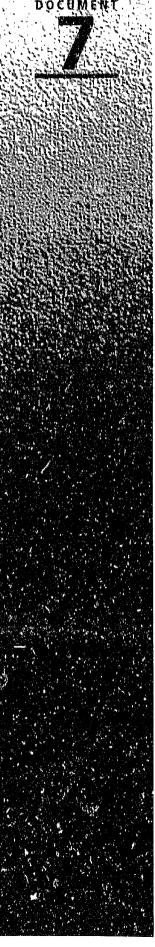Report of the

Web-based Consultation on the Skills Profiles

Prepared for the Expert Panel on Skills
by Woody Huizenga, Infolink Consultants

1999

Canada

Web-based Consultation Report

By the Secretariat of the Expert Panel on Skills

1999

This publication is also available electronically on the World Wide Web at the following address:
http://acst-ccst.gc.ca/skills

This publication can be made available in alternative formats for persons with disabilities upon request. Contact the Distribution Centre at the numbers listed below.

This document is part of a series of research documents which constitute background material for *The Report of the Expert Panel on Skills*. For additional copies of this publication, available on CD ROM, please contact:

Information Distribution Centre
Communications Branch
Industry Canada
Room 205D, West Tower
235 Queen Street
Ottawa ON K1A 0H5

Tel: (613) 947-7466
Fax: (613) 954-6436
E-mail: **publications@ic.gc.ca**

The views expressed in this document are not necessarily those of the Government of Canada

REPORT OF THE EXPERT PANEL ON SKILLS: Supporting Documents

INTRODUCTION

On March 12, 1999 the Panel of Experts on Skills launched its Web-based consultation with the first of a series of e-mail messages inviting more than 800 stakeholders from every part of Canada to comment on sectoral profiles of the aerospace, automotive, biotechnology/biopharmaceutical, environmental and information and telecommunications industries posted on the Panel's Web site. The invitation was sent to:

- industrial and labour organizations
- university, college and Cégep presidents
- national and provincial post-secondary education organizations
- government science and technology contacts
- networks of centres of excellence
- federal and provincial labour and education officials
- experts in learning technologies
- media

Fifty-seven stakeholders provided substantive responses arrived between late March and early June. The proportionally low number of responses for aerospace, automotive, environmental, and, to a lesser extent, biotechnology masks the large numbers of well-reasoned and well-documented responses which addressed issues relating to several (or all) of the profiles.

Sector	Responses
Aerospace	3
Automotive	3
Biotechnology/Biopharmaceuticals	5
Environmental	3
Information/Telecommunications	20
Multiple Sectors	23
Total	**57**

The responses focused almost exclusively on two major areas:

- Corrections to (and additional data for) the profiles
- Critical skills needs and gaps

The corrections and additional data have, over the course of the project, been forwarded to the authors of the respective profiles and incorporated where appropriate. They will not, therefore, be repeated here. It will be much more useful and interesting to discuss the critical skill needs and gaps identified and some of the suggestions offered for meeting those needs and closing those gaps. This is consistent with the Panel's mandate to find answers to the following three questions:

- What critical skills will be needed over the next decade to improve or maintain Canada's competitive position?

- Are these critical skills in short supply — currently and in the foreseeable future — and do we have appropriate means to monitor their availability?

- What practical approaches and strategies could help ensure that Canadians acquire and develop the critical skills that are necessary to succeed in a knowledge-based economy?

SUMMARY OF RESPONSES

One IT industry response captured the key issue — the transition which is the ultimate driver of this exercise — very aptly:

> "The shift from a manufacturing toward a knowledge-driven economy means that the ability to fabricate and assemble physical products efficiently and consistently, becomes a less powerful competitive differentiator than the ability to create and integrate innovative ideas efficiently and consistently. This requires a complete re-think of organization and operating methods. Traditional organizations and procedures for optimizing the performance and useful operating life of a team of machines... must be replaced by organizations and procedures to optimize the performance and useful operating life of a team of humans. In addition, normal HR management issues such as motivation, measurement, job satisfaction and reward take on increased importance, since humans in a knowledge-intensive business are not easily interchangeable or replaceable."

Aerospace Industry

A federal department suggested that the aerospace industry may have made a fundamental error: "It seems as if they are treating personnel in the same way that they are treating manufacturing parts used to assemble aerospace products. Just as they try to institute 'just-in-time' manufacturing practices, they are trying to put in place 'just-in-time' skill-base procedures... Organisations are not simply acquiring skills when they hire personnel, they are also getting the means for ensuring corporate memory, sources for novel solutions and personal pride that goes a long way for guaranteeing quality products." The industry does not seem to view skilled personnel as a long-term investment.

The same department suggested that it is up to the industry, which it described as one of the most profitable in the Western world, to "implement strategies for buffering this 'cyclic' phenomenon." Among the options proposed: long-term funding arrangements with universities and colleges, better forecasting of market cycles, more effective use of existing personnel to train their successors, and diversifying "the customer base to reduce the effect of market transients."

The department considers any skill shortages to be a problem of the industry's own making: "It seems that they have not had the vision to anticipate the problem and nor the wisdom to commit the resources to solve it. It is a problem of short-sightedness."

Nova Scotia's industry manufactures components for the larger aerospace companies in Ontario and Quebec. The industry's ability to get those contracts hinges on the availability of skilled and experienced workers. A federal official explained that "it is likely that the education system is producing enough graduates, but the companies want people who have experience." An academic observed that "owners of small companies are not willing to invest the time needed to develop junior staff," but predicted that the situation will improve as the owners of these companies gain experience and as the proportion with technical backgrounds grows.

The Canadian Aerospace Maintenance Council requested financial support for standard setting and curriculum and course material development, based on the value-added it provides "through a well-qualified workforce that has recognized international credentials."

An academic noted that for Canada's federally regulated aviation schools, equipment, tools and training aids are a major financial burden. "Canadian industry has been exceedingly generous in their support with consumables, tools and equipment plus surplus, damaged aircraft pieces and avionics equipment." The federal government has been far less helpful, recently denying a request for one surplus helicopter (of the 80 subsequently sold abroad) for each of the ten schools.

To alleviate the shortage of aerospace engineers, it may be possible for universities to introduce formal options in Aerospace Engineering, for far less than the cost of establishing an accredited program or a separate department. This has been done at the University of Manitoba, where there is also an Avionics course on the calendar (under Electrical and Computer Engineering) — "but we have no one to offer it." Continuing education and community college courses seem to be best able to adapt to the changing needs of communities.

Automotive Industry

A federal official noted that "technology in the automotive industry is going through a transformation." A reduced reliance on combustion technology is expected, along with a greater demand for skills in electronics, robotics, pneumatics, hydraulics, electro-mechanics and materials technology.

In order to meet the challenge of rapidly evolving technology in this industry, another federal official argued that the focus must be on finding ways to ensure that workers can upgrade their skills or develop new skill sets. This could be accomplished through innovative approaches to on-the-job training (including distance learning) that are accessible to smaller companies as well.

In parts of the country without a robust automotive sector, a federal official noted, training becomes problematic. Because Nova Scotia's industry is small, it is difficult to encourage youth to train for careers in it. New Brunswick's small automotive sector also suffers from a shortage of skilled personnel in a number of trades.

A federal official expressed concern that the industry might be "blind-sided by the environmental issue." At some point — perhaps soon — the industry's survival may hinge on "its ability to rapidly convert to an alternative to fossil fuel/internal combustion propulsion."

Biopharmaceuticals and Biotechnology

A federal official noted that "Canadian biotech companies absorb a relatively small number of new degree holders in biochemistry and related fields. This is partly because the vast majority of Canadian biotech companies are at early stages of development and require both scientific and business expertise that a new degree holder likely does not possess. It is only the later-stage companies that can afford to bring on a relatively inexperienced person and provide any training."

An official from another federal department agreed, and suggested that the Panel "recommend compulsory commerce courses as part of the undergraduate science degree program. The shortage of skills required for commercialization could be addressed in part through encouragement of multidisciplinary backgrounds, and particularly by cultivating managers with science backgrounds.

The first federal official noted that skills are important but "a lack of 'patient' money and over-long delays in securing regulatory approval for new products can — separately or in combination — starve a biotech company of operating revenues."

Nova Scotia has the education and research infrastructure to take advantage of this industry, but the large up-front costs, especially for R&D, are a major hurdle according to a federal official. "There is a large supply of educated labour and research facilities in the area. The labour supply is available from the school system — if the employers are able to offer sufficient wages."

Biotechnology could become important for New Brunswick because of linkages to the natural resource sector. Applications are now being developed in mineral leaching, pulp and paper processing and mill effluent treatment. Aquaculture applications are expected to increase, but the strongest growth is expected in agro-food.

As the industry matures, the demand for QC/QA expertise will increase. A federal official said that there is already increasing demand for people with the large-scale fermentation skills that are essential for manufacturing on a commercial scale.

Another federal official said that reliance on German-trained wood products engineers led secondary wood processing companies of all sizes to launch the National Education Initiative. This led in turn to the establishment of the Canadian Advanced Wood Processing program at the University of British Columbia. This program, supported by Industry Canada, HRDC and the provincial government, had its first graduates in 1998. The Woodworking Centre of Excellence in Campbellton, New Brunswick offers one- and two-year programs, and in 1988 the 16 graduates of the two-year program had 200 job offers. While such a model would work for any sector, these initiatives came to fruition only because there was a private sector "champion" with deep pockets.

Environmental Technologies

The challenge most often identified with respect to this sector is the blending of skill sets. The small and medium sized companies that dominate the environmental sector do not typically have the luxury of clearly defined specialist roles. A New Brunswick official concurred with the observation of a federal official based in Atlantic Canada: "Environmental technologies is a growth area that will require well-trained workers with a high degree of technical knowledge coupled with management and general business skills."

The Council for Human Resources in the Environment Industry reported a survey finding that 84% of organizations employing "environmental practitioners" felt it necessary to pr ide training or upgrading to most or all new employees. Four of the five most frequently identified problem areas were not environmentally related: written communications, computer skills, business skills and verbal communications. Technical skills which ranked highly included environmental risk assessment, environmental monitoring, environmental auditing and pollution prevention technologies.

The same survey found that 81% of organizations said entrepreneurial or managerial skills were "important" or "somewhat important" when selecting new environmental personnel. "Only 17% responded that, when hiring new environmental practitioners, entrepreneurial skills were not at all important." Respondents also reported difficulties in recruiting individuals trained in computer programming, business administration, site remediation, hydrogeology and technical sales.

A federal department commented specifically on the need for better programs in systems engineering. "The application of technologies across diverse disciplines to produce skill sets capable of addressing complex problems" was described as "a critical skill set for the environmental sector."

The Council for Human Resources in the Environment Industry noted that relatively few of the people working in the industry actually have environmental training. More typically, they are

chemists or engineers or geologists — the list could become quite lengthy — who have developed their environmental competencies through work experience and ongoing professional development." The Council noted that "this is slowly changing now that the recent graduates of environmental science programs and environmental engineering programs are entering the labour market."

A federal department also noted the important role that federal and provincial departments and agencies can play in developing a skilled workforce. / significant employers, they offer "potential fertile ground for the development of technical, policy and management skills of value to the industry sector." Unfortunately, government, academia and industry have developed pension/benefit and value/reward systems that impede intersectoral mobility.

The Council for Human Resources in the Environment Industry noted that companies' training and upgrading needs "vary significantly with organization size," and that SMEs, where the needs are greatest, are the "backbone" of the industry. The HRDC official noted that "business skills are necessary to enable small firms, which characterize Nova Scotia's industry, to grow and expand into offshore market opportunities... The industry moves quickly, so if the work cannot be done in Nova Scotia it will be done elsewhere. Without the proper flexible training infrastructure in place a chemical industry will not develop along with natural gas."

The Council for Human Resources in the Environment Industry noted that technologies are evolving to the point that pollution abatement often turns out to be a cost-saving or even revenue-generating factor: "Canada needs managers, scientists and engineers that will continue to foster the development of technological innovations that are more and more considerate of the environment (and technically efficient and economical from a business perspective)."

An academic noted that "the majority of the environmental workers have been historically employed by government agencies that have not nurtured creativity. Their level of risk taking was low relative to the business sector." While many new environmental technology companies are emerging, it may take years to develop a risk-taking culture.

Information and Telecommunications Technologies

This profile generated by far the most comment, some of it very forceful. Many would agree with the observation that "for the Canadian ITT sector, no other barriers are of comparable magnitude to the skills issue." Others argued that the "brain drain" issue is critical. Representatives of all sectors spoke of shortages both of skilled professionals and of teachers and trainers, and one respondent noted that none of the profiles reflected the important role of ITT as an enabler for all sectors.

Only one writer (a federal official) dissented from the view that a shortage of skilled staff is a major barrier to growth.

Academic Preparation

Issues raised here included marketing career paths in ITT to students before they reach post-secondary institutions. An industry official observed that "microelectronics is one of the sectors that has not done an adequate job to make primary and secondary school students aware of the opportunities and rewards of careers in engineering and high technology."

Other representations focused on the need for industry to clearly communicate "its changing skill and knowledge needs to the institutions, using continuous dialogue and resource interaction to maintain relevance in curriculum content and guidance on promising areas for research." An industry official indicated that there was "some acceptance" of the principle that as the skills threshold for entry level positions rises, it is appropriate "to download some basic skills education to the school system."

An academic commented on the importance of combining technical strength in Computer Science with such fields as fine arts, music and biology. "Employers also want students to learn teamwork and communication skills while at university, and to gain practical experience through coop and internship programs. To address the skills shortage in this sector it is critically important to (a) significantly increase our production of people with expert knowledge in computer science and engineering, and (b) do a much better job of retaining such people in Canada."

Retaining skilled people in Canada is an issue raised many times and will be addressed below, but an ICT industry official considered it subsidiary to the broader question of "the strategic re-building and expansion of a world-class post-secondary educational system in Canada. To achieve this, allocation of adequate research funds and salary budgets to attract and retain expanded university faculties of top class international calibre is absolutely essential. Nothing is more fundamental to Canada's future competitive ability and economic health."

Unfortunately, the shortage of skilled personnel interferes with the development of teachers and researchers: Masters' students in particular are frequently hired away before they complete their degrees. Industry may take their admission to graduate studies as an endorsement of their talent, but is often unwilling or unable to wait for them to complete their studies.

A federal department predicted that as many as half of IM/IT personnel in many large organizations like the public service will be retiring within ten years. "This will create some problems in the transition."

An academic noted that the ITT sector, particularly telecommunications manufacturing and services, is "a leading economic success story," accounting for 37% of all business R&D spending in Canada. "To sustain their leadership, these companies need a constant flow of highly-trained R&D personnel. The university system is a primary source of this crucial flow."

Another wrote that Canada's "MOST SERIOUS POTENTIAL skills shortage" would best be addressed by "a huge investment in Software Engineering programs that are offered by established Computer Science departments."

"The 40-year Degree Program"

"Universities and colleges are asked to be all things to all employers," wrote a university representative. "While academic institutions must be responsive to some of these expressed needs, industry must also take some responsibility in their specific skill needs and should, in some cases, take responsibility for training."

Another noted the importance of hiring lifelong learners able 'to adapt to the rapidly changing environment of information technology." University degrees should be viewed as indicators of ability to learn, to solve problems, to adapt — and to be molded i⸱ *   ·ely what an employer requires. "Since the industry is evolving at such a rapid pace, the   ·ng abilities and skills required today could be obsolete in less than five years, so this ong.   ung is vital."

A federal official said that while much of the information imparted in engineering programs will quickly become obsolete, "the discipline of systems engineering or software engineering programs is the residual skill required, not knowledge of a specific technology. I suggest that adaptive and continuous learning on the technology side is a more useful approach for IT, which changes very rapidly. The rate, scope and impact of change is too immense for technicians and managers to keep up across the board."

Soft skills matter. "Team skills such as being self directed, innovative and creative may be more important than having a PhD on the topic," the official said. Assembling project teams consisting of public servants and employees of one or more companies to develop technology solutions may provide a win-win solution for Canada. "People like to learn something new and master it and then move on in this sector. Learning one job and staying in the same job is no longer a work attitude. By providing a flexible work environment and job rotation, we may be able to keep more people." No skill set is more critical for developing technology solutions and bringing them to market than teamwork.

An academic complained that Canadian companies don't invest in ongoing training, which should account for 2-6% of payroll costs. Rather than building "knowledge assets", too many employers seem to view in-house training as a new form employee benefit. "Professionals going into high tech need continuous drip education."

Another commented on the sector profile's reference to the 3-10 years of experience that would allow an engineer to supervise other engineers. "I assume that implies that the experience would include project management, although growing 3-10 years older doesn't mean that you have acquired formal project management skills... There is a need for a much broader spectrum of skills than is represented in the discipline of software engineering with its emphasis on process improvement."

An academic noted that participation in training activities is almost always outside the "regular duties" of faculty members and often interferes with research activities. While "new hires" are much in demand as trainers "because of their recent experience with new approaches and technologies," they are usually given reduced teaching loads to allow them to establish their research. "The existing system is not impressed when these people take on training work." Training activities do not integrate well with the business plans of most universities.

Incubators

An industry official suggested that "only a large company can develop the depth of strategic vision for sustained global leadership, while training entrepreneurs that stimulate SME growth and diversity, creating in total a networked sector with the breadth, depth and agility to address any and all market opportunities competitively." He commented on the importance of government laboratories as "incubators and technological mentors," and said they did a good job "maintaining ITT competitive relevance" through close associations with large, innovative companies. Officials from all sectors commented on large "incubator" companies like Nortel as "an important ingredient for success."

A federal official noted that these companies "have very large and creative IT development projects that advance the science of IT, and are producing highly skilled software developers that are much sought throughout the industry." The official argued that without these companies, "Canada's IT industry would remain bloated with consulting companies implementing other companies' or countries' innovations, leaving Car .. as largely a consumer of software and not a supplier. Our high-potential people would either wind up lacking opportunity or emigrating to achieve their potential."

One federal official questioned the importance of large companies as incubators. Are the small companies — *tomorrow's* big companies — not the source of much innovation and the drivers of growth in this sector?

Whose field is it, anyway?

Several academics from various parts of Canada argued forcefully that the ITT sector profile focused too heavily on engineering: "Engineers are NOT computer scientists... If you concentrate solely on the engineers, you will make the same mistake children make when they mistakenly believe vegetables come from the grocery store." The same writer later asked whether "you would suggest that a law degree is appropriate background for your physician."

The President of the Canadian Association for Computer Science suggested that "The language and tenor of your document suggest that your committee's attention has been captured by the adherents of Professional Engineering."

The first writer concluded that it is inevitable that "legal and political constituencies will ratify what everyone else in the world already knows: that software engineering is a computing science discipline."

The discussion went beyond the argument that engineers are not computer scientists: an entrepreneur asserted that, notwithstanding the fact that some government agencies make no distinction, the engineering profession includes a great range of skill sets. All engineers are *not* created equal.

One federal official suggested that the most important component of engineering education is "a systems approach to problem solving and decision-making," and also commented on the importance of something equivalent to a *PEng* accreditation as a credential for software professionals. At present, "anyone with any background at all can claim to be a software professional as long as they can convince an employer to hire them as such. This has significantly diluted the level of competence that is seen among software professionals and, consequently, increased the risk to employers who are in the market for such highly skilled professionals."

Sub-Sectors

The importance of recognizing variations within the sector was noted: "The skill needs of a database developer and a new media developer vary significantly — and the skill needs of a new media developer in animation and a new media developer in Internet business applications are also light years apart." The same academic noted that while hardware and technology development is important, "it is software skill needs which are likely to become overwhelming in the coming years."

A federal official commented that "the software skill sets that are critical for the success of IT companies in Canada are software development skills... The IT industry in Canada appears to be flush with software consultants and integrators, but lacking in innovation and development. Consultants and integrators, while providing a very important function, operate on the periphery of the industry and contribute very little to the advancement of the science."

An IT industry official noted that "the intellectual asset leadership of established voice-switched network product suppliers has been heavily devalued by rapid growth of data and Internet-protocol (IP) based traffic, creating an essentially level playing field for SMEs."

Cross-Sectoral Issues

A single federal official suggested that there is no real problem: the "difficulties" reported in some sectors are the natural and inevitable results of growth. Few shared this view, or the official's expectation that managerial skills from the "old" economy will be easily transferred to the new.

The need to combine technical and managerial skills is a common thread among responses to several of the sectoral profiles. It is sufficiently pervasive to merit mention here, although it was not raised specifically as a cross-sectoral issue.

Career and Succession Planning

An industry official suggested that it was important to analyze the jobs expected to be filled in the medium and long term, "creating competency profiles for those jobs, and begin working with the educational community to provide competency based curriculum to support those students who want to go after those jobs."

Another said that the Labour Market Information System provides valuable data but that there only a few occupation codes "to describe this whole burgeoning industry, and the time to update the information and disseminate to industry is too long." This makes it difficult for private colleges and trainers to provide appropriate just-in-time training for industry, and for employers to identify and recruit appropriate new workers.

The first official added that "We need to redouble counselling efforts with students from grade eight and up discussing goals and ways to get there. We need to encourage Educational Institutions to provide clear, simple and reliable pathways for students who have a goal in mind to move unencumbered through the various levels of the education system. Industry needs to work with the educational community and government to ensure the volume forecasts are accurate and that the institutions can manage the flow."

An academic remarked that well-documented competitiveness problems begin at Kindergarten and continue through university. He noted that neither of Saskatchewan's universities has an effective degree program in international trade, and said that it was difficult to address the skills deficit "without taking into account the problematic infrastructure below and around."

Investment in developing highly skilled people is a net cost if the skills are exploited outside Canada. The same academic said that 80% of management graduates come from US schools — because Canadian schools can't compete. Only three Canadian business schools are counted among the world's top 50.

Technical Skills

One respondent commented that all five papers focus on "short-term quick-fix measures with an overemphasis on producing 'high-end' skills at the post-secondary level." It is equally important to ensure medium- to long-term competitiveness by ensuring that "all young Canadians acquire proficiency in ICT skills."

A federal official suggested that small and medium sized companies would be better able to compete if they partnered "with tier one companies and educational institutions... in coordinating and funding educational programs. These companies should have a strong voice in identifying skill sets needed by new graduates and what is needed in upgrading programs for current, experienced employees. This should help to smooth the cyclical demand for employees."

"Technical schools are not producing enough graduates to meet domestic demands and it is slowing the growth of the industry and adding to the cyclical highs and lows of the industry," said one federal official.

The issue of hands-on experience was raised by several contributors from the academic and government sectors: "More training spaces may not help if employers demand experience."

A federal official complained that Canadian companies "have not been able to adapt new technologies as quickly as competitors because the Canadian industry invests so little in training... There should be a focus on upgrading skills of employees already in the field to gain more creativity from those who already have the basic skills needed."

"Soft Skills"

A university representative noted that all five sectors, but especially Biotechnology and Environment, rely on lateral thinking and are not well served by over-specialization. He urged that universities be viewed not as job trainers but as "trainers of fast learners for any discipline."

An academic trying to emphasize the continuing importance of non-technology skills reported that the Business Council of British Columbia has conducted a skills survey each year since 1985. Communication skills have been ranked highest overall since 1989, and in 1999 topped 12 of 14 industrial categories. Technology skills made the top 15 for first time only in 1993, ranking 9th in 1995 and 7th in 1999.

Several responses addressed the critical importance of skills in such areas as project, human resource and financial management. One commented that companies are often established by entrepreneurs with highly developed technical skills. These skills, "accompanied by some intuitive knowledge of project, time and general business management skills, can take them only so far." These owners do not always recognize that they lack vital skills that would allow them to adapt to a larger employee base and address issues related to expansion — issues such as how to go about raising venture capital.

Operation ONLINE, in conjunction with Memorial's University's Technical Transfer Company, "operates a mentorship programme matching CEOs of small local firms wanting to expand their markets either nationally or internationally, with CEOs of successful larger firms in other areas of the country." The fundamental premise of the program is a recognition that "the formal education system can only go so far in meeting needs in this rapidly changing industry." Mentorships are an important tool to facilitate the transfer of skills between companies as well as within them, where the mechanisms might include "training, job shadowing, and seminars."

The Brain Drain

"The main issue that Canada currently faces is a constant brain drain which is occasioned by the tax differentials between Canada and the United States on the one hand and the lack of opportunity which is occasioned by the flight of capital on the other," noted an academic. Representations from all sectors discussed the difficulty of retaining teachers and graduates alike in the face of the higher salaries, lower taxes, and projects that "seem more appealing and innovative" offered by American employers to Canada's "best and brightest".

One academic noted that three of his department's 27 faculty were on leave, teaching in the US and tripling their incomes, and that more were likely to follow. He added that "it's hard to make the case for staying in Canada right now." Another academic noted that this loss of teachers limits both our ability to train people to fill vital roles and our capacity for innovation.

It was noted by another academic that both entrepreneurs and the best business teachers are drawn to the more favourable tax system and other benefits of working in the US. "The challenge we face is to persuade the public at large and our governments that there will be fewer opportunities in any of these sectors if we cannot have a favourable business climate for those who have the skills to be successful."

Issues Relating to the Scope of the Panel's Work

One intervenor argued that the oil sands industry, "a high tech knowledge based industry and fundamental to Canada's future," should have been treated as a distinct sector.

Another suggested that the overall exercise is not "an appropriate function of government. The whole idea of a central authority identifying skill shortages is a throwback to the days when we used to think that government had a role as the organizer of economic activity. Surely we no longer accept that governments can or should do that."

APPENDIX I: List of Contributors

The Panel is grateful for the substantive comments on issues, data and methodology provided by the following contributors:

Annette Albert, New Brunswick Department of Labour

Bob Atkinson, Aerospace and Defence Branch, Industry Canada

Calvin Caiger, Regional Coordinator-Community Colleges, PEI Department of Education

Tom Carey, Technical University of British Columbia

Manny Chetcuti, Director - IT Skills Development, Information Highway Applications Branch, Industry Canada

John W. Chinneck, Systems and Computer Engineering, Carleton University

Dr. Murray H. Colbo, Head, Department of Biology, Memorial University of Newfoundland

Janice Cooper and Craig Slaney, Operation ONLINE, Erin Keough, OLIN, and Genevieve Gallant, AMTEC

Ray Datt, President, Automotive Industries Association of Canada

John Davis, Paul Bellemare and Gary Boyd), Science Sector, Department of Fisheries and Oceans

Jonathan Dutton, Economic Analysis and Information Directorate, HRDC, Ontario Region

Mark Feldbauer, Biotechnology Human Resources Council

Barb Flynn, Policy & Evaluation, Saskatchewan Post Secondary Education & Skills Training

Richard Frost, PhD, Professor of Computer Science, University of Windsor

Dr. Jane Fritz, Professor and Dean, Faculty of Computer Science, University of New Brunswick

Jeffrey Gandz, Associate Dean, Richard Ivey School of Business, University of Western Ontario

Paulette Gay, Automotive and Transportation Branch, Industry Canada

Surendra Gera, Micro-Economic Policy Analysis Branch, Industry Canada, Ottawa

Brian Gillespie, President, British Columbia Institute of Technology

R.G. (Randy) Goebel, Chair, Computing Science, University of Alberta

Howard Green, Director General - Nova Scotia Region, HRDC

Barbara Guy, Canadian Congress for Learning Opportunities for Women

Lawrence E. Heider, Acting President, University of Prince Edward Island

Nancy S. Hamzawi, Environmental Affairs Branch - Industry Sector, Industry Canada

Doug Kinsey, Manufacturing & Processing Technologies, Industry Canada, Vancouver

Maria Klawe, University of British Columbia

Ulrich Krull, Associate Dean (Sciences), University of Toronto

Mike Lam, Information Manager, Alberta Advanced Education and Career Development

David J. Lapp, P.Eng., Director, Professional Affairs, Canadian Council of Professional Engineers

Timothy C. Lethbridge, Assistant Professor, University of Ottawa

Yves Lirette and André Desnoyers, HRDC Quebec Region

Patrick Loyer, Research Branch, Agriculture and Agri-Food Canada

Robert Macgregor, Department of Pharmaceutical Sciences, University of Toronto

Morris Maduro, Dean, University Extension, University of Regina

Brien Maguire, Computer Science Department, University of Regina

Eric Manning, President, Canadian Association for Computer Science; Professor & Director, Parallel, Networked & Distributed Computing & Applications (PANDA) Group, Departments of Computer Science and Electrical and Computer Engineering, University of Victoria

Colin R. Marr, Department of Education, PEI

Antony H. Marsh President, Canadian Microelectronics Corporation

Colleen McElary, Science Branch, Canadian Forest Service

Linda Melnick, Prior Learning Assessment Facilitator, Keewatin Community College, Manitoba

David Mulcaster, Industry Canada Atlantic Region, Halifax

Keith Parsonage, Information and Communications Technologies Branch, Industry Canada, Ottawa

Dr. Judith Potter, Department of Extension and Summer Session, University of New Brunswick

Dr. Birendra Prasada, President, Canadian Institute for Telecommunications Research

Marilyn Prus, Labour Market Information Analyst, HRDC Ontario Region

Jean-Guy Saint-Martin, ADM Strategy and Liaison, Canada Economic Development for Quebec Regions

C. Andre T. Salama, Program Leader, Micronet/Professor of Electrical and Computer Engineering, University of Toronto

Ted Seaman, GM-Human Resources, Syncrude Canada Limited

Dr. D.H. Shields, Dean, Faculty of Engineering, University of Manitoba

Steve Shugar, Natural Sciences and Engineering Research Council

Paul Stacey, Director of Corporate Education & Training, Technical University of British Columbia

Tony Stansby, Vice-Chairman, Strategic Microelectronics Consortium

Stephanie Stewart, Strategic Policy Branch, Western Economic Diversification

Emoke J.E. Szathmary, Ph.D., President and Vice-Chancellor, University of Manitoba

Louise Teckles, Materiel Group Human Resources, Department of National Defence

Skip Triplett, Kwantlen University College

Michael Walker, Executive Director, The Fraser Institute

Doug Wong, Director, Science Technology Centre, Carleton University