



A Human Resources Study of the Canadian Aviation Manufacturing and Maintenance Industry

Executive Summary

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Executive Summary

Chapter 1 – Introduction

Rationale for the study

Concerned about the employment picture within the aviation manufacturing and maintenance industries, a group of industry stakeholders, led by the Canadian Aviation Maintenance Council (CAMC), the Air Transport Association of Canada (ATAC), the Aerospace Industries Association of Canada (AIAC), International Association of Machinists and Aerospace Workers (IAM&AW) and the Canadian Auto Workers (CAW) commissioned a detailed, forward looking study to predict human resource needs for the industry over the next 20 years.

The study was funded through a costshared contribution agreement between the industry and Human Resources Development Canada (HRDC).

With more than \$20 billion in annual sales and over 100,000 people directly engaged in aircraft manufacture and maintenance, it is imperative to the industry and to the Canadian economy to build a more comprehensive view of how to attract, train and retain the skilled personnel who sustain the industry and whose availability will help determine that industry's future in Canada.

Methodology

The study began with a review of available literature on the subject from industry and government sources in Canada, the US and the European Community then progressed to Data gathering and Analysis of information obtained directly from the associations and companies who comprise the industry.

Hundreds of individuals from students to shop floor employees to managers, educators and government officials were then interviewed to compile their views on the past, present and future of the industry.

The final stage consisted of five roundtables of industry participants from across Canada.

Preliminary findings were reviewed and courses of action presented and discussed.

Summary of Findings by Chapter

Chapter 2 – The Current and Future Business Environment

1. Traditionally and consistently, the global aviation industry is among the most cyclical of industrial sectors, strongly influenced by factors such as fuel prices, political events and national and international economic performance.
2. Beginning in the mid 1990s, business activity and employment levels in the industry were on an upward trend, peaking in 2001. These levels have subsequently decreased in the face of a cyclical slowdown of the global aerospace industry, not caused by but certainly compounded by the events of September 11, 2001.
3. Canada's share of this sector is approximately 6% of global revenues in the civilian aircraft manufacturing and maintenance marketplace. This participation rate is roughly double our nation's contribution to the world GDP, making this business a key contributor to the Canadian economy.
4. Although this cyclical slowdown is expected to continue into 2004, the market niches that are the focus of Canada's aviation industry (e.g. regional aircraft manufacture and maintenance) will likely be less affected than the overall industry.
5. Despite the current cyclical downturn, growth in global air passenger traffic is forecast to average a respectable 4-5% per year for the next 20 years. In passenger terms, this means a virtual doubling of passenger-miles flown. Cargo traffic is expected to grow at over 6% per year.
6. To accommodate this growth in demand and to replace aging aircraft, the world's aircraft fleet is expected to more than double, to 32,000+ aircraft over the same 18-year period. Regional aircraft – an area of specialization for Canada – will capture a disproportionately higher share of the fleet coming on-line.
7. Business aircraft production is forecast to recover from its current slump by 2004.
8. Military aviation markets will enjoy modest growth during the study period.
9. Canadian aviation **manufacturing** turnover will likely not return to 2001 levels until 2004, possibly even 2005. However, the prospects for steady growth beyond 2004/2005 are good.
10. Canadian aviation **maintenance** activity will grow more significantly and more steadily throughout the period, likely in the 3-5% per annum range, to deal with an expanding, more complex fleet, aging aircraft and mounting regulations.

11. Employment growth in manufacturing will be modest at best (0-2% growth per annum) Over the next 4-5 years. More robust growth (2-4 % per annum) can be expected beyond 2007.
12. In maintenance, employment growth will be stronger, averaging 3-4% per annum, with strong potential for sustained growth as high as 5% per annum possibly achieved as soon as 2005-06.
13. Investment by government and industry in Research and Development is, however, declining. This serious issue, if not corrected soon, will continue to have negative impacts on the sector, first, on manufacturing and then on maintenance. Achieving these growth projections will require that Canadian firms take aggressive action to respond to changing market and supply chain dynamics, continue to invest in new products and processes and sustain their global competitiveness. It will also require concerted action on the part of the governments to create and sustain general business and regulatory environment in Canada that promotes and facilitates industry growth.
14. Investment in Human Resources to date made by both government and industry in training new recruits and skills updating of the existing employee base are paying strong dividends as the country is developing a highly skilled, mobile workforce which is allowing the Canadian industry to capture an increasing share of the global market.
15. Equipped with this skilled workforce, Canada is well positioned to capture increased share of the global market, particularly in the United States.
16. Maintenance suppliers are introducing trend monitoring and predictive maintenance techniques that require new competencies in data capture, storage and analysis.
17. A more demanding regulatory environment has required firms to increase staff for maintenance administration.
18. Generally, increased skills are required to perform maintenance while more personnel are required to meet the increased workload.

Chapter 3 – The Impact of Technology

1. The aviation and aerospace sector is, arguably, the most technologically advanced industry in the world.
2. Future technology advances, in both manufacturing and maintenance will, for the most part, continue to be dramatic when compared to most, if not all other industrial sectors. However, such technology strides are par for the course in aviation and should be seen as evolutionary, not revolutionary.
3. Key technology trends include a growing use of non-metallic materials, increasing electrical and electronic ‘content’ of aircraft, and a greater degree of integration of complex aircraft systems.

4. Increasing sophistication and effectiveness of repair technologies is putting a growing emphasis on repair over replacement in the maintenance sector.
5. Technology advances are driving changes in specific knowledge and skill sets, taking emphasis away from some traditional trades. This is resulting in the emergence of shifts in required skills sets within traditional trades and the creation of new trades.
6. New and evolving 'process' technologies have perhaps the greatest potential to affect the nature of workforce knowledge and skills requirements over the study period.
7. Collectively, the workforce will need to master a widening range of specialized skills, such as: advanced production, repair, quality and businesses processes.
8. The manufacturing sub-sector will place a greater reliance on computer-based design, analysis and modeling.
9. The maintenance sub-sector will expand its use of diagnostics and predictive maintenance tools.
10. An increasing proportion of the workforce will access and manage data and information using a range of electronic devices including desktop personal computers, portable computers and an array of Personal Electronic Devices (PED).
11. The workforce will require a generic ability to interact with electronic devices and their operating systems and to visualize and manipulate data and information in electronic form, as well as requiring knowledge of specific computer applications in order to effectively accomplish designated tasks.
12. Changing supply chain dynamics and the growing complexity of business management in an increasingly global industry will place a premium on effective management skills, especially for small and medium-sized businesses.
13. The industry generally adjusts and accommodates technology change well. The pace is manageable due to the slow rate of absorption required to safely prove new technology first, prior to acceptance and implementation.
14. Advanced technologies play a critical role in competitiveness. Canada already possesses world-class technology skills but needs to increase its investment in proprietary technology if it intends to be a player. The first step should be the expansion of our R&D efforts.
15. Industry workforce must be continuously up-skilled in order to maintain a competitive edge.
16. This competitive edge should produce more extensive participation in the fully integrated global extended enterprises that are now emerging.

Chapter 4 – Workforce Profile

1. The total workforce (manufacturing and maintenance) is estimated at 80,000; 20% of workers are management and administration personnel while 80% are scientific and technical personnel.
2. In the scientific and technical occupations, manufacturing activity accounts for about two-thirds of the workforce, maintenance activity accounts for one-third.
3. The manufacturing and maintenance workforces share common characteristics but have distinct differences. Many occupational categories overlap both sub-sectors, as skill sets are complimentary. However, their relative proportions differ markedly.
4. Scientific workers are predominantly employed in the manufacturing sector (90%). They account for over 25% of the total manufacturing workforce.
5. Assemblers are the single biggest occupational category in manufacturing, accounting for 30% of the total manufacturing sub-sector workforce.
6. Aircraft maintenance engineers (AME) are almost exclusively employed in maintenance. They account for almost 40% of the total maintenance sub-sector workforce, and account for 12% of the entire maintenance and manufacturing workforce.
7. Formal education levels in the industry tend to be higher than those of the economy as a whole.
8. Much of the industry's training activity is mandated by regulation. In maintenance, training is highly aviation-focused; in manufacturing a higher proportion of training is not specifically focused on aviation but, rather, on specific trades.
9. Scientific occupations include engineers, metallurgists and computer scientists. They drive new product development, process and production design, quality control and a variety of other processes. These occupations demand a university degree at either the undergraduate or graduate level.
10. Technical and trade occupations encompass a wide variety of production and process functions on the shop floors of manufacturing and maintenance organizations. There is no single training requirement for these occupations. In general, a high school education is a minimum requirement followed by a mix of structured training at the college level, an apprenticeship program, and/or on-the-job training. Certification to Canadian Aviation Maintenance Council (CAMC) standards is increasing in importance as a prerequisite for employment.

11. The AME is a Transport Canada-licensed designation, achieved through completion of an approved training program, required industry experience, and an examination process. Three categories of license exist, with different experience requirements and privileges.
12. A short training 'pipeline', provincial/local labour pools, characterize manufacturing operations. In times of peak demand for assembly workers, previously laid off staff can be recalled, training programs can be ramped up rapidly or compressed, and workers drawn from other local industry sectors by attractive salary and benefits packages. The manufacturing sub-sector has been relatively successful at managing labour supply in periods of both growth and decline.
13. Maintenance is characterized by a long training 'pipeline', highly skilled shop floor workers and a national labour pool. Maintenance careers often progress from initial employment in General Aviation, to larger maintenance organizations, and eventually to a large national air carrier. This is a less flexible environment within which skills shortages are more difficult to manage.
14. The age profile of the industry is comparable to the rest of the Canadian economy. In some key occupations the workforce, however, is considerably older than the industry average.
15. Rising retirement rates will have a significant impact within 5-6 years.
16. The skilled trades tend to be among the older groups and it will take much longer than average to train their replacements. Initially being able to attract younger people to these trades will be a problem in itself.
17. Industry is under represented by women and aboriginal groups compared to the national population profile.
18. The demographic profile is not uniform across the regions. Ontario and BC have a significantly older demographic. Atlantic Canada is of the least concern demographically.
19. Industry does not have a retention problem; people who join the industry tend to stay.
20. The broad trade demographic is not uniform. Some occupations are in a more dire state than others. Machinist, Tool and Die, Millwrights, Non-Destructive Inspection, AME S and Structures Technicians, Maintenance Inspectors and Quality Assurance/Control are occupations with serious age demographic problems.

Chapter 5 – Current and Forecast Skill Demands

1. The labour market for aviation scientific and technical workers is global, and overlaps other advanced technology sectors. Not only do Canadian aviation manufacturing and maintenance firms compete globally for business, they compete globally for the critical human resources that enable them to run and grow their businesses.
2. Until mid-2001, industry firms reported a shortage of workers in a number of scientific and technical occupations. AMEs, machinists, CNC programmers and analysts, tool and die makers, engineers and engineering technologists were among the occupations with the most acute shortages.
3. The industry slowdown relieved some of these shortages for the short term, but shortages have already emerged again, particularly for skilled trades common to other industries (e.g. tool and die makers, millwrights), and in the maintenance sub-sector.
4. Over the long-term, employment growth and attrition (primarily forecast retirements) modeling point to a large and sustained requirement for new entrants to the industry. By 2016, only 40% of the current manufacturing workforce, and less than 1/3 of current AMEs will be on the job.
5. Even at modest manufacturing industry growth rates (0-2% annual employment growth), the number of new entries will need to increase every year, from between 2,000 and 2,500 in 2003, to a peak of nearly 4,000 new entrants in 2016. At a 5% annual employment growth rate, the new entry requirement more than doubles. In this scenario, the manufacturing sub-sector would have to recruit 4,000 new workers in 2003, and over 7,500 in 2016.
6. At the low end of the maintenance sub-sector employment growth projections (2% per annum), annual new entry requirements for non-AME technicians increase only slightly, from 1,600 in 2003, to 1,800 in 2016. To achieve 5% annual employment growth, the annual new entry requirement accelerates from 2,100 in 2003 to 3,500 in 2016.
7. The 2% annual employment growth rate in the maintenance sub-sector requires nearly 900 new AMEs in 2003. Under this growth scenario, the annual requirement for new AMEs grows steadily to a peak of 1,100 in the 2009-2012 period, and then decreases to about 975 per year until 2016. At 5% annual employment growth, the annual new AME requirement grows steadily from just under 1,000 in 2003 to 1,700 in 2016.
8. Historically, entrants to the Canadian aviation industry came from both domestic and foreign sources of supply. Current trends indicate that it will be increasingly difficult to recruit workers to the Canadian aviation industry from its traditional foreign sources, and that domestic sources will become increasingly important. The out-

put from Canadian educational institutions, and the ability of these institutions to meet the demands of the industry will be critical to future employment growth.

9. Current capacity of relevant aviation programs at Canadian education institutions is insufficient to meet new entry requirements of the aviation industry - even at a modest projected 2% annual growth rate.
 - In the manufacturing sub-sector, past experience has shown that the industry can manage demand peaks with existing capacity and instruments at this level of growth – although modest ramping up of educational institutional capacity could be useful. At 5% annual employment growth, the current system would be unlikely to satisfy demand for engineers and skilled shop floor workers.
 - In the maintenance sub-sector, the situation is even more troubling. Even at 2% annual growth, a doubling of college program capacity is required by 2016. However, this increase in capacity, on its own, would not mitigate a projected AME shortage through 2005. The 5% growth scenario would see demand far outstrip supply, even with a doubling of capacity by 2016. Unless significant and fundamental changes occur now, shortages of AMEs and non-AME technicians will be widespread across the sub-sector, throughout the study period.
10. Beyond the specific technical skills needed to perform their respective duties, there is almost a universal recognition of the need for the workforce to develop stronger ‘employability skills’. This refers to a group of fundamental communication, problem solving, leadership and teamwork competencies essential for productive functioning in the current and evolving workplace.
11. There is a lack of university programs serving the industry, and, as it stands, most colleges are operating near full capacity.
12. In the longer term, meeting the demand for skilled trades, engineers and scientific personnel, as opposed to strictly licensing AMEs, will continue to be an issue.
13. Ensuring that educational institutions are aware of the industry’s needs and helping those institutions put themselves in a position to fulfill them are crucial and immediate initiatives.
14. After technical competency, the most important skill shortage will be for people with “crossover” skills. This includes engineers who understand business and information technology, business graduates who have engineering or computer knowledge, and technical and scientific employees who have training in strategic decision making in business.
15. Supply chain integration presents strong challenges to management. Design quality control and risk sharing responsibilities are pushed down the supply chain to tier 2 and tier 3 companies broadening the requirement for more and more skilled workers across both sub sectors.

Chapter 6 – Training, HR Development and Retention

1. The Canadian aviation industry is served by a wide variety of training institutions and well-established training practices within the industry.
2. Industry employment growth projections suggest current educational institution capacity is insufficient to meet industry demands in the coming years.
3. With expanded capacity, the challenge will shift to recruitment, as aviation must compete for the interests of youth with other advanced technology sectors like telecommunications and information technology.
4. With skilled trades requiring up to four years of combined formal and on-the-job training, cyclical variations in industry business volumes and employment levels have historically caused problems in coordinating the supply and demand of appropriately trained and experienced personnel across more than one business cycle.
5. This challenge of balancing supply and demand is made more difficult by the absence of timely and reliable, sector-specific labour market information.
6. Training time lags also create challenges for timely development of training programs that respond to changing technology and business trends.
7. There is considerable room for improvement in communication and cooperation between industry, educational institutions, and government. Clear ‘alignment’ of objectives, needs, expectations, strategies, relationships and responsibilities must be achieved.
8. Notwithstanding a number of exemplary training and development approaches and practices employed by individual industry firms and organizations, within industry there is consensus that industry training efforts and programs must be improved and expanded.
9. Exemplary practices in Canada and in other countries provide useful ideas and models from which the industry can draw. Better information access and sharing on these ideas and models is an urgent requirement.
10. With changing immigration flows, and the potential to recruit trained workers from non-traditional foreign sources, effective Prior Learning Assessment and Recognition (PLAR) programs that enable qualified immigrants to quickly enter the workforce are an essential tool. The industry will be more dependent on immigration and foreign workers, mainly from Asia and the Pacific Rim, as the US and UK are no longer significant providers of workers.

11. The industry must be prepared to present its concerns to government to ensure that valuable sources of skilled personnel can be recognized and employed without prohibitive cost.
12. CAMC occupational standards and training curricula, youth initiatives and other related activities have had a positive impact on the quality and quantity of skilled workers in the maintenance sub-sector. CAMC serves as an effective communication platform involving business, labour and educational institutions, enabling the maintenance sub-sector to share information and deal with issues that could not be addressed on an individual stakeholder basis.
13. Wages and working conditions are not an overall industry sector retention issue. There are, however, retention issues within the sector, as smaller firms, particularly those in the General Aviation sub-sector and those located in remote locations, have difficulty competing for workers with large firms. Should Air Canada's maintenance subsidiary experience significant success, these retention issues among smaller firms may intensify.
14. Similar problems are faced by the US, with little infrastructure to deal with the problems.
15. The Canadian industry is seen as a recruiting target by the much larger US industry. This poses a very significant threat to Canadian industry. While the US industry is in a deeper "trough" than Canada's, it is a situation that will not last. As the US industry emerges from its downturn, there is every possibility that Canadian workers will become prime recruiting targets, much the same way that a large proportion of Canadian nurses were aggressively recruited to work in the US. By definition, our workforce is mobile. The attractive American dollar and the potential for more exotic work locations present the clear danger of a major exodus of skilled workers.
16. In maintenance, the combined result of accelerating attrition rates, protracted industry growth and a shrinking labour pool will result in skilled worker shortages.
17. There needs to be better industry and labour market systems.
18. Improved information, co-op and internship programs for youth are required to develop a highly skilled "next generation" of workers.
19. Improved recognition of skills developed on the job or other experiences is needed.
20. An easier transfer of educational credits among jurisdictions would be beneficial.

Chapter 7 – Next Steps

Based on the work done in previous chapters of this study, several themes emerged which point to the necessity of increased multilateral co-operation in the sharing of information and provision of resources to avoid labour shortages in the manufacturing and maintenance sectors.

While forecasting human resource requirements will, almost by industry definition, always be difficult within for the aviation sector, there is the overriding conclusion that all trend lines point to the recovery then solid growth in air traffic in the near future. Such growth requires that sustained and co-coordinated action be undertaken by all stakeholders in the industry as soon as practicable during this “breather” afforded by the current economic downturn.

Recommendations contained in this report are meant as discussion points or signposts for further investigations and do not, in any way, constitute an exhaustive list of possible solutions to the current and impending human resource challenges within the industry.

Theme One – Industry Growth Will Create Demand

Notwithstanding the effects of September 11, 2001 and the general economic downturn which had started earlier in the year, increased air transport of people and goods will continue to be a feature of and a contributor to global economic expansion. Increased air traffic always translates to increased manufacturing and maintenance activity, with the only question being which country achieves what percentage of that activity.

Manufacturing will see flat to very modest overall growth in Canada over the next 3 to 4 years. After that point, growth will accelerate. Although for lower skilled manufacturing personnel, particularly assemblers, there are mechanisms for managing worker shortages, no such vehicles exist for higher skilled occupations, particularly in scientific, machinist and managerial positions where shortages exist now.

While not part of this study, it is evident that a key to the success of the manufacturing sector, as it is in most other sectors, is the rate of investment in R&D – a rate which, alarmingly, seems to be declining in Canada.

Maintenance may see more than 5% growth in activity over the study period, putting further strain on an educational system which, already, is close to capacity.

Theme Two – An Aging Workforce Will Create Demand

In addition to increased labour requirements resulting from industry growth, the “baby boomer” demographic phenomenon will see steadily growing numbers of skilled workers retiring. While this trend is being felt now, its full-blown effect looms within 5 to 6 years.

Within this study period, 60 to 70% of the industry's current employees will have retired, representing a huge challenge to replace them with younger, equally qualified personnel.

Moreover, traditional replacement vehicles (immigration and DND) will not compensate for the losses. Also, the degree of skill sophistication will be much higher as manufacturing and maintenance become more complex and more technology-driven. Finally, Air Canada's announced intention to significantly expand its maintenance arm will put pressure on smaller maintenance firms competing in the same labour pool.

The first area to be affected will likely be the General Aviation sector, particularly those firms in remote locations which have difficulty in attracting and retaining workers. Government can and should help in the provision of an adequate supply of skilled maintenance workers in the North and elsewhere to help ensure Canadians are well and safely served by the aviation sector in those communities.

Another help – but not a total solution - would be strengthening a Prior Learning Assessment and Recognition program which would allow immigrants to enter the Canadian aviation sector more easily.

Theme Three – Meeting The Demand Through Recruiting and Training

Industry should redouble its efforts to ensure that current employees, in both manufacturing and maintenance, have access to the training programs required to keep them as current as possible on the increasingly complex tools, techniques and processes of their respective trades.

Ensuring a robust educational infrastructure is in place faces significant hurdles which should be addressed now if the industry is to be in a position to satisfy its labour requirements. These hurdles include:

- **Lead Time** – Community Colleges and, to a greater extent, universities require extensive lead times to decide, design, develop, staff and promote aviation-related specialties. Together, industry, education and government must be active now in identifying, funding and developing programs.
- **Recruitment** - Recruitment is becoming an issue as the aviation sector must now compete with other industrial sectors such as information technology which did not even exist a generation ago. Industry should be intensifying its efforts to attract young people to it by emphasizing the importance, high degree of sophistication and rewards associated with a career in aviation.
- **Costs** – The start up costs for creating or expanding aviation-related programs are very high, perhaps higher than for any other discipline. Industry and government have to find ways to fund such expansion and should look to such instruments as the tax structure to find innovative ways to do so.

- Provincial Focus of Education – In the maintenance sector in particular, the provincial focus on education is, by definition, somewhat at odds with the goal of building a national labour pool. Greater coordination, likely through the federal government and CAMC is required to ensure that provinces receive the appropriate incentive and support for expanding their aviation-related training programs.

Theme Four – Enhancing Flexibility

In addition to upgrading the skill levels of the existing workforce and establishing the most appropriate size and depth of our educational programs for new entrants, the industry can undertake other initiatives to become more agile and more accurate in forecasting and accommodating shortages and surpluses within its workforces.

One such initiative could be greater cross-industry co-operation, particularly with the auto industry where many similar skill sets are required at the manufacturing level. Government support for such aspects as relocation should be examined.

On the maintenance side, CAMC can play a more active and “real time” role in working with educational institutions to soften the rigidity of structured training by pinpointing and covering interim or short term skills gaps.

Theme Five – Providing the Right Information at the Right Time

The key to successful human resource planning over time is the quality and availability of information.

While this study uncovered significant sources of information, there needs to be more in-depth data gathering and analysis, preferably on an annual basis so that industry and funding sources have the best information before them to support their decision-making.

The Manufacturing sector already has several well-established data sources. In the maintenance area, more and new work needs to be done to, for example, determine the optimal mix and location of AMEs and unlicensed technicians within the General Aviation sector, to identify skill shortages, to track the movement of graduates of structured training programs and so on.

CAMC should expand their role in this area and in regards to becoming a stronger clearinghouse of job data and applicant resumes.

Theme Six – Communicating, Planning and Acting Together

Sharing new and more extensive information is as critical as acquiring such data.

More crucial still is using that information as the sound basis for planning and action by all stakeholders in the industry to achieve a truly national alignment of visions, goals, strategies and programs which are of mutual benefit to the industry, to the country and to the new entrants to the aviation sector.