom education and applied work experience. How classroom education relates to the world of work is therefore extremely important.

This chapter looks at how Ontario's education and training system develops a supply of competent people for the aviation and aerospace industry. This discussion primarily draws on the original data collected through the survey of employers and educational institutions.

Educational Institutions' Contribution to Supply

As a key part of the methodology for this study, we undertook a census of aviation and aerospace programs at colleges and universities in Ontario. (Appendix A details the program offerings of post-secondary institutions in Ontario.) In total, we surveyed 44 educational institutions and found that 19 offered at least one program of study targeted at the industry. Most of these institutions (11) offer one program; the remainder offers two or more. All told, there are 37 courses of study in Ontario that produce workers for the aviation and aerospace industry.

Post-secondary education (PSE) is organized along disciplines and sub-disciplines. These generally award credentials for higher education that then serve as a basis for entry-level hiring decisions.

At the *university* level, there are some advanced engineering courses geared toward the design part of the industry. These are not defined by a specific occupation per se. Indeed, we found that graduates from aerospace engineering programs often are hired by other manufacturing industries. These are first and foremost engineering degrees that use advanced computer technology and teach analytical competencies. While the core curriculum is shared across various engineering sub-disciplines, optional courses specific to aerospace and aviation are offered.

Colleges of applied arts and technology offer two types of courses that relate to the industry. Some are closely aligned to specific occupations. This is the tendency in aerospace and aviation trades and licensed trades, most of which are formally supplemented by additional work experience. In other instances, colleges offer courses where aviation is added as an option. These tend to be arts or management courses with optional pilot training. Although we had not intended to consider pilot training, our census of courses inevitably picked up some pilot courses that are attached to arts and management courses.

In some instances, college courses produce a credential (outside of the pilot license) targeted at the industry — for instance, aviation management. Even when these courses don't produce an industry-specific credential, successful completion demonstrates an aptitude for aviation technology, and the arts or management courses add a level of analytical and communication competency beyond secondary school. As such, many graduates of these courses are suitably trained to enter the management occupations for airports and air carriers. This is especially true for smaller airports and operators where management personnel will fly planes as well.

The vast majority of university and college courses produce highly skilled people who are likely to be in demand by the industry. On average, it takes five semesters to complete a course, with most college courses taking four semesters and most university courses taking eight semesters. Table 7 looks at the distribution of courses by the occupations that their graduates are likely to enter.

Table 7
Programs Offered by Educational Institutions in Ontario
(by Principal Occupation)

	Programs
Manufacturing, Maintenance, Repair and Overhaul	
Management	1
Engineering Design (Degrees)	10
Manufacturing Technician	2
Aviation Machinist (including CNC Programmer)	1
Aircraft Maintenance Engineer (AME)	
M License (General Maintenance)	2
S License (Structures)	3
Aircraft Maintenance Technician (unlicensed)	3
Air Carriers (Outside of MRO and Pilots)	
Aviation Management	4
Airports	
Airport Operations Manager	2
Air Traffic Control and Navigation	
Flight Service Specialist	1
Air Traffic Controller	1
Other	
Commercial Pilot with Arts Courses	7
TOTAl	**37**

In addition to the courses listed in Table 7, a separate assessment was completed of the courses of interest to Transport Canada for safety management systems and inspections. This survey found that 12 colleges offer the sort of base training required for safety inspectors, including courses on communication skills, office technology and basic risk assessment. A similar number of colleges offer more specialized training in areas such as safety management evaluation (8 colleges), safety management systems (10 colleges) and organizational awareness (12 colleges). Most of these courses are not specifically geared to Transport Canada's requirements, likely because the student population is drawn from a much wider base.

There are three important accrediting organizations:

- Transport Canada
- Ontario Aerospace Council (OAC)
- Canadian Aviation Maintenance Council (CAMC)

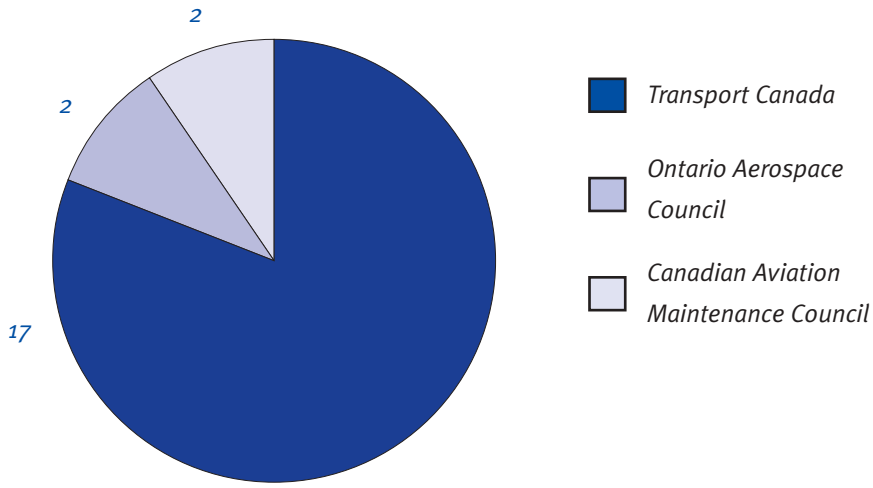
Transport Canada is responsible for accrediting programs that, when combined with a practicum in an employment setting, allow people to apply for a Transport Canada license. This is most important to the aircraft maintenance engineer (AME) and the air traffic controller (ATC) streams. The OAC has three streams of programs that focus on the manufacturing processes and their management:

- Aerospace Industry Training Program (AITP)
- Process Manufacturing for Aerospace (PMIA)
- Aerospace Executive Management Program (AEMP)

CAMC has developed occupational standards, curricula and accreditation for 15 maintenance trades.

The survey asked how post-secondary courses could be used toward licenses or certificates. Data relating to accredited programs (illustrated in Chart 5) indicates that institutions of higher learning, specifically colleges and NAV CANADA, tend to organize their offerings around Transport Canada licenses.

Chart 5
Post-Secondary Educational Programs that Can be Put Toward Industry Credentials
(Number of Programs by Credentialing Organization)



Source: Survey Findings

The alignment of programs with industry-sponsored credentials other than Transport Canada's is low for a number of reasons. In the case of the OAC, this is by design. The OAC has tended to focus on a few programs to build management competencies. The organization does not seem to be interested in developing specific occupational trades because there is already a well-established system of manufacturing trades. Moreover, the industry is looking for agility and flexibility; occupational trades have a reputation for narrowly defining what a person will do and how he or she will do it.

The low adoption of CAMC-accredited courses is explained by a number of other factors. To begin with, CAMC has taken the approach of defining a relatively large number of trades that are unique to the industry. Not all these trades are created equal in terms of their uniqueness in building competencies or in the number of students who may demand them if offered at a college. The cases in which colleges have adopted CAMC (e.g., structures) are in new areas where there are no existing curricula and where colleges believe there is sufficient *sustained* demand to warrant developing the capacity to deliver a program over a number of years.

CAMC has a thorough approach to developing curricula, accreditation and credentialing. Its approach is relatively new in Canada for defining industry standards. However, many college programs pre-date CAMC and are based on Transport Canada accreditation. CAMC uses a rigorous process to accredit colleges that deliver their curricula, as does Transport Canada. Yet, colleges are unlikely to go through both levels of accreditation unless they think there is additional benefit in terms of a new program that attracts students. Transport Canada has indicated, however, that it is willing to work with the industry to streamline accreditation and, if the industry demands it, to eventually devolve its accreditation to an industry-sponsored organization like CAMC.

The Pipeline of New Entrants

The survey design allowed us to align the flows of students through programs into occupations. The survey then asked education providers to estimate the growth of the programs in terms of enrolled students. This information was fed into a model that incorporates different program characteristics. This model estimates the number of people who will have core technical competencies to assume certain occupations in the industry.

The vast majority of programs do, indeed, prepare people to go to work in the industry — but other paths are also possible. For instance, people with degrees who are qualified to work in the engineering and design part of the industry may actually choose to work in another industry. Interestingly, in two instances, respondents indicated that even specialized courses like those for AMEs provide people with the basis for working in another industry. Another common path is that of pursuing more education or, more likely, work-based training leading to a trade license.

Table 8

Pipeline of New Graduates Emerging from Ontario Colleges and Universities, 2003-2010

(Selected Occupations)

	5 Year Program Growth	2003	2004	2005	2006	2007	2008	2009	2009	2010
Manufacturing, Maintenance, Repair and Overhaul										
Management	25%	27	34	38	43	48	54	61	68	77
Aircraft, Components, Systems										
or Process Engineer	0%	258	450	506	570	641	721	811	912	1,026
Manufacturing Technician (Certified)	60%	8	32	35	40	45	50	57	64	72
Aviation Machinist										
(including CNC Programmer)	0%	15	19	22	24	27	31	34	39	44
Aircraft Maintenance Engineer (AME)	70%	228	150	168	189	213	240	270	303	341
Aircraft Maintenance Technician	38%	84	185	208	234	263	296	332	374	421
Air Carriers (Outside of MRO and Pilots)										
Aviation Management	160%	81	150	168	189	213	240	270	303	341
Airport Ramp Attendant	125%	9	11	13	14	16	18	20	23	26
Airport Operations										
Airport Operations Manager	0%	23	28	32	36	40	45	51	57	64
Air Traffic Control and Navigation										
Flight Service Specialist	0%	121	169	190	214	240	270	304	342	385
Air Traffic Controller	0%	200	279	314	353	397	447	503	566	636

Source: Ontario Aviation/Aerospace Graduate Pipeline Model based on survey results

Table 8 looks at the pipeline of new entrants emerging from Ontario's colleges and universities. This pipeline was developed based on survey responses from the colleges about the nature of their courses (semesters, graduation rates) and anticipated growth rates. The colleges in particular plan to aggressively expand many areas that are directly relevant to the needs of the industry. Most noteworthy are planned expansions in courses for various types of managers, AMEs and maintenance technicians.

As shown in Table 6 earlier, new graduates are merely one source of supply for the industry — the main source of supply is employees that are already working for the employer or with another employer. Overall industry demand is actually more variable than the outflows of people from educational institutions. As such, graduates who enter the labour market during a downturn end up doing something else, either continuing their education or working outside the industry. Nevertheless, these graduates are added to the stock of skilled people that can be drawn on by employers during cyclical upswings.

Whether graduates find immediate work or have to wait, they will still require some company-specific training. Classroom education is important but it is not a substitute for workplace experience and training. For many trades, workplace education is part and parcel of the credentialing system. Consequently, it is important to consider how employer training creates a supply of skilled people. Aside from addressing specific employer needs, there is another reason why training is important — it creates demand for continuing education, which is a market that universities and colleges may be interested in developing.

We asked employers about the level and organization of their training supply for various occupations. In total, 30 of 42 employers indicated that they had training budgets. Surveyed employers plan to spend about $14 million a year on training. To put this into context, this annual training effort about the same as that made by the college system. The difference is that the training is applied to fewer people than is college education. Also, this training is focused on specific competencies needed to perform jobs. At least five thousand aviation and aerospace employees in Ontario benefit from this type of training annually.

When new entrants are hired, many are provided with further training. There may be some interpretation issues as to what is actually meant by “training.” Although we were referring to formal training, some respondents did not make a distinction between formal and informal training.

The 42 employers reported on 159 training programs that are targeted at different entry-level employees. Table 9 summarizes the volume and distribution of training by occupation. For positions such as AME and airport operations manager, ongoing training is a very significant portion of total education and training. This highlights the fact that increased supply is not merely a matter of increasing the flows through colleges and universities. Work-based training programs must also expand, and that means that employers either have to hire new entrants or create work terms for them. Many aspects of the industry are unique in this regard. There often is no adequate substitute for workplace training because the underlying technologies are unique to the workplace.

Table 9

Average Additional Hours Spent on Training New Entrants

(Selected Occupations)

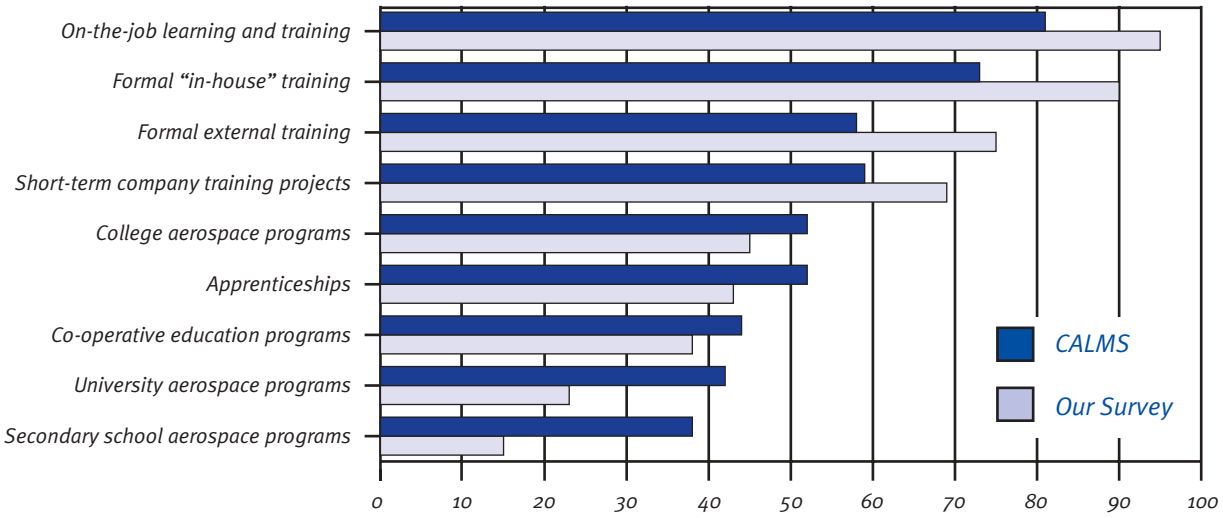
N=30

Manufacturing, Maintenance, Repair and Overhaul	
Engineering Design (Degrees)	40
Manufacturing Technician	95
Aviation Machinist (including CNC Programmer)	10
Aircraft Maintenance Engineer (AME)	
M License (General Maintenance)	95
S License (Structures)	342
E License (Electronics)	342
Aircraft Maintenance Technician (unlicensed)	195
Air Carriers (Outside of MRO and Pilots)	
Radio Operator	57
Ramp Attendant	60
Airports	
Airport Operations Manager	260
Airport Engineer	240

Source: Survey Findings

We asked the same question that was asked in the *Canadian Aerospace Labour Market Survey and Employment Forecast, 2001-2004* (CALMS) about the relative importance of different types of training in creating skilled workers. Chart 6 contrasts our findings with those from the CALMS study. The ranking of our findings and those of CALMS are roughly the same. Our study clearly backs up the CALMS finding that learning on the job is a very important element of employee development. Indeed, the findings can be interpreted thus: the further the source of supply is from the workplace, the less valuable the training is. Clearly, this data supports the contention of many employers in our survey that applied training in the workplace is extremely important and that the education system is not a substitute for this applied experience (see Chapter 6).

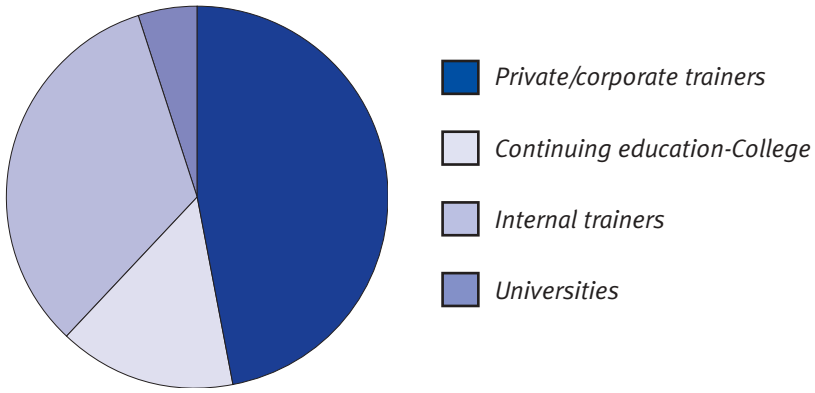
Chart 6
Employer Ranking of the Importance of Selected Types of Training
CALMS Study and Survey Findings
N=40



Source: Survey Findings

Another manifestation of the same phenomenon is employers' planned allocation of their training budgets (Chart 7). This shows that employers place a very high premium on courses that they design to address workplace needs. It appears that employers expect new entrants to have some core technical and employability skills, but they are willing to train these people further to develop specific competencies in the workplace. As such, the education system and the job-based training system have to be seen as an integrated effort to create skilled workers for the aviation and aerospace industry. If, in fact, these systems do not act in an integrated fashion, gaps will emerge between demand and supply.

Chart 7
Allocation of Employer Training Budgets
Percentage Allocation for Total Sample
N=45



Source: Survey Findings

Chapter 5
How Does Mobility Affect Supply?

An oft-heard complaint from the industry is that companies have difficulty finding and retaining skilled employees. The mobility of skilled people has a direct impact on this question. We are interested in two types of movement:

- inter-firm mobility
- geographic mobility

Inter-Firm Mobility

Table 6 in Chapter 4 supports an observation that emerges from the interviews conducted for the study: inter-firm mobility is an important source of people. Our interviews found that companies prefer applicants with two to three years of industry experience. Also, they will often consider an applicant's work in the auto sector as relevant experience.

The industry is not especially unique in terms of turnover. In a typical year, millions of Canadians are recruited outside of their organization. According to the Conference Board of Canada, the overall turnover rate for Canada is about 7 per cent. The rate for the manufacturing sector as a whole is around 4.5 per cent. Studies from the US suggest that the aerospace industry has a turnover rate of around 5 per cent.

Although these top-line turnover rates are no cause for alarm, there are several structural factors that may impact particular firms hiring for certain jobs. There has been a tendency for parts of the industry to move toward highly specialized ways of credentialing and licensing skills. In Chapter 2, we alluded to the friction that this causes between a firm's immediate need for people and an individual's need for flexibility.

A second source of structural shortages occurs between small and large firms. Larger companies are generally in a financial position to bid talent away from smaller firms. This is all well and good, as long as there are enough people who are willing to move and enough new entrants to top up the total level of employment. But it becomes more of a problem as the workforce ages, because older people are generally less inclined to move. Obviously, parts of the industry that are prone to growth spurts — such as manufacturing — are likely to face a bigger problem in this regard.

Geographic Mobility

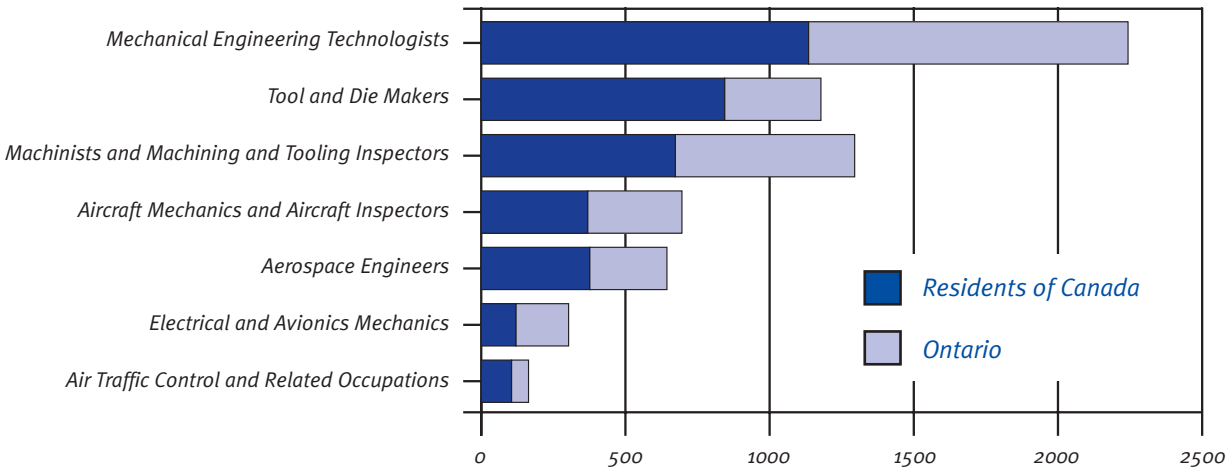
To what extent does geographic mobility make matters better or worse? The answer to this question has an impact on all three steams of supply: new entrants, experienced workers, and immigrants.

Some studies have been somewhat dismissive regarding the possibility of using skilled immigrants more effectively as a source of supply. Indeed, current industry practices may bear this out. At the same time, the industry complains about losing talented people to the US through the so-called "brain drain."

In light of the survey findings on sources of supply, it is possible to reflect on other data to paint a complete picture as to how mobility likely affects supply. The main data sources are Citizenship and Immigration Canada (on immigrants), Statistics Canada census data on mobility and US census data on Canadians working in the US.

Consider first the Citizenship and Immigration Canada data on immigrants. One reason why previous studies have downplayed the importance of immigration is that they have a national perspective. From this perspective, it is easy to underestimate the role of immigrants because the number of skilled immigrants is relatively small in relation to the total skilled workforce. However, it is well known that immigrants tend to concentrate in a few major urban areas, the most important of which is the GTA. This, coincidently, is where most of the aviation and aerospace industry is located in Ontario. So, at a sub-regional level, the impact of immigration is probably greater than at the national level.

Chart 8
Landings of Immigrants, Canada and Ontario, 1997-2001
Number



Source: Citizenship and Immigration Canada, special run

What do the data say about this? Citizenship and Immigration Canada undertook a special run of data based on immigrant landing records for 1997-2001. We constrained the run by only looking at those occupations under the National Occupational Classification (NOC) system that may be potentially relevant to the industry.[14] Chart 8 presents the findings.

Immigrants are asked which occupation they intend to pursue. Ontario immigrants accounted for 60 per cent of the total number of immigrants with skills of interest to the aviation sector: about one thousand every year.

Two trends are apparent. First, Ontario does have significant numbers of immigrants who possess skills, particularly skills in technical and trades that are in short supply, especially during cyclical upswings. Second, most of these people already have high levels of formal education and work experience. In this classification, about 85 per cent had education at the level of trade certificate or higher (up to and including PhDs).

To put all this in perspective, the skilled aviation and aerospace workforce is about 25 thousand people. If there is 5 per cent attrition, immigrants could almost fill the entire need for additional people.

Many immigrants will not know for certain which occupations they plan to pursue and therefore will not respond to the landing questionnaire. So the data presented in Chart 8 may actually underestimate the numbers of people with industry-relevant skills. In other words, *immigration could very well fill the entire attrition gap*.

However, to this point, immigrants tend to work in less-skilled positions in the manufacturing sub-sector. This could be due either to actual lower levels of skills or insufficient recognition of skills. The industry's position that immigrants are unlikely to make a make a major contribution to addressing the demand for skilled people may very well be reinforcing barriers to their integration.[15]

Admittedly, the integration of immigrants is not without challenges. To begin with, many will have difficulty working in English — a particularly relevant issue in technical fields that have specialized terminology and jargon. (Still, too much can be made of this point, as the greatest numbers arrive from the Indian sub-continent, many of whom will have been exposed to English education.) Second, Canada has a major issue with the recognition of existing learning. To be sure, colleges in particular have made some progress in implementing prior learning assessment systems. Yet, other research has shown that Canada (and Ontario) has a long way to go to develop efficient, consistent and transparent recognition systems that do not put applicants off getting their learning recognized.[16] This issue has become more acute with the movement towards heavy credentialing. But, in the past, Ontario has relied heavily on skilled immigrants and therefore has a tradition of integrating them into the workforce.[17] Although undoubtedly challenging, it would be foolish not to consider strategies for integrating immigrants more effectively into the industry.

Another source of concern is outward mobility, which may occur if Ontario's skilled workforce moves out of province — either to other provinces or to other countries. For economic and cultural reasons, the latter is most likely to be to the US. How important is this factor for mobility in determining available supplies of skilled people?

To begin with, Statistics Canada census data shows that most Ontarians do not like to move. When they do move, they tend to move within their province, or, more to the point, within their existing communities.

There are only a few major centres of significant aviation and aerospace activity in Canada. One of these happens to be around Montreal, which presents its own cultural and economic barriers to emigrants. That is not to suggest that other parts of the country will not develop their aerospace sector. Indeed, there has been some suggestion that maintenance jobs could be lost to British Columbia and Alberta, which have aggressively expanded their education to accommodate these occupations. The national nature of licensing in some occupations — such as air traffic controllers, air navigators and aircraft maintenance engineers — actually facilitates mobility.

Table 10
Ontario, Interprovincial Migrants and Immigrants in Selected Occupations
(1981 Standard Occupational Classification)
Number, 1996

Occupation (SOC 1981)	Total	Migrants	Immigrants	Migrants	Immigrants
Managers					
Facility Manager	13,405	205	225	1.5%	1.7%
Engineers					
Electrical Engineer	15,710	630	1,200	4.0%	7.6%
Mechanical Engineer	13,255	400	1,050	3.0%	7.9%
Aerospace Engineer	1,840	125	160	6.8%	8.7%
Technicians					
Mechanical Engineering Technologist	4,520	75	145	1.7%	3.2%
Electrical and Electronic Technologist	44,880	1,230	1,835	2.7%	4.1%
Aircraft Instrument, Electrical					
and Avionics Technician	1,555	85	50	5.5%	3.2%
Drafting Technologist	11,430	255	425	2.2%	3.7%
Air Traffic Controllers	960	90	10	9.4%	1.0%

Source: Statistics Canada 1996 Census

Table 11 reviews US census data and is narrowed down to look at the number of Canadian-born people working in managerial, scientific, technical and trade positions that may be of interest to the industry (but not unique to the industry). The striking thing about the table is that the majority of emigration is in managerial occupations. These are likely older people, many of whom are working in global companies with Canadian operations.

Clearly, Canada does lose some highly skilled people to the US in fields such as engineering, computer science and, to a lesser extent, skilled trades. Some of these people may be new graduates and others will have work experience. But, strikingly, the numbers are not large in relation to the Canadian labour force. The entire US aircraft and aircraft manufacturing sector employed just over three thousand Canadians in 2002.

For most occupations, the annual emigration to the US amounts to less than 1 per cent of the total labour force.[18] By far the greatest proportional emigration has been among physicians; even then, it is no more than 0.8 per cent of the occupational group. Of the occupations of interest to this study, engineers have the highest proportional emigration to the US at around 0.25 per cent.

Although there is plenty of anecdotal evidence about Canadians moving to the US for better opportunities, it is doubtful that this is a major issue for the Ontario aviation and aerospace industry. Motivations for moving to the US are partly economic and partly career related. Although it is true that the US is very tax competitive, this is especially so for higher-level managers and professionals.[19] Another factor is the transaction cost associated with moving. These factors combine to ensure that the people most likely to emigrate to the US are either highly skilled graduates who have not settled down or upwardly mobile managers and professionals.

Table 11
Canadian-Born Employed in United States, Selected Years
(Selected Occupations)

Occupation	1995	2002
Management-Related Occupations	16,941	33,609
Engineers	3,091	15,459
Mathematicians and Computer Scientists	5,890	16,932
Engineering Technicians	2,419	7,774
Precision Trades	12,159	11,298
Machine Operators	13,873	9,175
Fabricators and Assemblers	4,797	4,577
Note: Aircraft and aircraft parts manufacturing total, 2002		**3265**

Source: US Census Department, Current Population Survey, March Supplement. 1995 and 2002

Two criticisms can be raised to this sanguine analysis of the impact of emigration. The first is that the data tends to be in an aggregated format, which may be masking problems with specific sub-occupations. Another issue is whether or not the flows are emerging disproportionately from new graduates. Statistics Canada has found no significant "brain drain" overall, but has noted that emigration in fields like engineering amounted to 4 per cent of Canada's graduating class in 1996 and 1997.[20] This does not mean that all the emigrants were new graduates; it is merely another way of looking at the proportions.

As with inter-firm mobility, the highly specialized nature of many occupations reduces the total size of the relevant labour force. But this works both ways. Workers in parts of the industry under compulsory licensing are likely to encounter difficulty having their licenses recognized in the US. Non-compulsory trades, however, are by their very nature broader and thus have more supply.

Some observers point to looming retirements in the US in such fields as air traffic controllers and AMEs as evidence of a possible problem. These people disregard the fact that the US has a large and dynamic labour force. It also happens to be a younger workforce than that of Canada, Japan or Europe. As such, the notion that US will have to import labour from Canada to meet its skilled labour needs in aviation does not appear to be supported by the facts.

The data presented here seems to lead to two conclusions. First, the "brain drain" is probably not as big an issue some people think. Although there may be complaints about turnover in companies, this turnover is more likely due to people moving between employers within Canada than emigrating. Second, immigrants are an under-appreciated source of skilled labour. These immigrants may, however, present special training issues, most notably with language skills.

Chapter 6
Views of Educators and Employers

To this point, the study has reflected upon survey data and secondary source data to develop an understanding of the dynamics of the demand and supply. The study has shown that there are some unique industry characteristics that make it prone to gaps between supply and demand. The most important is the asynchronous relationship between education supply, employment demand and workplace training.

To shed more light on these issues, the study collected a considerable amount of qualitative data. This data was gleaned from employers and educational institutions through in-person interviews. Thirty-four people (17 each from industry and education) participated in these interviews. On the industry side, human resource executives and training supervisors at enterprises conducting significant training in the province were interviewed. This included the five largest aerospace manufacturers, the largest carrier in the country and the two international airports in Ontario. On the education side, the interviews were with program coordinators for every post-secondary education (PSE) institution in the province with an aerospace program.

Further, a workshop session was held in conjunction with the steering committee meeting for this project on December 20, 2002. The in-person interviews provided information about attitudes toward education and industry whereas the steering group session was geared more toward solutions to particular challenges facing education and industry. As such, the steering committee comments will be reviewed in the final chapter that considers future strategic directions.

These qualitative observations may help us understand the underlying reasons why education, employment and training looks the way it does. However, the sample is constructed primarily from large employers with significant training budgets. These same employers do not tend to recruit directly from colleges, as they tend to require work experience, which is usually accumulated with smaller employers. As such, although the findings may be indicative so some of the structural issues, one should be cautious when generalizing these findings to the entire employer base.

What Skills Do Employers Want?

Employers want graduates who have been exposed to basic mechanical, technical and professional skills and that have good work habits:

> *"The college system should be in tune with all the principles of world-class competitiveness. This should be integrated with technical training so that potential employees are prepared for the real world. Technical skill on its own is not sufficient for the employer. Much time and effort is spent on interpersonal and softer skills development, in addition to the job-specific technical training. The college system should spend time on elements that make a well-rounded employee".*
> VP HR, Components firm

> *"Help with leadership and presentation skills"* VP, HR, Components firm

"Colleges can help with leadership training and safety training" Operations Manager, Airport

"Training in composites structures and structural analysis….Knowledge of engineering drawings and developments. Have co-op programs that give experience in dealing with composite materials" VP, HR, Components firm

"Pre-apprenticeship training for CNC machinists" Executive, Components firm

"*More distance learning or more courses on regulatory, understanding regulations, courses in leadership management"* General Manager, Airport

In summary, employers have expressed demand in the following key areas and sub-areas:

Employability Skills

- Teamwork
- Ethics
- Leadership

Technical skills

- A good set of core technical skills
  - Engineering diagram reading
  - Computer-based technologies and communications
- Specific skills in demand
  - Non-destructive testing
  - Wiring
  - Machining
  - Composite materials processing

Other skills

- Regulatory training for non-regulatory employees
- First Aid, CPR, St. John's Ambulance

The Need for Practical Hands-On Skills

The lack of co-operative education led to a concern about a shortage of practical skills. Interviewees generally feel that too much time is spent on "book-learning" and too little on developing technical skills.

A complaint repeated by those in the maintenance, repair and overhaul sub-sector is that college graduates have "never worked on anything larger than a Cessna".

"Give them training more related to the job skills required. Give them big planes to work on" Technical Services Manager, air carrier

Exactly who is to provide the "big planes" is an open question. Employers are rightly reluctant to turn their workplaces into classrooms. So there is a dichotomy between the need for hands-on experience and the opportunities to develop this hands-on experience.

But another manifestation of the same problem is the difference between the scale that the college system operates at and the scale of workplace training. Consider, for instance, the following quotation:

> *"Colleges can't help me. There aren't enough employees in the materials processing industry for the college system to profit."* Director of HR, Materials Processing firm

This speaks to the mix between education and training. Obviously the closer one gets to a particular workplace setting, the greater the need is for firm-specific training. It will always be a challenge for the education system to determine how far down this education-training road it should go. In the final analysis, the education system must focus on sufficient volumes to justify programs but particular employers may only hire one or two graduates every year.

As the college system works with employers to design an effective system, there will inevitably be some frustration that the college is not "doing enough". Consider this sentiment culled from the interviews:

> *"Don't ignore us! [Community college] doesn't talk to us. We want them to beef up their machinist skills. We want them to call us up and find out what we need, what programs we want. We want more NDT"* VP HR, Components firm

Although this may not speak to a general unwillingness of colleges to listen to industry, it does demonstrate the need to develop effective channels of communication. Also it emphasizes the need for both the industry and the PSEs to recognize each other's constraints and to be innovative in the way they overcome these constraints.

The Shape of Education and Training Capacity

Who Should Develop the Skills?

It was difficult to interpret findings on where skills should be developed. Few of the interviewees admit to hiring graduates and those that do make it clear they are trained extensively after hiring or have worked at the plant already in an apprenticeship or co-op role.

These interviewees see the PSEs as a place where prospective job market entrants can learn the basic technical skills that will allow them to pursue further training in any number of sectors. As seen in the data, employers stress on-the-job training as the most important aspect of skills development. But the practice among these employers is clearly to recruit employees from other employers.

"Industrial experience is an asset" Director of HR, Materials Processing firm

Those employers that do hire grads tend to be in general aviation, airports and small and medium-sized manufacturing. These employers may have difficulty competing for skilled and experienced employees. It is these smaller employers from which skilled workers are eventually "poached" by the larger carriers and manufacturers. Our methodology made it difficult to ascertain the views of these smaller employers, but other data collected by Forum Research for the Ministry of Training, Colleges and Universities (Key Performance Indicators) shows a high level of satisfaction with new recruits out of the college system.

PSEs see themselves as the developers of fully trained and employable graduates whose training is directly related to a career path. Little mention is made of on-the-job training in the curriculum. Although the record on co-op placements is spotty, this is probably due to systemic problems such as the unwillingness of employers to resource co-op positions. In addition, PSEs place a high emphasis on student demand in setting priorities and in allocating resources. This reflects the way the PSE financing system works in Ontario where operating grants are tied to enrollment.

> *"[We'll get the program funded] if we meet our enrollment targets. It's all student demand"*
> Program Administrator, College

Are Current Resources Optimally Organized?

Frequent mention is made of the benefits of graduates working in a plant environment before finishing their studies, to get the "real world" exposure employers find lacking in recent graduates. Some executives explicitly state that it makes more sense to organize specialized training in the workplace than in the college system:

> *"The college comes to us and wants us to donate precision lathes. Don't bring the factories to the schools, bring the schools to the factories. Use our lathes when they're down. You can't afford lathes like these. They're a quarter of a million dollars each, and we replace them every year"*
> VP, HR, Sub-Assembly firm

On the other hand, PSEs want to respond to employer demand for more highly trained graduates by putting their own capacity in place. Given the high cost of instructional equipment, it is not surprising that a brand new gas turbine engine is seen as the best evidence of PSE responsiveness to employer demand. Where this is an issue (it is not mentioned frequently), industry would like to see more of the skills training process occur on-site at their plants, and PSEs would like to keep the training they have, and bring more inside. The resolution of this dichotomy will require a new strategic understanding of which skills are best developed (and most efficiently funded) in the colleges versus the workplace.

Are Resources Located in the Optimal Place?

Geographical location of skills training resources was not raised as an issue among industry respondents. There is some recognition among those PSEs located outside the GTA/Golden Horseshoe core that they are at a disadvantage due to their location, but many talk hopefully about an improving economy, corporate relocation, and the possibility that a skilled population will attract aerospace employers. It is clear that employers hire where they do business, and potential hires come to them.

PSEs who lie outside the GTA feel, to a certain extent, that the availability of a trained workforce in their locale is reason enough to create an industry demand there, but industry does not see it this way. Management at smaller carriers and companies mention a lack of trained AMEs (because all the entry-level AME's are hired away by larger carriers as soon as they have enough experience).

Those PSEs that are located outside the core GTA/Golden Horseshoe area (where majority of the industrial capacity resides) often mention that they expect employers to open shop in their area to take advantage of the skilled workforce. No industrial respondents mirror this view. They are more likely to open either near customers or sub-suppliers; people are easier to move than facilities.

By the same token, however, one manufacturer who is located in Eastern Ontario uses a local college for some of their contract training, but, for the most part, industry is willing to send its employees wherever the best courses are offered, and will pay their living expenses there. In the case of rural or non-core airports, semi-skilled labour and entry-level employees are often recruited from the local college.

Contrasting Views of Educators and Employers

Many PSEs hold the view that they are meeting industry needs because they are seeing increasing student enrollment. There is a feeling among PSEs that, as long as the students are being educated in sufficient numbers, industry's needs are being met. In some ways previous studies of the industry encourage this view by taking a mechanistic approach to developing pipelines of students to fill spots in employment.

As colleges attempt to build new capacity to meet employer demands, they are faced with a fundamental challenge in financing new capacity. The reality is that per student operating grants have fallen significantly over time. Moreover, PSEs are constrained in their ability to raise tuitions because of accessibility concerns. Furthermore, PSE's fixed and semi-fixed costs have not declined. As such, the extent to which PSEs are able to fund expansion through internal resourcing has been greatly diminished.

The universities have had some considerable success in recent years at attracting new public resources into its research activities. This will certainly go a long way to helping the university sector deal with their part of the funding constraint. However, colleges do not have the same mission as the universities with respect to research and therefore have had to seek other sources of funding.

The provincial government has attempted to rectify this situation by putting new resources into the system, through such mechanisms as SuperBuild. But the new money is conditional on the PSEs forming partnerships with other stakeholders to fund new capacity. This approach is certainly commendable inasmuch as it attempts to link new capacity to the specific needs of stakeholders as opposed to funding it out of general tax revenues. Yet it has changed the dynamics of the college-industry dialogue. Both colleges and industry were used to having the general tax base fund specific human resource needs and now they must enter into a dialogue as to how to fund capacity.

Not surprisingly, the interviews uncovered a good deal of frustration among the colleges with their financing constraint. In fact, it is almost a universal refrain among college administrators (when asked) that the major factor that will lead to increased funding for at-capacity programs is "government and industry funding" brought about by "increasing student demand".

"Government funding. We already have high student demand" Program Administrator, College

"Government and industry funding" Program Administrator, College

"Government funding and industry funding for research" Program Administrator, College

"Additional funding from SuperBuild or industry" Program Administrator, College

"External funding" Program Administrator, College

"External partnerships, fundraising, funding agencies, Strategic Skills Initiative across the board with carriers, airports, funding, banking, industry" Program Administrator, College

However important industry is seen to be as part of the funding cycle, however, the most important driver of skills training development at colleges is clearly student demand:

"Demand for the program is growing" Program Administrator, College

"We already have high student demand" Program Administrator, College

"Student demand, graduate placement" Program Administrator, College

"We need student demand" Program Administrator, College

"If we hit our enrollment targets. Student demand" Program Administrator, College

"If enrollment increases, student demand will force our partner to buy new planes" Program Administrator, College

"Industry need and student demand" Program Administrator, College

"Student demand for air operations" Program Administrator, College

"Increased student demand" Program Administrator, College

There is a conundrum. On the one hand colleges will only start programs where there is student demand. Yet they cannot raise more resources from the student base because of limits on tuition and operating grants. So the colleges must turn to industry to fund new capacity. But the industry is reluctant to make a commitment to provide co-op places or career pathways. The only way around this is for the college and industry to work more effectively together to define lifelong learning/career pathways.

How Do Employers See Their Training Fitting with PSEs?

Almost all employers make it clear that new aerospace employees are subject to a minimum of 40 hours of training when they are first hired and, as most come from other companies and very few from PSEs, it is apparent that employers see industrial training as a requirement for their staff.

Many employers mention that they would rather train new hires in the specific skills needed for their jobs themselves, leaving PSEs to inculcate the basic mechanical and technical skills and "good work habits":

"*I hire people with good 'hand skills', who also have some basic technical grounding. But you can't teach good hand skills, you either have them or you don't. Once I find that person, I can train them to do their job our way*" Project Director, Components firm

PSE's and Employers' View of Licensors and Accreditors

Industry accepts and values the role of Transport Canada as the third party accreditor, and, apart from an ironic comment noted earlier, no dissatisfaction with Transport Canada or its role is expressed. Respondents in the industrial sector do not, for the most part, mention other accreditors or potential accreditors, with the exception of the airport sector, where accreditation by the IAAE and the AAAE is in demand.

PSE's value Transport Canada accreditation of their courses, and courses or programs which result in a Transport Canada-approved diploma are seen to be more job-oriented and of a more serious nature than those courses that result in a college diploma or certificate. Some (few) colleges are familiar with the efforts of other bodies in offering accreditation (CAMC, OAC), but the practice is not widespread. The college system will continue to include Transport Canada accreditation in program content.

Flexibility of Skills Acquisition

One of the key themes that was discussed at the steering committee meeting of December 20, 2002 was the notion of agility. Some employers worry about portability of certification:

> *"[Offer} industry specific training that graduates can use at aerospace companies across Canada (ie: nationally recognized training)"*. Executive, MRO firm

Other issues are related to distance learning, which some employers see as a short-cut to filling gaps (entry-level employees with basic technical skills and no particular job-specific training). Some PSEs have embraced distance learning, although it is often seen in the Continuing Education programs, rather than the core programs.

Some schools which have seen the market for commercial pilots tighten have added business and management courses to their pilot programs and repositioned them as "aviation management" programs, nearly all (there are more than half a dozen) whose final credential includes a Transport Canada Commercial Pilot license with a multi-engine, multi-IFR rating. It must be said that these are not the run-of-the-mill college aviation programs. These are typically full cost and lengthy programs: students will pay up to $40 thousand to attend and the course may run over the course of 3 or 4 years. They are often delivered in collaboration with a local flight school.

Universities acknowledge they are less fleet of foot than colleges in responding to changing market demands, due to the complex dynamics of university funding and their joint teaching/research mandate. But most colleges, which are better equipped to resize their programs to changing demand, continue to predict steady growth for enrollment, based on "student and industry demand", despite the fact that market is in a cyclical downturn.

Colleges tend to see government and industry funding, always based on "student demand", at the core of any newer initiative (or the revival of older programs such as apprenticeships and co-ops).

Employers and educators mention co-ops and apprenticeship programs. Numerous employers cite having used these successfully in the past and all agree that on-the-job training is very desirable in a new employee.

> *"It's tremendously helpful to get him in here for two or three work terms, to get him familiar with the environment, the kind of work we do, and quite frankly, get a look at him before we hire him"* Project Manager, Aerospace company

> *"We used to have a sort of co-op program with [local community college] that worked really well for us. We spend a lot of time training new hires before they work on the shop floor, and this just reduced the amount of time we had to spend with them when we eventually hire them"* VP HR, Manufacturer

Other practices that appear successful include one-to-one relationships between specific employers and specific colleges:

> *"We've had a program for years with [community college] where we've placed their graduates, and we've been very happy with it. We get to know the kind of training they get, and we go down there too"*. Manager, Airport

> *"One year in our airport management program here, and you can get your masters in 2 years at [European university]"*. Program Coordinator, College

> *"We like the transport training they give at [community college]. We hire their co-op students"*. Operations Manager, Airport

Colleges cite Lufthansa's university as a program that proves graduate commercial pilots can go straight into the co-pilot's seat, and also because it is a rare example of a curriculum and resources driven entirely by industry need.

Chapter 7
Gap Analysis

In Chapter 2 we suggested that gaps emerge because of the differences in the motivations and actions of four groups of stakeholders: students/employees, accreditors, educational institutions and companies in the industry/trainers. Our survey explored the potential reasons for gaps directly by asking employers and educational institutions about their practices and their views regarding education and training capacity. This chapter presents an organized way of thinking about the gaps between the demand for, and the supply of, skilled employees.

There are essentially three perspectives on gaps that need to be considered:

- people
- competencies
- capacity

People gaps refer to whether there are sufficient applicants with the right basic level of education entering the labour force to account for growth and attrition. *Competency* gaps emerge if employees do not have the right competencies to do the work that employers would like them to do. Often, people gaps and competency gaps are directly related to the organization of education and training *capacity*. If capacity is insufficient, there may not be enough people to meet employment demand. If capacity is not organized where it should be, it may not be developing the right competencies.

People Gaps

There has been a tendency in other reports in this field to pay the most attention to people gaps. People gaps are calculated simply by running scenarios that take into consideration growth, attrition rates and the forecasted additions to the labour force through education and training. Given the tricky nature of demand forecasting, point estimates of people gaps are invariably flawed. They are best viewed in order-of-magnitude terms and as an indicator of parts of the system that require attention.

A good starting point for understanding people gaps is to consider the forecasted increases in new people emerging from PSEs. Chart 9 considers the number of new people emerging from Ontario PSEs as a percentage of the existing workforce.

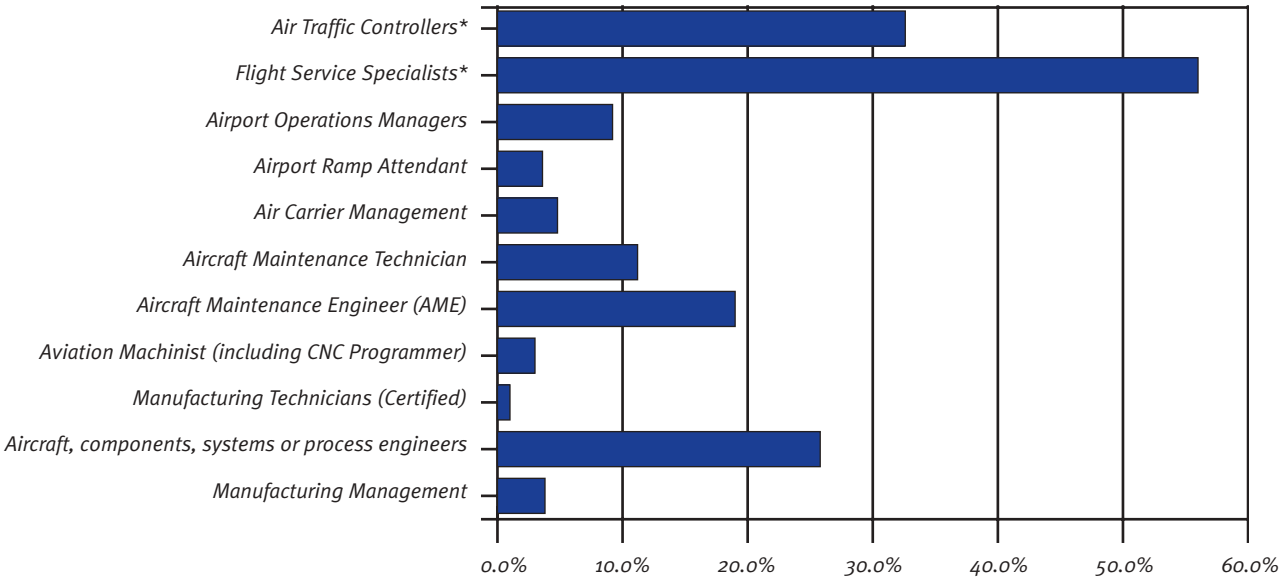
Leaving aside whether or not these people have the right skills, there are a number of factors that will determine whether these flows are adequate to meet industry demand. The main issues are:

- Demand: Is there exceptionally high demand in the industry because of growth and attrition?
- Competition: Does the industry sub-sector have to compete with other industries for these people?
- Other Supply: How important are the flows of new graduates to the total labour market supply?

Chart 9

Graduates as a Percentage of Existing Workforce

(Selected Occupations)



**Note: Ontario estimates from national figures*

Source: Ontario Graduate Pipeline Model, estimates of workforce from study survey, and A Human Resources Study of the Canadian Aviation Manufacturing and Maintenance Industry. 2002. Ottawa: Canadian Aviation Maintenance Council.

Exhibit 5 takes into consideration each of these factors in assessing the flows of people emerging from Ontario's PSEs. The exhibit outlines the likelihood of gaps for key occupations by industry sub-sector.

Exhibit 5
Risk of Gaps
(Selected Occupations by Industry Sub-sector)

Sub-sector/Occupation	Graduate Replacement Rate	Demand	Competition	Other Supply	Gap Risk
Manufacturing, Maintenance, Repair and Overhaul					
Management	1.9%	low	high	high	**low**
Engineering Design	12.9%	low	high	medium	**medium**
Manufacturing Technician	0.5%	medium	high	medium	**medium**
Aviation Machinist	1.5%	medium	medium	low	**medium**
Aircraft Maintenance Engineer (AME)	9.5%	high	high	low	**high**
Aircraft Maintenance Technician	5.6%	high	high	low	**high**
Air Carriers					
Air Carrier Manager	2.4%	medium	low	high	**low**
Airport Ramp Attendant	1.8%	medium	low	high	**low**
Airport Operations					
Airport Operations Manager	4.6%	medium	high	medium	**medium**
Air Traffic Control and Navigation					
Flight Service Specialist	69.9%	low	low	low	**low**
Air Traffic Controller	40.7%	medium	low	low	**low**
Air Regulatory Functions					
Transport Canada	NA	medium	low	low	**medium**

This analysis suggests that AMEs and technicians face the greatest threat of having people gaps emerge. This potential gap exists in spite of the fact that colleges are doing a very good job of expanding capacity to produce people in these areas.

However, the aircraft maintenance sub-sector is undergoing a structural change that is seeing it focus more on continental exports. Moreover, the Canadian military has announced its intention to step up its recruitment of aviation technicians.[21] The military is planning to pay $20 thousand bonuses for qualified technicians. This will only exacerbate the poaching issue faced by many approved maintenance organizations (AMOs).

Shortages may also arise among various types of manufacturing trades and technicians. This is unlikely to be a problem in the short term because the industry is in a lull. But past experience suggests that employment can grow very strongly when recovery does come. In the meantime, graduates will go on to work in other places. So, a big part of the issue for manufacturing employers will be their ability to attract these workers during cyclical upswings. The ongoing competition with other manufacturing sectors for these people will be an enduring reality.

One factor that could help alleviate gaps in the short term is a more systematic approach to incorporating skilled immigrants into the workforce. While evidence indicates that immigrants tend to work in lower-skilled positions in manufacturing, the data suggests that immigrants might be able to address a higher portion of skilled positions.

Other occupational areas are less likely to experience gaps, either because they have a very broad labour market from which to draw or because they have low competition for employees. An example of the former is various types of managers. As discussed earlier, Ontario colleges produce many people with some familiarity with aviation who have also taken either management or arts courses. Even when these people are not enrolled strictly in an aviation management course, they are likely to serve as a pool of labour that can be drawn upon by air carriers and airport operations. A possible exception here is airport managers who deal with the technical aspects of airport facility management. The point is made by airport management that operations managers trained under Transport Canada's regime will approach retirement in 2010, but there is no organized and accepted replacement airport operations training protocol yet in place. Still, these sub-sectors are unlikely to face major spikes in demand that might cause significant shortages.

Similarly, manufacturing managers are often developed within companies after accumulating years of work experience. The OAC has focused its continuing education curriculum on these people, who will often have a sound technical background but require management training.

On the air traffic control front, NAV CANADA appears to have things in hand and does not face high competition for its graduates. Although NAV CANADA faces the challenge of maintaining high staffing levels and has a high turnover rate, its courses are oversubscribed. The demand for flight service specialists is likely to fall because of technological innovation.

Demand for air traffic control personnel will grow over time as Ontario develops its airport system. But once again, this type of demand is not subject to major variation. The main risks are a wave of early retirements from the baby boom generation and increased competition from the military for air traffic controllers. Yet, technological innovation and the possible attraction of many people in pilots programs should be sufficient for NAV CANADA to manage these risks.

As for the regulatory functions, Transport Canada faces an issue with looming retirements. This will require relatively high levels of hiring over the next 10 to 15 years. As Transport Canada has typically hired experienced people, it may face recruitment challenges, especially if its recruitment periods coincide with an upturn in industry demand for people. Transport Canada has expressed concern that the current curriculum offerings of the PSEs are insufficient to develop many of the competencies required in their performance management regulatory system.

The people outlook for Ontario is reasonably good, with the noted provisos. But another question that arises is whether or not the people have the competency to do the job. All aspects of the industry involve high levels of technology and are subject to considerable change in their need for technical competencies and employability skills. For instance, the movement towards a performance-based regulatory structure has effectively changed the mix of competencies needed between Transport Canada, NAV CANADA and airport authorities. For Transport Canada, this change means having more people who can combine technical and employability competencies to work in a less intrusive way with the other players while still ensuring a high-quality air traffic system.

There are two major challenges in developing competencies. On the technical front, there is an inevitable gap between the technical competencies developed in the PSE system and the technical competencies needed in the workplace. This is a big issue for trades and technicians who require applied experience on very expensive capital equipment and high-technology aircraft and components. It is somewhat less of an issue for engineers, simply because information and communication design technology is somewhat more cost-effective to introduce into a classroom setting than are aircraft components. Rapid technological progress, therefore, has the effect of opening a gap between formal education and the shop floor for technicians and trades.

A second type of competency gap is with respect to employability skills. These are attitudes and behaviours that, if present, allow people to continue to develop in the workplace and to work effectively with co-workers. These skills have become even more important over time because of the movement toward high-performance work teams. Moreover, technological progress requires that employees be motivated to upgrade skills in the workplace.

In our in-person interviews, employers were not overly impressed with the current state of technical and employability skills of new graduates. The complaint is that new graduates tend to believe that PSE has already prepared them for work and that they do not need additional skills. It is not surprising that graduates are somewhat naïve of the demands of the workplace. The trend since the 1990s has been for young people to spend more time in school and less time in work.

Colleges can rightly point to their use of tools such as the Conference Board of Canada's Employability Skills Profile as showing their commitment to developing employability skills in concert with technical skills. Yet, there is no agreed-upon assessment system for employability skills comparable to the system used to assess technical skills.

After a certain point, technical and employability skills are best developed in the workplace, especially after a foundation of technical competencies has been developed. Classroom education cannot replicate the world of work. This is a world where people have to co-operate with older and more experienced colleagues and where lapses in judgment and bad attitudes can poison the work environment. It is a world of very expensive, high-technology equipment that colleges have difficulty acquiring. Although college instructors are effective, there is no substitute for learning from an experienced person on the job. These veterans have a huge amount of critical knowledge to pass along, and it is unlikely that many of them would want to return to the classroom to do so.

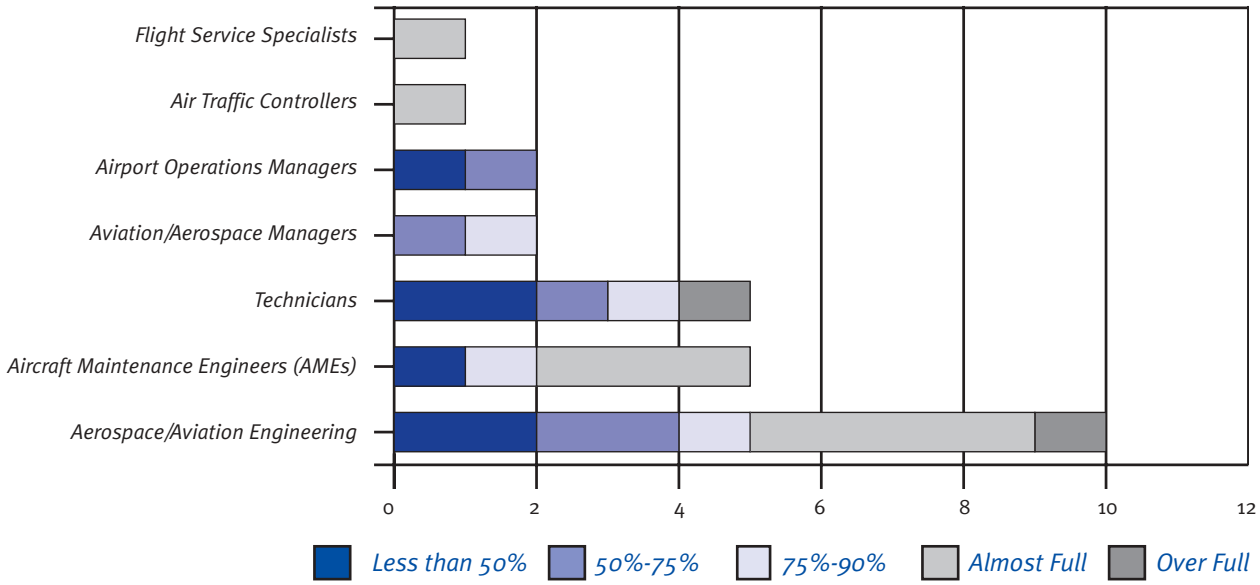
The discussion about competency gaps inevitably leads to a need to address capacity gaps. In this study, we view the education and training system as an integrated system of lifelong learning. That system is probably not, in reality, integrated. But there is still a need to understand the relative mix between classroom education and workplace training.

While the criticisms of too much classroom education have already been alluded to, workplace education is also not without its problems. The criticism here is that employers have the greatest incentive to invest in training that is unique to their workplace. At the limit, this implies that the training is non-transferable to other employers and may therefore reduce labour market mobility.

The criticisms of both classroom and workplace education are probably overrated. Although the two facets of education are not fully integrated, employers do indeed invest significant resources in training entry-level workers. Trades in particular are set up in such a way as to combine classroom and applied education. This is not to suggest that the system could not benefit from further reforms to adjust the mix between classroom and workplace education.

On the classroom front, there are two capacity issues: the management of growth and the spatial organization of capacity. Survey findings from the education stream shed some light on these issues.

Chart 10
Capacity of Existing Programs
by Occupation and Number of Programs



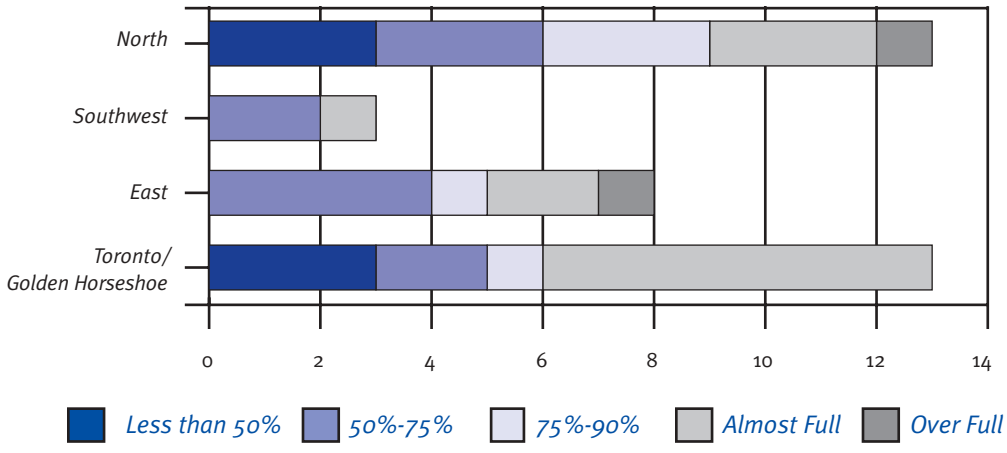
Source: Survey Findings

Education stream respondents were asked to comment on the extent to which their existing programs were full. Chart 10 presents the data from this question. The immediate concern has to be about capacity in areas that have been previously identified as potentially experiencing people gaps. Once again, the AME programs and, to a lesser extent, engineering and technician courses, are cause for concern. Readers will recall that AME programs might fall short of demand, even with strong growth in programming. New capacity is clearly required if these programs are to deliver the 70 per cent growth that is anticipated in enrollments between now and 2003.

Employers suggested that they were not too worried about the geographic distribution of PSE capacity, and educators felt that employers should move industrial capacity closer to them. But the location of capacity is probably of greatest interest to students who are effectively taking an investment risk when they apply to post-secondary schools. If they have to move away from home to make this investment, the cost (and therefore their financial risk) increases. Unless they are confident they will be able to recoup their investment with a good job, they may not take this risk. Alternatively, if they cannot get into a course that is close to home, they may choose another stream outside of the industry.

Chart 11 presents the findings on the spatial allocation of capacity. There are no clear conclusions about the geographic organization of capacity based on closeness to source population. Both Toronto and the North have a similar number of programs geared toward the industry, and their capacity constraints look very similar. This may reflect either the underlying demand for these courses or the amount of time that a course has been established.

Chart 11
Capacity of Existing Programs
by Location and Number of Programs



Source: Survey Findings

Another factor to consider is the relationship between demand and capacity. To some extent, there is a symbiotic relationship between demand and supply in education. Ontario secondary school students have good choices among post-secondary schools, but the main student subsidies only apply to the publicly funded part of the system. As such, their choices are biased toward public institutions and the programs they offer. Given that many students may not really know which program is best for them, their demand for programs is in some way conditioned by the supply of publicly funded programs. Yet, as seen in Chart 11, this is not purely a matter of "if we build it, they will come." Canada has one of the highest rates of post-secondary (especially college) enrollment in the world. Students do, in fact, find other publicly funded programs in which to enroll and they need not choose aviation or aerospace programs.

A bigger issue than geographic distribution of programs would seem to be the allocation between classroom education and workplace education. Fewer than half of our industry respondents ranked apprenticeships and co-operative education programs as either very important or extremely important. Yet, some employers suggest that it is important that more of the classroom be "brought into the workplace." There are definitely some advantages to this, most notably in the development of industry-relevant technical competencies and employability skills.

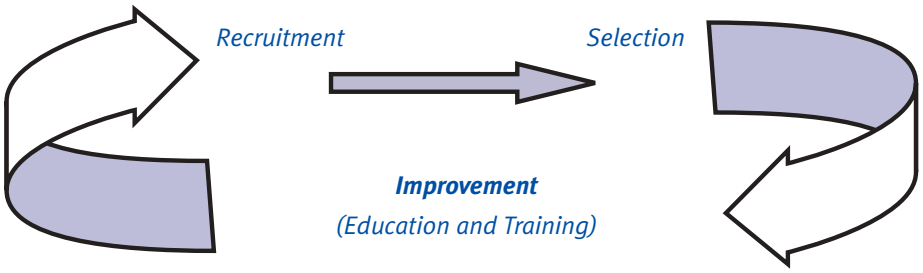
Employers tend to favour those who have worked in the industry because they are more confident that these employees will have work-relevant competencies. Moreover, the virtue of apprenticeships and co-operative educational programs is that they allow employers to observe prospective workers in the work setting. This not only helps them decide whom they might like to recruit but also facilitates identifying good candidates for further training.

The current apprenticeship system in Ontario is somewhat weak. To leave themselves open to making a better choice among a larger group of prospective employees, some employers have held out false hopes to apprentices. The apprenticeship system has also embedded structural and cost factors that hinder employers from encouraging apprentices to become fully qualified tradespeople. For these reasons, the rate of completion in apprenticeships is very low, and apprenticeship has effectively become more of a workplace re-entry system than a school-to-work transition system.[22]

Other jurisdictions have confronted many of the issues now facing Ontario's aviation and aerospace industry. Before considering some strategic directions, the report now turns to a review of promising practices in other jurisdictions.

In dealing with potential gaps, Ontario can reflect on experience in other jurisdictions. A review of the literature was undertaken and was supplemented through telephone and e-mail correspondence.

Many of the reviewed jurisdictions are similar to the Ontario system inasmuch as they have been influenced by British, American and German approaches to higher education. In thinking about the relevance of practices in other jurisdictions, these practices can be thematically grouped according to the aspect of the school-to-work transition that they are addressing. The following model illustrates the cycle that people go through in making their way from good student to good employee:



Students go through an initial cycle of recruitment, selection and improvement in their educational lives. PSEs recruit students for programs based on their academic and other competencies. They then select students in relationship to their available capacity, and they deliver education to improve these people. Graduating students then go through the cycle again when making the transition from school to work. Once employed, experienced employees may go through the cycle many more times as they switch jobs.

The best practices are essentially about improving each of these stages. Within this model, we have found the following key themes and have elaborated on them in this chapter.

Recruitment

- programs to reach young people

Selection

- air traffic control (ATC)-specific selection and skills requirements

Improvement

- competency-based vocational qualifications/standards
- education/government/industry partnerships
- simulation as a tool in education and training
- industry-specific management training

The current rate of retirement of experienced personnel and the negative image of the industry in the current downturn are considered to be important issues in attempts to supply future industry demand. This section presents two practices that attempt to interest younger people in the industry:

- Launchpad for Learning (United Kingdom)
- MentorNet (United States)

These practices transfer knowledge and experience from industry employees and retirees to students of various ages:

Launchpad for Learning (United Kingdom)

This UK initiative is lead by the Society of British Aerospace Companies (SBAC). Its primary purpose is to connect school children (9 years and older) with the aviation industry, thus encouraging them to consider aerospace/aviation as a career path.

Although this initiative is not strictly within the terms of reference, it is relevant to more global objectives of the aerospace/aviation industry. Furthermore, it attempts to use a well-respected e-learning concept (designed for teaching primary school and secondary school students) as its core platform.

The rather expansive objectives of Launchpad for Learning include:

- to create a business/school partnership initially centred on the aerospace industry and its partner schools to the mutual profit of all
- to recognize the fundamental role of schools in setting the school improvement agenda for a virtually real learning future
- to support schools in improving the quality of teaching and learning
- to promote co-operative learning strategies and resources among schools
- to exploit the potential of the global Web and 21st-century technology for learners and teachers
- to encourage young people already in industry to take part in educational activities in schools

The lead educational organizations include:

- Dudley Grid for Learning, which specializes in distance learning techniques
- Rushmore Educational Trust (RET)

The Dudley Grid for Learning has “pathfinder” status for Interactive Communication Technologies (ICT) in teaching and learning in the UK. It is also recognized as a leader in the use of ICT by the European Union (EU). Its approach is based on “challenges.”

MentorNet (United States)

MentorNet is a US-based not-for-profit e-mentoring network supported primarily by grants and donations from industry, government and foundations. Its specific mission is to further women's progress in science and technology, but its principles and objective could have wider application. MentorNet was originally primarily supported by information technology companies such as AT&T and Intel. However, its scope has broadened: the University Aviation Association is one of the current sponsors. MentorNet attempts to connect university students with experienced engineers by a range of one-on-one and collaborative online mentoring initiatives.

MentorNet relies heavily on corporate sponsorship and on retired industry workers donating their time as mentors; thus, it is probably challenging to establish a critical mass for such a program. However, given the number of experienced engineers and vocational workers now retiring, the concept may be worthy of investigation.

Selection

ATC-Specific Selection and Skills Requirements

The air traffic control environment demands a very particular and elusive set of skills and competencies. It also has a high burnout rate, short career spans (partly by regulation), relatively high training costs, and high failure rates during training. The three initiatives here attempt to:

- improve understanding of what makes an effective controller
- improve understanding of how changes in the ATC environment will affect controllers
- improve the pre-selection process to reduce failure rates

Federal Aviation Administration Training Environment (United States)

The Federal Aviation Administration (FAA) faces a unique challenge in that the combination of the 1981 PATCO strike and subsequent dismissals caused a huge peak in hiring, and now, a reflected peak in retirements. A US General Accounting Office (GAO) report of June 2002 claimed that:

- by 2010, almost 50% of the 7 thousand controller specialists will leave their positions
- 14 thousand of the 20 thousand controllers will be eligible to retire by end of 2011
- 93 percent of current supervisors will be eligible to retire by 2011

In May, 2002, GAO published a report titled *A Model of Strategic Human Capital Management* that includes "recommendations to help FAA meet its impending need to hire and train thousands of air traffic controllers." However, it is not clear whether FAA has adopted these recommendations, in part or in total.

These GAO recommendations are intended for all government departments and are based on an earlier finding (2001) that human capital management is a high-risk area, government wide. The report identifies four specific areas of concern:

- leadership, continuity and succession planning
- organizational alignment and strategic human capital planning
- acquiring and developing staff whose size, skills and deployment meet needs
- creating results-oriented cultures

CAST (European Union)

A European research initiative named Consequences of Future *ATM Systems for Air Traffic Controller Selection and Training*, CAST attempted to relate the future changes in air traffic control equipment and procedures to selection and training needs. It was a relatively exhaustive study carried out by:

- Netherlands: Nationaal Lucht- en Ruimtevaartlaboratorium
- France: AIRSYS ATM
- United Kingdom: The former Defence Evaluation and Research Agency
- Germany: Deutsche Flugsicherung
- United Kingdom: National Air Traffic Services
- France: Sofréavia – Société Française d'Études d'Équipements Aéronautiques

The CAST initiative is noteworthy because of its emphasis on selection methodologies — a critical challenge for this sector.

New Zealand "Selector" System

Available through an Internet site that Airways New Zealand claims is innovative, this system provides information to potential air traffic control program applicants. It also offers online access to a self-assessment module. The intent of this Web-based system is to allow potential candidates to determine whether or not they are suited to the occupation. The goal of this system is to increase the percentage of applicants who will succeed.

Improvement

Competency-Based Vocational Qualification/Standards

Competency-based training was identified in the literature as a priority issue to be researched. Two leading jurisdictions in the use of competency-based vocational qualifications are the UK and Australia. Competency-based standards now have relatively wide application, but these jurisdictions appear to be often quoted as leading practitioners. However, it is noteworthy that the approach took hold in the US in the 1970s and is now being resurrected under the auspices of the National Skills Standards initiative. The EU has also conducted significant research and evaluations in vocational training in attempts to identify best practices for pan-European application.

The key implementation issues appear to be exactly how to define and measure competence, and how to determine the degree to which "generic attributes" or "core skills" should be included in measurement. The trend in both the UK and Australia in recent years appears to have been toward inclusion, opening up the measurement of competence beyond the literal task or job to be performed.

United Kingdom: The UK's competency-based approach has been developing for some time and continues to evolve. The distinctive aspect of the UK's National Vocational Qualifications (NVQ) appears to be the creation of the General National Vocational Qualifications (GNVQ), a blend of competency-based and "core" qualifications. They are intended to prepare individuals for a range of related occupations rather than a single one.

The implementation process in the UK appears to have passed through several phases. This included skills consultations that emanated from the Foresight Skills task force initiatives. It appears that work still needs to be done to establish an industry-defined competency structure. The Sector Skills Development Agency (SSDA) of the Department of Education and Skills is encouraging and funding industry-based Sector Skills Councils. Interestingly, aerospace/aviation does not appear as a distinctive sector at the moment, although the beginnings of a transportation sector are evident.

Australia: Australia appears to have followed a similar path with respect to creating a blended academic and occupational standard like the GNVQ. In Australia, the National Training Board (NTB) uses the expression "key competencies."

The distinctive aspect of Australia's approach appears to be its attempt to combine e-learning distribution initiatives with its vocational education and training structure. The Australian Flexible Learning Framework for the National Vocational Education and Training System is an ambitious and aggressive way of doing this that also embraces the notion of "lifelong learning."

European Union: Since 1996, the EU has sponsored a range of human resources research projects with a primary focus on Vocational Education and Training (VET). This is a broad topic that we do not attempt to describe in detail here. The apparent innovation is the attempt to benchmark, and otherwise compare, the structure, strengths and weaknesses of approaches in the various European countries in an attempt to identify "best practices." The underlying driver is quite simple from an EU perspective: European integration.

In some of the research, significant emphasis appears to have been placed on so-called "dual" approaches that combine academic and vocational elements. The objective of dual approaches is to allow students enrolled in vocational courses to acquire qualifications for university access alongside their vocational qualifications. Primary initiatives investigated under the INTEQUAL series of studies included:

- vocational programs or streams within the comprehensive school systems of Norway and Sweden
- individual qualifications; e.g.:
  - Vocational Baccalauréat (Bac Pro) in France
  - General National Vocational Qualification (GNVQ) in England
  - long courses in senior secondary vocational education (MBO) in the Netherlands
  - WIFI Academy courses in Austria
- pilot projects within the established systems of vocational education and training in Germany (Bavaria and Brandenburg).

They comprise 196 completed or ongoing projects under the following themes:

- employment, occupations and qualifications
- skills and training needs
- transition from education to work, lifelong learning
- VET policy and system societal context, culture
- training provision, teaching and learning, trainers
- human resources development, including learning organization
- information technologies in VET

United States: In the US, the National Skills Standards Board (NSSB) has attempted to create voluntary partnerships to develop skills standards and to establish a basis for skills certification. The underlying reason is the "explosion in the number of industry certifications in the marketplace."

The NSSB is attempting to establish the "NSSB Certification Recognition," a system based on consistent evaluation criteria. This is obviously an ambitious goal. For this purpose, the NSSB has created fifteen industry sectors: the two that appear to be relevant to aviation/aerospace are "manufacturing, installation and repair" and "transportation."

In 2001, skills standards for the manufacturing, installation and repair sector were published in six "concentrations" including production, maintenance, production process development and quality assurance.

The approach taken to defining standards includes:

- description of the work including critical functions, key activities and performance indicators
- description of the required knowledge and skills of the worker in three categories: academic, employability (soft skills) and occupational/technical

The academic and employability knowledge and skills standards include "overall" and "sub dimension" complexity ratings.

Education/Government/Industry Partnerships

In performing the research, it was clear that most, if not all, jurisdictions recognize the need for close collaboration in order to maximize the relevance and value of the education and training system to the industrial end-users. Indeed, there is arguably nothing new in this notion. The key is in the "how." There does not appear to be any substitute for continued communications and revisiting of the issue. This need is reinforced by the rapid technology and business change that has occurred, and continues.

One example of education/government/industry partnerships has been selected for review here: *Centre d'adaptation de la main d'œuvre aérospatiale du Québec (CAMAQ)*. CAMAQ appears to be one of the earliest attempts to formalize this dialogue, and the model has survived the test of time.

CAMAQ was created in 1978 through a collaborative effort between the aerospace industry and unions with the support of the Québec and Canadian governments. It is a not-for-profit, sectoral manpower committee whose board of directors includes representatives from all the key sector stakeholders including aerospace companies, the provincial government and unions. Its role is to understand the human resource needs of industry and act as a single facilitator of effective communications between industry and the training and education system to deliver the necessary skilled workers.

Some distinctive aspects of the approach include the premise that industry defines its needs and the education system delivers the service. CAMAQ also attempts to identify unfulfilled needs and future requirements, particularly shortages in specialized skills as well as any deficiencies in the current system. It then catalyzes any required actions.

CAMAQ also conducts studies and polls related to historical and future human resources needs and has influenced the quality and quantity of training at the secondary, college, university and post-university levels. One study, for example, focused on the level of representation of women in technical positions in the aviation industry.

In 1994, in a joint initiative with the Québec Ministry of Education and the Catholic School Board of Montréal, CAMAQ created the École des métiers de l'aérospatiale de Montréal (ÉMAM) whose mandate is to train students in aviation-specific trades. ÉMAM demonstrates CAMAQ's distinctive approach to co-ordination of government, industry and the education system to meet a particular need.

ÉMAM is a public (governmental) secondary school. However, the board of directors includes representatives from industry, unions, the Québec government, the school board and CAMAQ. Furthermore, the principal of the school is appointed on an annual basis. His/her performance and continuation in the position is subject to review and approval by industry via the board of directors. Admission criteria are strict and comprehensive. The school applies rigorous discipline to students, especially in the first three months of their studies. This helps prepare them for the real-world industrial environment and also results in a very high graduation rate.

The approach includes close, ongoing collaboration between industry and the education/training system by means of regular communications events. These events include twice-yearly visits by industry representatives to review curricula, equipment, etc., and exchange views with staff and students. This ongoing communication helps to ensure that the school continues to meet the ongoing needs of industry

In summary, ÉMAM programs are delivered in a school environment by professional teachers but with strong, continued input from industry — both management and unions.

CAMAQ's priorities for the future include creating an environment in which students at all levels of the system develop an appreciation of the principles of continuous improvement and the "virtual enterprise" and their increasingly intimate interrelationship in the workplace.

Simulation as a Tool in Education and Training

A range of simulation technologies has the potential for more extensive use in the education and training system. Currently used extensively within industry in areas such as type-specific pilot and maintenance training, these technologies are slowly finding their way into environments such as university programs. The major obstacle to their wider adoption is cost. However, progressive cost reductions in computer hardware and software systems offer hope that they will become affordable for the wider education and training systems.

Aircraft design and development is performed today using sophisticated design software that can generate three-dimensional static and dynamic models of the product and its environment. Anthropomorphic models can be created to simulate the *performance of maintenance tasks*. With this technology, the maintainability and accessibility of the aircraft's structures and systems can be maximized.

A Canadian company, Safework — a leader in the field of anthropomorphics — was acquired by Dassault Systemès two years ago for integration into its CATIA/DELMIA systems. For new product development, Dassault has created a "classroom environment" which includes a central large-screen environment in which up to 50 or so designers can move through a virtual reality model. Also in development is a glove that will allow the manipulation of a virtual mechanic to simulate performance of maintenance tasks.

The next logical step is to use these simulated environments to allow maintenance technicians to virtually walk through an aircraft, performing the various maintenance tasks. From an industrial perspective, this is particularly useful in the type-specific training context. Also, the potential for application in more generic maintenance training environments such as college programs is clear.

An EU collaborative project called *Advanced Integrated Training in Aeronautics Maintenance (AITRAM)* is developing a virtual reality and enhanced 3-D system for training. It falls under the umbrella of PROACTe (Promoting Awareness and Communicating Technologies in Education), a service to communicate work funded by the EU under the Education Area of the Information Society (IST) Programme.

AITRAM program objectives are to "develop an advanced training system for maintenance training based on innovative concepts, new cognitive approaches and simulation technologies." FLS Aerospace, SR Technics and Air Europe are among the consortium's members. Specific goals include:

- design of an integrated training concept
- modeling and simulation of HF and environmental conditions
- development of integrated VR based training application
- authoring of training scenarios to demonstrate and evaluate the AITRAM training concept

Simulation technology is at an early stage. One lesson learned is that the development costs for each maintenance task, and for the entire system, are high. One observer comments that "time will tell if it can be produced at a cost that is realistic for an MRO organization." However, as a very cost-sensitive segment of the industry, MRO can tend to be skeptical about technologies imported from the manufacturing environment. Enabling technologies for this initiative are provided by the Freunhofer Institute.

Simulation technology also has applications in the area of *management training*. In Germany, Lufthansa Consulting provides a range of consulting and training services to airlines and airport operators. One of their tools is the General Airline Management Simulation (GAMS), a computer-based simulation of business processes. The philosophy of its application is to create teams of trainees representing "virtual" airlines. They are presented with a baseline situation and use the simulation to "work through" business processes. They can then visualize the results of decisions they make. In essence, the simulation is designed to model a complex business environment.

American Association of Airport Executives (United States/Canada)

An "accredited airport executive" program established by the American Association of Airport Executives (AAAE) includes the relatively distinctive requirement that AAAE accreditees must meet continued education requirements. The FAA co-sponsors (endorses) some AAAE courses and thus appears to recognize the integrity of what appears to be a rigorous accreditation system. AAAE also has an international presence via the International Association of Airport Executives (IAAE). IAAE Canada, located at the University of Manitoba Transport Institute, is now offering an accredited airport executive program.

The Canadian Accreditation Program (CAP) is based on the US model, including the continuing education requirements. However, the model has been adapted to incorporate Canadian-specific regulatory subject matter. The initial accreditation process includes a management presentation and oral and written exams. Administration of this program is the responsibility of a five-member Canadian accreditation committee that comprises experienced airport managers. Committee members, as well as the board of directors and the board of examiners, are all accredited under the program.

As a prerequisite for the accreditation program, applicants must have at least one year of experience in an airport management position. The program includes course work, exams, and a management paper on an approved topic. A draft outline is submitted to three members of the board of examiners for approval. The final steps are an oral interview and an exam — five areas of skills are tested. Finally, the individual must accumulate three full years' experience before obtaining accreditation.

In general, implementation has been smooth. It continues to undergo some fine tuning based on inputs by the accreditation committee. The primary challenge was the two-year period required to develop and launch the program.

IAAE Canada is also offering courses in wildlife management and financial management; also, a basic operations course will be offered by Georgian College in June, 2003.

British Columbia Institute of Technology (BCIT) Airport Management Training (Canada)

The BCIT program was developed based on a need for airport management training that arose when Transport Canada closed down the TICTI program. It was further recognized that a typical university MBA program did not offer enough relevance to the specific needs of airport managers. Thus, a request for proposal was drafted in 1997.

The champions of development of this program were the British Columbia Airports Council (BCAC) airport subcommittee and the municipalities of Vancouver, Kelowna, Castlegar and Victoria.

The program was designed using both top-down and bottom-up approaches. Subject areas were benchmarked with existing and well-respected US programs (North Dakota and Embry Riddle University). What evolved was a two-year diploma program that responds to the municipalities' needs for operators in all facets of airport operations. An additional 18-month degree option is also available.

Distinctive characteristics of the BCIT program include its all-inclusive nature and its objective of preparing graduates to take entry-level management positions at both large airports (typically specialized positions) and small airports (typically general management positions).

The prerequisite for success was the clear and immediate demand created by the demographics of the industry. The primary obstacle encountered was the two-year duration of the implementation procedure. In hindsight, there is a belief that an enhanced political strategy would have accelerated the process because it would have created an earlier awareness of some of the regional jurisdictional intricacies that inevitably must be managed.

IATA Management Training (International, based in Montreal)

IATA's Aviation Training and Development Institute is not necessarily innovative, but the organization is based in Canada. It offers (primarily) management courses for private airport operators with commercial orientation and substantial use of distance learning.

Corporate Universities

The expression "corporate universities" encompasses a wide variety of concepts and levels of commitment. The idea originated in the US but has now been adopted relatively aggressively by many of the larger European companies, especially German ones.

Two notable examples are the BAE Systems Corporate University in the United Kingdom and the Lufthansa School of Business in Germany.

The BAE Systems Corporate University attempts to create links between the company and multiple universities, each of which is considered to be a centre of excellence in the selected field. It is based heavily on virtual collaboration. It comprises four basic frameworks:

- integrated development
- benchmarking and best practices
- strategic research and engineering
- communications

BAE Systems Corporate University comprises relationships with approximately twelve British universities.

The distinctive nature of this initiative is its broad scope both with respect to content and collaborating universities. The challenge is to maintain momentum for such a substantial undertaking, especially in difficult economic times.

Germany's Lufthansa School of Business is a leading example of a European corporate university. It was created in 1997, and the timing was partially related to recognition that investments in training and development need to be made in "good times." This has been borne out by drastic cutbacks made by Lufthansa and other airlines in the current downturn.

The school responds to five principle areas of concern to Lufthansa:

- general management and leadership including "managing ambiguity"
- large-scale change networks
- strategic dialogues
- defining the "future generation"
- future competency needs

The Lufthansa school collaborates with several universities in Europe, including the Management School of Cranfield University which is a leading aviation/aerospace post-graduate school. Lufthansa Business School engages the university environment in defining its management training needs.

The Lufthansa School of Business has also initiated an interesting mentoring concept. Young Lufthansa experts, so-called Web mentors, explain the intricacies of the Internet to experienced executives, the Web mentees, in up to eight individual sessions. The Web mentees include managers at all levels, right up to the executive board. Through this activity, the young Web mentors gain an insight into the everyday work of senior management and also have an opportunity to familiarize themselves with different areas within Lufthansa. To date, some one hundred executives have developed their Internet skills with the aid of young staff members. While modest in scope, this initiative demonstrates an innovative approach to management training and recognition of the strengths and weaknesses of the various generations.

Management Training for Engineers (European Union)

Published by the European Association of Aerospace Industries (AECMA), the document titled *Human Resources: A Major Aspect of European Integration* highlighted a key lesson learned in the EU aviation industries: engineers are still inadequately equipped to manage in today's business environment. In particular, they are not well prepared to lead multidisciplinary and multicultural design-build teams in an integrated product development (IPD) environment. They are also ill equipped to properly incorporate real-world business issues into their activities, most notably lifecycle costing.

Lack of management training among engineers is a well-documented and recognized challenge for Canadian industry as well.

The report identifies categories of activity that are supported by the EU and intended to help improve the situation, notably the following two:

- development of dedicated international university programs which incorporate links with foreign academia and students
- development of joint industry/university training programs which incorporate trans-national, multicultural issues

ECATA and EURESAS, two examples of the second category cited, are described below. Other best practices cited in the report include the previously mentioned BAE Systems Corporate University and the Network for Aerospace Management in Europe (NAME).

ECATA, the European Consortium for Advanced Training in Aerospace, is considered to be a best practice because it has existed for several years and appears to be well established. ECATA is managed by the Ecole Nationale Supérieure de l'Aéronautique et de l'Espace (SUPAERO) and includes seven universities and six large aerospace companies. Oriented towards working engineers, it is modular and multi-site in nature.

The objectives of EACTA are to help young aeronautical engineers acquire the knowledge and skills to assume leading positions at a later stage in their careers. This comprises three key areas:

- to stimulate the formation of a European network of aeronautical engineers who are known to each other
- to provide a modern, high-level and intensive environment giving engineers experience of working in multinational project teams
- to expose participants, in as realistic a manner as possible, to important aspects of high-level program management

ECATA comprises an academic program and a multinational team project. The academic program includes case studies, debates, project simulations, visits, seminars and tutoring.

For several years, ECATA was completely or partially funded under successive EU programs. It appears that in some cases this resulted in inordinate bureaucracy. However, it is now totally funded by industry, and this is the preferred model. The question remains whether industry would have initiated the project without the EU stimulus, notwithstanding the painful nature of the administrative process.

A second example, oriented specifically to the air transport environment, is the European Centre for the Aerospace and Aviation Industries (EURESAS). EURASAS is based in Toulouse and supported by Airbus and Rolls Royce. Local French schools collaborate to offer courses in business management, marketing, communication, economics and finances.

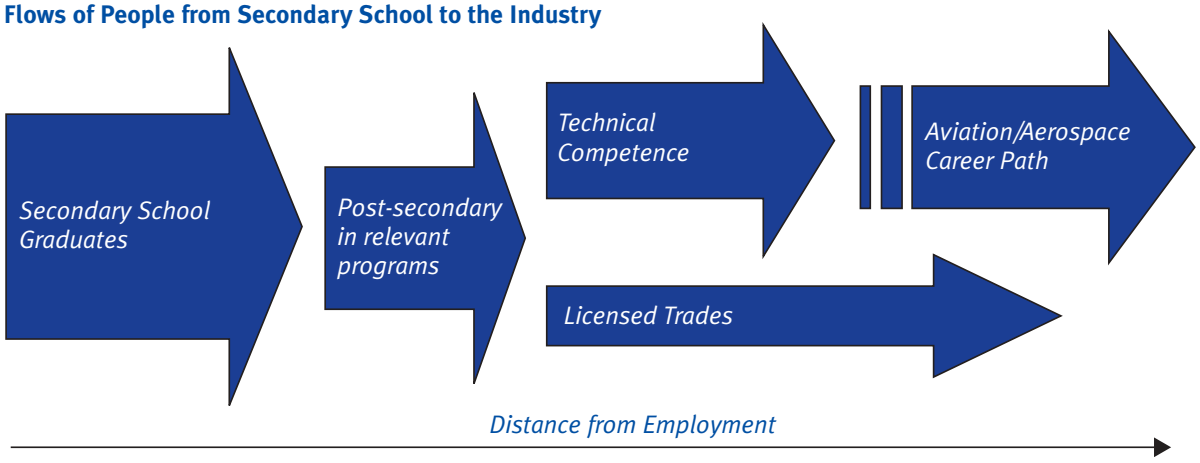
Electronic reports detailing these programs will be distributed through a website along with the current report. A complete summary of the programs is provided in Appendix B.

The way forward is for the industry and the education and training system to work together in managing the gaps between supply and demand. There are two aspects to this process:

1. A shared understanding of the strategic issues: specifically, a common understanding of the underlying markets and drivers of change;
2. A joint program for action based on shared interests.

At a steering committee meeting on April 3, 2003, members reviewed the main findings of this report and offered their insights to the strategic issues. Their comments have been incorporated in this report. Between the report and the steering committee's ongoing discussions, members have begun to develop a shared understanding of the strategic issues. This is a necessary prerequisite to effective action. The steering committee also made considerable progress in defining a joint program for future action based on this shared understanding. These initial steps will also be reviewed in this final chapter.

Exhibit 6
Flows of People from Secondary School to the Industry



The Strategic Issues

The main strategic issue is to increase the number of people who want to pursue a career (as opposed to "job") in aviation/aerospace. If people see aviation/aerospace sector as a good place to develop a career, they are likely to make the investments in education that are necessary to pursue this career.

Student volumes are determined by the interplay between education, the recognition of education, credentialization and employment. In particular, industry-specific credentials are likely to be demanded in cases where individuals either have a strong passion for working in the industry and/or believe that they can develop a secure career in the industry. Understandably, the industry wants people to show up at the door with exactly the right skills. The existing industry accreditation and credentialing system attempts to manage this process. But if it manages too specifically, too early, and without a good process for securing people employment, then it risks over-specifying jobs and effectively cutting down the volumes of people who will take an interest in the industry.

Although much attention has been paid to the flows of young people from PSEs to employment, in the current uncertain employment environment it is also important to consider other pathways, including reintegration of laid-off workers. Also, the report has made the point that immigrants are an underappreciated source of potential supply and should also be considered in any future strategy.

Exhibit 6 provides one way of thinking of these flows. The diagram attempts to bring together a number of different issues. To begin, there is a fairly large group of secondary school students that have an initial exposure to the base technological education required to proceed to later stages of industry-relevant education. One of the first issues is simply make this arrow as large as possible to ensure that many people have at least the basic technical competencies to proceed into advanced streams of education that are of interest to aviation/aerospace.

The next issue arises when people with the necessary secondary school prerequisites decide which postsecondary paths to pursue. They will do so in reference to their notions of those occupations that provide the best career pathways. They are already looking well down the road. If they do not have a clear idea of these pathways, the tendency will be to opt for those postsecondary streams that allow them to keep their options open.

This stage is critical for addressing student impressions about career stability and gender bias. There is a direct connection between the willingness to follow certain paths and the industry reputation for employment stability and career advancement. People are unlikely to commit to a level of certification if that certification does not help them develop a good and reasonably stable career. In terms of gender, many competent women will choose other paths if they believe that the industry has a reputation for excluding women from career advancement.

There are several strategic issues that can be addressed at this stage. The industry may work with PSEs to improve students' confidence that there is an effective school-to-work transition system and therefore it is worth the student's time to invest in education. Alternatively, sub-sectors of the industry, like manufacturing, may accept that employment variability is a natural part of the industry and therefore students should be encouraged to gain good technical credentials that are relevant to a variety of similar work settings. Yet even within sub-sectors, there will be occupations that are subject to greater variability than others. For example, within manufacturing the engineering design element is likely to show steady growth whereas production jobs are likely to be much more variable.

At this stage special issues of immigrant and re-entry workers can also be addressed. Many times immigrants will have good technical competencies and indeed, good credentials. But a failure to recognize these may dissuade immigrants from entering the industry and/or pursuing the incremental education and training that is required to make them work-ready. This may also be an issue for workers that have been recently laid-off, especially if they lack educational credentials yet have work experience that has enabled them to develop useful competencies. For both these groups an aggressive system of outreach and recognition may have the effect of greatly increasing the stock of workers that the industry can draw upon as it enters its inevitable upswing.

As Rod Jones, Executive Director of the Ontario Aerospace Council rightly puts it; this is all about 'building bridges and ladders'. That is why the end arrow in Exhibit 6 is laddered. That initial ladder into the workplace is absolutely key for all groups—new entrants, immigrants and re-entrants. All parts of the industry place such a premium on workplace experience and yet there is not a highly developed system for getting people this experience during while in education. If any of these three groups are outside the industry for a prolonged period of time, there workplace skills are likely to atrophy. Hence the need to develop a very dynamic system for getting people into work settings as soon, and as much, as possible. If the industry is in a lull, it is important that they have other means of maintaining competencies, either through ongoing training or by working in a similar setting outside of the aviation/aerospace industry.

The Need to Work Together to Address Gaps

Part of the challenge is within hiring organizations' capacity to control on their own account, through their human resource practices and the way they work with the education system. Large employers such as Bombardier, Air Canada and NAV CANADA have the size and the internal training capacity to engineer more effective system on their own account or by developing linkages directly with institutions.

In some cases, organizations can achieve the same economies of scale by working in collaboration with others outside of the aviation/aerospace industry. For instance, Transport Canada combines with other federal regulatory agencies to create sufficient demand to generate a programmatic response from the PSEs. Likewise, the aviation/aerospace manufacturing sector may find common cause with the automotive sector. There is a common issue with respect to the flows from secondary school and postsecondary school. Colleges have observed continual declines in student demand for industrial technical programs. In other cases, these economies of scale are best realized at an industry-wide level through organizations like OAC and CAMC. There are a variety of strategic alliances that can be crafted but these need to flexible and relevant to the particular issue being addressed.

The challenge of economies of scale can also be addressed on the supply side. For instance, it is well known that Canada is an international leader in regulatory approaches and in maintenance competencies. As such, it may be possible to market these programs to a broader international audience, initially to international students but eventually through distance learning. These approaches to international students will inevitably involve recognition of learning. So the approach has the useful spillover benefit of addressing another key issue facing the industry.

The important point here is that a response from the PSEs is most likely to be where there is sufficient and sustainable demand for a program. To be sure, the PSEs (especially colleges) are interested in expanding their capacity to deliver continuing education. But it should be noted that the PSEs are best at delivering classroom-based learning to young people. To do so, they need sufficient numbers to make this economic for them. It makes little sense for colleges to install capacity for temporary changes in low volume programs. Rather the continuing education and corporate education programs are likely to be a way to respond to industry demand.

Of course this has inevitable implications for PSE capacity. If PSEs observe a drop-off in student demand, they will adjust their programs toward areas where student demand is rising. So a person with a good set of core technical skills may choose to enter the medical lab technician's course as oppose to the aviation technician's course. There are literally thousands of these choices that are being made as young people flow from secondary school to work.

In the short to medium term, we have observed that people gaps may emerge in some technical fields like AME's and technical trades. In the longer term, certain sub-sectors will be faced with large-scale replacements that are the result of the baby boom generation retiring. For some industries in particular, the air traffic control and Transport Canada, this issue is likely to emerge earlier rather than later. There needs to be a way of understanding which aspects of demand call for permanent capacity and which are best dealt with through temporary capacity.

All parts of the industry face a similar challenge in ensuring that school-developed competencies align with work-required competencies. This is where competency gaps are created. To be sure, it helps to have industry input into the education system about the relevant competencies that need to be developed. But there is room for all parts of the industry to work more effectively with education in, for instance, creating places to develop people in the workplace and in sharing where they believe employability skills are lacking. The idea is to ensure that industry's recruitment and selection criteria are clearly explained to students so that they can make the appropriate choices well before applying.

As capacity gaps get addressed, there is need to revisit how capacity should be organized through industry and colleges. Some competencies are clearly better developed in a work setting. Yet organizations do not see themselves in the training business per se, so there has to be alignment between their investment in training and the required competencies. Industry competency-based approaches can make a major contribution here.

People, competency and capacity gaps are likely to persist, but with concerted effort the gaps can be managed. The number of people attracted to the industry is actually fairly small in terms of the total number of students coming through the post-secondary system. Canadians have clearly made a commitment to higher levels of education and training, especially tertiary education. As such, the main challenge is to channel the already high volumes toward pathways that lead to careers in the aviation/aerospace industry.

Recognizing Rigidities in the System

There needs to be more attention paid to making the system more flexible and in constructing bridges and ladders. Yet it is important to recognize the differing interests that generate rigidities in the system. The juxtaposition of interests creates friction in the system that makes it more difficult for supply to adapt to changes in demand.

It is important for stakeholders to control the things they can control and be aware of the things they can't control. Something that stakeholders can control are creative solutions to the inherent differences in outlook and motivations. Resolving these juxtapositions will move the system towards greater flexibility.

This resolution is what Exhibit 7 is trying to work towards. Exhibit 7 is a tool that flows out of the analysis undertaken in the report. It is primarily a demonstration of barriers to finding solutions. But for actual action, it is important for the various stakeholders to agree on the fundamental juxtapositions and determine which ones can be addressed through cooperation based on a mutual understanding of each party's motivations and constraints.

Through this process, it is possible to define a joint program of action. That program naturally flows from the type of exercise in Exhibit 7 and, when complete, might look something like Exhibit 8. In this exhibit, the underlying juxtapositions set an agenda for co-operation to reduce friction and improve flexibility. One can then see how this defines a framework for specific co-operative initiatives that substantively improve the flexibility of the system and eliminate gaps.

In our view, the problem with many action plans that emerge from studies like this is that they start at a tactical level. So we get things like: "we need more visits to high schools to tell the kids about how great our industry is" or "we need a website to tell kids about the great careers they can have with us". These types of tactics may be well-intentioned but lack a sound strategic basis for improving the situation over the long term. As such, they are effectively one-off actions that have no lasting effect on the fundamental issues. When tactics work together toward a common strategic goal they are much more likely to be effective. For instance, if the strategic goal is encourage more secondary school interest in careers in aviation/aerospace, one might begin by working with secondary schools to extend the aerospace module of the transportation technology course. At the same time, CAMC secondary school programs could be instituted and local businesses could offer secondary school students who have taken these modules the opportunity to spend time in a work setting. Then one of the employers could do a joint presentation with one of the students to discuss the challenges facing the industry and what the students observations related to the challenges of the workplace. One can easily see how the tactics are aligned to a strategic outcome.

Exhibit 7
The Main Juxtapositions in the Organization of Education and Training

From the Perspective of...	Students/Employees	Education	Industry	Regulation and Accreditation
Students/ Employees		Students want skills for jobs Education needs students but needs to develop a range of skills training relevant to different job circumstances	Students want job experience to improve resume Companies want to hire when they need people and value employee loyalty	Students want flexibility Regulators want demonstrated capacity to perform specific jobs
Education	Education wants sufficient demand to put capacity in place for classroom-based programs Students may need skills that are not best delivered through PSE classroom model		Education wants to train to company demands within its capacity constraints The work environment of companies cannot be replicated in a classroom setting	Education system is expert on teaching and only needs broad guidance Regulators and accreditors want to ensure that people are trained to standards
Industry	Companies want people as demand increases Students emerge at all points in business cycle and want relevant work when they graduate	Companies want education to provide right mix of technical and employability skills Education will lag companies technical skills and does not have a system for assessing employability skills		Companies must conform to standards but want flexibility to manage performance Regulators/ accreditors want to regulate quality of employees
Regulators and Accreditors	Regulators/ Accreditors want to set standards for occupations Students want flexibility to respond to changing labour market.	Education needs guidance on industry standards	Industry must hire from Transport Canada accredited grads	

Exhibit 8:
Minding the Gaps: Leadership and Partnerships for Change

	Working With...			
Leadership	**Students/Employees**	**Education**	**Industry**	**Regulation/ Accreditation**
Education	Provide students with more work-relevant skills Help students accredit employability skills Provide students with more flexible learning environments		Adopt learning technologies to replicate workplace environment Work with companies to provide more workplace experience	Work with accreditors and regulators to streamline accreditation Work with accreditors to design programs that respond to industry needs
Industry	Provide a better commitment to students on job security, especially for industry-specific occupations Provide students with more workplace experience Demonstrate to students career pathways Demonstrate how industry relates to widely applicable skills	Work with education to rationalize and build up capacity where there is demand Work with education to develop flexible systems for education and training Provide education with insights on human resource systems for assessing employability skills		Work with regulators/ accreditors to streamline systems of accreditation
Regulators and Accreditors	Work with all parties to demonstrate career pathways to students Demonstrate how industry competencies relate to good jobs through life	Work with education to develop flexible and performance-based accreditation systems	Work with industry to rationalize accreditation capacity between Transport Canada and Industry accreditation	

We stated at the outset that the success of this report "...will be gauged by subsequent actions taken by the Ontario aerospace industry and Ontario educational institutions to bridge the gaps". Obviously this report is merely a contribution. Hopefully it helps galvanize stakeholders and provides them with a strategic approach to guide their actions. These actions require leadership, resources and mechanisms to be effective.

Exhibit 9
Steering Committee's Ideas for Action

Main Action	Sub-Actions
Bridge the Gaps Between • Customer needs • Industry needs • Education and training	• Competencies – General vs. Specific • Refine understanding of demand • Training and education for management • Produce more Transport Canada inspectors • Expand partnerships between education and industry to produce new programs • Improve global perspective of learning and develop capacity to reach global markets • Create a laddering mechanism
Create education and training capacity	• Create capacity by co-operating between companies on shared competencies • Refine understanding of demand • Training and education for management • Produce more Transport Canada inspectors
Build Strategic Alliances	• Between aviation/aerospace and other sectors • Work with CAMC, HRDC and Industry to facilitate federal/provincial linkages • Build alliances between education organizations across Canada
Improve the policy and regulatory environment	• Work with federal and provincial governments to ensure effective industry policies • As specific initiatives emerge, make sure that government policies support these initiatives • Draw on government assistance to resource initiatives
Communicate more effectively with all stakeholders	• Promote career paths to students • Communicate ways in which immigrants and re-entry workers can get into the industry • Develop communication to support strategic alliances and other initiatives
Improve recognition of learning	• Create a laddering mechanism • Reach out to immigrants and improve global perspective of both education and industry • Work on standards and make them transparent

A very positive step in the direction of effective action came out of the steering committee meeting on April 3, 2003 at the Sheraton Gateway hotel at Lester B. Pearson International Airport in Mississauga, Ontario. Stakeholders from industry, education and government attended this meeting. Some time was spent exchanging ideas on the key aspects of the report and the strategic thrusts. Eventually, this lead to the definition of specific courses of action that could be taken to improve the aviation/aerospace education and training system. These individual actions were then grouped and individual stakeholders volunteered to move the process forward.

In Exhibit 9, the main actions and sub-actions are detailed. This is the result of stakeholders making suggestions as to what actions they think need to be taken and are, effectively, the recommendations for this report. In addition to this list of actions, several actions effectively cut across all the main actions. Specifically, although communication was seen as an important enough activity to qualify as a main action, there is a need for all actions to contain a communication component. Similarly, subject matter experts will be required at various stages of the process and a number of stakeholders suggested that they would be willing to serve, as needed, in this way to support the main actions. Provincial and federal government members also expressed an interest in possibly supporting these actions through government financial assistance. CON*NECT and OAC assured the steering committee that they would continue to co-ordinate and support the strategy.

Exhibit 10
Steering Committee Implementation Teams

Main Theme	Steering Committee Contact	Other Team Members
Bridge the Gaps Between • Customer needs • Industry needs • Education and training	Michelle Decoste	Steven Dick, Mike DeBonis Sylvia Klarer, Keith Fleming Kim Current, Ted Brown
Create education and training capacity	Marjory Overholt	Steve Dick, Victor Ujimoto Sylvia Klarer, Michelle Decoste
Build Strategic Alliances	Steve Dick	Lucie Boily, Victor Ujimoto
Improve the policy and regulatory environment	Lucie Boily	Steve Dick, Michelle Decoste
Communicate more effectively with all stakeholders	Jo-Ann Ball	Steve Dick, David Alcock Brian Stewart, Robert Bell
Improve recognition of learning	Bernie Wurster	Steve Dick, David Alcock

Exhibit 10 then takes this one step further by attaching responsibilities to the action. Although much work needs to be done, it is important to note that industry, education and government representatives have come forward to take responsibility. This is a key step. But these groups must pick their key strategic priorities, decide on a comprehensive set of tactics, mechanisms for action and resources. So there is much work to be done, but the steering committee has made major strides in the direction of fulfilling the main objective of this study “actions....to bridge the gaps”.

References

Air Canada. 2001. *2001 Annual Report.* (Montreal: Air Canada).

Air Transport Association of Canada (ATAC). 2001. *Human Resource of Commercial Pilots in Canada.* (Ottawa: ATAC).

Association of Colleges of Applied Arts and Technology of Ontario (ACAATO). 2001. *Environmental Scan 2002*. (Toronto: ACAATO).

Aviation Week. 2002. *ATC Market Report*. Vol. 11, Issue 19,September 19, 2002.

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

Bloom, Michael and Michael Grant. 2001. *Brain Gain: The Economic Benefits of Recognizing Learning and Learning Credentials in Canada*. (Ottawa: The Conference Board of Canada).

Canadian Urban Institute. 2001. *Industry Sector Study: Aerospace Industry* (Toronto: Canadian Urban Institute).

Cantor, Jeffrey. 2002. "Skills Certifications and Workforce Development: Partnering with Industry and Ourselves." *Leadership Extracts.* League for Innovation in the Community College. Vol. 15, No. 1.

Frank, Jeff and Éric Bélair. 1999. *South of the Border: Graduates from the Class of '95 who Moved to the United States.* Statistics Canada Catalogue No. 81-587-XPB. Human Resources Development Canada and Statistics Canada. (Ottawa: Minister of Public Works and Government Services Canada).

Gingras, Yves, and Richard Roy. 1998. *Is There a Skill Shortage in Canada?* Applied Research Branch. Research Paper No. R-98-9. (Ottawa: Human Resources Development Canada).

Government of Canada. Citizenship and Immigration Canada. 2001. *CIC Facts and Figures.* (Ottawa: CIC).

Government of Canada. Human Resources Development Canada. 2002. *At a Crossroads: First Results for the 18- to 20-Year-Old Cohort of the Youth in Transitions Survey.* (Ottawa: HRDC).

Government of Canada. Industry Canada (Aerospace and Defence Branch). 1999. *Assessment of the Skills and Training Situation in the Canadian Aerospace Industry.* (Ottawa: Industry Canada).

Government of Canada. Industry Canada (Aerospace and Defence Branch). 1999. *National Aerospace Skills Symposium.* (Ottawa: Industry Canada).

Government of Ontario, Ministry of Training, Colleges and Universities. 2001. *Employment Profile: A Summary of the Employment Experience of 1999-2000 Graduates Six Months After Graduation*. (Toronto: MTCU).

Government of Ontario, Ministry of Training, Colleges and Universities. 2001. Update: *Ontario's Plan for Students in the Double Cohort.* (Toronto: MTCU, Fall).

Government of the United States of America. Bureau of Labor Statistics and Bureau of the Census. Selected Years. *Current Population Survey* (March Supplement). Accessed through Internet Ferret System. (http://ferret.bls.census.gov/cgi-bin/ferret)

Grady, Patrick. 1997. *Apprenticeships in Canada. Issues and Problems.* Unpublished Discussion Paper.

Greater Toronto Airports Authority. 2001. *Briefing Paper #3: Economic Impact Briefing Paper.* (Toronto: GTAA).

Henson, Harold and Clayton Newton. 1995. *Tools and Methods for Identifying Skills Shortages: A Cross Country Comparison*. Human Resources Development Canada Discussion Paper. No. T-96-3-E. 1995.

Honeywell Aerospace. 2002. *Business Aviation Outlook 2002*. Presentation to National Business Aviation Association Conference. September. (Orlando: Honeywell Aerospace).

International Business Aviation Council. 2002. *Business Aviation Outlook 2002.* (Montreal: IBAC).

Jones, Rod. 2002. *Canadian Manufacturing and Process Sector: Issues, Challenges and Action Plan on Innovation and Learning for Global Competitiveness*. Unpublished paper. Canadian Agility Forum.

Malatest and Associates Ltd. 2001. *Final Survey Report Vol.2.2. Canadian Aerospace Labour Market Survey and Employment Forecast, 2001-2004*. Prepared for CAMAQ, OAC and MAHRCC. August.

Moisis, Abraham. 2002. The Role of Foreign Born Workers in the US Economy. *Monthly Labor Review.* May.

Nadeau, Serge, Lori Whewell and Shane Williamson. Beyond the Headlines on the Brain Gain. *Isuma*. Spring 2000, pp. 154-57.

Canadian Aerospace and Defence Sector Survey, 2000/2001. Strategis Website. (http://strategis.ic.gc.ca/SSG/ado3752e.html)

Ott, Jim. 2002. Farnborough Mood Reflects Bleak Industry Outlook. *Aviation Now*. July 24.

Statistics Canada. *Civil Aviation in Canada*. Cat. No. 51-206. (Ottawa: Statistics Canada).

Tegtmeier, Lee Ann. 2002. Training Not Immune From Market, Technology Forces Shaping Industry *Overhaul and Maintenance*. November.

Transport Canada. 2002. *Aviation Forecasts 2001-2015*. (Ottawa: Transport Canada).

Ward, Debra. 2002. *Airline Restructuring in Canada: Final Report.* Report by the Independent Transition Observer on Airline Restructuring.

Zhoa, John, Doug Drew and T. Scott Murray. 2000. Brain Drain and Gain: The Migration of Knowledge Workers from and to Canada. In Statistics Canada, *Education Quarterly Review*. Cat. No. 81-003. Vol. 6, Issue 3, pp. 49-61.

Electronic Resources

The following electronic resources are also available through this report's website.

Organization	Title
Sandra Kerka	Competency-Based Education and Training
Aviation National Training Organization	An Overview of the Structure of the UK Education System (including NVQ and GNVQ)
The Mackinnon Partnership Segal Quince Wicksteed Ltd For UK Foresight Initiative	An Assessment of Skills Needs of Transportation
Sector Skills Development Agency, UK	An Overview of Sector Skills Councils
The EdNA VET Advisory in conjunction with the Australian National Training Authority	Australian Flexible Learning Framework
European Union	European Union Vocational and Educational Training Research Summary
National Skills Standards Board (NSSB), US	Skill Standards for the Manufacturing Concentration of Maintenance, Installation, and Repair
General Accounting Office (GAO), US	A Model of Strategic Human Capital Management
EU- funded research. Team leader NLR (Netherlands)	Consequences of Future ATM Systems for Air Traffic Controller Selection and Training (CAST) — Executive Summary
AECMA – European Association of Aerospace Industries	Human Resources – A Major Aspect of European Integration
American Council on Education Center for Adult Learning and Educational Credentials	Lifelong Learning Trends in the United States: The Risks and Challenges to Higher Education
Consortium for Research on Emotional Intelligence in Organizations	A technical report issued by the consortium for research on emotional intelligence in organizations
The Open Polytechnic of New Zealand	Technical and vocational education through open learning trends, developments and issues from a local perspective
Richard E. Boyatzis, Department of Organizational Behavior, Weatherhead School of Management, Case Western Reserve University	Unleashing the Power of Self-Directed Learning
Bettina Lankard Brown	Corporate/School Partnerships: Learner Centered or Business Centered?
Sandra Kerka	Lifelong Learning
Overhaul and Maintenance, November 2002	Training Not Immune from Market, Technology Forces Shaping Industry
Michael E. Wonacott (funded by US DOE)	The Learning Organization: Theory and Practice
EU- funded research. Team leader NLR (Netherlands)	Consequences of Future ATM Systems for Air Traffic Controller Selection and Training (CAST) — Complete Report
Christopher Prince and Graham Beaver, Nottingham Business School	The Rise and Rise of the Corporate University: The Emerging Corporate Learning Agenda
National Skills Standards Board (NSSB)	A Master Mapping System for Linking Occupation Classifications, Education Classifications, Industry Clusters and Career Clusters
Australian National Training Authority	Australian Flexible Learning Framework. Strategy 2001

Appendix A

A Summary of Aviation and Aerospace Programs Offered by Post-secondary Organizations in Ontario

Post Secondary Education Institution	Programs (as of October 2002)	Semesters	Graduates Per Year	Planned 5 Year Growth
Algonquin College	Commercial Pilot & Aviation Management	3	9	160%
Canadore College	Aviation Technician - Aircraft Maintenance	4	54	25%
	Aviation Technician - Avionics Maintenance	4	8	60%
	Aircraft Structural Repair Technician *	2	15	50%
	Helicopter Flight Training	2	11	25%
Carleton University	BEng - Aerospace Engineering	8	55	-
	MA Sc - Aerospace/MEng - Aerospace	6	15	20%
	PhD - Aerospace	10	8	20%
Centennial College	Aviation Technician - Aircraft Maintenance	4	100	125%
	Aviation Technician - Avionics Maintenance	4	70	125%
	Simulator Technician	4	7	500%
Conestoga College	Arts & Science - Aviation Option	4	12	-
Confederation College	Aviation Technician - Aircraft Maintenance	4	36	25%
	Aviation Manufacturing Engineering Technology	6	15	40%
	Aviation Flight Management	5	23	40%
First Nations Technical Institute	Aviation Diploma Program	6	9	10%
Georgian College	Aviation Management	6 (+3 coop)	35	100%
Humber College	Business Management - Flight & Aviation **	*****	27	125%
Lambton College	Professional Aviation Program *	4	11	125%
NAV CANADA	Air Traffic Controller	1	200	20%
	Flight Services Specialist	2	121	-
Rotman School of Management (University of Toronto)	Aerospace Executive Management Program ***	4	19	60%
Royal Military College	BEng - Mechanical Engineering	8	40	-
Ryerson University	BEng - Aerospace Engineering	8	60	10%
Sault College	Aircraft Structural Repair *	2	22	5%
	Aviation Machinist	2	15	-
	Aviation Technology - Flight	7	33	-
	Flight Attendant	1	7	20%
	Airport Operations	1	3	-
	Airport Administration & Services	2	20	-
Seneca College	Aviation Flight Technology	8	43	-
	Bachelor of Applied Technology Flight Program (Commencing Fall 2004)	8	n.a.	-
University of Toronto	BSc - Engineering Science - Aerospace	8	30	-
	MSc - Engineering Science - Aerospace	6	15	-
	PhD - Engineering Science - Aerospace	10	10	-
University of Western Ontario	BACS - Aviation Management	8	14	20%
York University	BSc - Space a & Communication Sciences	8	10	-
	BSc - Space Engineering Sciences	8	15	100%
19 PSEs	**37 Programs (3 CAMC, 1 AITP, 1 OAC)**	**Avg 5.1**	**1197**	**Avg 49%**

** CAMC accreditation, ** AITP accreditation, *** OAC accreditation, **** Transport Canada accreditation*

Appendix B
Summary of Best Practices from Other Jurisdictions

Theme	Practice
Competency-based vocational qualifications/standards	UK implementation of National Vocational Qualification/General National Vocational Qualification (NVQ/GNVQ)
Competency-based vocational qualifications/standards	Australia National Vocational Educational and Training System
Vocational qualifications and standards	European Research Projects in Vocational Education and training
Competency-based vocational qualifications/standards	US National Skills Standards Board (NSSB)
Education/Government/Industry Partners	CAMAQ, Quebec
Simulation as a tool in education and training	Simulation for technical training
Simulation as a tool in education and training	Simulation technology in management training
Industry-specific management training	American Association of Airport Executives Accreditation Program

Characteristics/Focus/Distinctiveness	Applicability by Sub-sector	Delivery Methods
Competency-based vocational qualifications/standards in UK. Establishing Sector Skills Councils (SSC) to create an environment in which industry genuinely defines its requirements at a sector level according to a defined structure.	Applies to many sub-s ectors, but particularly manufacturing	Various
Competency-based vocational qualifications. Heavy orientation toward "lifelong learning" and on-demand e-distribution supported by online mentoring. Requires accommodation of State-specific issues similar to Canada. Similar geographic and diversity challenges as Canada.	Applies to many sub-s ectors, but particularly manufacturing	e-learning network (Flexible Learning Framework)
Vocational education and training. Comparison of practices in European countries. Focus on dual vocational/education structures like UK GNVQ. A search for "best practices" by EU to be used as basis for a "common" approach. Creation of an environment that facilitates mobility of labour is a key consideration. Strong lifelong learning emphasis.	Applies to many sub-s ectors, but particularly manufacturing	Varied
Establish sector-specific national skills standards and associated certification process. Standards defined by describing the work to be performed and the skills and knowledge required (academic, soft skills and occupational).	Applies to many sub-sectors but particularly applicable to manufacturing/MRO	N/A
Single sector-specific co-ordinating agency. Strong industry input into needs definition on an ongoing, structured basis. One-stop-shop for co-ordination of aviation/aerospace needs definition. Customized solutions for specialized needs.	Manufacturing and MRO	Classroom "work-place in school"
Using modelling and simulation (VR) technologies developed for design purposes to train engineers and maintenance technicians. Use of 3-D static and dynamic models to "walk through" products and tasks. EU Advanced Integrated Training in Aeronautics Maintenance (AITRAM) initiative is researching this environment with major participation from Fraunhofer Institute.	Design, development and MRO	Computer interactive
Simulates complex business environments for training purposes. Demonstrates effect of decisions taken in team-oriented case study work. Lufthansa Consulting teaches by creating competing "teams" which make decisions under specified scenarios.	Air carrier and airport operations	Computer-based training with class-room support
Accreditation programs for airport management. Rigorous criteria. FAA endorses some programs in relation to delegated responsibilities. Retention of accreditation based on "currency" evaluations on annual basis. IAAE Canada delivering accreditation program customized to Canadian regulatory environment.	Airport operations	Various

Theme	Practice
Industry-specific management training	BC Institute of Technology Airport Management Training
Industry-specific management training	IATA Aviation Training and Development Institute
Industry-specific management training	Corporate Universities
Industry-specific management training	European Union ECATA and EURESAS
Reaching out to youth	Launchpad for Learning
Reaching out to youth	MentorNet
ATC-specific Large volume hiring and training	FAA hiring challenges
ATC-specific Use of Internet for pre-selection, self-audit	New Zealand “Selector” System
ATC-specific. Defining the requirements to perform the task	European CAST research project

Characteristics/Focus/Distinctiveness	Applicability by Sub-sector	Delivery Methods
Two-year diploma program. Significant focus on small airports (result of privatization).	Airport operations	
Sector-specific management training. Significant use of industry personnel to deliver training. Focus on management of complex environments. Based in Montreal. IATA also collaborates with Concordia U on air transport MBA for airline employees. This is a "flexible e-based" program which is accredited by Association to Advance Collegiate Schools of Business (AACSB).	Air carrier and airport operations	Classroom/distance leaning combination for employed people
Customized schools funded by large corporations and dedicated to their needs. Leading examples are Lufthansa Business School and BAE Systems Corporate University. Collaboration between universities and industry. Lufthansa has program wherein "management trainees" teach computer skills to executives and in so doing become familiar with various company functions.	Primarily air carrier operations, but also manufacturing	Primarily air carrier operations, but also manufacturing
Teaching engineers to be effective managers of integrated product teams. Emphasis on cultural issues and on effective communications.	Design and development	Design and development
Promote/familiarize the industry to high school students via the Internet. Project-oriented teaching designed by industry personnel and based on real-world situations.	Various	Various
Use of Internet to promote mentoring of university students by (primarily) retirees. Recognizes that substantial experience is leaving industry and may be captured by transfer direct to students. Relies heavily on voluntary mentoring. This particular initiative aims to encourage females to enter science/ engineering programs and is supported by University Aviation Association.	Various but especially design/development	Various but especially design/development
FAA faces concentrated retirements of experienced controllers. US General Accounting Office (GAO) has made recommendations on strategy to respond to the need.	Air traffic control/air navigation systems	Air traffic control/air navigation systems
Online pre-selection. Based on online self-evaluation and aptitude testing. Attempts to reduce failure rate in actual applicants and during training.	Air traffic control/air navigation systems	Air traffic control/air navigation systems
Adjustment of selection and training needs to meet technology-driven changes in operator/machine relationship. Emphasis on selection methodologies, because this cluster experiences high failure rates due to "difficult to evaluate" nature of the requirement.	Air traffic control/air navigation systems	Air traffic control/air navigation systems

This document presents the technical appendix to the main report for the Aerospace and Aviation Skills Training Survey, conducted by Forum Research Inc. and Allan Martel Consulting for Colleges of Ontario Network for Education and Training (CON*NECT) and the Ontario Aerospace Council (OAC).

Three methodologies were employed in this study:

- The first involved field research to contrast the offerings of the post-secondary organizations with industry demand; this was conducted by Forum Research, Inc.
- The second methodology looked specifically at the demands of Transport Canada; the research was conducted by Allan Martel Consulting.
- Finally, a review of best practices was undertaken, again by Allan Martel Consulting.

Each of these methodologies will now be considered.

Survey of the Post-Secondary Organizations and the Industry

The objectives of the survey were to:

- describe the supply of skills training resources available in Ontario
- examine existing demand data and relate it to the findings of the supply survey
- document any gaps between supply and demand

Survey objectives also required that the sample be segmented by sector, as follows:

- aviation and aviation systems design, manufacturing, maintenance, repair and overhaul
- air navigation and air traffic control
- airports
- air carriers
- regulatory and regulatory systems

This document presents the methodology used to complete the supply survey component of this assignment. The review of demand data and gap analysis is documented in the main report.

Methodology

A combination of in-person, on-site interviews, telephone interviews, e-mail contacts and fax-back questionnaires was used for the supply survey.

In-person interviews were used to gather information from respondents with especially significant skills training activities, to allow a richer and deeper qualitative understanding of the issues raised in the questionnaire than a telephone interview would allow.

A combination of telephone, e-mail and fax surveys was used to gather information from respondents in a second tier of training activities, in order to allow a wider coverage of the sampling universe than in-person interviews alone would allow.

Response Rates

An overall response rate of 81% was achieved on this survey, although the response rate for the critical in-person interviews was 94%. Response rate for phone/fax/e-mail interviews was 75%.

Overall response rate for the education stream was 100%. The response rate for the industry stream was 69%, or more than two-thirds overall. Once again, the response rate for the critical in-person interviews was higher than for the phone/e-mail/fax interviews.

The response rates for this survey, by stream and industry sub-sector, are shown in Exhibit A.

Sampling

A sampling universe of post-secondary educational institutions (PSEs), manufacturers, MRO firms, carriers and airports was defined. As a first step, the universe was divided into two streams: education and industry (including NAV CANADA, airports and carriers).

Education Stream Sample

The sampling universe in Ontario consists of 44 PSEs, 25 of which are colleges and 19 universities (or, in one case, a business school with an aerospace program associated with a university). For this sampling universe, it was decided to apply a census approach, and every PSE was interviewed, many in multiple industry clusters. The sample was assembled with the assistance of the Association of Colleges of Applied Arts and Technology of Ontario (ACAATO).

Seventeen of these PSEs were known (through the preliminary website and data review undertaken as part of the demand component of the survey) to have aerospace and aviation skills training programs that fit the survey definitions. These PSEs were assigned to a first "tier" of the sample and all were interviewed in person. It should be noted that, while it is assigned to the industry stream, NAV CANADA, because of the nature of its training function, was interviewed in person using a PSE questionnaire.

The remainder of the PSEs in this sample (27) was assigned to a second tier and was contacted by a combination of telephone, e-mail and fax-back questionnaire.

Industry Stream Sample

The sampling universe for the industry stream was segmented into four industry clusters:

- aircraft and aircraft systems design, manufacturing, maintenance, repair and overhaul
- air navigation and air traffic control
- air carriers
- airports

Manufacturing/Repair/Overhaul Sample

The approach taken to the manufacturing, repair and overhaul sample was that of a "judgement" sample. The sampling frame was the membership of the Ontario Aerospace Council (OAC), accounting for almost all manufacturers and MROs in the province. It was assumed that the majority of the skills training in this sampling frame would be concentrated in the minority of significant industry players.

With the assistance of OAC staff, a sampling list of 33 companies was assembled which included some of the most significant training activities in the province.

This list was further segmented into a first tier of seven very large companies, all of which were interviewed in person.

Twenty-six smaller companies were assigned to a second tier of telephone, e-mail and fax interviews.

Air Navigation and Air Traffic Control Sample

A census approach was taken to this sector, as it is a universe of one: NAV CANADA. Though counted in the industrial sample, an education stream questionnaire was used for this target.

Air Carriers Sample

This sample was assembled with the assistance of the Air Transport Association of Canada (ATAC), of which all carriers sampled were members. Once again, a census approach was taken to this sample. Nearly every carrier with operations in the province was included, whether international, domestic, regional or charter, for a total of 21 carriers.

Seven international, domestic and major regional air carriers were assigned to a first tier of interviews, and in-person interviews were attempted with them.

Fourteen other carriers were assigned to a second tier that was contacted by telephone, e-mail and fax.

Airports Sample

This sample was assembled with the assistance of the Canadian Airports Council (CAC). Once again, an approach close to a census was employed, and every airport of significance in Ontario (20 in total), including the 12 towered airports in the province, was included in the sample. The two Level 1 (international) airports in the province were assigned to a first tier, along with a sample of smaller regional airports. These four were all interviewed in person.

Sixteen other airports in the province were assigned to a second tier of telephone, e-mail and fax interviews.

QUESTIONNAIRES

Two overall questionnaires were designed, one for the industry stream and one for the education stream.

Although the sampling frame was PSEs and industry, the Primary Sampling Unit (PSU) was the individual educational program or industrial occupation category, of which there might be several at any one plant or school.

Thus, a screener was employed which gathered information on the institution or firm; then, separate questionnaires were filled out, one for each program or occupational category.

Separate screeners were designed for each of the industrial clusters being interviewed. The master occupational code list was developed with input from the Canadian Aerospace Manufacturers Council (CAMC).

Questionnaires were pre-tested in person. Minor adjustments were made, and then questionnaires were presented to, and approved by, the steering committee for the survey.

Exhibit A
Response Rates

	Sampled #	Interviewed #	Response Rate %
In Total	**112**	**91**	**81**
In-Person	36	34	94
Phone/E-mail/Fax	76	57	75
Education Stream	**44**	**44**	**100**
In-Person	17	17	100
Phone/E-mail/Fax	27	27	100
Industry Stream	**68**	**47**	**69**
Design/Mfg/MRO	**26**	**23**	**88**
In-Person	7	7	100
Phone/E-mail/Fax	19	16	84
Air Nav/ATC	**1**	**1**	**100**
In-Person	1	1	100
Phone/E-mail/Fax	-	-	-
Air Carriers	**21**	**9**	**43**
In-Person	7	5	71
Phone/E-mail/Fax	14	4	29
Airports	**20**	**14**	**70**
In-Person	4	4	100
Phone/E-mail/Fax	16	10	63

Regulatory Interviews and Survey

Interviews were conducted with Transport Canada to ascertain its specific needs as a regulator. Transport Canada's needs were then juxtaposed with the offerings of Ontario PSEs. This survey was sent to 27 Ontario colleges and universities in the fall of 2002. Follow-up phone calls were also made to each institution to ensure that the questionnaires were received and to answer any initial questions related to the purpose of the study.

Twenty-seven institutions responded. Most of the responding institutions were also interviewed by phone. The survey package outlined important characteristics of the demand, such as modular delivery, distance learning, and Transport Canada marketing support.

PSEs that indicated interest in developing or delivering programming that would align with regulatory agent requirements provided outlines of current related courses for preliminary review by Transport Canada. This was seen as an early indicator of applicability of some programming that has been developed for alternate purposes to the Transport Canada requirement.

Other Jurisdictions Methodology

A full literature review and set of telephone interviews were undertaken with other jurisdictions. This included the following steps:

- An initial scan of a relatively wide range of jurisdictions other than Ontario, including Canadian provinces, was conducted to look for evidence of distinctiveness. This was done primarily by Internet search, but also drew on experience and contacts acquired during previous studies, most recently the National Sector Study. The scan was geographically based, but also attempted to identify practices of particular relevance to each of the four industry clusters.
- Practices which appeared to offer the most promise of true "distinctiveness" were identified.
- The data collection plan was developed. Because of the diverse nature of the programs and initiatives identified, there are variations in methods of information collection. Our data collection has relied heavily on Internet research and other published information. Site visits were not planned nor conducted. Telephone interviews have been attempted but with limited tangible success.
- The research design was implemented with some adjustments, including response to input from the Canadian Airports Council (CAC) and identification of additional initiatives of potential interest.
- Literature review was augmented by telephone interviews.

The process for securing and completing interviews included:

- Identify resource person(s).
- Make initial contact by telephone to secure involvement of resource person(s). This included a brief verbal overview of the objectives. Determine a date/time/duration for a definitive interview.
- Send e-mail or fax prior to interview with suggested agenda. This was not applicable in many cases, the interview taking place "on the spot."

Interviews focused on the following questions:

- Why was the initiative undertaken (key drivers)? What were the deficiencies or environmental changes to which it attempted to respond? Who were the initial champions?
- How was the initiative designed and by whom? What were the key design criteria?
- Who are the leading participants?
- What are the key distinctive characteristics that make the initiative worthwhile?
- What are the prerequisites for it to succeed?
- What are the primary obstacles to its success?
- What are the primary (potential) weaknesses of the practice?
- What would you do differently if you were to go through the process again?

Exhibit 11
Research Conducted for Other Jurisdictions

Sub-sector	Practice	Methods	Interviewed
Manufacturing and Maintenance, Repair and Overhaul	National Vocational Qualifications (NVQ)	Web, Interviews	SBAC
	EU Research	Web	
	Quebec/CAMAQ	Interview	CAMAQ
	Australia Flexible Learning	Web	
	EU Engineering Mgt	Web, Interview	Cranfield
	US NSSB	Web, Interview	NSSB
ANS/ATM	(FAA) of 14 post-secondary educational institutions	Web, Literature Review	
	CAST	Web Research,	
		Literature Review	
	New Zealand “Selector”	Web	
Airport/Air Carrier	IATA AMTI programs	Web, Interview	IATA AMTI
	Corporate Universities	Web, Interviews	Cranfield School of Management
	BCIT	Interview	BCIT
	AAAE Accreditation	Web, Interview	AAAE
Other	Launchpad for Learning	Web, Interviews	Dudley Grid for Learning

[1] A most recent example is the Canadian government's papers on innovation that view sub-regional clusters as being key to Canada's economic success. See: Canada. Industry Canada. 2002. Achieving Excellence: Investing in People, Knowledge and Opportunity. (Ottawa: Government of Canada). See also: Canada. Human Resources Development Canada. 2002. Knowledge Matters: Skills and Learning for Canadians. (Ottawa: Government of Canada). For a very good discussion of aerospace industry clusters in Ontario, see: Canadian Urban Institute. 2001. Industry Sector Study: Aerospace Industry. (Toronto: CUI).

[2] A Human Resources Study of the Canadian Aviation Manufacturing and Maintenance Industry. 2002. Ottawa: Canadian Aviation Maintenance Council, and Malatest and Associates Ltd. 2001. Final Survey Report, Vol.2.2. Canadian Aerospace Labour Market Survey and Employment Forecast, 2001-2004. Prepared for CAMAQ, OAC and MAHRCC. August.

[3] Readers interested in pilots should refer to: Air Transport Association of Canada (ATAC). 2001. *Human Resource of Commercial Pilots in Canada.* (Ottawa: ATAC).

[4] Since the mid-1980s, the enrollment/population ratio for the 15-24 cohort has increased significantly while the labour force participation rate has declined. The reason is that young people are staying in school longer, are less likely to combine school and work, and are delaying entry into the full time labour force.

[5] Ontario. Ministry of Training, Colleges and Universities, *Colleges Receive $16.4 Million Funding Based on Performance*, Press Release. March 4, 2002.

[6] *A Human Resource Study*. 2002, p. 128. In their pipeline analysis, over 70 per cent of new hires are non-certified technicians. The rate for the maintenance side is 40 per cent.

[7] Tegtmeier, Lee Ann. 2002. Training Not Immune from Market, Technology Forces Shaping Industry *Overhaul and Maintenance*. November.

[8] See for instance: G. Picot, J. Baldwin and R. Dupuy. 1994. *Have Small Firms Created a Disproportionate Amount of New Jobs in Canada? A Reassessment of the Facts*, Statistics Canada Discussion Paper No. 71. November. Table 4.

[9] Air Canada. 2001. 2001 *Annual Report*. (Montreal: Air Canada), p. 13.

[10] Malatest & Associates. 2001. Table 4-1, p. 22.

[11] Greater Toronto Airports Authority. 2001. Briefing Paper #3: *Economic Impact Briefing Paper*. (Toronto: GTAA), p. 2.

[12] Briefing Paper #3: Economic Impact Briefing Paper, p. 3.

[13] Charles Davies. 2002. Taking a Flyer. *National Post Business Magazine*. December, pp. 68-74.

[14] National Occupational Classification occupations that were considered:

Aircraft Assemblers and Aircraft Assembly Inspectors
Dispatchers and Radio Operators
Transportation Managers
Pursers and Flight Attendants
Machining Tool Operators
Air Traffic Control and Related Occupations
Aircraft Instrument, Electrical and Avionics Mechanics, Technicians and Inspectors
Other Trades and Related Occupations
Facility Operation and Maintenance Managers
Contractors and Supervisors, Mechanic Trades
Air Pilots, Flight Engineers and Flying Instructors
Aerospace Engineers
Aircraft Mechanics and Aircraft Inspectors
Machinists and Machining and Tooling Inspectors
Tool and Die Makers
Mechanical Engineering Technologists and Technicians

[15] For instance: *A Human Resources Study of the Canadian Aviation Manufacturing and Maintenance Industry* makes the assumption in its pipeline that immigrants will fill no skilled positions over the long term.

[16] See: Michael Bloom and Michael Grant. 2001. Brain Gain: The Economic Benefits of Recognizing Learning and Learning Credentials in Canada. (Ottawa: The Conference Board of Canada).

[17] See for instance: Government of Canada. Industry Canada (Aerospace and Defence Branch). 1999. *Assessment of the Skills and Training Situation in the Canadian Aerospace Industry*. (Ottawa: Industry Canada).

[18] Zhoa, John, Doug Drew and T. Scott Murray. 2000. Brain Drain and Gain: The Migration of Knowledge Workers from and to Canada. In Statistics Canada, *Education Quarterly Review*. Cat. 81-003. 6 (3): Graph 11.

[19] Comparing Ontario to North Carolina, the after-tax wage difference for an engineer is about $15 thousand a year and for a senior executive it is about $70 thousand per year. Taxes account for only 8 per cent of the wage difference for the engineer and almost 40 per cent of the wage difference for the executive. See: Nadeau, Serge, Lori Whewell and Shane Williamson. Beyond the Headlines on the Brain Gain. *Isuma*. Spring 2000, Table 1, p. 156.

[20] Zhoa, Drew and Murray. *Brain Drain*, p. 17.

[21] Chris Wattie. 2003. Forces Sets Out to Entice Skilled Personnel Back. *National Post*. February 1, p. A2.

[22] For a good discussion of the weaknesses in apprenticeships in Canada see: Patrick Grady. 1997. *Apprenticeships in Canada. Issues and Problems*. Unpublished Discussion Paper.

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