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Critical Skills in Five Canadian Industries

A Summary Report on Sectoral Interviews

Prepared for the Expert Panel on Skills
by Derwyn Sangster
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September 1999

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Human Resources Development Canada;
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Expert Panel on Skills.

Canada

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Introduction

The Expert Panel on Skills was established in late 1998 to determine whether shortages of critical skills existed, or might exist in future, in five strategic Canadian sectors — aerospace, automotive, biotechnologies, environmental industries, and information/telecommunications. In its discussions, the Panel viewed these sectors as representative of knowledge industries more generally, and cast many of its discussions in this broader context.

As part of its work, the Panel first asked firms in these five sectors what critical skills they felt were most difficult to obtain. The responses to this question, in large part, were expressed in terms of *occupations* and *jobs* — labels used by firms to summarize a combination of skills. In relatively few cases did respondents to these first interviews go beyond the jobs to identify *skills*, or combinations of skills, which were hard to obtain.

Accordingly, the Panel undertook a second set of interviews with firms in each strategic sector, the objective of which was to probe further within the difficult-to-fill occupations and identify the specific skill sets which made these occupations difficult to fill. This report summarizes the main findings of these interviews. The individual interviewers' reports, and copies of the interview protocols used, are available separately.

One hundred interviews, including some with recruitment firms and post-secondary educational institutions, were conducted in various regions of Canada, as follows:

- Aerospace — Quebec (19 interviews);
- Automotive — southern Ontario (21 interviews);
- Biotechnology — Atlantic Region and Saskatoon area (10 interviews in each location);
- Environmental Industries — Calgary area (20 interviews);
- Information/Telecommunications — Ottawa area and Atlantic Region (10 interviews in each location).

Firms were grouped by sector and region in order to facilitate interviews by interviewers knowledgeable about the sector in question. The selection of sector/region combinations did not in all cases focus on regions where individual sectors were most heavily concentrated. This selection was also intended to provide a degree of representation for all regions of the country. The interviews covered the following broad areas:

- Nature of the duties, decision-making responsibilities, and work organization of the hard-to-fill occupations referenced within each sector;

- For each reference occupation, the key technical skills/knowledge, management/business skills, personal skills, and other skills and attributes perceived as important by employers, together with employers' assessments of the difficulty of finding these skills;
- Employers' recruitment practices and experiences regarding these occupations/skills;
- Employers' experiences in retaining these skills;
- Employers' practices in maintaining or updating these skills among their employees.

In reading this report, several important points should be kept in mind, as follows:

1. It will be recognized at the outset that many of the sectors differ significantly from each other in terms of maturity, firm size, or the fundamental nature of their business. In particular, the automotive and aerospace industries are relatively mature, with more larger firms and an increasingly integrated North American market. The other sectors, in contrast, are 'newer' and include a higher proportion of small firms. In a single summary covering all five sectors, therefore, it is very difficult to capture adequately the full 'texture' of each sector which is contained in individual sector reports. These differences, in turn, often make generalizations across sectors difficult or meaningless, and instead require that sectors often be compared or contrasted. The analysis below reflects this.

2. A maximum of about 20 interviews were conducted within each sector. Since this is not a large sample size, the interview findings must be seen as directional rather than being assessed in terms of statistical significance. This small sample size, for the most part, also made it impossible to correlate results by other characteristics such as firm size, nature of product/service, etc.

3. Since seven different consultants conducted the interviews in different sectors in different parts of the country, some methodological differences resulted, as individual interviewers dealt with the realities of particular sectors. Some interviewers, for example, left the protocol to be completed by respondents. Others, finding respondents unwilling to sit through a long interview, dealt with the interview questions in a more qualitative fashion.

Because the same issues were covered in every sector, the interviews nevertheless added significantly, both to the Panel's understanding of skill issues in each sector, and to its perspective on differences among the sectors themselves. These included in particular the relationships between occupations and skills in the five strategic sectors, the priorities firms attach to particular skill sets or skill combinations, and firms' experiences in recruiting, retaining, and training, individuals with the required skills.

Interview Findings
Reference Occupations

In each sector, the interviews were conducted with reference to specific occupations or occupational groups which earlier interviews had identified as hard-to-fill. These were as follows:

- Aerospace — junior (0-3 years experience) and senior (7+ years of experience)[1] mechanical or software engineering occupations;
- Automotive — junior (less than 2 years experience) and middle-level (2-5 years of experience) engineering and design occupations;
- Biotechnologies — senior level biotechnologists, in management or research;
- Environmental industries — environmental management and senior science positions,
- Information/telecommunications — software engineering and senior management.

Across all sectors, the reference occupations were similar in that they all required a high level of technical expertise. In most sectors, furthermore, these occupations were found in project teams or other 'flat' organizations which, depending on the sector, might be relatively homogeneous or multi-disciplinary. Senior level individuals in these occupations often played a significant management and team leadership role.

In sectors containing a number of relatively small firms (e.g. Biotechnologies, Environmental Technologies, I/T) senior personnel in the reference occupations participated not only in technical decisions but also in marketing and financial decisions. The most senior individuals participated in strategic business decision-making.

In contrast, in sectors such as Aerospace and Automotive, where firms tended to be larger, senior engineers participated extensively in technical and financial decisions, but much less so in strategic or marketing decisions. More junior staff focussed on technical and operational decisions — a tendency most pronounced among the largest firms in these two sectors. These differences likely reflected not only firm size, but also the differing nature of the business in each sector.

Skills Needed

Technical Skills and Education

It was clear in all sectors that technical skills and education were the *sine qua non* among the requirements in the reference occupations. Without these fundamental technical qualifications,

[1] The distinction between senior and junior engineers was made possible by the size of the responding firms, and the number of engineers they employed, which ranged from 40 to 1900.

individuals were simply ineligible to work in these highly technical areas. While firms in every sector identified post-secondary education or training as a requirement for the reference occupations, there were variations, both in field and level, which are noted in Table 1. In virtually all sectors, however, responding firms did not report high levels of difficulty in recruiting individuals with sufficient technical skills and knowledge. Table 1 shows the perspective and experience of individual sectors.

Table 1: Sectoral Perspectives on Required Technical Skills and Knowledge, and Recruiting Difficulty

Sector and Reference Occupations	Sectoral Perspectives
Aerospace • (junior (0-3 years experience) and senior (7+ years of experience) mechanical or software engineering occupations)	Degree in mechanical or software engineering required. Software or systems engineers required some knowledge of 3D software and/or particular platforms (C++, Java, etc.) Recruitment problems are seen as manageable by the industry; entry-level candidates normally have the required technical skills. Some difficulty finding gas turbine engineers.
Automotive • (junior (less than 2 years experience) and middle-level (2-5 years of experience) engineering and design occupations)	For design work, large firms tend to hire university graduates, often in mechanical engineering, and sometimes technicians and technologists. Small firms with only Canadian operations are less rigid, and will also hire tradesmen with high levels of computer knowledge. Because their salary levels are relatively high, automotive assembly companies have relatively few difficulties hiring the staff they need. Tier 1 and Tier 2 suppliers, however, have more difficulties, not because of the quality of candidates' technical skills, but simply because there are so few individuals coming out of the education institutions. Automotive employers expressed uniformly high regard for the analytical skills and knowledge of graduating engineers and technicians/technologists.

Sector and Reference Occupations	Sectoral Perspectives
Biotechnologies • (senior level biotechnologists, in management or research)	Firms required primarily Master's or Doctorate, with the majority qualified at the Ph.D or even post-doctoral level, especially for research positions. Lesser academic qualifications were considered if accompanied by strong experience or personal attributes. The main related scientific field is Biochemistry. Biotechnology firms in Atlantic Canada identified difficulty in finding certain very narrow specialties, such as Molecular Biology or Affinity Chromatography. Only one-third of responding firms in the Atlantic indicated that recruiting technical skills is often or always a problem. In Saskatchewan, the level of recruitment difficulty for technical skills was higher
Environmental Industries • (environmental management and senior science positions)	Firms required mostly Master's or Ph.D in engineering (hydrology, geology), natural sciences, environmental science or physical science. Only 4 out of 17 interviewed firms indicated that they always have difficulty meeting the technical needs of the position. These tended to be in highly specialized areas such as hydrogeology or soil science.
Information/Telecommunications • (software engineering and senior management)	Bachelor of Science or Engineering degree is preferred, but not always required. Community college and private computer school graduates are also acceptable at some levels. In the Atlantic I/T sector, technical skills are usually necessary for entry-level positions, but with increased responsibility and career growth, non-technical skills gain in relative importance. Only one-quarter of responding firms indicated that recruiting technical skills is often or always a problem. But it is always difficult to recruit *managers* with relevant technical skills. In the Ottawa I/T sector, the smaller firms noted that they could always steal employees from other firms, and had little difficulty doing so.

Management/Business Skills

In all five sectors, management/business skills as a group were viewed as very important for senior employees in the occupations under study. In virtually all sectors, finding senior employees with the needed levels of management/business skills was seen as more of a challenge than recruiting for technical skills.

While sectoral perspectives are summarized in Table 2, there were some sectoral parallels. For example, in sectors such as Biotechnologies, Aerospace and I/T, where a firm or a team will take a new product or component from the research/conceptual stage to final market, product development skills were extremely important. Some Saskatchewan Biotechnologies respondents also highlighted the importance of strategic planning as a key skill; firms must identify future customer needs and competitors' strategies, and put in place a process to use science to develop new products to meet those needs. In sectors such as Automotive and Aerospace, where the product development process may also be relatively long, complex, or spread among workplaces, project management skills are particularly important.

In Aerospace, the levels of management/business skills expected of senior engineers were sharply higher than those expected of junior engineers.

Table 2: Sectoral Perspectives on Required Management/Business Skills, and Recruiting Difficulty

Sector and Reference Occupations	Sectoral Perspectives
Aerospace • (junior (0-3 years experience) and senior (7+ years of experience) mechanical or software engineering occupations)	Senior Engineers require high skill levels in project management, product development, budget management, and business writing. Most difficult management/business skills to find among senior engineers are negotiation and strategic planning. Junior Engineers require moderate to high skill levels in product development
Automotive • (junior (less than 2 years experience) and middle-level (2-5 years of experience) engineering and design occupations)	Hardest skills to find: Project management, problem solving, and budget management/cost control (defined together as the ability to take an ill-defined problem and derive a reasonable solution which makes business sense.) Virtually all responding firms in the sector mentioned these. Most companies expect to train for these skills.
Biotechnologies • (senior level biotechnologists, in management or research)	Atlantic Biotech: Most important skills: Project management, product development, financial management, operations management, business writing. Hardest skills to find: Product development skills, financial management skills.

	Saskatchewan Biotech: Most important skills: Strategic planning product development, project management, negotiation. Hardest skills to find: Strategic planning, operations management, understanding market needs
Sector and Reference Occupations	**Sectoral Perspectives**
Environmental Industries • (environmental management and senior science positions)	Seventy percent of respondents indicated that it was often or always difficult to recruit management/business skills. Most important and hardest to find skills: Pr[illegible] management, budget management and communi[illegible] skills.
Information/Telecommunications • (software engineering and senior management)	Atlantic I/T sector: Most important skills: Project management, product development, business writing. Five of eight respondents indicated that it was often or always difficult to recruit these management/business skills. Hardest to find skills: Project management, marketing, and business writing skills. Ottawa I/T sector Most important skills: Project management, product development, strategic planning, operations management. Hardest to find skills: Project management, strategic planning, and marketing skills.

Personal Skills

In many sectors, senior technical/management staff supervise teams, often multidisciplinary, in carrying out projects. This requires well-developed interpersonal skills, including communications and leadership, among others. Accordingly, in many sectors personal skills ranked somewhat higher than management/business skills in overall importance. In some sectors, including Atlantic I/T firms, personal skills were seen as a prerequisite for candidates, since fitting into the organization was given a high priority. In the Aerospace sector, both senior and junior engineers — particularly the latter — required much higher levels of personal than management/business skills.

In virtually all sectors, in fact, very few of the personal skills covered in the interviews ranked as unimportant. Among those that were perceived as most necessary, Table 3 highlights the sectoral perspectives on the highest priority personal skills.

Numeracy and computer literacy were seen in many sectors as "givens" for technical positions, i.e. such fundamental technical skills that it was assumed that incumbents possessed them. In the interviews, therefore, discussion often focussed less on these and more on other skills and attributes. Similarly, in some sectors where the focus was on management positions, numeracy and computer literacy received less attention than other personal skills.

Table 3. Sectoral Perspectives on Required Personal Skills, and Recruiting Difficulty

Sector and Reference Occupations	Sectoral Perspectives
Aerospace • (junior (0-3 years experience) and senior (7+ years of experience) mechanical or software engineering occupations)	Senior Engineers required all listed personal skills, particularly problem solving, teamwork, oral communication. Most difficult personal skills to find among senior engineers are interpersonal and teamwork skills. Junior Engineers required, in particular, teamwork skills and a willingness to learn.
Automotive • (junior (less than 2 years experience) and middle-level (2-5 years of experience) engineering and design occupations)	Hardest skills to find: Problem solving, teamwork skills, written/business communications.
Biotechnologies • (senior level biotechnologists, in management or research)	Atlantic Biotech: Most important skills: Willingness to learn, problem-solving, teamwork, written and oral communications; Firms reported little difficulty in finding candidates with these skills, though broad communications skills were often noted as lacking. Hardest skills to find: Willingness to learn, teamwork Saskatchewan Biotech: Most important: Interpersonal skills, teamwork skills, willingness to learn Hardest to find: Interpersonal skills, teamwork.
Environmental Industries • (environmental management and senior science positions)	Overall recruitment difficulty seemed somewhat less than with business/management skills. Most important skills: Interpersonal skills, teamwork, self-management, oral and written communication.
Information/Telecommunications • (software engineering and senior management)	Atlantic I/T sector: Most important skills: Willingness to learn, teamwork, interpersonal skills, problem solving. Three of eight respondents indicated that it was often or

Sector and Reference Occupations	Sectoral Perspectives
	always difficult to recruit these management/business skills. Hardest to find skills: Self-management, problem-solving, written and oral communications. Ottawa I/T sector Most important skills: Willingness to learn, problem-solving, self-management, interpersonal skills. Firms saw recruitment of these skills as 'often difficult'. Hardest to find skills: Interpersonal, teamwork skills.

Other Skills and Attributes

Not surprisingly, the great majority of respondents in all sectors prized positive attitudes, leadership, and a willingness to take risks. In those sectors or firms which varied from this view, the source of the variation was sector- or firm-specific, and included the following:

- In the automotive sector, leadership skills are not a hiring requirement, but they are very much a requirement used later to determine who goes into management and who remains in a technical position.
- In biotechnology and environmental technologies, a knowledge of relevant regulatory environments was expected as a priority, given the nature of these industries. In the environmental technologies sector, this knowledge did rank higher than in other sectors. In biotechnology, however, this did not emerge; firms noted that because such knowledge is of such paramount concern in the sector, firms often employ specialists in this area.
- Some larger responding firms in several sectors noted that risk-taking and entrepreneurial attitudes were not always as essential at less senior levels of the firm, where the firm is trying to encourage loyalty and dedication.

Respondents noted that it was sometimes difficult to secure these other attributes. There was considerable consistency among respondents concerning the attributes which were most difficult to find. In the great majority of cases, firms encountered most difficulty finding leadership skills and risk-taking attributes.

Skill Combinations

Respondents in all five sectors placed a strong priority on a balance of technical, business and personal skills for individuals in the reference occupations. It was also evident that while

technical skills were essential prerequisites in these positions, they were not the areas of greatest weakness. Rather, it was in the areas of business and personal skills that respondents cited the greatest difficulty finding qualified candidates. The specific skill combinations emphasized by individual sectors are presented in Table 4.

Table 4. Specific High-Priority Skill Combinations, by Sector

Sector and Reference Occupations	Sectoral Perspectives
Aerospace • (junior (0-3 years experience) and senior (7+ years of experience) mechanical or software engineering occupations)	Senior: Broad combinations of business, personal and technical skills were important. Junior: Greater focus on technical skills as a minimum requirement, together with willingness to learn and teamwork skills.
Automotive • (junior (less than 2 years experience) and middle-level (2-5 years of experience) engineering and design occupations)	Highly developed technical skills are the minimum requirement, and these are usually obtainable. But it is hard to find individuals with sound technical skills and good management/business and personal skills, since the supply of people with both the latter is limited. A number of responding firms maintain vacancies for people with these skill combinations, which they would fill if the right candidate were available. As noted earlier, the highest rated combination of skills included project management, problem-solving, and teamwork.
Biotechnologies • (senior level biotechnologists, in management or research)	Atlantic Biotech: Technical competency, communication skills, creativity and leadership may constitute the core skill-set for the sector. A mix of teamwork, project management and leadership skills also figure prominently. Most difficult skill combinations to find: Teamwork and communications skills; technical skills and experience; multidisciplinary experience. Saskatchewan Biotech: Specific skill combinations are more important to employers than individual skill sets on their own. The most important skills needed, in combination with others, were: Strategic planning, technical skills, communication, management, leadership, teamwork. Most difficult to find: Strategic planning, interpersonal, technical

Sector and Reference Occupations	Sectoral Perspectives
Environmental Industries • (environmental management and senior science positions)	Business and personal skills are a necessary requirement for environmental manager positions, and are generally most lacking. In some positions, however, technical skills are paramount.
Information/Telecommunications • (software engineering and senior management)	Atlantic I/T sector: Skill combinations are particularly important. These include basic technical skills combined with project management, teamwork, and interpersonal skills (communication). Essential skills include problem-solving, self-management, and positive attitudes. Leadership was noted by more thai. half the respondents. Skill combinations often difficult to find, especially combinations of technical and personal skills. Ottawa I/T sector Technical knowledge is essential. Personal skills are seen as somewhat more important than management/business skills. Firms have to 'get by with less' in these non-technical categories.

Most Frequently Lacking Skills, Attributes, or Combinations

When asked to identify the skills which they felt were most frequently lacking among employees in the reference positions, responding firms cited management/business skills, personal skills, and other attributes to a much greater extent than technical skills. Specific sectoral responses to this question follow:

- In the Environmental sector, the most lacking skills were written and oral communications, financial management skills, and interpersonal skills.
- In the Atlantic I/T sector, most lacking skills were entrepreneurial spirit, risk taking, communication skills, written and oral communications, problem solving, positive attitudes, project management. Only one firm mentioned technical skills, noting in any case that this wasn't as important a problem as other skills.
- In the Saskatchewan Biotechnologies sector, the most lacking skills were management and strategic planning. Communication and entrepreneurial skills were the next most lacking.

- In Atlantic Biotechnologies, most firms had great difficulty locating people with the desired combination of technical skills and experience. Also frequently lacking are business skills (e.g. budget management, project management) and personal skills (e.g. teamwork, communications, supervisory skills) and leadership.

- In Aerospace, the most difficult skills to recruit were strategic planning, negotiation, teamwork, interpersonal skills, and risk-taking.

Provision of Skills by Educational Institutions

A small number of educational institutions were included among the interviews. Because of their limited representation, it is not possible to derive strong conclusions from these interviews. Nevertheless, the interviews with educational institutions did explore whether, and how, the institutions felt they were conveying to their graduates the skills — both technical and non-technical — that were the focus of the study. Responses to these questions highlighted several themes, as follows:

One group of institutions stressed their focus on technical skills and questioned the extent to which they should be expected to teach the softer skills. Several of these institutions questioned whether the softer skills are in fact formally 'teachable', and suggested that these were personality traits which might be honed through work experience. There was a view among these institutions that while academic programs can provide skill development in such areas as problem solving, teamwork, written and oral communications, and computer literacy, they are less able to formally teach what they regard as personal traits, and should not be expected to do so. These include positive attitudes, leadership, risk-taking, willingness to learn, self-management, interpersonal skills, and creativity.

A second, somewhat larger group of institutions indicated that many of the non-technical skills are either formally taught or "embedded" in their curriculum. Examples include the following:

- One university noted that its engineering programs teach management/business skills, since its bachelors students receive courses in engineering projects and economics, while its masters students take courses in strategic planning, business and quality management. In addition, since the program requires that the students work in teams, this facilitates the development of teamwork and related personal skills.

- Another university noted that its graduate computer science and software engineering programs now included strategic planning, project management, and product development, as well as problem solving and communications. The institution is moving to expand the number of 'soft' skills being taught. A community college reported that its computer science program included project management and business writing.

- A third university noted that thesis research helps develop writing skills, creativity, project management and self-management, while scientific communication and teaching contribute to communications and interpersonal skills.

- In the environmental industries area, many universities offer interdisciplinary graduate degrees (e.g. Master of Natural Resources Management) to individuals with undergraduate degrees in natural, physical and social science as well as engineering. These interdisciplinary degrees emphasize management, personal, and technical skills, through team projects, presentations, report writing, and computer literacy. Interdisciplinary college degrees are also offered in the environmental area.

There is nevertheless a sense in some sectors that universities might focus more explicitly and objectively on teaching the 'softer' skills, relying less on the view that these skills are acquired incidentally to, or as a by-product of, course or thesis work. An evaluation by CAMAQ of the Master's Degree in Aerospace Engineering in Quebec, for example, recommended that the program include more activities designed to improve written and oral communications skills as well as computer skills. Some institutions, though, noted in this regard that even when they had offered softer skills in their curricula, students often did not subscribe to these courses in large numbers. This suggested that the students themselves do not appreciate the importance of these skills to their future careers.

Another university whose graduates often enter the automotive industry noted that problem-solving skills are imparted through specific projects, which are graded and marked, but admitted that this might not be sufficient exposure. The university's capacity to incorporate these softer skills more extensively into its program, however, was limited both by budget limitations as well as the slowness of the curriculum planning process.

The Automotive sector's increasing use of engineers, technicians/technologists, and skilled tradesmen in the design function at the supplier level is placing an increasing level of accountability and capability on these technical personnel. This has led responding firms in this sector to note the absence of laddering, articulation agreements, and bridging programs among institutions, through which employees could move from one technical level to another. Although respondents noted progress on this issue, their view was that Canadian institutions are well behind American institutions in this regard.
A definitive assessment of the role of educational institutions in providing management/business, personal, and other skills would require a much larger number of extended interviews with the institutions themselves. The limited picture provided by the interviews conducted under this project, however, suggest that:

- some institutions continue to focus on providing technical skills and knowledge, with less stress on non-technical areas;

- many other institutions are increasingly building non-technical skills into their programs, partly through formal courses and partly through the way the programs are organized and taught (e.g. theses, team projects, etc.);

- in some areas, firms see room for an even greater inclusion of these non-technical skills in educational institutions' programs;

- budget limitations and slow planning processes are cited by some institutions as obstacles to a more rapid inclusion of these non-technical skills in programs.

Human Resources Practices

Recruitment

Recruiting Protocols and Methods

The majority of firms in all sectors reported that when vacancies occurred, they recruited internally first, in order to maintain employee morale and give promotion and career development opportunities to their own employees. This was particularly the case in larger firms, such as those in the Automotive sector, who had an internal pool of talent and often a formal company-wide internal staff development program. In some cases, simultaneous internal and external recruiting occurred when the chances of finding a candidate internally were seen as slim. Smaller firms, especially those which were starting up and growing, often recruited externally because they didn't have the internal pool of candidates to draw from.
Firms in the Atlantic I/T sector reported that they were constantly on the lookout for skilled people, and would hire even if they didn't have a formal 'vacancy'.

In sectors other than Aerospace, firms used a common core of recruitment methods, with some sectoral variation. The methods used in all sectors included newspapers, word of mouth, and to a degree, Internet recruiting. Private recruitment firms and campus recruiting were used, though less frequently, in the I/T, environmental technologies, automotive and biotechnology sectors. In campus recruiting, automotive respondents reported that they kept in touch with local educational institutions to identify the most promising graduates.

Firms in Aerospace used Internet recruitment most frequently, followed by campus recruitment for junior engineering positions. Private recruitment firms were used moderately often, but newspapers were used infrequently.

In the aerospace, automotive and I/T sectors, firms often hired students they had employed on co-op placements, who had a knowledge of their operations. Reliance on co-op students was particularly marked in the automotive sector; some responding firms hired only individuals with co-op experience.

Several recruiting methods were used rarely if at all, in any sector. These included government employment centres, recruitment from other countries, and employee incentives to identify potential candidates. Respondents in the automotive sector, however, noted that foreign recruiting, especially from Eastern Europe, was becoming more common.

Some sectors reported specific other practices, including the following:

- In biotechnologies, firms also placed employment opportunities on their own websites, sought candidates through technical or science magazines and journals, or used research scientist inventories such as recipients of NSERC awards.

- In Aerospace, firms reported using Intranet, professional engineering associations, and the firms' own overseas offices in their recruiting efforts.

The Importance of Experience

In all sectors, experience was an essential or very important requirement for the more senior positions which were the focus of the interviews. Few hired inexperienced workers in these roles. While the actual amount of experience required in individual sectors varied with the seniority of the position involved, most respondents required a minimum of five years' experience. Specific sector responses were as follows:

- Automotive: after 5 years experience, employees are considered fully experienced;
- Aerospace: Junior Engineer — 0-3 years experience; Senior Engineer — 7+ years experience;
- Biotechnology: most firms require 6 years; some required 15 years for some positions;
- Environmental Technologies: most firms require 8 -10 years, depending on the position;
- Information/Telecommunications: most firms require 5 years for senior systems engineer; some respondents sought 10 or 15 years.

In many sectors, respondents praised the level of technical skills possessed by new and inexperienced graduates. In the view of most respondents, however, experienced workers had a higher level of the important non-technical skills, described above, than inexperienced workers. Examples from the interviews included:

- higher levels of management/business skills such as financial understanding, budgeting, project design and management, planning, strategic thinking, communications
- higher levels of personal skills such as leadership, entrepreneurial skills, teamwork, and interpersonal skills,
- higher levels of product development skills (Atlantic Biotechnologies)
- higher levels of problem-solving skills, as well as a 'willingness to get their hands dirty' (Automotive)

In addition, however, respondents identified further qualities which experienced workers possessed, which went beyond the individual skill sets noted above. These included a broader outlook, maturity, knowledge of the real world, an appreciation of customer service, flexibility and self-confidence. Experience also brought with it a valuable understanding of the industry.

In this connection, co-op graduates were perceived by firms in the Aerospace and Automotive sectors to have advantages over other graduates who lacked this experience. Co-op students were seen as more flexible and better adapted to the tasks at hand, having been exposed to the work environment. In Automotive, virtually all responding firms wanted co-op programs expanded; some remained surprised that some institutions retained non-co-op programs, in the face of the industry's obvious hiring preferences for co-op graduates.

Recruitment Difficulties

In most sectors, the majority of respondents indicated that they had had difficulty in recruiting for the reference positions. For the most part, respondents reported that recruiting during the last two years had been more difficult than in the two years before that. In terms of recent recruitment experiences, however, there was not a completely uniform picture across the five sectors. Recruitment difficulties appeared most intense in the I/T sector, and to a lesser extent, the environmental technologies sector and parts of the biotechnologies sector. Sector-specific summaries in this regard follow:

Atlantic I/T: Despite continuing recruitment difficulties regarding experienced workers, some respondents noted an increase in the volume of entry-level candidates, and remarked on the potential for the market to be saturated at this level over the next few years.

Environmental Technologies: Recruitment difficulties seemed somewhat less than in other sectors. A higher proportion of respondents indicated that they had had no difficulty recruiting, and almost all reported that their recruitment difficulties had not worsened in the last two years.

Biotechnologies. In Saskatchewan, recruitment was difficult and had become more so in the last two years. Atlantic respondents reported that though continuing to have hiring difficulties during the past two years, they found that recruitment had become easier.

Automotive: Because of their high salaries, the large manufacturers had few problems hiring the staff they need. Recruitment problems were concentrated in the smaller Tier 2 suppliers, many of whom find it difficult to compete with the big firms on salary. In the Windsor, Ontario area, proximity to jobs in Detroit (and the opportunity to earn U.S. salaries while living in Canada) results in continuing shortage situations, especially for workers with more than 5 years experience.

Aerospace: Half of the responding firms, including a higher proportion of the larger firms, reported difficulties in recruiting during the previous two years. Recruitment difficulties were seen as greater than in the preceding two years.

Reasons for Recruitment Difficulties

Firms were asked to identify and rank, from a list, factors which had contributed to their recruitment difficulties. Some of these factors related to the absence of key skills among candidates, while others related to broader labour market issues such as compensation, firm location, etc.

In virtually all sectors, the lack of specific skills among candidates was seen as a more important factor than other labour market issues. In particular, firms pointed most often to a lack of *relevant experience*, a lack of *specific skills combinations*, and a lack of *management/business* or *personal* skills, as the main reasons for recruiting difficulties.

Only in Aerospace was a lack of *specific technical skills*, on its own, seen as more important than a lack of non-technical skills or skill combinations. This reflects the sector's relative stress on technical skills among its junior engineers. (It was noted earlier, that firms in the industry expect less of their junior engineers than of their senior engineers in terms of personal and management/business skills (particularly the latter)).

In Automotive, where the interviews focussed on junior and middle-level design workers, the issue was one of numbers; there were simply not enough qualified workers coming out of the educational institutions.

In the Biotechnologies sector, both in Saskatchewan and Atlantic Canada, firms pointed to the higher salaries and compensation offered by other firms as a factor in their recruitment difficulties. Saskatchewan firms found it difficult to compete with other industries, while Atlantic firms perceived that the region is outside the mainstream, and that limited job opportunities for candidates' spouses might affect the region's attractiveness.

A further commentary on the recruitment difficulties of the Atlantic Biotechnologies sector came from one of the educational institutions interviewed. The interviewee indicated that in his experience, many of the best students entered Medicine, Dentistry or Law, drawn by the incomes and lifestyles associated with these professions. Straight research and postgraduate science degrees, which led to positions in sectors such as Biotechnologies, were often seen as less attractive. Recruitment in science-focussed sectors could therefore suffer.

Some regional variation was apparent in the I/T sector. While in both the Atlantic region and the Ottawa area, the stress was on a lack of key non-technical skills and experience, Atlantic region firms pointed to the higher salaries offered by other Canadian firms in the industry as a further important factor. For Ottawa firms, the compensation competition was perceived to come not from other *Canadian* firms, but from firms in other *countries*, notably the U.S. Notwithstanding the salary competition, however, a number of Atlantic companies in this sector saw their location as an asset.

In contrast to the preceding sectors, the Calgary-centred firms interviewed in the Environmental Technologies sector concentrated on the absence of experience and key skill sets, placing other companies' or industries' compensation much further down the scale of importance. The salaries and benefits paid by firms outside of Canada were seen as the second *least* important source of recruitment difficulties among respondents in this industry.

At the other extreme, regardless of sector, certain factors were universally seen as unimportant in contributing to recruitment difficulties. These included the poor perception of the industry itself, the lack of information on sources of available candidates, and high recruiting costs.

Loss of Employees

The experience of firms in losing employees to other Canadian companies varied by sector. While most responding I/T firms in both the Atlantic and Ottawa samples had lost employees to other Canadian firms in the preceding two years, most Environmental Technologies and Biotechnologies respondents had not. Similarly, responding firms in the Automotive and Aerospace industries reported little loss to other Canadian industries because of their high salaries. In Automotive, however, there was a steady flow of staff *within* the sector, as smaller Tier 2 suppliers tended to lose staff to larger, better-paying Tier 1 suppliers and assemblers. Sectors' experiences in losing employees to the U.S. were broadly similar to their patterns of loss within Canada, although generally fewer had lost employees to the U.S. in the preceding two years. In the Environmental Technologies sector, in fact, none of the responding firms had lost employees to the U.S. in this period. The exception to this was the Aerospace sector, whose firms reported significant loss to the United States, and who are particularly conscious of retention issues in the face of high American demand. Similarly, loss to American firms was an issue for Automotive respondents near the U.S. border. About half of the Ottawa I/T respondents had lost employees to the U.S.

Asked to identify the main factors behind their loss of employees to other Canadian companies, most firms pointed to higher salaries and compensation as the most important factor, with better career advancement possibilities as the second most important. The opportunity to have more challenging work, or a stronger team of colleagues, were generally the third and fourth-listed. Loss of employees to the United States was also linked primarily to the higher salaries available in the U.S. Career advancement opportunities and more favourable tax treatment in the U.S. were also cited in degrees which varied by sector.

In these responses, of course, it is important to keep in mind that these reflect the perceptions of the employers and not of the leaving employees themselves.

The interviews with Ottawa I/T firms identified a strong dissatisfaction with Canadian taxation levels, which, it was felt, reduced the competitiveness of the Canadian industry relative to its U.S. counterpart. Some respondents felt that the relative taxation situation would affect younger workers in particular, who had not yet put down roots in Canada. Others saw it as affecting workers at more senior levels, for whom taxes were a more critical issue. Still others saw the taxation question as an important aspect of a more complex problem of competitiveness, which included issues such as relative salary levels, stock option regimes, and "being where the action is".

This view, however, was not shared by one educational representative, who felt that there were shortages of experienced people in the sector, but not shortages at the entry level.

Response to a Shortage of Workers

Across all five sectors, responding firms facing shortages tended, first, to extend the recruitment period, train existing staff, and reorganize the work to reflect the available skills. Secondary measures included overtime and outsourcing/contracting out. Projects were occasionally postponed.

The least-used strategies were also significant; only a small minority of responding firms in any sector hired less-qualified, temporary, or part-time workers, apparently preferring to go without, rather than hiring 'second-best'. Perhaps most significantly, only a similar small minority resorted to increasing salaries to attract workers.

In Aerospace, response strategies were somewhat different, perhaps reflecting the penalties which firms incur if the industry's tight delivery timeframes are not met. While the majority of firms trained staff to meet shortages, many also found short-term solutions, using overtime extensively or hiring less qualified workers. The smaller firms in the industry also extended the recruitment period, outsourced, or reorganized work — medium-to-longer term solutions which relatively few larger firms adopted.

Some small Automotive firms deliberately sought to avoid a loss of engineers' skills by hiring skilled trades to do design engineering with the aid of sophisticated software Automotive firms also used overtime relatively frequently, and occasionally called on recruiting firms for temporary staff. A number of respondents in the sector also practiced 'employee leasing', under which the automotive firm leased workers from a leasing company on a long term basis. The workers remained employees of the leasing company and could be released at very short notice by the automotive firm. An important variant of this, in the design engineering field, was the reliance of many companies on contract engineering firms.

Training Practices

Training and Updating

The great majority of respondents in all sectors stressed the importance of formally updating

employees' skills, particularly in view of the rapid changes in technology in most of the sectors under study. Respondents universally indicated that technical skills required the most frequent updating, followed by management/business skills and personal skills.
A high proportion of respondents in all sectors also reported that they provided or supported formal training in these skills. Some noted the importance of training not only in maintaining skill levels, but also in maintaining staff morale and ensuring their eligibility for advancement opportunities.

In individual sectors, however, training support practices varied. In several sectors, notably automotive, this employer support for management/business or personal skills updating appeared to be somewhat 'passive'. In many instances, the initiative to take training was left to the employee, rather than being deliberately planned and scheduled by the employer. If asked to do so by an employee, many employers would subsidize tuition and books for a particular course, but sometimes only if the employee achieved a satisfactory standing in the course.

Training Methods

A review of the training methods used in five sectors to provide technical, management/business and personal skills yielded a great deal of variation, both by sector and skill type. A number of broad patterns emerged from these questions, however, as follows:

To provide updating in ***technical skills***, firms in most sectors relied on traditional training methods. In varying proportions, these included workshops, seminars, and conferences, as well as in-house classroom and on-the-job training. Very few respondents reported that they used distance/Internet-based training, or computer-based training, although some noted that these were growing areas. One set of reasons for not using distance learning techniques was spelled out in the Atlantic Biotechnologies interviews, which noted that such approaches were of limited use where hands-on laboratory experience with specific instrumentation and techniques was essential.

Respondents in most sectors reported a primary reliance on company staff, university, and private trainers for technical skills updating. Respondents in several sectors also used vendors, where specific equipment was involved. Environmental Technologies respondents reported using industry associations extensively. Community colleges, however, were generally used infrequently in all sectors.

In the automotive sector, mentoring and coaching is a widespread method of developing technical skills. While applied more formally in the larger companies, it is also seen as an important practice by the smaller firms. In smaller firms, mentorships may last 6 months to three years, while in some larger firms, they last five years.

Methods to update ***management/business*** and ***personal skills*** differed somewhat from those used to update technical skills, in that firms in most sectors relied more heavily on in-house classroom and on-the-job training, together with seminars and workshops, and notably less on conferences. While respondents in the Atlantic I/T sector reported a significant use of distance/Internet training and a growing use of computer-based training, this was not as apparent in other sectors.

Again, respondents in most sectors relied on company staff, university staff, and private trainers, as well as industry associations to a lesser extent. Private trainers were used particularly often to update personal skills. Community colleges were used more frequently than in the case of technical skills, but in general were still the least-used training source.

Compensation

Average Salaries

Responding firms provided salaries for both experienced and less experienced workers, in the reference occupations, except in the Environmental Technologies sector, where responding firms indicated that they did not hire inexperienced workers in these positions.

Because the reference occupations are different in each sector, intersectoral comparisons of salary levels are of course meaningless. The fact that these data were gathered in an interview setting also made them very subjective and not statistically reliable.

Nevertheless, respondents were consistent across sectors in their perceptions that experienced workers earned significantly more than inexperienced workers. In the Biotechnologies and Automotive sectors, for example, respondents felt that experienced workers earned of the order of 20% - 25% more than inexperienced workers. In the I/T sector, the experience premium appeared even larger; Atlantic I/T firms reported paying experienced workers 50% more than inexperienced workers, while in the Ottawa I/T sector, the differentials were, if anything, greater. Intersectoral comparisons of the perceived differences in the rate of annual increase in salaries were also informative. In Biotechnologies in both the Atlantic region and Saskatchewan, employers reported salary increases of two to five percent, per year, since 1997. In contrast, most Atlantic and Ottawa I/T respondents reported salary increases of approximately 10% per year over this period.

The higher 'experience premium' and more rapid recent rise in salaries in the I/T sector are consistent with an impression that the I/T sector has recently faced a labour market in many ways tighter than that facing Biotechnologies. This of course is qualified by the small number of firms included in the comparison.

Similarly in Aerospace, the experience premium ranged from about 50% in the smaller firms to as much as 70% in the larger firms. At the same time, the larger firms reported salary increases of approximately 6% per year since 1997, in comparison to the 4% per year reported by the smaller firms. This compensation pattern reinforces the finding, identified in the interviews, that small firms in the industry often lose workers to larger firms, who in turn lose to American firms.

In Automotive, because of the competitive influence of Detroit, design engineering staff in Windsor-area firms tended to receive $5,000-$10,000 more than corresponding staff in the Toronto area.

Other Forms of Compensation

A majority of the respondents in the Biotechnologies and Environmental Technologies sectors indicated that they offered other forms of compensation to their employees. Profit sharing and stock options were the preferred methods. In the I/T sector, somewhat fewer firms reported that they offered these forms of compensation.

Conclusions

A number of broad conclusions emerge from the interviews which will be of relevance to the Panel's thinking about skills issues. Because of the number of interviews, of course, these conclusions are impressionistic and directional, rather than statistically significant. Nevertheless, they would appear to be as follows:

Skills and Skill Shortages

- All five sectors contain jobs or occupations which in varying degrees are difficult to fill. These are sectors which, like others in the knowledge-based economy, are marked by growth and innovation, and the difficult-to-fill occupations are universally very technical in nature.
- High levels of technical skills and knowledge, sometimes at doctorate and post-doctorate levels, are essential requirements for these hard-to-fill occupations. Without these, candidates for the most part simply do not 'get in the door'.
- Responding firms in most of the five sectors, however, report that in recruiting for these hard-to-fill occupations, their greatest problems came not in finding the technical skills, but in finding various non-technical skills, often in combination. These included a variety of management/business and personal skills, as well as other attributes. The skill shortage, in fact, was in these non-technical skills areas.
- In the view of many respondents, these non-technical skills are acquired through experience, and this was evident in the central importance of experience in firms' recruiting practices for middle-level and senior jobs. Firms tended to point to a lack of relevant experience, a lack of specific combinations of skills, or a lack of management/business or personal skills, as the main reasons for recruiting difficulties.

- The role of educational institutions in providing these non-technical skills as part of their curriculum is a matter of considerable debate. The importance of these non-technical skills and firms' difficulties in finding them, however, adds urgency to this debate.

Human Resources Practices

- Responding firms which lost employees to other Canadian or American firms cited higher salaries/compensation and better career advancement possibilities as the contributing reasons. Loss to the U.S. was also affected by the latter's more favourable tax treatment.
- Firms responded to a skill shortage most frequently by extending the recruitment period, training staff, or reorganizing work. In some sectors, overtime was used, as well as outsourcing or contracting out. Few firms outside the Automotive sector, however, hired less qualified, temporary, or part-time workers. Few firms in any sector reported that they increased salaries to attract workers.
- While firms stressed the importance of frequently updating employees' technical skills, non-technical skill required less frequent updating. There was also a sense in many sectors that updating non-technical skills was left more often to the employees themselves, rather than being part of a firm's training plan or strategy.
- In updating technical and non-technical skills, responding firms relied on traditional approaches such as seminars, conferences, or on-the-job training. Distance education and computer-based training were used infrequently in almost all sectors. Company staff, private trainers and university staff were the most frequently involved in providing skill updating, with community college staff used much less often.
- In terms of compensation, an 'experience premium' is common in all sectors, and varies in size across sectors, consistent with varying degrees of sectoral labour market tightness. Firms in Biotechnologies, Environmental Technologies and I/T are moving to profit sharing and stock options as part of their compensation packages, although these trends were not apparent in the more mature Automotive and Aerospace industries.

APPENDIX I : LIST OF INDIVIDUAL REGIONAL/SECTORAL REPORTS AND RESEARCHERS

Atlantic Canada Biotechnologies Sector:	Cornwallis Technology Brokers 21 Acadia Avenue Kentviile, Nova Scotia B4N 5E1
Atlantic Canada Information and Telecommunications Technologies Sector:	Collins Management Consulting & Research Ltd. 106 Crichton Avenue Dartmouth, Nova Scotia, B3A 3R5
Quebec Aerospace Sector:	Vestimetra International, 57 Hautvilliers Outremont, Quebec H2V 4P1
Ottawa - area Information and Telecommunications Technologies Sector	T. M. Denton 37 Heney Street Ottawa, Ontario K1N 5V6
Ontario Automotive Sector:	O'Hagan Consulting 691 Richmond Road Ottawa, Ontario K2A 0G6
Saskatchewan Biotechnologies Sector:	The Trimension Group 104 - 110 Research Drive Saskatoon, Saskatchewan S7N 3R3
Alberta Environmental Technologies Sector:	Praxis Inc. 2215 19th Street S.W. Calgary, Alberta T2T 4X1