

Strategies for attracting and retaining a Skilled Workforce in a Cyclical Industry

Prepared for
Aerospace Review Secretariat

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Strategies for Attracting and Retaining a Skilled Workforce in a Cyclical Industry

A Study Prepared for
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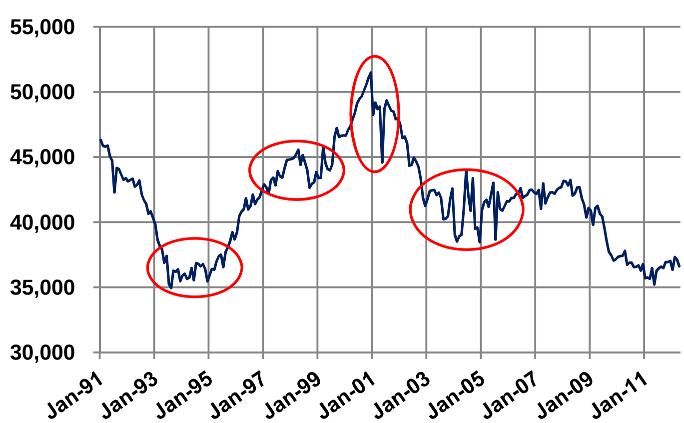
Executive Summary:

This report describes the cyclical nature of the Canadian aerospace and space industries and the challenges that cyclicality poses to retaining and replenishing the industries' human capital. The report also describes human resources management initiatives and strategies that might assist the industries in attracting and retaining skilled and experienced workers. The report is based on a literature review, a review of statistical sources, and eight key informant interviews.

Causes and Implications of Cyclicality

Data for the aerospace manufacturing industry shows that the industry is subject to significant short-term and long-term cycles in its human resources needs.

Monthly Employment
Aerospace Product and Parts Manufacturing (NAICS 3364)
January 1991 to April 2012
Statistics Canada, CANSIM (Table No. 281-0023)



From 1995 to 2000, employment in the industry increased by more than 35%. Two-thirds of this employment gain was lost between 2000 and 2004. After 2008, the industry then experienced further losses, such that virtually all of the employment growth achieved since 1995 was lost. Employment swings of this magnitude impose especially significant challenges for preserving the industry's human capital base. The depletion of the human capital base during downturns limits the industry's capacity to respond to subsequent opportunities for growth.

Causes of Cyclicality:

The principal cause of short-term fluctuations in human resources requirements is instability that is inherent in the scheduling of manufacturing. These fluctuations primarily affect hourly-paid employees, i.e., semi-skilled materials handlers and skilled tradespersons. However, technicians and technologists, engineering staff and project managers may also be affected. The data suggest that this short-term variability in employment has *increased* in the last decade.

Long-term cycles in employment stem from three causes. The first of these, and the most important, is fluctuations in capital spending in the civil and military aviation markets. The second is fluctuations in R&D spending within the aerospace and space industries. Because most R&D is financed from cash-flow, fluctuations in R&D spending are closely related to changes in capital spending by end-users. The third source of long-term cyclicality is fluctuations in government support. There are a number of dimensions to government support. Government support is critically important to the aerospace and space industries. Internationally, the industries derive approximately one quarter of their direct revenues from government sources. Support delivered through the tax system would increase this proportion. Long-term cyclicality has more serious implications than short-term cyclicality because it affects virtually all classes of employees, including highly trained and specialized engineering and project management employees.

Consequences of Cyclicality:

A distinguishing characteristic of both the aerospace and space industries is their reliance on high levels of industry-specific and firm-specific human capital. This type of human capital is additional to general human capital which is acquired through formal training and education. Industry-specific and firm-specific human capital can only by created by the aerospace and space industries. The dispersion of this human capital during periods of cyclical downturns represents a serious loss. This loss is reflected in the industries' chronic challenges in recruiting new employees who have industry-relevant experience. With rare exceptions, the industries' challenge is not to find persons with the required university degrees or other training. Rather the challenge is to find persons with industry-relevant experience. Difficulties in meeting the need to retain or replenish the industry's pool of industry-specific and firm-specific human capital have two serious implications for the aerospace and space industries. The first is to constrain the ability of the industries to respond to improved business conditions. The second is to put at risk the ability of Canadian operations to secure R&D mandates. More subtle, but important consequences of cyclicality are the deterrent effect of down-sizing on early career and training decisions of undergraduates. Cycles of down-sizing also adversely affects immigration intentions.

Employment cyclicality dampens growth in one of Canada's leading knowledge-intensive industries. Strategies to mitigate the adverse effects of cyclicality therefore are among the aerospace and space industries' most urgent human resources challenges.

Mitigating the Adverse Effects of Cyclicality

A. Retention Strategies at the Firm Level:

Relative Remuneration: Among the most common retention strategies is higher remuneration to compensate for the risks associated with potential employment instability. The aerospace and space industries have historically been high wage industries. However, data on industry remuneration trends suggest (but do not conclusively prove) that the relative position of the aerospace and space industries may need attention. In particular, the aerospace and space industries need to be aware of how their compensation benchmarks may have deteriorated relative to other *knowledge-intensive* industries which compete for the same human capital pool.

Supplementary Unemployment Benefit (SUB) plans have a long history, especially in the manufacturing sector. These plans apply chiefly to hourly-paid production workers, though some companies may extend SUB benefits to other employees. SUB plans mitigate income loss during short-term lay-offs. These plans thereby discourage workers on short-term lay-off from seeking permanent employment elsewhere. The plans may be particularly important in assisting companies to retain experienced production workers and skilled tradespersons. As with any insurance scheme, there are scale issues that make such plans less feasible for small and medium-sized employers owing to the reduced ability to pool risk. There may be value, therefore, in exploring a multi-employer approach to the provision of SUB benefits.

Work Sharing is operated under the aegis of the *Employment Insurance Act*. The objective of Work Sharing is to enable employers to avoid lay-offs when there is an expectation that business conditions will turn around. Under the current rules, Work-Sharing can extend for up to 54 weeks. In the past few years approximately 60% of Work-Sharing plans were *outside* the manufacturing sector. Almost 10% of recent plans operated in the professional, scientific and technical services industry. Among the more significant, recent examples of Work-Sharing was the plan instituted by ArcelorMittal Dofasco. The company successfully used Work-Sharing to preserve its skilled work force during the 2008-09 downturn.

Training and Short-Term Unemployment: Providing training to workers while they are on short-term lay-off could increase retention. However, current EI policy does not easily accommodate a linkage between training and short-term unemployment. It is important to avoid creating an incentive to lay workers off for the purpose of accessing EI benefits to support them during training. At the same time, there is no real expectation that large numbers of workers on short-term lay-off will cast aside the likelihood of recall and undertake a rigorous search for alternative, permanent employment. Between these two perspectives there should be a middle ground that would accommodate the needs of the EI system while also not impeding the opportunity to use periods of short-term lay-off to strengthen skills, especially if this training is designed and financed by employers.

B. Strategies to Replenish Human Capital

Entry-Level Engineering Positions: Many companies, especially smaller companies, have a threshold of five years of industry-relevant experience for new engineering hires. These experience thresholds reduce the entry-level jobs below the number required to support long-run human resources needs. Today's systemic shortage of engineers with industry-relevant experience is the result of insufficient intake of junior engineers in the past. If there are too few 'junior engineers' hired today, it is a virtual certainty that in five years times, there will continue to be a chronic shortage of engineers industry-relevant experience. The under-supply of experienced engineers can only be addressed if companies act in concert to increase their intake of 'junior engineers'. A consensus to implement such a strategy will create a significant human resources advantage. There may be scope for governments to promote the development of this competitive advantage by incenting the recruitment of 'junior engineers'.

Co-op and Internship Programs: Participation in co-op and internship programs contributes to the human capital pool by strengthening the attachment of motivated students to careers in aerospace and space engineering. Co-op and internship experience at least partially bridges the experience gap that is so serious a human resources challenge. Many aerospace and space companies currently participate in co-op and internship programs. However, there are no sector-wide data on this participation. Hence there is no statistical basis on which to gauge the sufficiency of this participation. In the United States, the Aerospace Industries Association tracks company participation in co-op and internship programs and facilitates placements through its "Launch into Aerospace" web site. Similar tracking and facilitation would be advantageous in Canada.

Shared Apprenticeships: Companies report ongoing challenges in recruiting and retaining skilled tradespersons. Many companies have been reluctant to invest in apprenticeship training, owing to high rates of attrition and fear of human resources investment being 'poached' by other companies and other industries. For this reason, many companies in the aerospace and space industries prefer to recruit tradespersons who have already completed their apprenticeship and have industry experience. The difficulty with this strategy is that the supply of experienced tradespersons is not keeping pace with demographically driven replacement demand. Companies need to explore mechanisms for training apprentices without taking on the full risk of losing that investment. A noteworthy experiment that has addressed many of the barriers to hiring apprentices is the Hamilton Skilled Trade Apprenticeship Consortium (HSTAC). The essence of the HSTAC model is that apprentices are sponsored by HSTAC, not by an individual employer. Apprentices complete their in-school training under HSTAC auspices and supervision. The apprentices are then assigned to work for a participating employer. However, that employer does not assume any long-term obligations. In the event of a temporary or permanent lay-off, the apprentice can be assigned to another employer. At any time during the apprenticeship period, a participating employer has the option to formally hire the apprentice and transfer the apprentice's sponsorship from HSTAC to the employer. The consortium approach has demonstrated its effectiveness in reducing the risk to employers of losing their early stage investment in an apprentice. The aerospace and space industries should explore the potential applicability of the consortium approach to apprenticeship.

Immigration: Immigration makes an important long-run contribution to the pool of skilled workers. Census data show that, in 2006, almost 40% of aerospace engineers were immigrants to Canada. While immigration increases the pool of workers with the requisite formal educational qualifications, many of these immigrant professionals lack the industry experience that is so central to the needs of Canadian companies. In some respects, therefore, immigrant professionals are in a position that is similar to that of recent university graduates. They both have high levels of 'general human capital' but lack the 'firm-specific' or 'industry-specific' human capital that is so central to the skill needs of companies in the aerospace and space industries. Bridging and internship programs can narrow this gap.

Some employers use the Temporary Foreign Worker (TFW) program to meet immediate requirements. However, the nature of skills requirements in the aerospace and space industries often makes the TFW program a poor fit for the industries needs. Most technology is proprietary. Companies require workers who have experience in that technology. The learning curve often does not align with the TFW program. However, global companies may be able to use the TWF program to achieve internal transfers thereby mitigating the learning curve barrier. Perhaps more relevant are Provincial Nominee Programs that enable companies to 'fast track' internationally recruited candidates for admission as permanent residents.

C. Strategies to Preserve Human Capital at the Sector Level

The PARC Experiment: The *Partage Automatisé des Ressources dans les Communautés* (PARC) is being developed for the aerospace and space industries in Quebec by JMJ Aéronanautique. The initiative will receive $1.2 million in funding from the Quebec government. The foundation of PARC will be a real-time database of human resources in Quebec's aerospace and space industries. Companies that participate in PARC will contribute human resources information on their employees. A key feature of PARC is its proposed mechanism for holding onto workers affected by temporary lay-offs. Employees who are laid off will retain their benefits and their employment relationship with their employer-of-record, including the right to be recalled to work. However, these workers will be available for assignment to other aerospace companies, usually, but not necessarily, in the same supply chain as the employer-of-record. The 'assignment companies' will pay the wages of the assigned workers plus an amount that will reimburse the employer-of-record for the ongoing costs of maintaining benefits. The 'assignment companies' will not take on any of the other obligations or liabilities, *e.g*., severance or notice obligations. Workers who benefit from the PARC scheme must agree in advance to return to their 'employer-of-record' if requested to do so during a specified recall period. The PARC model offers advantages to all stakeholders. The 'assignment companies' will benefit from access to a pool of workers with industry-relevant experience and training. The assigned workers will benefit from continued employment and a broadening of their experience. The employer-of-record will benefit from the ability to recall workers when business conditions permit. The sector as a whole will benefit from the retention of valuable human capital. The PARC model has been endorsed by major aerospace and space employers in Quebec. The PARC model should be monitored by the aerospace and space industries in other regions to determine its potential applicability to their circumstances.

Industry-Recognized Certifications: Industry-recognized certifications contribute both to raising skill levels and to strengthening the attachment of workers to a sector. Workers with industry-recognized certifications are more likely to seek re-employment in that sector when they are laid off and also more likely to return to that sector when business conditions lead to an improvement in employment conditions. Through the Canadian Council for Aviation and Aerospace, the industry has invested considerable resources in developing industry-recognized occupational standards and certifications. Currently there are 26 sets of standards which are also recognized by Transport Canada. The recent termination of core funding for sector councils raises questions about the future of CCAA's investment in occupational standards and industry certifications. The industry should explore various options to ensure that this investment is not lost.

Tracking Human Resources Trends at the Industry Level: There is a serious deficit in the basic data needed for human resources planning and the industry level in the aerospace and space industries. The most recent industry-based survey of human resources dates from 2001 and has been overtaken by changes in the industry. Outside of Quebec, the basic data to support industry-level human resources analysis and planning are not available. This should be a matter of concern to both governments and industry.

On their own, none of the strategies canvassed in this report can overcome the adverse effects of cyclicality. However, a portfolio of these initiatives may hold out a realistic promise of mitigating the worst effects of cyclicality.

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Introduction:

The objectives of this study, as provided in the Statement of Work, are threefold:

1) to describe the cyclical nature of the Canadian aerospace/space industry from the period 1996-2011,
2) to describe any challenges faced by the aerospace/space industry in attracting and retaining professionals and tradespersons owing to this cyclicality, including any specific dimensions of this challenge experienced by small and medium sized enterprises,[1]
3) to identify strategies to assist the aerospace/space industry in attracting and retaining talented and skilled human capital over the short-term (5 years), medium-term (10 years) and long-term (20 years).

The methodology to support these research objectives encompassed a literature review, a review of statistical sources, and eight key informant interviews.

The statement of work defines the aerospace industry as comprising:

- commercial aerospace,
- military aerospace, and
- maintenance, repair and overhaul (MRO) services for aircraft.

Simulator technology is included in the aerospace sector. Airlines (except for their MRO divisions) are not included. Nor are airport operations.

The space industry encompasses the development, deployment and operation of space assets and the processing of raw data received from space-based systems.

Statistical Sources:

NAICS Classification

Figure No. 1 shows the correspondence between the definition of the aerospace industry mandated for this study and the relevant classifications in the North American Industry Classification System (NAICS). Industry data are normally published at the 2,3 and 4-digit levels of disaggregation. Beyond the four-digit classification level, statistical unreliability increases significantly. As well, Statistics Canada is often obliged to suppress such data to maintain the confidentiality of survey respondents.

[1] Small and medium size enterprises were defined in the statement of work as companies employing 500 or fewer employees.

Figure No. 1
Correspondence between Aerospace Industry
And North American Industry Classification System (NAICS)

NAICS	Description	Comment
3333	Commercial and service industry machinery manufacturing	includes flight simulator manufacturing, but also encompasses significant segments of manufacturing unrelated to aerospace and space
3342	Communications and equipment manufacturing	includes 33422 - see below
33422	Radio and television broadcast and wireless communications equipment manufacturing	includes space satellites, communications equipment manufacturing, but also encompasses significant segments of manufacturing unrelated to aerospace and space
3345	Navigational, measuring, medical and control instruments manufacturing	includes 33451 - see below
33451	Navigational and guidance manufacturers	includes various categories of aerospace component manufacturing, but also some systems unrelated to aerospace and space
3364	Aerospace product and parts manufacturing	strong correspondence with aerospace and space industries, but combines these industries
4881	Support activities for air transportation	primarily airport operations, but also includes specialized aircraft repair and maintenance. See 48819 below
48819	Other support activities for air transportation	primarily specialized aircraft repair, maintenance, testing and inspection
5413	Architectural, engineering and related services	includes 45133 - see below
54133	Engineering services	includes engineering consulting related to aerospace and space
5417	Scientific research and development services	includes 54171 - see below
54171	Research and development in the physical, engineering and life sciences	includes contract engineering R&D

As can be seen from Figure No. 1, the only four-digit NAICS classification that has a close correspondence with the definition mandated for this study is ‘3364 - Aerospace product and parts manufacturing'. This industry classification accounts for approximately two-thirds of the aerospace sector's estimated 2009 employment.[2]

The space industry poses distinct analytical challenges. Employment in the space industry is 'buried' in other statistically defined industries. For example, '33422 - Radio and television broadcast and wireless communications equipment manufacturing' includes space satellites but also other unrelated types of manufacturing. Similarly, it is not possible to distinguish space industry employment from aerospace industry employment in '3364 - Aerospace product and parts manufacturing'.

An additional consideration when analyzing the supply of specialized human resources is the role of the consulting engineering industry. It is not feasible to measure the actual magnitude of this industry's contribution to the aerospace and space industries. However, employment data suggest that the contribution may be significant. Data from the 2006 Census indicate that there were approximately 4,200 aerospace engineers directly employed in the Canadian aerospace and space industries. At the same time, the Canadian consulting engineering industry employed 770 aerospace engineers. In labour market terms, the consulting engineering industry is an important 'buffer'. During down cycles in the aerospace and space industries, the consulting industry absorbs specialized resources when these persons cannot be fully engaged by the aerospace and space industry. During the up-phase of the cycle, the consulting sector is both a potential source for recruitment and a source of supply to meet short to medium-term needs for specialized human resources. Given the smaller size of the aerospace industry in Canada, the 'buffer' role of the consulting engineering industry may be more important than in the U.S. and the E.U.

Occupational Data:

All occupational estimates are based on the National Occupational Classification system (NOC) that is maintained by Human Resources and Skills Development Canada (HRSDC). For some occupations, notably those in Information and Communications Technology, the NOC definitions are significantly more aggregated than industry-based job descriptions. For example, the NOC agglomerates all computer programmers, irrespective of the programming environment in which they operate or their level of experience. Similar challenges arise in engineering and technical occupations where the NOC system does not distinguish levels of experience or particular fields of expertise within broadly defined disciplines. For other occupations, notably the skilled trades, the NOC definitions largely correspond to industry practice.

The benchmark for estimating the occupational distribution of employment in the aerospace industry is the 2006 Census. Stokes Economic Consulting Inc. has provided additional estimates of historic

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[2] Deloitte, *Profile of the Canadian Aerospace Industry: Analysis of the 2009 AIAC Annual Survey*, AIAC Phase I Report, October 2010. Note continued on next page.

	Low Bound Estimate	Central Estimate	Upper Bound Estimate
Engineering & Scientific Staff	8,928	12,770	16,612
Production Staff	19,271	37,102	52,509
Technicians and/or Technologists	3,862	8,559	14,477
All others	11,220	19,201	24,154
Industry (Total)	47,785	78,529	109,273

employment by occupation using the firm's proprietary model, the Provincial Occupational Modelling System (POMS).[3] POMS uses co-efficients to translate changes in industry output into changes in employment by occupation.

Other Statistical Sources:

Four industry sources provide additional information on employment and output in the aerospace industry:

- On behalf of the Aerospace Industries Association of Canada, Deloitte administers regular surveys of the aerospace and space industries. These surveys include estimates of employment.[4]
- The Canadian Space Agency publishes *The State of the Canadian Space Sector*. Data are available to 1996.
- The Canadian Council for Aviation and Aerospace (formerly the Canadian Aviation Maintenance Council) published a labour market study in 2002 based, in part, on a survey of human resources in the industry in 2001.[5]
- The Centre d'adaptation de la main-d'œuvre aérospatiale au Québec (CAMAQ) has developed estimates and projections for industry employment in Quebec.[6]

Structure of Report:

This report is divided into two parts. Part I examines the nature of employment cyclicality in the aerospace industry. Part II discussed human resources management strategies, at the enterprise level, the regional level and the sectoral level which mitigate the effects of cyclicality.

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[3] The POMS model is described at: www.workforceoutlooks.ca/index.html. Data for the aerospace industry were supplied to Prism Economics and Analysis which used these data to develop employment forecasts for a related study commissioned by the Aerospace Review Secretariat.

[4] Deloitte, *Profile of the Canadian Aerospace Industry: Analysis of the 2009 AIAC Annual Survey*, AIAC Phase I Report, October 2010

[5] Canadian Aviation Maintenance Council (CAMC), *Study of the Canadian Aviation Manufacturing and Maintenance Industry*, November 2002

[6] CAMAQ, *Recensement des emplois au 1er janvier 2009 et 2010 et prévisions au 1er janvier 2011 - industrie aérospatiale au Québec*, avril 2010

CAMAQ, *Recensement des besoins de main-d'œuvre industries du transport aérien et de l'entretien a'aéronefs au Québec 2010 – 2012*, avril 2010

Part I

Cyclicality in the Aerospace and Space Industries

Short-Term and Long-Term Cycles:

Figure No. 2 shows monthly employment in '3364 - Aerospace product and parts manufacturing'. As noted earlier, this industry classification accounts for the majority of employment in the aerospace and space industries. In light of this industry's size, the employment patterns NAICS 3364 will be broadly reflective of patterns across the aerospace and space industries, though timing and causes may differ.

Figure No. 2
Monthly Employment
Aerospace Product and Parts Manufacturing (NAICS 3364)
January 1991 to April 2012
Statistics Canada, CANSIM (Table No. 281-0023)

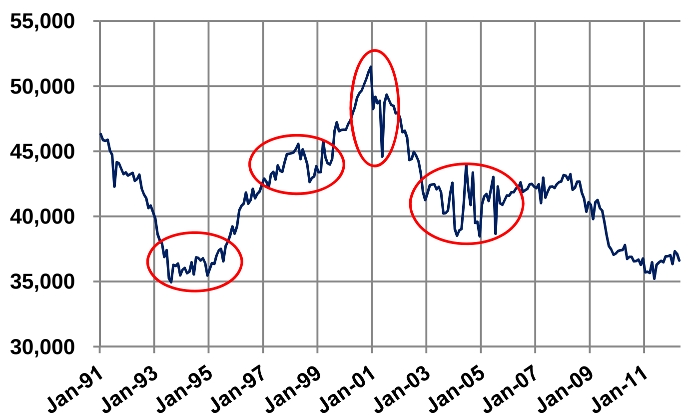


Figure No. 2 shows two distinct types of cyclicality - short-term and long-term. The impact of long-term cycles is particularly apparent. From 1995 to 2000, employment in the industry increased by more than 35%. Two-thirds of this employment gain was then lost between 2000 and 2004. After 2008, the industry then experienced further losses, such that virtually all of the employment growth achieved since 1995 was lost. Employment swings of this magnitude impose especially significant challenges for preserving the industry's human capital base. The depletion of this base limits the industry's capacity to respond to subsequent opportunities for growth.

Figure No. 2 also shows the pattern of short-term cyclicality that is also a feature of the aerospace and space industries. Short-term fluctuations occur at most times. However, they are more pronounced in the months that precede a major upward or downward shift in long-term human resources needs.

The principal cause of short-term fluctuations in human resources requirements is instability that is inherent in the scheduling of manufacturing. As will be discussed below, this instability may have increased in the last decade.

Long-term cycles in human resources needs stem from three causes. The first of these, and the most important, is fluctuations in capital spending by end-users in the civil and military markets. The second cause of long-term cyclicality is fluctuations in R&D spending within the aerospace and space industries.

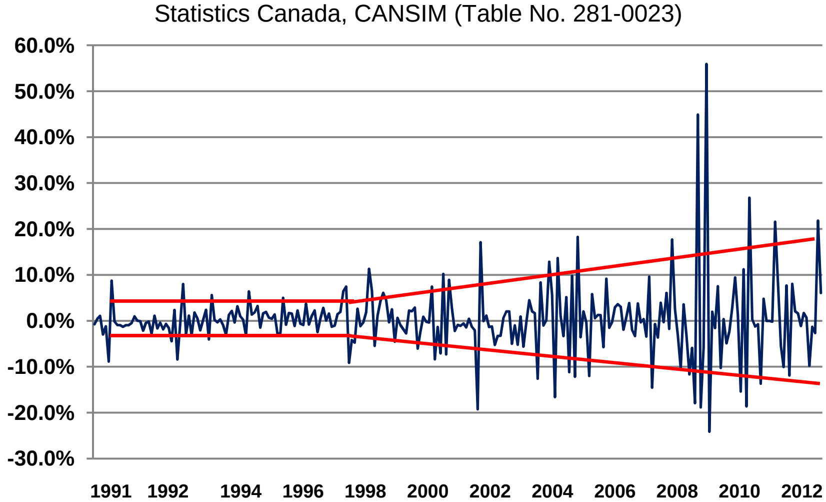
Because most R&D is financed from cash-flow, fluctuations in R&D spending are closely related to capital spending by end-users in the civil and military markets. And finally, the third source of long-term cyclicality is fluctuations in government support. There are a number of dimensions to government support that are relevant to the aerospace and space industries. These include: direct spending on defence products, direct support for R&D projects, and indirect support for R&D delivered through the tax system. As well, government also indirectly supports the industry through funding of university-based research (National Scientific and Engineering Research Council) and funding of relevant post-secondary programs.

Short-Term Cyclicality:

In the aerospace and space industries, production is based on specific orders. Unlike many other manufacturing industries (*e.g.*, vehicles), little or no production is undertaken for inventory purposes. Companies therefore schedule production based on orders. Production also takes considerable time. It is therefore the practice for end-users to purchase options for future delivery. When there is a downturn in the business environment, end-users may defer delivery or allow their options to expire. This creates a gap in the manufacturing schedule. If producers are able to bring forward other orders, this gap will not create an interruption in manufacturing operations. However, if other orders cannot be substituted, an interruption in manufacturing operations is unavoidable. Interruptions in the manufacturing operations of the major assemblers of end products necessarily flow down the supply chain. These interruptions affect primarily those employees who are directly engaged in manufacturing operations, *i.e.*, production workers, skilled trades, technicians and technologists, quality assurance specialists, and production engineers and managers. Most production and skilled trades workers are paid by the hour and are subject to short-term lay-offs. Other classes of employees directly engaged in the manufacturing process are paid on a salary basis and are less likely to be laid off for short periods of time.

Figure No. 3 shows the month-on-month percentage change in hourly-paid workers in '3364 - Aerospace product and parts manufacturing'.

Figure No. 3
Month-on-Month Percentage Change in Hourly-Paid Employment
Aerospace Product and Parts Manufacturing (NAICS 3364)
January 1992 to April 2012
Statistics Canada, CANSIM (Table No. 281-0023)



The month-on-month employment instability shown in Figure No. 3 implies sporadic lay-offs lasting a few weeks to a few months. As can be seen from Figure No. 3, the data suggest an increase in employment instability as evidenced by a widening of the corridor within which month-on-month employment fluctuates. The widening of the corridor is especially evident after 2008. However, the trend to increased month-on-month instability is also evident *before* 2008. A possible explanation for this pattern of increased short-term cyclicality is that a change in human resources management occurred after the mid-to-late 1990s. Prior to 2000, most companies endeavoured to avoid lay-offs so as to minimize the risk of being unable to ramp up production when conditions turned around. For some companies, this human resources management strategy proved too costly in the 1990s owing to the severity of the downturn. In response to the experience of the 1990s, some companies organized their production work force into a core work force to which they endeavour to provide uninterrupted employment and a non-permanent work force that functions as a buffer. Other companies maintained their policy of resisting short-term lay-offs, but outsourced a greater proportion of their work to other companies that subsequently bore the brunt of short-term instability in manufacturing schedules.

Whether or not human resources management strategies changed after the 1990s, the fundamental cause of the increase in month-on-month employment instability is the increased uncertainty in the economic environment of end-users. This is especially evident today and is likely to remain the case at least over the medium term.

Long-Term Cyclicality:

(a) Capital Spending Cycles:

The Canadian aerospace industry is predominantly geared to the civil aerospace market.[7] In the civil aerospace sector, capital spending by end-users is driven by two factors. The first is the need to meet increased demand for passenger travel and air transport. The second is the need to replace aircraft that have reached the end of their usable life.

Over the last decade, growth in passenger travel and air transport led to an increase in the global stock of civilian aircraft. This was the primary driver in manufacturing demand. This growth was dominated by Asian airlines and by the emergence of low-cost carriers in the European and North American markets. Over the next decade, the impact of the replacement cycle will be more evident, especially in the North American and European markets where there is a significant number of aircraft which have been in service for 20 years or more. A 2009 study by Cambridge University's Institute for Aviation and the Environment estimated that retirements from active fleets peak after 30 years of operation, though there are examples of airlines continuing to fly aircraft that after almost 40 years of continuous operation.[8] However, retirements of aircraft can be accelerated by higher fuel costs, an increase in annual maintenance and repair costs, and regulatory requirements.

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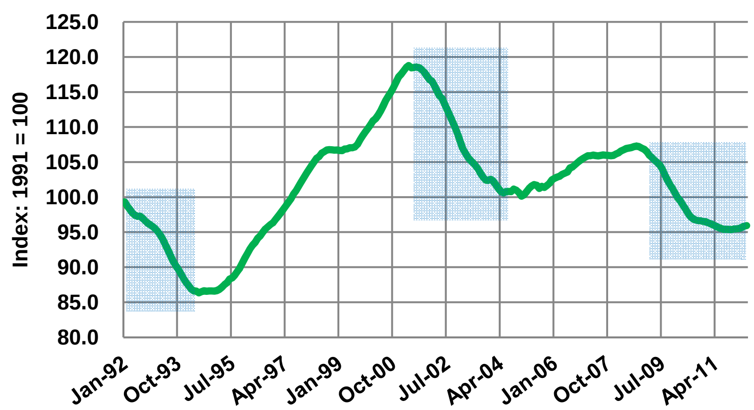
[7] The Deloitte study (note 4) estimated that in 2009, 83.4% of revenues were generated by sales to the civil aerospace market.

[8] Peter Morell and Lynette Dray, *Environmental Aspects of Fleet Turnover, Retirement and Life Cycle: Final Report*, Institute for Aviation and the Environment, University of Cambridge (17 March 2009)

Although there is considerable uncertainty surrounding the timing of major capital investments, industry analysts are broadly forecasting a significant growth in end-user demand over the next decade. This will reflect the overlaying of significant fleet replacement demand on the trend growth in the global stock of commercial aircraft. Industry commentary suggests that the ramping up of production will be associated with the adoption of new technology platforms and also with a restructuring of the supply chain.[9] A greater proportion of final assembly will involve components whose manufacture was outsourced to Tier I and Tier II suppliers. Globalization of the supply chain will also lead to more specialized Tier I and Tier II suppliers. Specialization often increases the volatility of both production and employment in Tier I and Tier II suppliers.

Figure No. 4 shows a composite index of employment that approximate trends in the principal industries in the aerospace sector. The index uses a 12-month moving average to remove short-term variations in employment and reveal underlying long-term trends.

Figure No. 4
Aerospace and Space Industries:
Composite Employment Index (1991 = 100)[10]
12-Month Moving Average
January 1992 to April 2012



From the 1994 trough to the 2000 peak, employment increased by approximately 38%. Thereafter, employment declined by 15% through to 2004. From 2004 to 2008, employment increased by 7%, but then declined by 11% between 2008 and 2011.

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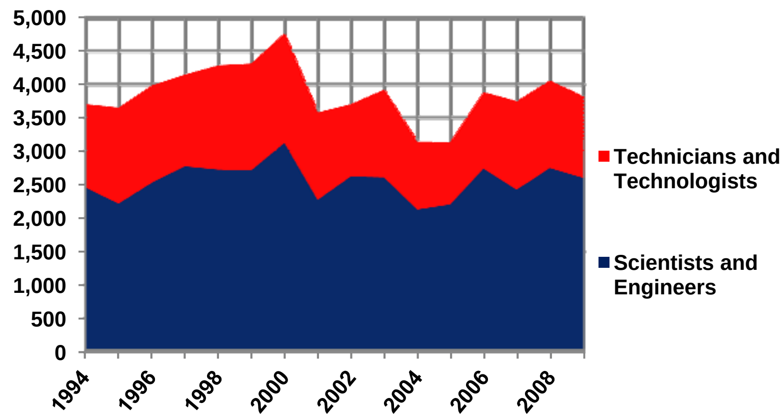
[9] *Financial Times*, "Airbus and Boeing push supply mergers", July 8, 2012

[10] Then composite index is constructed from:
NAICS 3333 - Commercial and service industry machinery manufacturing
NAICS 3341 - Communications equipment manufacturing
NAICS 3345 - Navigational, measuring, medical and control instruments manufacturing
NAICS 3364 - Aerospace product and parts manufacturing
NAICS 4881 - Support activities for air transportation

(b) Fluctuations in R&D Spending:

The R&D is an investment that is made by a producer industry. Hence, R&D spending is distinct from the end-user capital spending cycle. However, except when public monies are committed, R&D is predominantly financed from cash-flow generated by sales. Hence, R&D spending is jeopardized by a sustained downturn in the capital spending of end-users. This is shown in Figure No. 5 which depicts employment of R&D personnel (excluding support staff) in '3364 - Aerospace product and parts manufacturing'.

Figure No. 5
Employment of Scientists and Engineers and Technicians and Technologists in R&D
Aerospace Product and Parts Manufacturing (NAICS 3364)
1994 to 2009
Statistics Canada, CANSIM (Table No. 358-0024)



The employment pattern shown in Figure No. 5 is broadly similar to overall employment trends in the industry shown in Figure No. 4. These swings in the direct employment of R&D staff are significant challenges for the aerospace and space industries. In the absence of strategies to mitigate these fluctuations, employment swings of this magnitude make it difficult for Canadian companies to accumulate the specialized human capital that is required in a highly competitive and globalized industry.

(c) Government Support:

The principle channels for government support for the aerospace and space industries are: direct purchases for defence purposes, direct support for R&D, and tax-delivered support for R&D. As well, funding for NSERC supports university-based research. Some provinces also support centres of excellence which link university researchers to industry. Different segments of the aerospace and space industries access this support to different degrees. The Scientific Research and Experimental Development Tax Incentive Program (SRED) is important in all segments of the aerospace and space industries. So also is direct support provided under the Industrial Research Assistance Program (IRAP) and by the Canadian Space Agency.

Direct government support is especially important in the space industry owing to the risks associated with R&D in this field. According to estimates developed by the U.S.-based Space Foundation, in 2011, governments overall accounted for roughly 25% of the estimated US$289.8 billion of global space sector spending. The U.S. (chiefly NASA) represented two-thirds of this spending.[11] Canadian government support for the space industry is lower than in many other jurisdictions. Figure No. 6 summarizes sources of funding and employment trends, based on data drawn from the Canadian Space Agency's *State of the Canadian Space Sector* reports.

Figure No. 6
Canadian Space Sector
State of the Canadian Space Sector, (2009 and 2010 Reports)
Canadian Space Agency

	2005	2006	2007	2008	2009	2010
Revenues ($ Millions)						
Government	$236	$311	$268	$262	$299	$319
Private (Domestic)	$1,016	$1,090	$1,111	$1,127	$1,235	$1,417
Exports	$1,245	$1,099	$993	$1,405	$1,491	$1,703
Total	$2,497	$2,500	$2,372	$2,794	$3,025	$3,439
Inflation Adjusted Revenues	$2,653	$2,629	$2,436	$2,796	$3,025	$3,439
Work Force	6,710	6,678	6,481	6,742	7,564	8,256
Inflation Adjusted Revenue per Worker	$395,380	$393,681	$375,868	$414,714	$399,921	$416,546

These data indicate that in Canada, between 2005 and 2010, direct government funding accounted for 9.3% to 12.4% of the space industry revenues. This does not include support provided under IRAP or delivered through SRED tax credits. Although this is probably a lower proportion than would be available to the space industry in the U.S. or the E.U., 9.3% to 12.4% is nevertheless significant fraction of revenues.[12] Consequently, from the industry perspective, changes in levels of government support or changes in program criteria are often destabilizing, especially when they cannot be anticipated. Recently announced reductions in support for the Canadian Space Agency may fall into this category.

Implications of Cyclicality:

From the perspective of human resources management, the principal consequence of cyclicality is the risk to losing skilled and experience employees and the related feasibility and cost of replacing those employees. The feasibility and the cost of replacing employees is directly related to the amount of human capital - *i.e.*, skills and experience - those employees embody.

Three types of human capital are relevant: firm-specific skills and experience, industry-specific skills and experience, and general skills and experience. Firm-specific human capital refers to an employee's knowledge of and experience with a company's proprietary technology, its production methods, and its business procedures and customers. Industry-specific human capital pertains to skills and experience which are germane to most companies in an industry, but have less relevance to companies outside that

[11] Space Foundation, *The Space Report 2012*

[12] Euroconsult, *Profiles of Government Space Programs: Analysis of 60 Countries & Agencies*, (2012)

industry. This is particularly relevant to knowledge of industry standards (*e.g.*, AS9100 and the more generic ISO 9001), governmental procedures and regulatory requirements. Familiarity with proprietary technologies, especially major technology platforms, is relevant across most levels of a supply chain. In contrast with firm-specific and industry-specific human capital, general human capital is acquired the education and training system, though to some degree most work experience also contributes to a worker's general human capital.

Interviews with companies support an important conclusion drawn from industry studies: in Canada, the principal cost from the loss of skilled and experienced workers is the erosion of a company's of industry-specific and firm-specific human capital. In general, the post-secondary system and the immigration system provide a sufficient supply of persons with general skills. The challenge is not to find a person with the required university degree. Rather the challenge is to find someone with the required university degree and *five or more years of relevant industry experience* (depending on the job). The 'five or more years of relevant industry experience' which is the key attribute sought by human resources managers is simply another way of describing 'firm-specific' and 'industry-specific' human capital.

The impact of an industry-wide down-sizing is to disperse skilled and experienced workers. Once these employees have re-situated themselves, it is unlikely that they will return to the company that terminated their employment. As Figure No. 4 showed, the aerospace and space industry has gone through at least three periods of industry-wide down-sizing. Interviews confirm that the loss of human capital during the downturn imposed significant constraints on the subsequent capacity of companies to benefit from the upturn in business conditions. The severity of this constraint was directly related to the number of types of employees who were lost to the company during the downturn.

The aerospace and space industries are both characterized by a high degree of industry-specific manufacturing processes and proprietary technologies as well as a significant role for industry standards and government regulations. Even for semi-skilled production jobs, there is often a significant learning curve. For technical jobs, such as instrumentation or quality assurance, the learning curve is much steeper. The same is true for project managers and engineering managers. Engineering and other R&D professionals need both significant investments in their own training as well as substantial experience in the technologies with which they are engaged. Indeed, the supply chain system in the aerospace and space industry attaches a particular premium to the engineering experience that a company can deploy. Companies are often required to demonstrate the depth of their engineering experience with particular technologies (sometimes called 'heritage') to be eligible as suppliers.

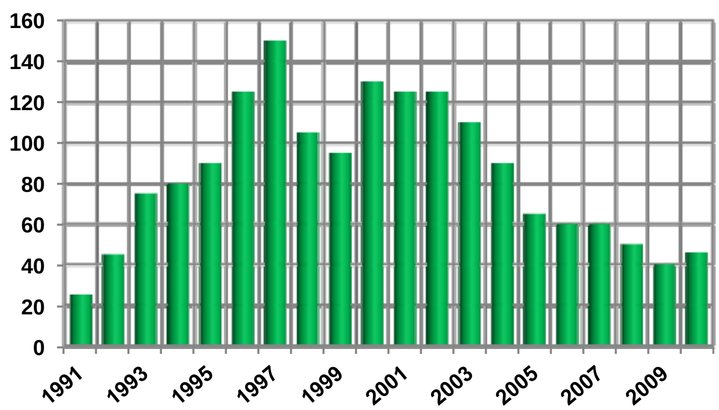
The loss of experienced employees therefore does more than constrain a company's capacity to respond to improved business conditions. The erosion of the human capital base - especially in regard to firm-specific and industry specific human capital - can jeopardize the viability of a company as a candidate for product or R&D mandates.

In addition to the dispersion of human capital that is directly attributable to cyclical downturns, there are also secondary costs associated with employment instability. Uncertainty about employment tenure leads incumbent employees to consider other opportunities. In general, opportunities to pursue other opportunities increase with levels of skill and experience. Consequently retention is often a greater challenge with more highly skilled employees. This is confirmed in a 2008 study that found significantly higher turnover rates among skilled workers in comparison with unskilled workers in the aerospace industry.[13]

A more subtle, but nevertheless important, consequence of employment instability is its impact on early stage career and training decisions. Fields associated with employment instability often must struggle to recruit undergraduate and graduate interest. The consequences of the deterrent effect of employment instability on early career and training decisions usually lags labour market trends by three to five years. Undergraduates who are approaching completing of their studies usually continue down the path they originally chose. However, down-sizing discourages new admissions. The effect of this drop-off in admissions is reflected in declining graduations three-to five years later.

A similar lag is evident in immigration. As word of deteriorating employment opportunities filtered through to prospective immigrants, they changed their country of intended destination or altered their intended employment. Figure No. 7 shows how down-sizing in the aerospace industry had a delayed, but long-lived, impact on the immigration intentions of aerospace engineers.

Figure No. 7
Immigration: Permanent Residents, 1991 - 2010e
Intended Occupation: Aerospace Engineer
CIC



Summary:

Cyclical swings in employment, together with the perception of uncertain career prospects, have had a serious, detrimental impact on the human capital base of the aerospace and space industries. Short-term cyclicality primarily affects hourly paid production workers, including skilled tradespersons. This short-term cyclicality has its roots in the unavoidable instability of manufacturing schedules. Long-term cyclicality has more serious human resources implications because it affects virtually all classes of employees, including highly trained and specialized engineering and project management employees. Long-term cyclicality has its origins in fluctuations in capital spending by end-users, related swings in R&D spending which is usually financed from cash-flow, and changes in the level and nature of government support.

[13] Canadian Manufacturers and Exporters, "Aerospace Manufacturers Fact Sheet", prepared by Ki-squared (August 2008). The study reported a 7% turnover rate for skilled workers and a 4% turnover rate for unskilled workers.

The principal consequence of cyclicality is to disperse a significant proportion of the two industries' pool of skilled and experienced workers. The primary loss to the industry is the accumulated firm-specific and industry-specific human capital. This type of human capital can only be created by the aerospace and space industries. The loss of this human capital is reflected in the industries' serious challenges in recruiting new employees who have the required training together with five or more years of relevant industry experience. Challenges in meeting the human resources requirements will constrain the ability of the aerospace and space industries to respond to improved business conditions. As well, human resources constraints can jeopardize a company's role in the supply chain or its ability to attract R&D mandates. More subtle, but important consequences of cyclicality are the deterrent effect of down-sizing on early career and training decisions and on immigration intentions. Employment cyclicality exacerbates human resources management challenges in the aerospace and space industries and thereby dampens growth in one of Canada's leading knowledge-intensive industries. Strategies to mitigate the adverse effects of cyclicality are among the aerospace and space industries' most urgent human resources challenges.

Part II

Human Resources Management and Employment Cyclicality

<u>Instability in the business environment is a fact of life for most companies in the aerospace and space industries</u>. It is difficult to imagine fluctuations in the capital spending intentions of end-users in the civil aircraft market diminishing. Similarly, it is difficult to see how fluctuations in R&D spending can be avoided when such a large proportion of R&D is financed out of cash-flow. While both the aerospace and space industries would welcome a more stable policy environment, changes in the policy environment are as much a fact of life as changes in private sector capital spending intentions. <u>For purposes of human resources management, cyclicality in business conditions is a parameter that is unlikely to change</u>. The relevant question for human resources strategy is how companies can mitigate the adverse consequences of cyclicality. It is unrealistic to think that either cyclicality or its adverse consequences will ever be wholly removed from the business environment of the aerospace and space industries.

This section reviews initiatives and strategies that have been tried in other industries and in some segments of the aerospace and space industries. None of these strategies, on their own, can overcome the adverse effects of cyclicality. However, a portfolio of these initiatives may hold out realistic promise of mitigating the worst effects of cyclicality. The various initiatives and strategies are organized into three groups:

- Retention strategies at the firm level,
- Strategies to replenish the human capital pool, and
- Strategies to preserve the human capital pool at the sector level

Retention Strategies at the Firm Level:

1. Wages and Benefits

Among the most common retention strategies is higher remuneration to compensate for the risks associated with potential employment instability. Higher remuneration also puts employers in a favourable position when recruiting from local and professional labour markets. (For highly specialized skills, professional labour markets are national and sometimes international). The aerospace and space industries have historically been high wage industries. They have offered their employees benefits that exceed those provided in many other industries.

Figure No. 8 compares wage trends in '3364 - Aerospace product and parts manufacturing' with other relevant comparators. Specifically, Figure No. 8 measures the premium or discount over other comparators based on the 'all employee average weekly wages and earnings'. Data are based on Statistics Canada's monthly Survey of Employment, Payroll and Hours (SEPH). A five-year moving average is used to show robust trends. This comparison does not capture variances across companies or specific labour markets. Nor does this comparison capture the effect of compensation strategies that are focused on particular skills or occupations or remuneration strategies that are not reflected in weekly compensation, e.g., annual bonuses and stock options. Nevertheless, the comparison is broadly indicative of trends in relative compensation across a range of comparators.

Figure No. 8
Aerospace Product and Parts Manufacturing (NAICS 3364)
Wage Premium / Discount over Select Comparators
Five-Year Moving Average
Average Weekly Wages and Earnings (including Overtime) - All Employees
1995 to 2011
Statistics Canada, CANSIM (Table No. 281-0027)

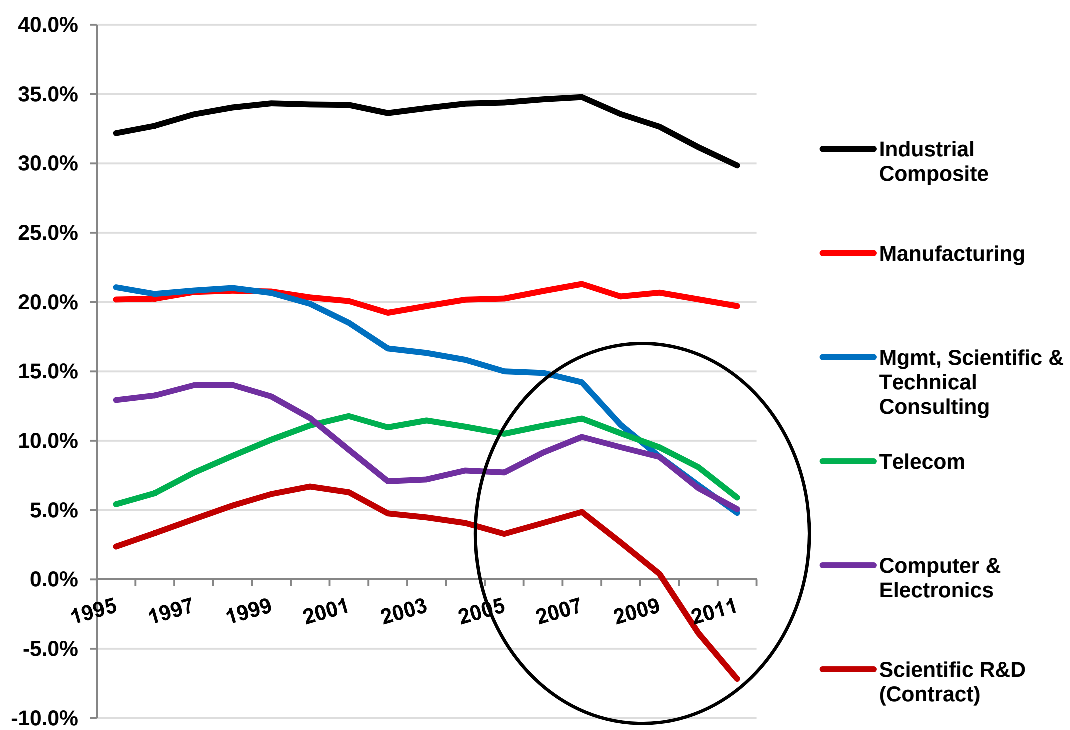


Figure No. 8 shows that the premium over other manufacturing industries has been stable at around 20% over the entire period, 1995 to 2011. The premium over the industrial composite (i.e., 'all industries') is approximately 30%, but appears to have declined somewhat in the last few years. There are four industry comparators where the data suggest a more significant decline in the wage premium: consulting, telecom, computer and electronics manufacturing, and contract R&D. To the degree that these industries are competitors for key categories of human resources, Figure No. 8 indicates that there may have been some deterioration in the relative position of the aerospace manufacturing industry. It should be noted, however, that the aerospace industry continues to pay a premium over all of these industries, except contract R&D. Nevertheless, that premium does appear to have declined. The decline vis à vis the scientific and technical consulting industry and the contract R&D industry appears to have occurred over most of the last decade. The decline vis à vis telecom is more recent.

Most commentary on the aerospace and space industries sees Canadian companies continuing to focus their domestic operations on the high value-added segments of the supply chain. These trends may make traditional comparisons to the 'industrial composite' or the 'all manufacturers' indices less relevant.

It would be an error to draw strong conclusions from the above findings. At most, the data are only indicative of possible trends. Nevertheless, the implication of these data is that the relative position of the aerospace and space industries may need attention. In particular, the industries need to be particularly aware of how their benchmarks compare to other *knowledge-intensive* industries, how those comparisons have changed over time and how they are likely to change.

2. Supplementary Unemployment Benefits

Supplementary Unemployment Benefit (SUB) plans have a long history in the manufacturing sector that dates back to arrangements established in the auto industry in the 1950s. These plans are a common feature in unionized segments of the aerospace and space industry. As such, these plans apply chiefly to hourly-paid production workers. Some companies, however, may also extend SUB benefits to non-union employees. SUB plans supplement regular Employment Insurance benefits for workers who are on qualified lay-offs. The criteria for eligibility are established by the plans. Benefits are fully taxable as income. The effect of SUB benefits is to mitigate the economic effects of short-term lay-offs and to discourage workers on short-term lay-off from seeking permanent employment elsewhere. These plans therefore assist companies in retaining experienced production workers and skilled tradespersons.

SUB plans must be registered with the Canada Revenue Agency and must comply with conditions described in CRA circular 72-5R2. Typically SUB plans are employer funded. Employers' obligations are typically limited to a specified contribution to a trust plan. SUB plans are essentially a self-funded type of insurance plan. As with any insurance plan, there are scale issues that make the implementation of such plans less feasible for small and medium-sized employers owing to the reduced ability to pool risk. There may be value, therefore, in exploring a multi-employer approach to the provision of SUB benefits.

3. Work Sharing

Work Sharing is operated under the aegis of the *Employment Insurance Act*. The objective of Work Sharing is to enable employers to avoid lay-offs when there is an expectation that business conditions will turn around and that there will be a resumption of normal operations within a reasonable period of time. Work Sharing allows an employer to reduce weekly hours of work while employees draw EI benefits to replace a portion of their lost earnings. In unionized operations, the agreement of the union is required to establish a Work Sharing plan. Under the current rules, the initial duration of a Work-Sharing agreement must be a minimum of six weeks and a maximum of 26 weeks. Employers may request an extension of up to 12 weeks. The 2011 Budget allowed for an additional 16 weeks. Total potential Work-Sharing time is therefore 54 weeks. Work-Sharing agreements must include a reduction in work activity between a minimum of 10% of the employees' regular work schedule and a maximum of 60% (*i.e.* one half day to three days). A recovery plan must accompany applications to establish a Work Sharing plan. Recent technical changes have simplified requirements for recovery plans.

In 2010-11, 1,379 Work-Sharing agreements commenced operation. These agreements covered 29,522 employees. In the previous fiscal year, 7,717 agreements were commenced, covering 200,919 employees. <u>Although Work-Sharing is associated with the manufacturing industries, 60% of recent Work-Sharing plans were outside the manufacturing sector</u>. <u>In 2010-11, the professional, scientific and technical services industry` had the second-highest proportion of Work-Sharing agreements, with 9.1% of total agreements</u>. These agreements covered 1,503 employees. <u>In 2010-11, more than three quarters of Work-Sharing agreements involved enterprises with fewer than 50 employees</u>. Work-Sharing claims established in 2009-10 lasted an average of 19.3 weeks, compared with 21.5 weeks and 13.9 weeks for agreement that commenced in 2008-09 and 2007-08, respectively.

While there are many examples of the use of Work-Sharing to avoid permanent lay-offs, one of the most significant recent examples was the Work-Sharing plan instituted by ArcelorMittal Dofasco. The company successfully used Work-Sharing to weather the 2008-09 downturn and preserve its skilled work force.

Interviews with companies in the aerospace and space industry indicate that there is some industry experience with Work-Sharing. Based on a limited number of interviews, opinion on Work-Sharing is mixed. While some companies welcomed the opportunity to avoid permanent lay-offs, others found that Work-Sharing impeded the efficiency of operations. An important complicating factor is the challenge in determining whether a downturn is short-term or long-term. Figure No. 2 showed that increased short-term variability in employment is sometimes a precursor to a significant downturn (or upturn). There may be negative implications for employees who participate in a long-term Work-Sharing plan, but who are subsequently laid off permanently. These employees may be entitled to lower EI benefits following their permanent lay-off. In some cases, senior employees who would have a measure of protection against permanent lay-off resent the income loss associated with Work-Sharing. Notwithstanding these complications, Work-Sharing may still hold out opportunities to mitigate the effects of short to medium-term employment swings. It is particularly notable that Work-Sharing is no longer a predominantly manufacturing industry arrangement. Nor is Work-Sharing confined to hourly-paid workers. Work-Sharing, of course, is not relevant to work force management challenges arising from long-term fluctuations in employment.

4. Linking Training to Short-Term Unemployment

Providing training to workers while they are experiencing short-term lay-off could increase the retention of experienced and skilled workers. However, current EI policy does not easily accommodate a linkage between training and short-term unemployment. As a general rule, to maintain eligibility for regular EI benefits a recipient must be able and willing to work and actively seeking suitable employment. Recent amendments to the EI rules broaden the definition of suitable employment while maintaining the obligation to actively seek alternative employment. Workers who are unemployed and also taking training on their own initiative must declare that training at the time they apply for EI benefits to determine whether the training interferes with their obligation to actively seek suitable employment. Service Canada advises as follows:

> "As a general rule, to be entitled to regular benefits, you must show that you are unemployed, able and willing to work and actively looking for suitable work. Therefore, if you are taking a training course on your own initiative, without being directed to do so by a designated authority, you must show, without a doubt, that taking a course is not an obstacle to your active job search or to your acceptance of appropriate employment."

The centrality of the obligation to actively seek suitable employment is understandable. However, workers who are on short-term lay-off with a reasonable expectation of re-call are unlikely to actively seek alternative, permanent employment. This is especially so when the jobs to which they are expecting to return are well paid jobs that offer good benefits, as is the case in the aerospace and space industry. Moreover, it is not in the interests of employers in this industry for workers on shot-term lay-off to drift away to other industries. Companies, however, are in a difficult situation. If companies provide training, especially full-time training, that coincides with receipt of EI benefits, there is a risk that EI benefits could be discontinued.

Developing a viable link between training and short-term unemployment is complex. From the perspective of the EI system, it is important to avoid creating an incentive to lay workers off for the purpose of accessing EI benefits to support them during training. As well, the EI system does not want to detract from the principle that EI recipients have an obligation to maintain an active search for employment. At the same time, there is no real expectation that workers on short-term lay-off will ignore the likelihood of recall and undertake a rigorous search for alternative, permanent employment. Between these two perspectives there should be a middle ground that would accommodate the needs of the EI system while also not impeding the opportunity to use periods of short-term lay-off to strengthen skills, especially if this training is designed and financed by employers.

Strategies to Replenish Human Capital

1. Increasing the Number of Entry-Level Engineering Positions

Companies in the aerospace and space industries attach a high premium to experience, especially, though not solely, in engineering positions. Many companies, especially smaller companies, have an experience threshold for new hires. This threshold is usually five years of relevant industry experience. It is understandable why many companies would have such a policy. The productive contribution of an engineer to a company increases substantially with five years of industry experience. Many companies, especially smaller companies, cannot afford the time it takes to train a 'junior engineer'. Some companies may be discouraged from hiring 'junior engineers' by the fear that after investing in training, the now experienced engineer will be hired away from them by another company which chose to avoid the initial training cost.

The difficulty with experience threshold policies is that policies which are rational at the company level can have negative consequences at the sector level. In the engineering profession, experience thresholds for new hires have the effect of limiting the number of entry-level jobs while increasing demand for experienced engineers. The result of constricting intake at the 'junior engineer' level is to create a systemic shortage of experienced engineers. If there are too few 'junior engineers' hired today, it is a virtual certainty that in five years times, there will be a chronic shortage of engineers with five years of experience. Today's systemic shortages are the result of insufficient intake of junior engineers in the past. There is no short cut to experience. The tension between the sector's need for an adequate intake of 'junior engineers' and the need of individual companies for engineers who meet the five-year experience requirement is not unique to Canada. Most companies in most labour markets will voice the same concern about a chronic shortage of experienced engineers. The essence of the challenge is that the problem of the under-supply of experienced engineers can only be addressed if most companies in a particular regional cluster act in concert to increase their intake of 'junior engineers'. Regional clusters which develop the consensus to implement such a strategy will have a significant human resources advantage over regional clusters that are unable to do so. There may be scope for governments to promote the development of this regional advantage by incenting the recruitment of 'junior engineers'.

2. Augmented Participation in Co-op and Internship Programs

Over the past two decades, there has been a significant growth in both the number of university engineering faculties offering specialized training in aerospace and a commensurate increase in the number students graduating from these programs. Some universities offer this training as part of a mechanical engineering program. Others have specialized programs in aerospace or space engineering. Data provided by Engineers Canada to Prism Economics and Analysis suggest that compared to the early 1990s, the number of engineering graduates with specialized training in aerospace has more than doubled.

Many engineering faculties provide their students with a co-op or internship option. Participation by aerospace and space companies in co-op and internship programs contributes to the human capital pool of the sector by strengthening the attachment of motivated students to careers in aerospace and space engineering. Co-op and internship experience is much shorter than the five years of experience that many employers in the aerospace and space sector seek when recruiting new engineering and scientific staff. However, co-op and internship experience at least partially bridges the experience gap. Such programs also allow companies to screen prospective recruits without incurring the obligations or costs associated with regular new hires. Many aerospace and space companies currently participate in co-op and internship programs. However, there are no sector-wide data on this participation. Hence there is no statistical basis on which to gauge the sufficiency of this participation. In the United States, the Aerospace Industries Association tracks company participation in co-op and internship programs and facilitates placements through its "Launch into Aerospace" web site. Similar tracking and facilitation would be advantageous in Canada. Data gathered by tracking participation would also provide valuable information on the future sufficiency of skill supply.

3. Shared Apprenticeships

A frequently expressed concern of companies in the aerospace industry is the challenge they face in recruiting and retaining skilled tradespersons. These individuals are key to maintaining production equipment. Some skilled tradespersons, principally welders, machinists, instrumentation technicians and sheet metal workers are also directly involved in production work. Training in these occupations is a combination of classroom based training and structured workplace experience. Apprenticeships typically take three to five years to complete, depending on the trade. Attrition rates are often high. In part, this is owing to the age of apprentices. Some apprentices also decide that a particular trade is 'not for them' after they commence their training. The short-term variability of employment can also impede completion of apprenticeship training or discourage an apprentice from pursing training through to completion. For all of these reasons, many companies have been reluctant to invest in apprenticeship training, preferring to recruit experienced tradespersons. The difficulty with this strategy is that the supply of experienced tradespersons is not keeping pace with demographically driven replacement demand.

<u>Companies need to explore mechanisms for training apprentices without taking on the full risk of losing that investment</u>. Other industries face similar challenges. A noteworthy experiment that has addressed many of the barriers to hiring apprentices is the Hamilton Skilled Trade Apprenticeship Consortium (HSTAC). HSTAC comprises a number of Hamilton area employers, chiefly in the steel industry. The initiative was pioneered by the Canadian Steel Trade and Employment Congress. The essence of the HSTAC model is that apprentices are sponsored by HSTAC, not by an individual employer. Apprentices complete their in-school training under HSTAC auspices and supervision. The apprentices are then assigned to work for a participating employer (with the agreement of that employer). However, that employer does *not* assume any long-term obligations while the apprentice is completing his or her on-the-job training. In the event of a temporary or permanent lay-off, the apprentice can be assigned to another employer so that he or she can complete the required on-the-job training. At any time during the apprenticeship period, a participating employer has the option to formally hire the apprentice and transfer the apprentice's sponsorship from HSTAC to the employer. The consortium approach has been effective in reducing the risk to employers of losing their early stage investment in an apprentice. The consortium model has also reduced attrition rates arising from lay-offs. Union involvement in HSTAC contributed to the increased flexibility needed for the consortium model to succeed.[14] The aerospace and space industries should explore the potential applicability to their circumstances of the consortium model of shared apprenticeship.

4. Immigration

Immigration makes an important long-run contribution to the pool of skilled workers. In the 1990s, the majority of qualified engineers who entered aerospace engineering were immigrants to Canada. After

[14] Additional information on HSTAC is available at: www.hstac.ca/

2000, immigration continued to be an important source of labour supply, but diminished relative to the increase in domestic graduates from specialized training in aerospace engineering. While immigration increases the pool of workers with formal educational qualifications in aerospace and space, many of these immigrant professionals lack the technology experience that is directly relevant to the needs of Canadian companies. In some respects, therefore, immigrant professionals who are admitted as permanent residents under the Federal Skilled Worker Program are similar to recent university graduates. They have high levels of 'general human capital' but lack the 'firm-specific' or 'industry-specific' human capital that is so central to the skill needs of companies in the aerospace and space industries.

Some employers reported using the Temporary Foreign Worker (TFW) program to meet immediate requirements. However, the nature of skills requirements in the aerospace and space industries makes the TFW program a poor fit for the industries needs. Because most technology is proprietary, companies require workers who have considerable depth in that technology. This can entail a significant learning curve that often does not align with the TFW program. A potentially important exception is internal transfers within global companies. In these circumstances the learning curve may not be a factor and the TFW program will align well with human resources needs.

Provincial Nominee Programs enable companies to 'fast track' internationally recruited candidates for admission as permanent residents. These programs have been used by a range companies in knowledge-intensive industries. Some companies in the aerospace and space industries have used these programs, notably in Quebec and in western Canada where they have played a more prominent role.

Strategies to Preserve Human Capital at the Sector Level

1. The PARC Experiment

A current initiative of note is the *Partage Automatisé des Ressources dans les Communautés* (PARC) being developed for the aerospace and space industries in Quebec by JMJ Aéronanautique. The initiative will receive $1.2 million in funding from the Quebec Ministère du Développement économique, de l'Innovation et de l'Exportation (MDEIE). The foundation of PARC will be a real-time database of human resources in Quebec's aerospace and space industries. Companies that participate in PARC will contribute information on their employees, including basic demographics, educational background, and employment experience. <u>A key feature of PARC is its proposed mechanism for holding onto workers affected by temporary lay-offs</u>. Employees who are laid off will retain their benefits and their employment relationship with their employer-of-record, including the right to be recalled to work. However, these workers will be available for assignment to other aerospace companies, usually, but not necessarily, in the same supply chain as the employer-of-record. (PARC is currently developing rules to protect intellectual capital. Focusing 'assignment' of laid off employees to other companies in the same supply chain reduces the potential scope of this problem.) The 'assignment companies' will pay the wages of the assigned workers plus an amount that will reimburse the employer-of-record for the ongoing costs of maintaining benefits. However, the 'assignment companies' will not take on any of the other obligations or liabilities associated with being an employer, *e.g.*, severance or notice obligations. Workers who benefit from the PARC scheme must agree in advance to return to their 'employer-of-record' if requested to do so during a specified recall period. The PARC model offers advantages to all stakeholders. The 'assignment companies' will benefit from the experience of the assigned workers who will already be familiar with many of the relevant technologies. The assigned workers will benefit from continued employment and a broadening of their experience. The employer-of-record will benefit from the ability to recall workers when business conditions permit. The sector as a whole will benefit from the retention of valuable human capital.

The PARC model has been endorsed by major aerospace and space employers in Quebec who have indicated that they will come on board when the system is launched in September of this year. Funding provided by the Quebec government will cover the majority of development costs. Ongoing costs will be financed by participation fees. The PARC model reflects the Quebec industry's strong desire to avoid a repetition of the dispersion of human capital that occurred during previous downturns in the aerospace and space industries. The PARC model should be monitored by the aerospace and space industries in other regions to determine its potential applicability to their circumstances.

2. *Industry-Recognized Certifications*

Industry recognized certifications often feature centrally in sector-based strategies to develop skills. The Canadian Council for Aviation and Aerospace (CCAA) has developed 26 occupational standards and certifications:

- Aerospace Materials Specialist
- Aircraft Gas Turbine Engine Repair and Overhaul Technician
- Aircraft Interior Technician
- Aircraft Maintenance Technician
- Aircraft Mechanical Assembler
- Aircraft Propeller Systems Technician
- Aircraft Reciprocating Engine Technician
- Aircraft Refueller
- Aircraft Simulator Technician
- Aircraft Structures Technician
- Aviation Electrical/Electronic/Instrument Component Technician
- Aviation Ground Services Attendant
- Aviation Machinist
- Aviation Maintenance Inspector
- Aviation Maintenance Manager
- Aviation Mechanical Component Technician
- Aviation Non-Destructive Inspection Technician
- Aviation Painter
- Aviation Special Processes Technician
- Aviation Welding Technician
- Avionics Maintenance Technician
- Composite Fabricator
- Electrical/Electronic Assembler
- Quality Assurance Manager
- Quality Systems Auditor
- Structures Assembler

These occupational standards have been recognized by Transport Canada (Airworthiness Notice AN C009) for personnel working in an Approved Maintenance Organization (AMO). In addition to developing occupational standards and certifications, CCAA has also accredited training institutions to deliver the curriculum to achieve the competencies set out in these standards. Industry-recognized certifications contribute both to raising skill levels and to strengthening the attachment of workers to a sector. Workers with industry-recognized certifications are more likely to seek re-employment in that sector when they are laid off and also more likely to return to that sector when business conditions lead to an improvement in employment conditions. Industry-recognized certifications should therefore be understood as playing a potentially useful role in preserving a sector's human capital during periods of cyclical instability. The recent termination of core funding for sector councils raises questions about the future of CCAA's investment in occupational standards and industry certifications. The industry should explore various options to ensure that this investment is not lost.

3. Tracking Human Resources Trends at the Industry Level

There is a serious deficit in the basic data needed for human resources planning and the industry level in the aerospace and space industries. The most recent industry-based survey of human resources dates from 2001 and has been overtaken by changes in the industry. Many industry estimates continue to rely on the 2001 survey notwithstanding the dated nature of its findings. Census data, as noted in Part I of this report, are tied to the NAICS definition of industries and the NOC system for defining occupations. While these definitions are suitable for some purposes, they do not provide sufficient granularity to support human resources planning at the industry level. Moreover, there are broad differences on such elementary matters as the definition of the aerospace and space industries and the number of workers employed by them. The Deloitte survey commissioned by the AIAC provides overall employment estimates for 2009 that range from 47,785 to 109,273 with the central estimate being 78,529. The AIAC currently quotes 87,000 workers on its web site. The OECD uses a more limited definition that tallies under 40,000 workers in the aircraft and spacecraft industry. None of these estimates can be readily reconciled with estimates for space industry employment published by the Canadian Space Agency. Outside of Quebec, the basic data to support industry-level human resources analysis and planning are not available. This should be a matter of concern to both governments and industry.

Summary

Cyclical fluctuations in employment pose serious challenges to the aerospace and space industries. Both of these industries are highly dependent on skills and experience that can only be developed through employment in the industry. The dispersal of this human capital as a result of cyclical downturns potentially undermines an important source of competitiveness and constrains the capacity of the industries to fully exploit an upturn in business conditions. This section of the report examined various strategies and initiatives that have been used in the aerospace and space industries and in other industries to mitigate the adverse effects of cyclicality on the available pool of skills and experience. These strategies were examined in three groups.

The first group of strategies focused on firm-level strategies to retain skilled and experienced workers. These strategies included relative remuneration, supplementary unemployment benefits, work-sharing, and strengthening the linkage between short-term lay-offs and industry-relevant training.

The second group of strategies focused on potential strategies to replenish the human capital pool available to the aerospace and space industries. These included: formulating a consensus to increase the number of entry-level engineering positions, augmenting support for co-op and internship programs (including tracking participation), exploring the scope for shared apprenticeship management, and utilizing various options under federal and provincial immigration schemes.

The third group of strategies that were discussed pertain to sector-level human resources planning. An important experiment that will be of interest to the industry is the PARC initiative in Quebec. This section also looked at the industry's need to consider options to preserve investments already made in industry-recognized certifications. It was also noted that, outside of Quebec, there are data deficiencies that will need to be addressed as part of any broadly-based strategy to address human resources planning on a sector level.

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Interviews

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