Advisory Council on Science and Technology

Conseil consultatif des sciences et de la technologie

Stepping Up

Skills and Opportunities in the Knowledge Economy

Report of the Expert Panel on Skills

Canada

About This Report

The following pages summarize the investigations, conclusions and recommendations of the Expert Panel on Skills. We made the narrative portion of our report as brief as possible and tried to avoid the use of highly technical language.

Our report is divided into five sections. Part I describes the Panel's mandate and approach taken in its investigations. In Part II, we provide definitions for a number of key terms and concepts used throughout the report. Part III contains brief sketches of the five sectors that were studied, and identifies the key conclusions we have drawn from our investigations. In Part IV, we propose a conceptual model to describe the relationship between skills and other factors in the knowledge-based economy, and identify the interrelated factors on which growth and prosperity depend. This section also specifies the roles and responsibilities of the various players in the economy. Finally, Part V contains our recommendations to individuals, governments, private industry, education and training providers, and others.

A hypertext version of our report is provided on the attached CD-ROM, along with additional details on our work and over 1000 pages of supporting documentation.

In the hypertext version of the report, the following linking conventions have been used:

- Highlighted text links to a relevant section within the report itself.
- Numbered endnotes link from the report to supporting documents.
- URLs listed in the report link from the report to external Web sites.

The report and supporting material are also available from the Web site of the Advisory Council on Science and Technology (**http://acst-ccst.gc.ca**).

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Presented to:
The Prime Minister's Advisory Council
on Science and Technology

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Advisory Council on Science and Technology
Conseil consultatif des sciences et de la technologie

Expert Panel on Skills

October 28, 1999

Dr. Gilles G. Cloutier
Deputy Chair
Advisory Council on Science and Technology
Ottawa

Dear Dr. Cloutier,

We have the pleasure of submitting to the Advisory Council on Science and Technology our unanimous report entitled *Stepping Up: Skills and Opportunities in the Knowledge Economy.*

We wish to thank the Advisory Council for the confidence it has placed in us. We hope that our analysis, conclusions and recommendations will help Canada and all Canadians seize the unique opportunities offered by the new, global, knowledge-based economy.

Yours sincerely,

Jacquelyn Thayer Scott, Chair

Paul Gallagher

John McLennan

André Bazergui

Clermont Le Breton

Tim J. O'Neill

Sheryl Feller

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[a] Formerly, Deputy Minister of Human Resources and Employment.

[b] Formerly, Deputy Minister of Education.

Chair's Message

This report has been both a labour of love and frustration for those of us who undertook, at the invitation of the Prime Minister's Advisory Council on Science and Technology, to provide advice on present and future skills issues.

The "love" came from our enthusiasm and commitment to Canada and to our fellow Canadians in these rapidly changing times. This seemed to us to be important work, well worth doing, to help secure for our children and grandchildren the quality of life we enjoy. The "frustration" came from knowing we had a short period of time and limited resources to address a complex and complicated issue – involving three orders of government, business and labour organizations, education and training institutions at all levels, professional associations and industry sector councils, and individuals and their families. Indeed, our Panel membership reflected this diversity, with individuals from all regions, some provinces, and from the business and educational communities. Our approach to research and consultation reflected the concern that all those who wanted to participate in our deliberations could be involved throughout the discovery process.

So, not surprisingly, our recommendations pertain to a variety of stakeholders – federal, provincial and First Nations governments; business and labour organizations; educators and trainers, and even individual Canadians. We hope this report will stimulate dialogue on the roles and responsibilities of the various stakeholders in creating the future we all want.

This report is longer than we had hoped (although, because of our interactive format, it's a lot shorter than it might have been!). We tried, rather desperately (and unsuccessfully) over several months to render a few tasteful and simple suggestions – in an even more compact, explanatory package – that, if implemented in the usual ways, would have demonstrable and positive impacts.

Our lack of success in achieving the policy equivalent of a couple of good "sound bites" is a tribute to both the intelligence and commitment of my Panel colleagues. The challenges and complexities of both this issue and our report are "the nature of the beast". There came a time when we concluded we would render no one a service by offering simplistic analysis and delicately pastel and subtly nuanced suggestions.

As well, we owed frankness to the hundreds of stakeholders who worked with us on defining the problems and pointing toward solutions. Across the country, throughout the various stakeholder groups and sectors, participants conveyed their worry and frustration about how fragile our current, apparent economic success is and what the future holds. They expressed concern about the skills stock of our work force in five to 10 years' time – especially our stock of essential skills (teamwork, problem analysis, the ability to generate options and solutions, and good communication skills, both written and oral) and management skills. Stakeholders told us how we need to invest more in creating new knowledge, finding new applications for existing knowledge that can be commercialized, and developing them in Canada. They were also concerned about the lack of prioritization of public investments in skills and enterprise opportunities, and the tendency to divide every modest expenditure into tiny portions allocated across a broad spectrum, instead of strategically investing for success. They expressed their frustration that decisions are not made and action is not taken on issues they believe are urgent and important. "Just do it" was heard in many venues.

Most of all, the stakeholders shared with us their worry about Canada's future, for our children and grandchildren. They know that matters will not simply work out on their own. And they know that we don't have unlimited human and financial resources to throw at problems. In their view, our geography and demography require selected strategies, rather than a laissez-faire fatalism born out of jurisdictional gridlock.

I want to note on the Panel's behalf that this report is fundamentally optimistic and action-oriented. Like those we consulted, we believe that the issues related to skills and opportunities in Canada over the next decade are urgent but remediable – if we have the will and ingenuity to address them.

Our recommendations are mostly very specific and targeted, because we believe this is what is required to move forward. Some recommendations may seem bold, even mildly radical or at least beyond the conventionally incremental. However, they were carefully considered and thoughtful: where we thought action could be taken through existing structures and institutions, we recommended accordingly. In the end, we concluded that the existing structures were incapable by their very nature of advancing and completing all the work that needs to be done.

Finally, let me note that no Chair was ever so fortunate in Panel members. There were no "shrinking violets" and our discussions were brisk and passionate, in our efforts to achieve a report that was appropriately complex but very clear in its direction.

Jacquelyn Thayer Scott, PhD
Chair, ACST Expert Panel on Skills
President and Vice Chancellor, University College of Cape Breton

Acknowledgments

We were very fortunate to have an excellent staff. The Panel's Secretary, Gilles Jasmin, was a dogged pursuer of fact and clarifier of fuzziness, while Bernardo Li and our student intern, Chris Braeuel, and administrative assistant Debra Roháč kept the details together and the paper catalogued and flowing. We are sincerely grateful to the Canadian Labour and Business Centre and its CEO, Shirley Seward, for the "loan" of Derwyn Sangster as our Research Advisor. He, together with Research Coordinator Bert Pereboom, managed a crushing workload with very tight time lines and a wide variety of contractors. Geoff Poapst, our talented writer, helped mightily in translating academic and bureaucratic language. Dr Chummer Farina and other staff of the ACST were unfailingly helpful, as were Kevin Lynch, Deputy Minister of Industry, and Mel Cappe, and subsequently Claire Morris, Deputy Minister of Human Resources Development Canada, whose departments jointly funded our work.

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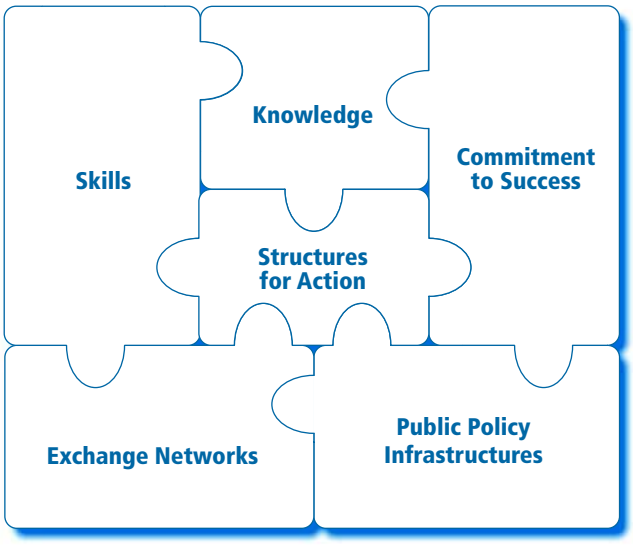
Executive Summary



For industry sectors, regions and entire countries to succeed in the knowledge-based economy, skills are vitally important. But the recipe for success is complex. The following elements are essential: creating and applying new knowledge and technology; building networks to disseminate ideas and information, and connect people and communities; and adopting appropriate public policies. Moreover, the key players in the economy must have a strong will to succeed and build the structures needed to transform collective will into concrete action. Every one of these ingredients must be present to ensure success.

Our report's analysis and recommendations, therefore, cover all of the basic ingredients: from education and training systems, to attitudes toward success and failure, to immigration, labour market information, capacity for research and development, and the country's digital infrastructure. We also propose new decision-making structures to help Canada and Canadians chart the most prosperous route into the knowledge economy.

Mandate and Approach

The Expert Panel on Skills was appointed to examine the skills picture in five strategic industry sectors: aerospace, automotive, biotechnologies, environmental technologies, and information and communications technologies. We were asked to identify current or potential skill shortages and suggest ways of ensuring that firms in these industries have access to the skills that they need to compete in the global, knowledge-based economy. The Panel was also asked to assess whether or not Canada's labour market monitoring systems are providing the information that individuals, employers, governments, and education and training providers need in order to plan effectively for the future.

We based our sector-specific conclusions in this report on commissioned research and on discussions and detailed interviews with senior corporate executives and industry observers. Our recommendations also stem from enquiries made into

broader labour market issues, through an extensive research program, expert seminars and workshops held across the country, and through open dialogue with interested Canadians via the Internet. Another very valuable information source was a fact-finding survey of national and regional approaches to skills and enterprise development in the United Kingdom and Ireland.

The action steps we propose are directed not only toward the five strategic industry sectors, but also to all stakeholders in the Canadian economy in general. The recommendations also extend well beyond Canada's skills development and learning systems. This is a reflection of our belief that an adequate supply of skills is but one of several interrelated and essential ingredients for growth and wealth creation in the knowledge economy.

Main Findings

Is There a Skill Shortage?

In the five industry sectors examined, we found no current evidence of a generalized and persistent shortage of *technical skills.* On the whole, Canada's education and training providers and immigration system appear to be keeping up with the demands of Canadian employers for technically skilled people. Indeed, in some highly specialized and advanced fields of study, Canadian universities are producing more graduates than Canadian firms currently can absorb.

We note, nevertheless, that in all five sectors, some firms are already incurring difficulties recruiting and retaining the technically skilled workers they need in a number of niche areas. These challenges will grow and become more generalized in the coming years. In the automotive and aerospace sectors, for example, a wave of retirement among skilled tradespeople will strain supply channels over the next decade. In other sectors, due to rapid growth or the requirement for extremely specialized skills, some firms may find it very difficult to fill positions with fully qualified people. However, based on reports from industry executives, at the moment most firms are coping adequately with these difficulties, which are not inconsistent with the normal ebb and flow of dynamic labour markets.

In sharp contrast with the technical skills picture, but equally critical to the competitive success of Canadian industry, is a persistent shortage of people who combine strong technical abilities with *essential skills* (e.g. communications and teamwork) and *management skills* (e.g. cost control and budgeting). In all five sectors, executives reported that finding technically competent people who can work in teams, communicate effectively and apply their technical knowledge to real world business problems, is a significant challenge.

Most employers expect, and by and large find, that recent post-secondary graduates are technically competent. They believe, however, that young people will only acquire the "softer" management and essential skills through progressive work

experience. This finding provides some explanation for the seemingly contradictory situation in which employers complain of skill shortages while many young post-secondary graduates have trouble finding their feet in the job market. We believe this finding holds important implications for Canada's primary and secondary schools as well as for the post-secondary education system. It strongly suggests the need to revisit both what and how young people are taught and whether or not schools and businesses could prepare them better for the world of work.

Dealing with Issues of Scale

The vast majority of firms in the five sectors studied fall into the category of small and medium-sized enterprises (SMEs). Many face problems in areas such as recruitment, retention and skill development, access to capital, technology transfer, commercialization of research and development (R&D), and export marketing. Often these difficulties are the direct consequence of their small size and limited financial and management resources.

These problems are not new. For decades, governments in Canada and elsewhere have developed policies and programs to help SMEs overcome the disadvantages of smallness. We believe there is an important role for governments in this area. Programs observed in Ireland and the United Kingdom were particularly impressive. By reinforcing capacity, these programs provide small firms with the means to upgrade different types of skills in their existing work force and to hire highly educated, but inexperienced, university graduates whose knowledge and skills will help them to innovate and grow over the long term.

At the same time, in four of the five sectors studied, the work of organizations known generically as industry sector councils was impressive. Companies have formed sector councils, in most cases with government assistance, to provide members with sophisticated human resource management programs and services that few firms could afford to develop on their own. We believe that sector councils hold enormous potential to address human resource and other management challenges, such as pre-competitive research, the commercialization of R&D, and export marketing, in all industry sectors dominated by small firms.

The Supply of Labour Market Information

Individuals and organizations need accurate, timely information on trends and conditions in the labour market to make sound career and learning choices, and investment decisions. From discussions held with leading authorities, it can be concluded that Canada's labour market monitoring systems, although among the best in the world, will have to improve in order to keep pace with economic and technological change. In particular, the basis for data collection must shift away from occupational titles and focus more specifically on the skill sets actually required for any given – often rapidly changing – occupation. Equally important will be enhancing Canada's capacity to analyse labour market information and put it to use.

A Skills Development System Under Stress

Although we found no evidence of a current shortage of technical skills, we cannot afford to be complacent. The pressures of economic, technological and scientific change, combined with an ageing work force, and intensifying global competition for skilled people, will soon strain our skills development system to the limit. Indeed, the signs are already present.

A persistent and generalized shortage of management and essential skills among technically trained high-school and post-secondary graduates has already been noted. In several occupations, the demand for skilled tradespeople will soon outstrip supply. Demographic trends also raise alarm bells related to the skills of both entering and exiting workers. With a relatively smaller youth cohort reaching working age over the coming decade, we must ensure they are not only technically competent, but also adequately prepared for the world of work. This will not be achievable unless targeted changes are made to the funding of our education and training institutions. For the existing work force, new methods and initiatives are required to assure continuous upgrading.

The loss of some highly skilled people to the United States is also a concern, particularly in the information and communications technology sector. Although we believe this situation remains well short of crisis proportion, the "brain drain" draws attention to a very perplexing challenge. We not only have to ensure that Canadian firms have access to the higher-order skills that the knowledge-based economy demands. We must also ensure that highly skilled and educated Canadians have the opportunity to put their skills to work in Canada.

Understanding the New Economy

As Canada makes the transition from the industrial to the Information Age, our stock of skills and capacity to develop skills will shape our economic prospects. But skills alone will not guarantee success. In addition to a strong skills development and learning system, we will also require the following:

- systems and processes such as R&D to create knowledge, put new knowledge to use through innovation and technology transfer, and translate new knowledge into commercial products;
- exchange networks to carry goods and services and, increasingly, information and ideas across the country and around the world;
- public policies to encourage wealth creation, sustain our social values and support public information systems that can help individuals, families, governments, and education and training providers to plan effectively;
- a broadly shared commitment to success, coupled with a willingness to set collective goals and work together toward them; and
- decision-making structures that cross traditional public and private sector boundaries and allow all of the players in the economy to pursue both individual and collective goals.

To compete and win in the knowledge-based, global economy, individuals, families, governments, private industry, education and training providers, and others must accept responsibility for ensuring that all of these interrelated elements are in place.

Recommendations

The Panel's recommendations reflect our belief that, in the knowledge-based economy, much like in a healthy ecological system, all of the elements necessary for success must be present for countries and regions to prosper and grow. In order to achieve these winning conditions in Canada, **the Panel calls for specific actions to address six main challenges**.

Public Policy Infrastructures

The challenge: labour markets are increasingly complex and dynamic

Individuals, employers, education and training providers, and other stakeholders require help to cope with the growing complexity and increasing pace of change in labour markets. By taking steps to meet their needs, we can improve the performance of our labour markets and hence, our economy.

Recommended Actions

To strengthen our capacity to understand labour markets, by

- identifying and documenting the skills required in science and technology occupations;
- encouraging stakeholders to adopt standard definitions, measurements and terminology in relation to skills;
- creating a new federal/provincial/territorial Labour Market Research Fund; and
- providing additional funding to the Social Sciences and Humanities Research Council for graduate training and targeted research on labour market issues.

To make better use of labour market information, by

- creating a Centre for Labour Market Statistics at Statistics Canada, under federal/provincial/territorial direction;
- engaging employers, unions and sector councils in the collection and dissemination of sector-specific labour market information; and
- establishing competency standards for career and employment counsellors.

To overcome barriers to labour mobility within Canada, by

- sustaining and further developing Prior Learning Assessment and Recognition (PLAR) expertise and services; and
- ensuring the full implementation of the mobility provisions of the Agreement on Internal Trade by July 1, 2001.

To improve Canada's ability to compete for highly skilled workers from abroad, by

- involving employers in the selection of skilled immigrants;
- making it easier for Canadian universities and colleges to recruit highly talented foreigners to faculty positions;
- making it easier for foreign nationals studying in Canada to become permanent residents;
- requiring professional regulatory bodies to "fast track" the accreditation of immigrants in regulated occupations; and
- making Prior Learning Assessment and Recognition (PLAR) part of the review process for skilled workers applying to immigrate to Canada.

Knowledge

The challenge: skilled Canadians are facing a shortage of opportunities

Canadian post-secondary institutions produce some of the most talented and sought-after graduates in the world. Unfortunately, many firms, especially SMEs, have difficulty absorbing highly educated graduates, particularly in science and technology. In addition, our investments in R&D remain small compared with most other G7 nations. As a result of these factors, there is a shortage of opportunities in Canada, which is leading some of our most highly qualified people to seek employment elsewhere.

By taking steps to expand investments in basic and applied research, by directing part of these investments toward the most promising fields, and by helping knowledge-intensive SMEs to grow, we will create new opportunities, reverse the "job drain" and allow highly skilled Canadians to apply their talents at home.

Recommended Actions

To boost the capacity of our universities and colleges to do high quality basic and applied research, by

- allowing federal granting councils to underwrite not only the direct, but also the indirect costs of the research that they support.

To improve the return on public and private sector investments in science and technology, by

- creating a process through which our best science and business minds can project current science and technology trends into the future and identify high-return areas for current and future investments in research and development (R&D).

To stimulate growth among small knowledge-intensive firms, by

- establishing up to 20 "enterprise incubators" on university and college campuses across Canada, particularly outside of major metropolitan areas, to provide a full range of scientific, technological and management services to small knowledge-intensive firms, particularly in the startup phase; and
- establishing a program to help knowledge-intensive small and medium-size enterprises (SMEs) absorb recent graduates in science and technology while helping participants to acquire business management skills.

Skills

The challenge: our learning systems are under growing stress

There is no evidence of a generalized shortage of technical skills in Canada at this time, although shortages do exist in specific sub-sectors of industry. On the other hand, our education and training systems are showing unmistakable signs of stress. Many high-school, college and university graduates lack the essential skills and management skills that most employers seek. The current intake of our apprenticeship programs will not be adequate to counterbalance a wave of retirement among skilled tradespeople over the coming decade. Moreover, a decade of budget restrictions has significantly weakened our college and university establishments. Although there is much talk about the importance of lifelong learning, we are in fact only beginning to put theory into action.

To succeed in the knowledge-based economy, relieving these points of stress and modernizing our formal and informal learning systems are clear priorities.

Recommended Actions

To ensure that young people have a solid foundation for future learning and acquire all of the skills they will need to succeed in the knowledge-based economy, by

- improving the learning environment for young children;
- making "work studies" and other experience-with-work programs more widely available at the elementary and secondary school levels;

- monitoring the acquisition of essential skills by elementary, secondary and post-secondary students
- ensuring that teachers are well equipped to deliver essential skills education;
- building stronger linkages between schools and the world of work;
- ensuring that there is a sufficient pool of qualified teachers of mathematics, science and technology at elementary and secondary levels; and
- attracting more young people to apprenticeship programs.

To improve the capacity of post-secondary institutions to meet the skill needs of students and employers, by

- increasing operating funding to post-secondary institutions to restore deteriorated facilities and equipment and to address strategic priorities;
- improving the recruitment of students and their retention through to graduation in science and technology programs, and enhancing the resources available to these programs;
- developing appropriate planning tools to help avoid an under-supply of university and college professors for the next decade and beyond;
- building stronger links between post-secondary institutions and employers; and
- improving the tax treatment of real property and stock donations to the capital campaigns of universities and colleges, and addressing regional biases in corporate and personal contributions.

To improve our capacity to upgrade the skills of the existing work force and make lifelong learning accessible to all Canadians, by

- making lifelong learning a national priority and ensuring that all policies related to education and training support that objective;
- helping employers, particularly SMEs, to upgrade the skills of their employees and managers;
- making Canada a world leader in the development and use of learnware and other new learning technologies; and
- helping Aboriginal communities address their special learning and skills development needs, particularly with respect to the knowledge-intensive areas of the economy.

Exchange Networks

The challenge: there is a risk of a widening gap between the "information-rich" and the "information-poor"

Much of Canada's social and economic success in the latter half of the 20th century has been due to an accessible primary, secondary and post-secondary public education system. As we move into the 21st century, we must ensure that all Canadians have access to the lifelong learning opportunities made possible through Information Technology. Making high-speed Internet connections widely available will open up huge learning opportunities for all Canadians. It will also create the opportunity for Canada to become a world leader in systems and applications for connectivity, Internet-based learning and electronic commerce.

Recommended Actions

To make Canada "first in the world" in connectivity and on-line learning, by

- engaging the private and public sectors in providing affordable, high-speed Internet access to every home, school and business in Canada; and
- making learning opportunities more broadly available, particularly to rural and northern residents by transforming Community Access Program sites into true learning centres.

Commitment to Success

The challenge: attitudes toward entrepreneurship, risk taking and success are not changing fast enough

As a result of globalization and rapid technological change, markets are placing a growing premium on innovation, entrepreneurship and risk taking. By and large, however, these are not the characteristics commonly associated with Canadians. Instead, we see ourselves, as do others, as being more concerned with fairness and equity than competitiveness and wealth creation. In fact, too many Canadians view these value sets as mutually exclusive. To prosper in the knowledge-based economy, we must learn to recognize that "being successful" and "being fair" are not incompatible. We must change our thinking about risk and innovation in order to create wealth and protect the values that we hold dear.

Recommended Actions

To encourage the development of a more innovative and entrepreneurial culture, by

- familiarizing young people with the basic concepts of risk management, innovation and entrepreneurship over the course of their elementary, secondary and post-secondary education;
- articulating a national vision that demonstrates the compatibility of risk, wealth creation and competitiveness with the values of fairness and equity; and
- celebrating the achievements of risk takers, innovators and entrepreneurs.

New Structures for Action

The challenge: our machinery for making decisions and taking action about skills and enterprise development is inadequate

For a country to prosper in the new economy, it must have decision-making structures through which all stakeholders can accept responsibility and work together as required to create the conditions necessary for growth and wealth creation. In particular, there is a need for decision-making structures that can integrate our national skills and enterprise development agendas. This reflects the necessity not only to improve our capacity to generate high-order skills, but also our capacity to deploy those skills among growing enterprises within our own borders. Many decision-making structures designed for the industrial age are simply not suited to the pace and complexity of the Information Age.

New structures are required that both respect market forces and our democratic institutions, and provide the means for making country-level decisions quickly and effectively on issues connected with skills and enterprise development.

Recommended Actions

To create decision-making structures suited to the knowledge-based economy, by

- establishing "Enterprise Canada", a federally funded, private sector-led executive agency that will operate at arm's length from government and work at the national, regional and local levels to integrate skills and enterprise development strategies.

To keep the skills and enterprise development priorities front and centre on the agenda of Canadians and their governments, by

- appointing an "Ambassador for Skilled Enterprise" for a defined term, to monitor and report on the response of all stakeholders to the conclusions and recommendations contained in this report.

PART I

Introduction

Canada has the talent, resources, technology and institutions it needs to be a world leader in the global, knowledge-based economy. These words introduce the Expert Panel's terms of reference; and since our work began in September 1998, we found little reason to think otherwise.[1] Our examination of five strategic industry sectors has shown that the technical and scientific skills situation is essentially sound, except in some niche specializations. We believe that this conclusion extends to much of the Canadian economy. However, that is the current situation and that is bound to change. Given the current economic, technological and demographic trends, Canadians cannot afford any complacency about their skills stock. Indeed, our Panel was told on many occasions across the country that the problems and their solutions within the skills and enterprise system are known and urgent. As several of those consulted put it: "Just get on with it!"

Labour force projections, based on demographics and some middle-of-the-road assumptions on economic growth and policy change, suggest that Canada's labour force will grow to 17.8 million by 2010, up from 16 million in 2000.[28] Roughly one quarter of the total in 2010 will be young people who entered the labour force between now and then. Perhaps another 10 percent of the work force will be immigrants arriving in Canada between now and 2010. Given our comparatively high rates of unemployment, creating opportunities for these new entrants will present an enormous challenge. Meanwhile, competition for top-flight specialists in knowledge industries is increasingly global, and a further challenge is to make Canada an exciting place of opportunity for bright young people.

When we consider that nearly two thirds of the labour force we will have in 2010 is already working today, a still greater challenge emerges. Do we have the means to keep the skills of an ageing work force up to date? Are we really embracing the concept of lifelong learning? Are we tapping every potential source of talent available? As globalization and technological change reshape the demand for skills at a blistering pace, are schools teaching the right things? Do we know what schools should be teaching and how they should be teaching it? Can we ensure that all of our regions rise to the skills challenge and share in the fruits of the knowledge-based economy? How can we create a work and learning environment that will keep our most skilled people in Canada and, at the same time, attract talent from around the world?

Each of these questions is perplexing on its own. They are more perplexing still when we consider that the knowledge-based economy is a complex "ecological system" in which these and other questions are inextricably linked and must be answered together. Readers may be surprised at some of the conclusions we reached in addressing these tasks. In our view, however, it makes little sense to talk about Canada's present and future skill challenges without considering other factors directly connected to skills.[17] As a result, we decided to take a broad approach in our investigations and analysis of the skill challenge. From the outset, however, the Panel wishes to stress that moving forward in only one or two areas of our recommendations will not secure Canada's place among the leading knowledge-based economies. The challenge is to find the commitment, resources and organization needed to move on many fronts simultaneously.

Our Panel's Mandate

The Expert Panel on Skills was appointed by the Prime Minister's Advisory Council on Science and Technology (ACST). It was asked to examine the skills challenge in five industries where Canada is strong already or where opportunities for economic growth and employment creation are high. The five industries are the following:

- **Aerospace**, including aircraft and propulsion systems manufacturers, makers of components, sub-assemblies and parts;
- **Automotive**, including vehicle assembly and parts manufacturing (but excluding retail and repair services);
- **Biotechnologies**, including biopharmaceuticals and a range of products and applications used in agriculture, aquaculture and forestry;
- **Environmental technologies**, including equipment and process design and manufacturing, consulting and related construction services; and
- **Information and communications technologies** (ICT), including computer hardware and software manufacturing, Internet service providers, telecommunications equipment manufacturers and carriers.

The Panel was also asked to assess whether Canada's information systems provide individuals, employers, governments, and education and training providers with the labour market information they need to plan for the future.

At first glance, these sectors may seem an unusual combination. Two are mature industries, automotive and aerospace manufacturing, and have been part of our industrial landscape for decades. The other three are relative newcomers. Still, all five industries increasingly compete globally in capital, labour and product markets. Moreover, for these industries and most others, a primary source of competitive advantage lies in the skills and knowledge of their employees. Seen in this context, the five strategic industries share much in common with other industry sectors trying to survive and thrive in the knowledge-based economy.

In the simplest terms, our job has been to determine whether or not the volume and quality of skills available to these industries will allow them to achieve their full potential in the coming decade. We were asked to examine the current skills picture, to identify areas where shortages may emerge over the next five to ten years, and to suggest steps to ensure that Canadians acquire the skills and attitudes they need to prosper in the knowledge-based economy.

Our Panel's Approach

The pace of change in the global economy, the uncertainty of competitive outcomes and relentless technological change make it difficult to predict what labour markets will look like a year from now, let alone five to ten years hence. Many of the new "jobs" we hear about today – such as Web mastering, digital animation or genome mapping – did not exist in the 1980s; and many of the jobs that did exist then look very different now. There is every reason to believe that the pace of change in the decade ahead will be just as fast and that the character of work will continue to be reshaped.

In view of these factors, it would be extremely difficult and time-consuming to make precise forecasts of the number or type of skilled workers that each of the five sectors will require down the road. Projection difficulties can be due in part, to the influence of significant, unpredictable events that can dramatically affect the demand for goods or services and, hence, the demand for skilled workers across entire industry sectors. Examples would include the cancellation of major projects, developments in the international arena, such as trade disputes or interest rate hikes and other unanticipated changes in general economic or political conditions at home or abroad.

More problematic still is a lack of reliable data. In some cases, such as the information and communications technologies (ICT) sector, there is little agreement on where the boundaries of the sector should be drawn, let alone the occupational categories and skill sets involved. Where this kind of projection has been done successfully, it has taken years of effort and cooperation among employers, educators and trade unions to build effective sectoral monitoring systems. With the one-year deadline that the Panel faced, it was simply not possible to do this adequately for each of our five sectors.

To make reliable predictions about potential skill shortages, there is a need for a different approach to collecting labour market information. One priority will be to shift our current monitoring systems away from occupations to focus more specifically on skills. Another more difficult challenge will be to develop techniques for projecting basic trends in science and technology. With a better idea of where science and technology are headed, we can speculate from a more informed standpoint as to the kinds of jobs that are likely to be created, and factor this into the supply and demand sides of the skills equation.

Despite current data limitations, we began our work by critically examining the best information available from industry and government sources for the five sectors. From these sources, we developed detailed profiles for each of the five sectors, including assessments of the skills perceived to be in short supply. We then doubled-checked our observations in talks with senior industry officials and documented industry responses to a range of human resource management challenges.[a] A further set of interviews with individual firms looked at a sample of "hard to fill" positions in each industry sector and identified the specific skills associated with these positions.[8] The Panel's conclusions and observations about the five specific sectors flow largely from these investigations.

In addition to industry-specific enquiries, the Panel also commissioned leading researchers to probe into key skills-related issues pertaining to Canadian industry and the economy more generally, including critical inventories of recent skills-related policies and programs across Canada.[19] [20] Important input was also received from a series of workshops[24] [25] [26] [27] and seminars[22] [23] involving close to 300 industry stakeholders, education and training providers, scholars, and labour market specialists and practitioners. Finally, the

[a] A list of all the documents assembled by the Panel can be found in the ACST Web site (**http://acst-ccst.gc.ca**) under the heading: "Expert Panel on Skills Information Sources."

Panel remained accessible to all interested parties by posting material on its Web site and gathering on-line feedback.[7]

The Panel examined skills issues, trends and practices in the United Kingdom and Ireland, as well as in the United States, Canada's largest trading partner.[21] A highly informative part of our information gathering involved fact-finding in Ireland, Northern Ireland, Scotland and Wales. These areas were chosen quite deliberately because, apart from their obvious difference in geographical size, they offer many parallels to Canada. Their economies are largely populated by small firms and, where larger firms do exist, they are often branch plants of multinational companies whose operations are heavily influenced by decisions from the head office. With the exception of Ireland, the populations of these areas are ageing. They are also located on the periphery of a huge domestic common market, namely England and the European Union, which is nearly the size of the North American Free Trade Agreement (NAFTA) market. Their experience in skills development holds important lessons for Canada.

Readers will note that our recommendations, while informed by sector-specific issues and concerns, are focussed on actions that apply to the knowledge-based economy in general.

PART II

What Are We Talking About? Defining the Issue

Should We Focus on Skills or Occupations?

The distinction between skills and occupations is important. A *skill* is the ability to perform a task, while an *occupation* is the label attached to a job or kind of work requiring a given set of skills. For example, someone who is a machinist by occupation must have the skills (knowledge and know-how) to read technical diagrams, shape metal and other materials to exacting specifications using a variety of equipment, and test the final product.

Unfortunately, the skills and attributes employers seek seldom come in neat occupational packages and, increasingly, those employers are looking for more than just technical or scientific capabilities. On many occasions, we heard from employers seeking engineers who can understand market research, biologists who can manage research teams and commercialize products, or tradespeople who can work in teams. Occupational labels, which can be quite static (despite the best efforts to incorporate changes), cannot do justice to the constantly evolving and expanding mix of technical, management and essential skills and attributes sought by employers. No one is more aware how difficult it is to keep up with changing classification than those at Human Resources Development Canada (HRDC) who look after the national Occupation Classification (NOC) system. Thus, when we heard that there is a "shortage" of millwrights or biotechnologists or computer scientists, we were careful to dig deeper, beyond jobs or occupations, and ask not only what jobs are hard to fill, but also which particular skill or skills sets are in short supply?

The question of skills versus occupations is also central to our discussions of Canada's labour market monitoring systems. Many of the labour market monitoring and projection tools, especially those featuring quantitative statistics, are primarily occupation-based. Some skill-based data sets exist, but are still in their infancy and cannot be used easily to monitor labour market dynamics.

What Do We Mean by Critical Skills?[32]

The Panel has defined *critical skills* as the knowledge, aptitudes and abilities without which companies cannot grow. They are the skills that firms must have in order to compete in the global economy. Moreover, the critical skills for a given industry will always be shifting due to changing technology, market conditions and management strategies. To succeed, individuals, organizations and entire countries must develop and apply new skills at the rate that change demands. To put it another way, we are always trying to hit a target that moves at a rapidly increasing speed. This is a very different situation from the old economy, in which skills

Different Types of Skills

Labour market skills can be grouped into the following five basic categories.

Essential Skills refer to the ability to read, write, calculate and operate basic computer applications. They also refer to the ability to think; analyse and solve problems; learn independently; exercise responsibility; adapt to a range of situations; communicate effectively; cooperate with others; and work in teams. Essential skills – coupled with attitudes such as drive, determination, enthusiasm and commitment – are broadly recognized as basic building blocks for productive participation in the work force.

Technical Skills (including professional and scientific skills) refer to the "ability to do" or to perform specialized tasks that may be particular to a single occupation or industry or cross a range of industries.

Management Skills refer to the ability to undertake organizational activities such as planning, marketing and evaluation, as well as the ability to manage people, capital, budgets, and so on, which has broad application across industry sectors.

Leadership Skills refer to the ability to motivate and assist others to achieve their full potential, to take risks, and to formulate and champion a vision.

Contextual Skills refer to the ability to operate successfully in different settings, such as in different countries, different regions, or a culturally diverse workplace. Each organization and industry sector operates within its own context, and some may operate in several contexts. Each context requires different skill sets.

had a much longer shelf life. These new skill dynamics call for a different perspective on education and training systems, the collection of labour market information, and enterprise and sectoral development.

The concept of *technical skills* is relatively straightforward. In most industries, technical skills provide the critical foundation. Aircraft manufacturers, for example, need the skills of specialized engineers and cannot survive without them. Increasingly, technical skills are a necessary, but by themselves not sufficient, condition for commercial success.

Since the mid-1980s, global competitive pressures have reshaped most large organizations, shortening the distances between the executive suite, shop floor and front-line operations. Information and communications technologies have dispensed with whole layers of managers and clerical staff who once shuffled data and instructions back and forth. Moreover, with markets placing an ever-higher premium on response time, large and small firms alike have struggled to become more flexible and capable of forming partnerships and competitive alliances.

In many workplaces, employees no longer wait for instruction and then do strictly as they are told. Increasingly, they are self-directed or work in "self-managing" teams using Information Technology to access data banks globally, to communicate with customers and suppliers, and to improve business and operating decisions.

Imbalances vs. Shortages

The concept of a skill shortage is not as straightforward as it may first appear. In one sense, shortages always exist in every market, because workers, employers or investors rarely get exactly what they want. For example, it is highly unlikely for an employer to be able to hire an experienced, world-class engineer at an entry-level salary. The price mechanism in markets serves to ration goods and resources to those who are willing and able to pay the going price. The rest simply drop out of the market or make do with substitutes. Those are the realities of a market-based economy.[a]

More typically, however, employers may express concerns about skill shortages when they offer the wages they are accustomed to paying for a certain set of skills, and suitable candidates do not apply for the job. Sometimes the problem lies in the fact that those trained for a particular job or occupation lack some specific qualities that an employer regards as essential or highly desirable. In some cases, an industry may be concerned about future shortages, when it appears that current enrolment in the programs or fields they favour are not rising at the same pace as jobs that are currently being created. In all these examples of what people may call "skill shortages", there is some shortfall of appropriately skilled labour relative to the available jobs.

Are these sorts of skill shortages something we need to worry about? A growing, dynamic economy is almost guaranteed to generate many shortages and surpluses of various types of skilled labour.[18] As technologies and consumer tastes change, workers with certain skills may no longer be required, and workers with skills suited to emerging industries find themselves in demand. Exactly when and where these shifts in skill demands will take place is enormously difficult to predict, particularly when economic and industry cycles send confusing messages about industry skill needs. Predicting exactly how many workers with specific sets of skills will be required in a given industry in five to 10 years' time is as difficult as predicting the amount of rain that will fall on a certain date two months away.

Given the difficulty of forecasting the future, how should the concept of a skill shortage be understood? An economist might define a skill shortage as a *persistent* shortfall in the supply of qualified personnel at the prevailing wage or salary levels. If markets are functioning normally, the existence of a shortfall would trigger the response of higher wages, as firms compete with one another to hire the talent and skills they need.[18] Rising wages have two effects that tend to eliminate the shortage. First, some firms decide they cannot pay the going wage and either find substitutes or decide they can live without that type of skilled individual.

This reduces the demand for that skill. The other effect of rising wages is to increase supply. Young people choosing fields of study hear that wages are rising and jobs are easy to find in a certain occupation, and they rush to fill the gap as fast as formal education or training requirements will allow. Similarly, experienced workers with skills fairly close to those demanded by the industry might seek retraining or hope they are close enough to the requirements to satisfy the employer.

[a] See, for example, Richard Roy, Harold Henson and Claude Lavoie, *A Primer on Skill Shortages in Canada*, Human Resources Development Canada, 1996.

Both reduced demand and increased supply serve to eliminate the shortage. Sometimes the response is overdone, and the resulting surpluses throw the adjustment mechanisms into reverse.

For a *persistent* shortfall in the supply of certain skills, something has to go wrong with the market's adjustment mechanisms. For example, more students might be attracted to a field because of rising wages and better job prospects, but there may not be enough spaces in the appropriate education or training institutions to train them all. This could happen if institutions are slow to recognize and adjust to the increased demand, place relatively low priority on making sure their graduates find jobs, or because they themselves are unable to find the skilled personnel to provide the required education or training. If the education and training system forms a bottleneck, opportunities may be permanently lost. The growth of Canadian firms may be stunted, making them less able to establish themselves in the market, while firms in other countries can seize the opportunities. In this situation, the shortage disappears with the opportunity and the problem is solved, but not in a satisfactory way.

An additional factor complicating the skill shortage question is the definition of the boundaries of the labour market. The geographic boundaries of a labour market are defined by the distances over which workers hear about jobs, and their ability and willingness to move to take those jobs. With improvements in travel and communications, increased cross-border commerce under NAFTA, wider personal networks, and fewer restrictions on skilled Canadians working in the United States, there is evidence that labour markets, particularly for high-knowledge workers, have expanded geographically. These changes have served to create a North American labour market for skilled workers.

A North American, if not global, market for skilled labour means that labour market shortages do not necessarily originate in Canada, nor can they necessarily be easily remedied in Canada alone. If the United States fails to produce enough high-knowledge workers to meet the needs of U.S.-based employers, the impact will almost certainly be felt in Canada as Canadians are offered jobs in the United States and the going wage is bid up across North America.[a] Again, that is the reality of living in a market-based economy, one that is increasingly defined in North American rather than in purely Canadian terms.

It is worth noting that, in some fields, American colleges and universities have dramatically reduced the supply of new graduates. In 1995, for example, they awarded 24 000 bachelor's degrees in computer science, 43 percent fewer than in 1985. By way of comparison, in Canada, some 3000 bachelor's degrees in computer science were awarded in 1995, the same number as a decade earlier.[b] In engineering in the United States, 57 228 bachelor's degrees were awarded in 1995, some 18 percent fewer than in 1985.[c] In Canada, 7769 bachelor's degrees were awarded in 1995, an increase of 15 percent compared with 1986.[d]

Under these circumstances, it is no wonder that salaries in the U.S. ICT sector are on the rise and that American employers are seeking to attract workers not only from Canada, but from many other countries.

Although there are many more examples of what might cause persistent shortages of skilled workers in the Canadian economy, it should be clear that the key issue is not whether or not shortages or surpluses develop, but how long they last. The key question that concerns the Panel is whether or not our economy collectively has the capacity to recognize imbalances – shortages or surpluses – and whether or not the labour market is flexible enough to increase or reduce the supply of appropriately skilled individuals in a timely fashion.

In a knowledge-based, global economy, countries with the capacity to anticipate and respond quickly to changing demands for skills are more likely to prosper. It is therefore critical for Canada's education and training providers – at all levels – to have strong links to employers and offer experience-with-work programs at all levels. Canada also needs to improve the diagnostic capacity of our labour market monitoring systems. We need better cooperation between all levels of government and among all of the other players in the labour market, on training, education, immigration and related issues. It is also useful from time to time to take stock of how we are doing by asking and trying to answer the questions that the Panel has addressed over the past year.

[a] See for example United States Department of Commerce, Office of Technology Policy, *America's New Deficit: The Shortage of Information Technology Workers*, 1997, and *The Digital Work Force: Building Infotech Skills at the Speed of Innovation*, 1999.

[b] Association of Universities and Colleges of Canada, *Trends: The Canadian University in Profile*, 1999, p. 74.

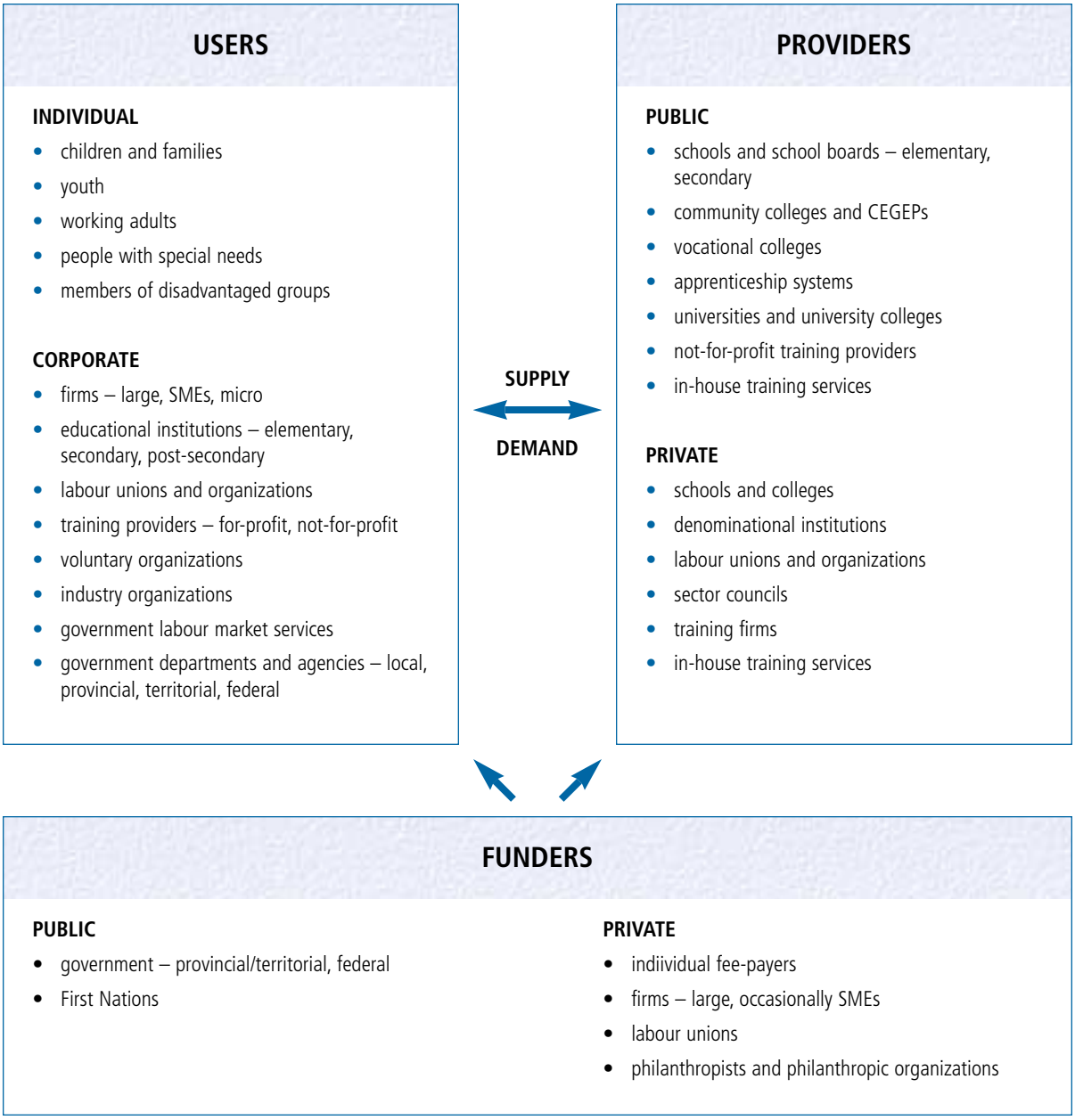
[c] National Science Foundation, *Science and Engineering Indicators 1998*, p. A66 (U.S. citizens and permanent residents of the United States).

[d] Natural Sciences and Engineering Research Council of Canada, *Highly Qualified Personnel*, 1997, p. 129 (Canadian citizens and permanent residents of Canada).

A Final Word About the Learning Market

In a knowledge economy, we need to be as concerned about the "learning market" and learning systems as we are about the labour market, because we need the right skills to continuously drive enterprise and maintain our high standard of living. All developed countries have complex learning systems, but Canada's may be more complicated than most because of our political and geographic realities. The responsibilities for funding and delivering education and training at all levels are shared among three or more orders of government, and seven or more types of education and training providers.

During the industrial era, educators collectively tried to meet the needs of children and young adults, with some small amount of attention paid to immigrants, historically disadvantaged groups and the incumbent work force. Education was delivered mostly at public cost and at specific times and locations throughout Canada – which may or may not have been convenient for learners.



Today, the "supply" of learning must be continuously available and easily accessible to "demands" by parents and families of very young children, and by older children and young adults, disadvantaged groups, and the incumbent work force. It needs to be delivered in a variety of modes and at times and locations that are convenient to learners, firms and other organizations. Earlier learning has to be assessed and equivalencies accredited, or "bridge learning" provided to link to the next learning goal. Increasingly, and as the learner ages, more of the cost is shared by the individual or an employer. The rate of change in curriculums and equipment needs presents new funding challenges for both capital and operating resources. Many learning packages will be jointly funded, developed and delivered by private firms and public education and training institutions based not only in Canada but also abroad.

The pace of change in the "learning market" and in learning systems continues to accelerate. If managing the learning agenda was jurisdictionally complicated in Canada in earlier times, these new conditions make the task harder still (as illustrated in the diagram on the previous page). We require new mechanisms and structures for decision making that will allow multiple actors and stakeholders to come together quickly to coordinate and integrate efforts appropriate to keep Canadian enterprises and learners competitive in a global, knowledge-based economy.

PART III

The Five Sectors: How They Operate

As mentioned earlier, the five sectors that the Panel was asked to examine share many characteristics. Each faces ongoing rapid and competitive changes driven by the development and application of new technologies. Each requires increasingly skilled employees, with excellent scientific or technical skills, but also good management, problem-solving and communications skills. Each requires flexible and nimble management that can provide the sector with strategic leadership to continuously define profitable Canadian niches in a global marketplace.

Five Industry Sectors at a Glance

For 1997, in Billions of Dollars Canadian (or US$)

	Aerospace	Automotive	Biotechnologies	Environmental Technologies	ICT
Total World Market	US$235	55 million units	US$22	US$469	$100.2
Canadian Revenues	$13.4	$85.8 (or 2.6 million units)	$1.1	$18	not available
Rank in the world	5th	6th	2nd	5th	not available
Contribution to GDP in 1992 (% of GDP)	$4.1 (0.6 %)	$15.4 (2.2 %)	not available	not available	$42.3 (6.1 %)
R&D Expenditures	$1.4	$0.15	$0.6	not available	$3.6
Exports	$9.5	$70.1	$0.4	$1.8 to 12.7e	$26.8
Trade Surplus/(Deficit)	($0.4)*	$11	(deficit)	(deficit)	($17.9)
Employment – in 000s	64	159	9,8	100e	474

e = estimate

*Data from Strategis, Trade Data On-line, and includes only SIC 321.

Sources:

Aerospace: *Aerospace and Defence-Related Industries – Statistical Survey Report*, Industry Canada, http://strategis.ic.gc.ca/SSG/ad03279e.html, Trade data from Strategis (SIC 321).

Automotive: *Automotive Industry Statistics*, Industry Canada (includes automotive tire and tube industry), http://strategis.ic.gc.ca/SSG/am01188e.html

Biotechnologies: *Canadian Biotechnology '98: Success From Excellence*, BIOTECanada, 1999.

Environmental Technologies: *A Profile of the Canadian Environment Industry and its Human Resources*, Canadian Council for Human Resources in the Environment Industry (CCHREI), 1999.

Information and Communications Technologies: *Information and Communications Technologies Statistical Review, 1990-1997*, Spectrum, Information Technologies and Telecommunications Sector, Industry Canada, May 1999.

The Aerospace Sector[2]

Through the 1990s, many Canadian aerospace producers have become world leaders in a range of niche products such as regional aircraft, business jets, small turbine engines, helicopters, simulators, landing gear, retrofitting and rebuilding. With more than 64 000 employees, and sales of $13.4 billion in 1997, Canada was the fifth-largest aerospace producer in the world with 5 percent of the global market.

The global aerospace industry is dominated by giant firms such as Boeing and Airbus Industrie. In Canada, even though 80 percent of industry shipments come from a handful of firms, they are still small by world standards, and the remaining 1000 or more firms are smaller still. Competitive pressures are forcing Canadian producers to accept more project and financial risk. This has already led to some mergers and further consolidations are expected. Prospects for Canadian producers are directly linked to their capacity to develop and market new products and technologies which, in turn, depends on levels of research and development (R&D). Levels of R&D in the aerospace sector are high by Canadian standards, but low by world standards.

The critical skills challenge facing Canadian aerospace producers are in design- and computing-related fields, and the industry places a particular premium on engineers with advanced software skills. A 1997 survey conducted by the Aerospace Industries Association of Canada identified the availability of skilled and experienced workers as the top issue facing the industry. The Panel's interviews with industry officials confirm these findings and point to possible shortages among engineering staff, skilled trades and production personnel. The cyclical nature and project orientation of the aircraft business creates special challenges for Canadian producers. Currently, with strong world demand for aircraft products, they face stiff competition from U.S.-based firms for both engineers and skilled tradespeople. When there is a downturn, the challenge is in retaining the skilled employees and generating the revenues to pay for them.

Although industry officials point to difficulties finding competent people in some technical categories, they still describe recruitment problems as "manageable".[8]

For entry-level positions that emphasize technical skills, aerospace producers have worked hard to establish, and now profit from, innovative degree and diploma programs developed jointly with universities and community colleges. However, the picture is much different for senior engineering personnel. Aerospace firms require senior engineers who also have solid negotiation, strategic planning, budgeting, project management and business writing skills. Employers stressed that they seek a hybrid skill set that is quite particular to their industry and far beyond the capabilities normally expected of an engineer. Finding junior engineers with strong interpersonal and teamwork skills, coupled with a willingness to learn was also seen as being difficult.

INDUSTRY–UNIVERSITY PARTNERSHIP

Several Quebec universities – Concordia, École Polytechnique de Montréal, Laval, McGill and Sherbrooke – have joined forces to offer a Master's Degree in Aerospace Engineering. The study program includes course work, a case study course conducted by industry experts, and a work term supervised by senior engineers of participating companies. The program is coordinated by the Comité Industries/Universités de la maîtrise en génie aéronautique et spatial and by the Centre d'adaptation de la main-d'œuvre aérospatiale au Québec.

http://www.polymtl.ca/2511aer1.htm
http://www.mecheng.mcgill.ca/Grad/Aerospace/index_e.htm

The Automotive Sector[3]

The automotive sector, including vehicle assembly and parts production, is Canada's largest manufacturing industry and a mainstay of the Ontario economy.[a] With 16 percent of North America's production of assembled automobiles in 1997, Canada is the sixth-largest auto-producing nation in the world. The Canadian industry employs 160 000 people, of whom 40 percent hold post-secondary certifications or degrees.

By virtue of the Canada–United States Autopact, a single North American market for automobiles has been evolving since the 1960s. Although non-Autopact producers now operate facilities in Canada and the United States, our automotive market is more North American than global. It is a consumer-driven industry that operates in the context of the North American business cycle.

a Although the Panel did not include automotive retail and repair services in its review of the sector, it was impressed by the human resource development and management activities made possible through the Canadian Automotive Repair and Services Council (CARS). **http://www.cars-council.ca/default.htm**

Canadian vehicle assembly, dominated by large, multinational corporations with 29 assembly plants was nearly a $60-billion industry in 1997. In the $25-billion auto parts sub-sector, on the other hand, production was spread over more than 550 plants. Although some parts manufacturers are large (some, even by world standards), 72 percent of parts firms have fewer than 50 employees, and 77 percent have fewer than 100 employees.

Intense global competition, industry mergers and rationalization, combined with worldwide excess productive capacity, have exerted enormous pressure to reduce costs throughout the Canadian industry. In the process, there has been significant downloading of R&D and design work from the assemblers and larger parts manufacturers to smaller firms. Compressed product development cycles are also pressing assemblers and parts producers to change their technology and processes. On the whole, however, Canadian assemblers and parts manufacturers invest relatively little in R&D, relying instead on technology transfer, often from their parent companies.

Canada's auto industry has fared well in the 1990s, coping with pressures stemming from globalization, and technological and regulatory change. Future success will depend on (i) maintaining production cost advantages over U.S. assembly, stemming from an estimated 25 to 30 percent labour cost advantage, and (ii) improving design and R&D capacities among parts makers, particularly small firms. These success factors are rooted in skills.

The most immediately pressing skills challenges are on the production side of the assembly and parts industries. In particular, the industry anticipates that existing apprenticeship and training programs will not produce skilled tradespeople quickly enough to counterbalance heavy worker retirements over the next two to seven years. This shortfall may run as high as 4000 skilled tradespeople.

Increasingly sophisticated equipment and processes will also require higher literacy and numeracy standards among production workers. In the parts sector, the need for greater technological sophistication and design capability within small firms and small-firm consortia will place a premium on design engineers, technicians, technologists and, in some firms, skilled tradespeople.

The automotive sector relies principally on established apprenticeship programs and has worked closely with community colleges and other training providers to develop co-op and full-time programs to improve the supply of skilled automotive tradespeople, technologists and to improve management and supervisory skills. The Canadian Auto Workers Union is also heavily involved in basic skills upgrading.

Since the auto industry output has been growing quickly in recent years, it is not surprising that executives from the assembly and parts sectors reported some problems recruiting or retaining people with technical skills and knowledge.[8] Middle-level design workers with five years of experience were a heavily recruited group. With this group, not only technical skills, but also experience, management and essential skills were seen as important.

On the whole, industry officials appear quite pleased with the technical competence of engineers, technicians and technologists graduating from post-secondary institutions. However, the situation with respect to management and essential skills is much different. At senior levels, project management, problem-solving and cost-control skills are in short supply, as are production workers with solid written communications and teamwork skills.

To one extent or another, this scenario – adequate technical skills but insufficient management and essential skills – was reported by executives in all five sectors.

INDUSTRY–COLLEGE PARTNERSHIP

In Windsor, Ontario, St. Clair College of Applied Arts and Technology, in partnership with DaimlerChrysler Canada, the Canadian Autoworkers Union and Industry Canada, is implementing a training program combining the best features of the traditional Industrial Electrician Apprenticeship with post-secondary education in Electronics Engineering Technology. Students work in industry three days per week and attend classes the remainder of the time, thus acquiring practical, as well as theoretical training and education. At the end of the program, students will have completed the in-school portion of their Industrial Electrician Apprenticeship, acquired significant practical hours as registered Industrial Electrician Apprentices, and earned an Electronics Engineering Technology Diploma. The skilled trades areas to be covered in the next phase of this major initiative are Industrial Mechanic (Millwright), Precision Metal Cutting (Mould Making), and Industrial Pipefitter.

http://www.stclairc.on.ca/amsi/amsi.html

The Biotechnologies Sector[4]

Biotechnology is an emerging industry in Canada, involving nearly 300 firms, most with fewer than 50 employees. Bio-pharmaceutical companies form the largest and fastest-growing segment of Canada's biotechnology industry with 50 percent of sales and employment, increasing by 25 percent per year through the 1990s. Agri-biological products account for 44 percent of sales, and industrial enzymes, aquaculture and forestry products make up the remainder. Total sales in 1997 were approximately $1.1 billion, or roughly 5 percent of the $22-billion global market. The Canadian industry is forecast to maintain its market share as the global market more than doubles to US$50 billion by 2005.

Biotechnology is extremely science and research-intensive. Half of the companies devote more than half of their revenues to R&D, and half of the work force is involved in R&D. Unfortunately, many firms find it difficult to translate accomplishments in the laboratory into commercial success stories. This can be a long and expensive process, particularly for agricultural chemicals and pharmaceuticals, where regulatory requirements must be very rigorous. Bringing a new drug to market, for example, may often take from eight to 12 years at a cost of $150 million to $250 million. Since small firms dominate our biotechnologies sector – 70 percent have fewer than 50 employees – few can generate the cash flow, or pay the premium for the management skills required to underwrite long-term product development costs. Not surprisingly, two thirds of Canada's biotechnology firms view access to capital as their "most pressing hurdle" to growth and to the commercialization of new products. Government support for R&D is also a vital success factor for biotechnology firms as are close links with university research and training programs, particularly teaching hospitals.

Given its scientific orientation, the biotechnologies sector's work force is highly skilled and highly educated. The most sought-after individuals are those with multidisciplinary scientific and engineering backgrounds. Firms also require senior personnel with combined science and business backgrounds and expertise in product development, investor relations, strategic planning and alliances, and financial management. Without these management skills, firms have great difficulty translating R&D outputs into successful commercial products.

Industry officials reported some difficulties recruiting people with adequate scientific credentials, particularly in highly specialized fields.[8] Still, as in the other sectors the Panel studied, it is the combination of technical and management skills – including strategic planning, and project and financial management – that is in the shortest supply. In the area of essential skills, industry officials reported that problem solving, teamwork, and written and oral communications were the most difficult skills to find.

CAREER GUIDE TO BIOTECHNOLOGIES

The Biotechnology Human Resource Council has created a unique multimedia career-awareness package called the *Biotech Career Kit*. The kit helps students appreciate how science has an impact on their lives and understand the diverse career opportunities that the biotechnology industry offers. Students also learn about the skills and the tools required to compete in today's labour market.

The kit includes a primer for students, a list of resources, a career game on CD-ROM, and a teacher's guide. It is designed to fit into provincial science and career-planning curricula.

http://www.bhrc.ca/

The Environmental Technologies Sector[5]

Canada's environmental industry includes roughly 5000 firms, which produced environmental goods and services worth $14 billion in 1997. It is estimated that industry sales have more than doubled since 1990, although Canada's share is less than 3 percent of the world market, which is expected to grow by 3 to 5 percent annually for the next five years. It is difficult to get a clear picture of employment in the Canadian industry, since many firms also produce non-environmental goods and services. Nonetheless, industry estimates place practitioner employment in the 100 000 range.

Critical skills in the knowledge-intensive environmental sector include a wide range of technical specialities. On the consulting side of the industry, 70 percent of positions require professional or technical skills in the sciences. Virtually all of the technical work force are university, community college or CEGEP graduates. Non-technical skills and knowledge are also important. For example, familiarity with Canadian and foreign regulatory practices, communications skills, training, negotiating and conflict resolution are in high demand.

Industry executives are generally satisfied with the supply of people with M.Sc. or PhD degrees in engineering, natural, environmental or physical sciences, and suggest that technical skills are in short supply only in highly specialized fields.[8] At the same time, most environmental industry executives, as in the other sectors, reported difficulties recruiting people with adequate business skills including project and budget management and communications. They report that, among essential skills, written and oral communications and interpersonal skills are the ones most lacking.

The strength of Canada's environmental industry lies in technical expertise and consulting services. Its major challenge is to convert technical prowess into high value-added products that help individual, corporate and institutional customers to meet pollution abatement, energy conservation and other sustainable development goals. Canadian firms are generally small compared with foreign competitors and have difficulty meeting growing capital requirements, offering integrated service packages and approaching major projects on a turnkey basis. It is expected that competitive pressures will lead to consolidations within the Canadian industry in the near future.

NEW OCCUPATIONAL STANDARDS

The Canadian Council for Human Resources in the Environment Industry has undertaken to define the specific skills and knowledge required for environmental work and to assist post-secondary institutions in designing programs to meet those skill needs.

Through the development of national occupational standards, the Council has identified the core skills necessary for environmental practitioners. This information will form the basis of a national, voluntary occupational certification and assessment system for environmental practitioners in Canada.

http://www.cchrei.org/

Even after consolidation, only a few Canadian firms will be large enough to be global players on their own. In order to tap the enormous potential that world markets offer, Canadian companies will have to collaborate and form value-added partnerships, especially export consortia.

The Information and Communications Technologies Sector[6]

Just as heavy industries such as railways and machine tools were seen as an economic driving force for much of the industrial age, the information and communications technologies sector (ICT) is widely viewed as the driver and enabler of growth in the Information Age. Industrial analysts now differentiate between "technology-enabled companies" and others that have not adopted the latest ICT systems and solutions, including the latest Internet-based applications. Thus, although ICT can be viewed as a sector in its own right – albeit a complex and fluid one – it also cuts across many other industrial sectors including aerospace, automotive, biotechnologies and environmental technologies.

In many respects, ICT is the engine of the knowledge industries and a magnet for technical and entrepreneurial talent. But although the manufacturing side of this industry has enjoyed strong growth in revenues and share of gross domestic product (GDP), the services segment of the industry grew much faster than the goods segment between 1992 and 1997. ICT services, especially software and computer services, with its focus on the *application* of new technologies in a variety of industries, has enjoyed much faster growth in revenues, as well as GDP, and accounted for all of the ICT sector employment gains over that period.

Converging technologies and the pace of change make it difficult to define this sector. However, figures compiled by Industry Canada based on the new definition by the Organisation for Economic Co-operation and Development (OECD), showed total sales for ICT companies of $100 billion in 1997, generating slightly more than 6 percent of Canada's GDP. Employment in 1997 reached 474 000 jobs, up from 390 000 in 1992, across a wide range of technical, professional, assembly and administrative functions. Much of the work force is highly educated, though some acquire their expertise

in computer applications through less formal ways than university degrees in computer science and electrical engineering. Newspaper business pages regularly profile successful ICT start-ups run by people in their teens and early twenties.

Large ICT firms such as Nortel, Ericsson, ATI, IBM and Microsoft tend to dominate the business headlines. Nonetheless, the overwhelming majority of firms in this sector are small, particularly in the fast-growing computer and related services field. In 1996, for example, the average computer services firm employed 9.1 people, according to Statistics Canada data on employment dynamics. Firms with fewer than 500 employees accounted for 68 percent of employment, while those with fewer than 100 employees provide just over half of all jobs in this field. In 1995-96, some 3400 new firms, almost all small operations, were launched in computer services. Although nearly 1500 firms went out of business over the same period, the nearly 12 000 computer services firms operating in 1996 generated a net gain of 18 000 new jobs in comparison with 1995 totals. These data illustrate the "churning" under way in the industry that, in a pattern of job destruction and creation, holds enormous potential for employment gains.

OCCUPATIONAL SKILLS PROFILE

The Software Human Resource Council, in cooperation with the Canadian Information Processing Society, has developed the Occupational Skills Profile Model, a tool to describe the skills and responsibilities typically associated with 24 occupational streams in the software industry. A series of workshops was conducted across Canada to refine the content of each stream of the model. The model was then validated by an extensive survey of Canadian workers and managers in the industry.

The information contained in the model is being used by Human Resources Development Canada in its revision of the National Occupational Classification.

http://www.shrc.ca/

The supply of ICT-relevant technical skills from Canadian colleges, universities and other training programs has expanded quickly in the 1990s. In fact, the number of computer science-related PhDs nearly tripled between 1986 and 1995. At the community college level, applications to computer-related programs nearly doubled between 1994 and 1998. It is worth noting, however, that the pipeline from computer science programs to the ICT industry is not particularly direct, as many computer science graduates move into financial services, utilities and other industries. At the same time, ICT companies have a strong ability to attract graduates from a wide range of fields and give them the programming and other skills they require.

From whatever source – computer science or engineering programs, retraining or immigration – the supply of technical skills to the ICT sector appears to have more or less kept pace with demand. In our discussions with industry executives, few reported *entry*-level recruitment problems, at least as far as technical competencies are concerned.[8] Technical skills are necessary but, as in the other sectors studied, employers have difficulty recruiting senior-level people who combine a solid technical background with experience and management skills such as project management, strategic planning, marketing and business writing. They also reported that, in the essential skills category, requirements such as teamwork, problem-solving and a willingness to learn were difficult to fill. Notably, however, there would appear to be some difficulty in this predominantly small-firm sector in absorbing the advanced skills that could enhance its global competitive position.

Due to the fluidity, pace of change and global scope of the ICT sector, it is extremely difficult to identify and gauge the impact of skill shortages on growth prospects. Some industry observers suggest that the skills picture in ICT is changing too quickly to be accurately captured by current labour market monitoring systems.

Key Observations on the Five Sectors

Is There a Current Skill Shortage?

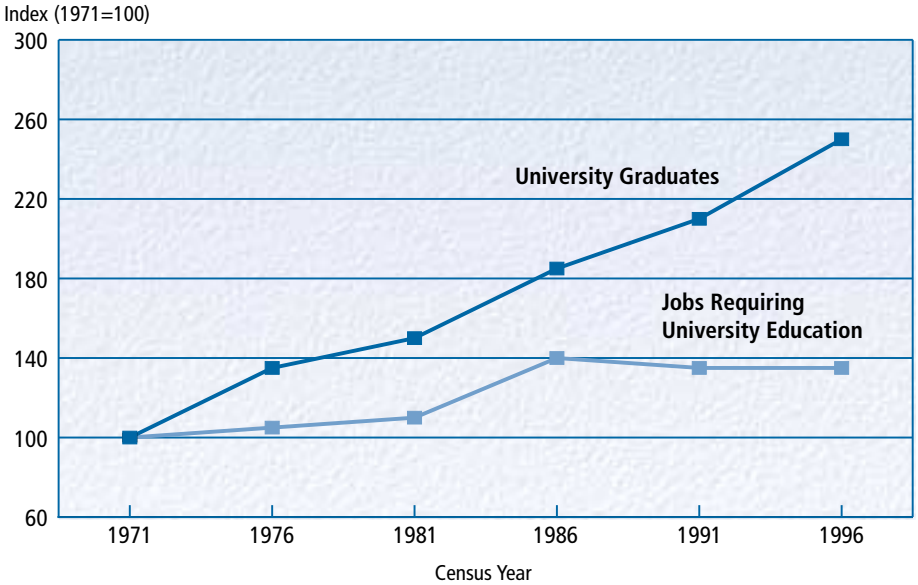
In our studies, consultations and interviews with industry executives and other stakeholders, there was no evidence of a *generalized* shortage of *technical* skills immediately threatening the ability of Canadian firms to compete in global markets. In fact, there is every evidence that our education and training systems have been able to produce at least as many (or even an excess of) technically skilled people as Canadian employers have been capable of absorbing, as the graph below illustrates.

We acknowledge that in all five strategic sectors there are skill sets in high demand and some positions take a long time for employers to fill. Some of these situations are aggravated by the sector's rapid growth, as is particularly the case in ICT, or by unique, sector-specific skill requirements, as in biotechnologies. It would seem, however, that these recruitment difficulties are consistent with the normal ebb and flow of labour markets. On the other hand, executives in each sector pointed to persistent shortages in management and essential skills, especially teamwork and oral and written communications. Skills such as these, in combination with technical skills, were what many executives consistently reported as being the most difficult to find. They also told the Panel that many of the recent graduates they hire have difficulty applying their knowledge and skills to a commercial setting and to solving "real world" business problems.

We have conducted our investigations against a backdrop of media accounts of a growing "brain drain" to the United States, particularly but not exclusively in the ICT sector. Since this would obviously have an important bearing on the question of skill shortages, it is an issue we studied carefully. It is clear from the available data that no massive brain drain is occurring,[11] although this does not mitigate the concerns of companies or industries that have lost a key employee or employees to another firm, another sector or another country. There is clearly a cost to losing qualified people. However, we must expect as inevitable some movement to an economy 10 times our own, with half of the unemployment rate. At the same time, there is also clear evidence that Canada continues to attract a good supply of skilled immigrants. Unfortunately, we sometimes fail to take full advantage of the potential contribution that newcomers can make to Canada's prosperity and well-being.

On the whole, we believe that growth prospects in Canadian industry are most vulnerable to a shortage of individuals who combine management and essential skills and attributes with strong technical skills. This important finding highlights a qualitative dimension of the skills challenge that is not new, but has received scant attention in the popular media. Clearly, economic and technological change and the growing complexity of work sets a higher standard across a broad spectrum of skill requirements. Therefore, simply convincing more of our young people to complete high school and enrol in post-secondary studies will not get to the heart of the skills challenge. In addition, we should re-examine the elementary, secondary and post-secondary curriculums to ensure that young people acquire both technical and essential skills over the course of their

Demand and Supply of University-trained Workers



Source: Applied Research Branch, Human Resources Development Canada, using census data for 1971, 1976, 1981, 1986, 1991 and 1996.

education. We also need to focus on both the acquisition of essential skills and the updating of technical skills by the current work force.

The Issue of Size

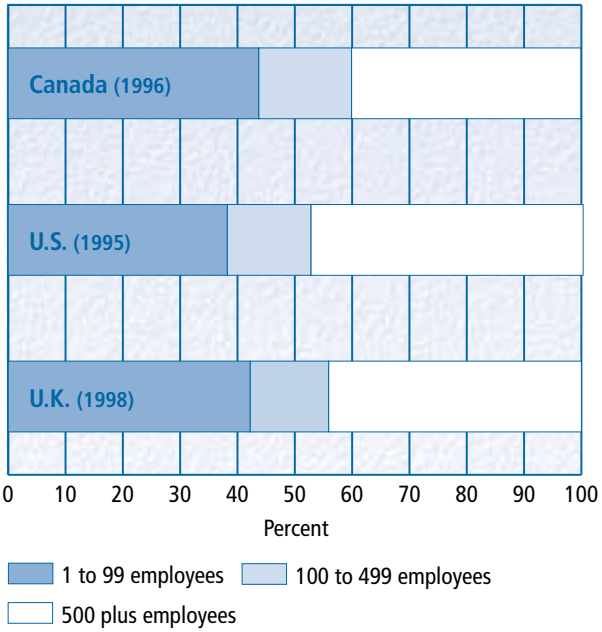
In the five sectors studied, there are very few firms large enough to be considered global players. Of the large firms that do exist, most are foreign-owned or -controlled. The overwhelming majority of companies in the five sectors, and across the entire Canadian industrial spectrum, fit into the micro- and small-sized category, with fewer than 50 employees.

In some respects, "small is beautiful" is more than just a figure of speech. Small companies can often respond faster to market opportunities and stay in closer touch with customer needs than larger organizations can. In other respects, however, the size of the company is important, particularly in the context of highly competitive, global markets for goods, services, capital and, of course, people. This is where the benefits of smallness go head-to-head against the advantages of scale that accrue to large firms.

For example, data show that frequency and incidence of training is closely associated with the size of the firm.[15] The cost of identifying needs, evaluating options and procuring training services seems to pose a real barrier to many small firms. Even among the firms – which depend heavily on skills and knowledge – the Panel found that most training is related only to technical skills. Although people are clearly the most important asset in knowledge-intensive industries, many small firms lack the resources or the management skills and time to treat them that way. When the president is also in charge of marketing, sales and R&D, and those are the things he or she does best, human resource management responsibilities may be neglected, despite their critical importance over the longer term. Other key management and strategic functions may also get short shrift because of insufficient resources within the firm.

Paid Employment by Employer Size

(Percentage of paid employment, excluding government services)



Sources:
Statistics Canada, Small Business and Special Survey Division.
U.S. Census Bureau: **http://www.census.gov/**
U.K. Department of Trade and Industry:
http://www.dti.gov.uk/SME4/pn993.htm

Compared with large firms, small operations generally have poorer access to risk and operating capital. They have trouble shouldering the risk of large projects. In science- and research-intensive activities, access to capital and government programs that support research and development (R&D) are often critical success factors. Many small and medium-size enterprises (SMEs) also have trouble translating laboratory findings into commercial success stories; even the best ideas will fail if not implemented and managed properly. Not surprisingly, the most sought-after educational background in the environmental and biotechnologies sectors is a graduate degree in science or engineering, coupled with a Master's in Business Administration.

Finding effective measures to help otherwise sound small firms to overcome these obstacles would provide a significant boost to our growth and success prospects as a country.

Opportunities for Regional Development

As our investigations and consultations have taken us from coast to coast, we have been sensitive to comments in both Atlantic and Western Canada that our focus is on industry sectors in which Ontario and Quebec are the major players. We understand this sentiment and its roots. Market forces and government policies have given Central Canada a large share of economic opportunity, particularly in manufacturing.

At the same time, we note that except for automobile assembly, the five sectors examined are present, to some extent, in all regions of Canada. It is worth emphasizing that the critical success factors in knowledge-based activities are often highly portable. When markets are global, the only enduring source of competitive advantage is the minds and ideas of highly skilled people who will gravitate to places offering the best combination

of opportunity and quality of life.[17] All regions have a chance to share in the growth of the five key industries (and others), but the appropriate skills, infrastructure, and effective vehicles for collaboration and industry support are necessary.

Many of Canada's outlying regions are also challenged by the departure of young people to economically stronger areas in search of opportunities they cannot find at home. As a participant from Atlantic Canada in one of the Panel's regional seminars put it: "Whenever Toronto loses someone to the United States, we hear about a problem called the 'brain drain.' But, when they pick up bright young talent from Cape Breton, it's a good thing called 'labour mobility'." In reality, increased labour mobility – both within Canada and across international borders – is to be expected as trade restrictions fall.

Our fact finding showed that, in Scotland, for example, barriers such as distance to markets and lack of critical sectoral mass can be overcome through a range of skills and enterprise initiatives.[21] The former initiatives include measures to encourage individuals and employers to invest in skills and continuous learning. The latter include a range of measures that facilitate access to capital, boost R&D and technology transfer, and augment capacities in areas such as human resource management, commercialization and export marketing. These programs are aimed primarily at small firms and may hold important lessons for Canada. They are discussed later in this report.

Qualifications vs. Experience

"You can't get a job until you have experience; and, you can't get experience until you get a job." Although this sounds like the labour market version of Catch-22, it is also a fact of life. Young people, including those with post-secondary credentials, usually have not had the chance to hone their technical skills or develop the management and essential skills that come from practical on-the-job learning. Moreover, Canada's under-performing economy kept unemployment high through much of the 1990s. This situation meant that first-time job seekers had to wait in line as employers turned first to experienced, older workers to fill job vacancies. This contrasts with the U.S. experience, where economic performance has been robust and the line-ups for jobs are much shorter or even non-existent. This factor has no doubt encouraged a small proportion of Canadian graduates, in fields such as computer science and nursing, to seek their first jobs south of the border and has prompted American employers to pursue these people.[a]

On the whole, we found that Canadian firms place a very high premium on experience for entry-level and senior jobs. For example, aerospace industry officials reported that a junior engineer needs two to three years' experience to get a foot in the door. For senior jobs, seven years' experience or more may be required. ICT employers want to see five years' experience for senior systems engineers and some firms look for as much as 10 to 15 years. In other sectors a similar picture emerges.[8]

Why does experience count for so much for Canadian employers? In some cases, an experience requirement can be a screening device in developing a short list if there is an excess supply of applicants. To a considerable extent, however, this is a function of firm size, not just in Canada, but in all industrialized countries. To a small firm, breaking in new employees can be a drain on the cash flow. As a result, they want to hire people who can start to pay their way almost immediately. Most employers told us that recent graduates are technically competent, but often unable to apply their knowledge in a business or commercial context. Most believed that management and essential skills will develop only through maturity and experience.

This situation suggests that foundational learning in these areas should begin in school and that experience with work should be a feature of learning at all levels.

HANDS-ON EXPERIENCE FOR NEW GRADUATES

McGill University's Graduate Certificate in Biotechnology aims to prepare students, with at least an undergraduate degree in the biological or medical sciences, for entry into the biotechnology industry. This certificate, which can be completed within four months, provides students with hands-on experience through an intensive laboratory course using the latest molecular biology techniques, and its biotechnology management course provides information on how the biotechnology industry works. The program can also include a 12-week complementary course involving a placement in a biotechnology company, and a bio-informatics course covering the latest developments in the use of computer technology for research in molecular biology.

http://genera.biotechnology.mcgill.ca/biotechnology/certificate/certificate.html

a Human Resources Development Canada and Statistics Canada, *South of the Border: Graduates from the Class of '95 Who Moved to the United States*, August 1999.

It may also be possible to improve the capacity of small firms to absorb recent graduates through programs to make well-educated, but relatively inexperienced, young people more attractive to SMEs. Building this capacity would help young people develop a foothold in the labour market and help to build "smarter firms". The expanding number of co-op and work experience components of college and university programs represent a step in the right direction – but they are not long enough or focussed enough to build the revenue stream needed for hiring by many smaller firms. In addition to a few promising initiatives in Canada, we have discovered innovative programs in Ireland and the United Kingdom[21] that ease school-to-work transitions and place technologists and other scientifically trained college and university graduates in small firms. Similar initiatives are well worth exploring for Canada.

Recruitment and Retention Issues

Firms consulted in the five sectors are taking broadly similar approaches to dealing with shortages of skilled personnel.[8] The most common responses are to improve recruitment techniques, extend hours of work, train lower-skilled personnel and outsource work to get around problems. Lowering recruitment standards to obtain second-best people is a less popular strategy. We thought it very significant, however, that only a small minority of firms reported raising salaries to attract the people they need.

The Panel believed the pattern of wage changes to be an important consideration in its assessment of the evidence for persistent skill shortages in the five sectors under review. Increasing wages are both a sign of shortage and an important mechanism for addressing the shortage by attracting skilled workers to a particular industry. Stagnant wages can indicate either that there is no skill shortage, or that employers are not able or willing to compete for the scarce resources on the market. The Panel asked Personnel Systems, an Ottawa compensation survey firm, to provide data on wage trends in those occupations where compensation was growing fastest over the past five years in the two industries they currently monitor: information and communications technology (ICT) and biotechnologies. Because of sample limitations, regional data could be provided for British Columbia, the Prairies, Toronto, Ottawa and Canada east of Ontario.[a] [29]

In the ICT sector, jobs such as database analyst and programmer analyst have enjoyed increases in base pay of 5 to 7 percent annually between 1995 and 1999. This compares with the 2 to 2.5 percent average annual increase for the ICT sector generally, and 1.5 percent annual increase for the paid labour force in Canada as a whole. (These figures do not adjust for inflation.) There was also considerable regional variation in the compensation trends, and no region consistently showed the highest wage increases for all occupations. Further, the national data showed no consistent pattern in the wage changes for entry-level jobs compared with more senior positions. In some occupations, entry-level job wage increases were higher; in other cases, the most senior positions enjoyed the most rapid increase in wages. Thus, while specific occupations or sets of skills have been in relatively high demand, wage increases for the sector as a whole seem to be in line with a modest need to attract workers from other segments of the economy. Based on wage data, there seems to be little basis to conclude that the ICT sector is generally starved of talent.

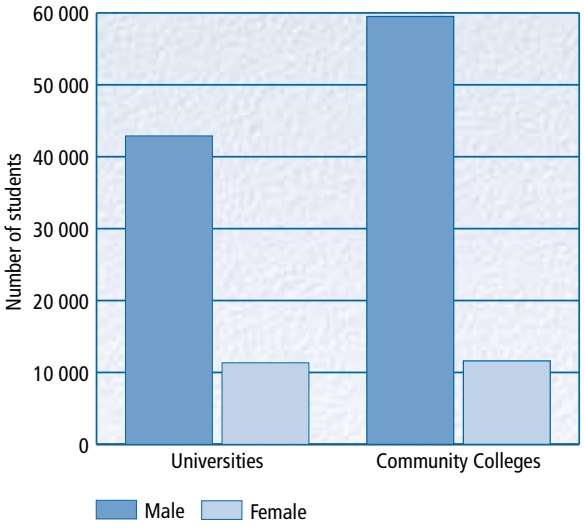
In the biotechnology industry, the sample is much smaller and therefore could be subject to wider swings in measured wage changes. Nevertheless, recent wage data indicate that R&D project managers have the most highly sought-after skills, with annual wage increases averaging more than 8 percent. Base compensation for research scientists has fallen 1 percent annually between 1995 and 1999. However, this decline is more than compensated for by incentive-based pay that raises compensation increases to nearly 4 percent annually. In most of the job categories reported, wages were rising faster in the more junior positions. Overall, wage increases in biotechnologies were estimated in the range of 2 to 2.5 percent annually, somewhat higher than the 1.5 percent increase in the economy overall.

During our consultations with stakeholders, a number of recruitment and retention issues surfaced regularly.[26] We heard from several industry officials, for instance, that skilled trades suffer from an image problem. Despite relatively high wages, many young Canadians and their parents do not believe that the trades offer

a The Panel also consulted HRDC's most recent Job Futures publications, which show the work prospects and earnings for many occupational groups, as well as for recent graduates in particular fields of study. While these data are not specific to the five industries, they did provide helpful as overall labour market indicators. Thus, in 1996, graduates from community colleges and programs in computer science and electrical or electronic engineering had significantly above-average earnings and, in many cases, below-average unemployment rates. The situation was different for graduates in biology, chemistry and physics, who faced earning levels 10 to 20 percent below average – and above average unemployment rates. These observations suggest that the labour market is tighter for new graduates in fields of study relevant to the ICT sector than it is for graduates in fields of study often associated with the biotechnologies or environmental technologies sectors.[30]

rewarding or worthwhile career prospects. In several of our regional workshops, participants commented further, suggesting that whole industries suffer from a negative image. For example, the cyclical nature of the aerospace sector may make it less attractive to young people who are planning their careers. There are also negative perceptions of the ICT sector as a place where people get "chewed up and spit out" and employers do not understand or take seriously the needs of employees with family-related responsibilities. This may explain, in part, the under-representation of women in engineering, computer science and other ICT-related programs in colleges and universities.

Total Full-time Enrolment in Engineering, Applied Science and Related Fields in Canadian Universities and Community Colleges, 1997–1998, by Gender



Source: *Education in Canada*, 1998, Statistics Canada, Catalogue No. 81-229, Tables 13, 14 and 15.

A further conclusion drawn from our consultations is that many employers do not yet recognize that many people want to acquire something above and beyond salary from their employment relationship. There appears to be considerable room for improvement in the recruitment and retention practices of most Canadian firms.[12] Young people in particular are interested in stimulating work challenges and the opportunity to make a difference through their jobs. They are also interested in continuous learning, suggesting that employers stress training and development opportunities within their recruitment and retention strategies.

Collective Action in Human Resource Development

In four of the five sectors, companies have banded together to form multi-party, member-service organizations called sector councils. These include the Software Human Resources Council (SHRC – **http://www.shrc.ca**), the Biotechnology Human Resource Council (BHRC – **http://www.bhrc.ca**), the Canadian Council for Human Resources in the Environmental Industry (CCHREI – **http://www.cchrei.org**), and in the aerospace sector, the Canadian Aviation Maintenance Council (**http://www.camc.ca**), as well as three provincially focussed organizations: the Manitoba Aerospace Human Resource Co-ordinating Committee (MAHRCC), the Centre d'adaptation de la main d'œuvre aérospatiale du Québec (CAMAQ) and the Ontario Aerospace Council (OAC). The Canadian Technology Human Resources Board (CTHRB – **http://www.cthrb.ca**) is also an important sector council that focusses on applied science technicians and technologists across all industry sectors.

These are among the approximately 25 sector-based partnerships established in Canada by, in varying combinations, firms, industry associations, unions, governments and educational institutions (**http://www.councils.org**). The activities of each sector council address specific human resource issues identified by the sectoral partners as priorities. The activities have included surveying sectoral skill needs, establishing sectoral occupational/skill standards, developing education and training programs, and playing a broad advocacy role on behalf of skills in the sector.

In our discussions with industry stakeholders across Canada, we often heard that many skills-related issues and problems are too broad and complex for any single party or organization to manage.[25] In this respect, we were impressed by the track record of sector councils at marshalling the efforts of many partners to address human resource issues. In particular, the councils offer an effective means for firms, especially SMEs, to access services and participate in projects that they could not afford to undertake on their own. For instance, the MAHRCC and CAMAQ actively market aerospace trades and professional careers and have worked with vocational schools, community colleges and universities to set up accredited aerospace training programs. BHRC maintains a database of résumés of skilled potential employees to help member firms with recruitment. The CCHREI has developed national

occupational standards for the environmental sector that support training, recruitment and compensation decisions. These are but a few examples from the continuously growing list of successful sector council initiatives.

Lack of Collective Action on Other Strategic Fronts

Given the evident contribution of the sector councils to improved human resource management practices, the Panel was struck by dividends that could accrue to sectors from collaborating in other areas. In compiling the sector profiles, for example, we noted a virtual absence of additional strategies to enhance the global competitive position of the five sectors. There is little collaboration in export marketing or in pre-competitive research. Nor have firms systematically developed collaborative linkages to colleges and universities for pre-competitive research, technical and business assistance. Outside of the field of human resource development, there is no benchmarking, sharing of best practices or setting of sectoral goals in conjunction with government support. Finally, despite the successes noted above, many regions lack sufficient sectoral and innovation infrastructure that could help small firms to grow.

We were impressed by the linkages that some aerospace and automotive firms have established with community colleges, institutes of technology and universities for training purposes, as well as the linkages established by a number of biotechnology companies with universities and teaching hospitals for research purposes. It is worth noting that, in the areas outside Canada visited by the Panel, sectoral cooperation in terms of the amount, quality and complexity, is more developed than in Canada and clearly contributes to the country's competitive edge. As stated by a senior official of the British aerospace industry: "Small firms must learn to collaborate nationally in order to compete internationally." We believe this advice is equally relevant to Canada.

The Capacity to Manage Information and Knowledge

Most large organizations, and increasingly medium-sized and smaller ones, are adopting ICT-based strategies to improve operational effectiveness. This is true within the five sectors and across the economy as a whole. Leading-edge firms recognize that their ability to gather, manage, analyse and distribute information and to create new knowledge with this information has become a core competency. These activities increasingly permeate production, marketing, sales, service delivery and other operational functions, and have huge bottom-line implications. The growing recognition of information and knowledge management, in all its aspects, as a core activity for many companies has already made basic computer literacy a requirement for many positions. As this trend continues, more sophisticated computer and information management skills will be required across the whole business spectrum, heightening the competition for people with essential skills. These developments hold important implications for elementary, secondary and post-secondary institutions.

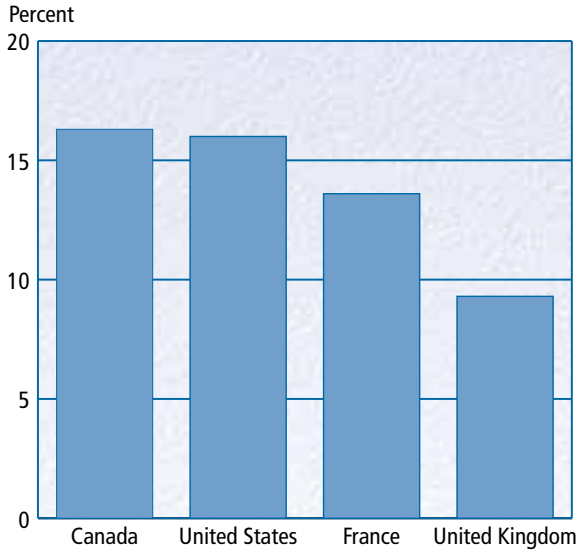
PART IV

Skills and Opportunities: The Big Picture

Looking to the future, Canada's skills challenge will be heightened by relentless, fast-paced economic, scientific and technological change.[a] Under these pressures, the skill sets required in the workplace will continue to change and expand. An ageing work force will impose further pressures, as will intensifying competition for skilled people among countries and across Canada's regions. As a result, we conclude that the approach to skills development that served Canada well enough in the industrial age will not be adequate for the Information Age and knowledge-based economy.

Indeed, there is already stress in the system. Many employers are having difficulty filling positions requiring a combination of strong technical, management, leadership, contextual and essential skills. Small firms encounter problems in meeting their specialized human resource needs. There are also concerns about the loss of some highly skilled people to the United States.

Proportion of Persons Aged 17 to 34 Enrolled in Public and Private Tertiary Education, 1995



Source: *Education at a Glance*, OECD Indicators, 1997, p. 171.

However, a second part of the equation remains. Of far greater concern than a lack of skills is a *shortage of opportunities* in Canada, particularly compared with the United States. This lack of opportunity provides some explanation for persistently higher rates of unemployment and slower growth in real personal and family incomes compared with the United States. In its consultations, we heard many stories of highly talented Canadians packing up their tax-paid post-secondary degrees in science or engineering and heading south in search of greener pastures.[24] As stated earlier, the outflow *to date* is not of sufficient size to threaten our ability to compete.[11] Nor would it seem that those heading south are essentially economic refugees fleeing high taxes and low salaries. Instead, most people are drawn to Silicon Valley, Route 128 and other American centres because they want to work with the world's best people, undertake ground-breaking research and development (R&D), and bring exciting new products to market for companies with truly global aspirations.

We remain confident that Canada's work force still ranks among the best in the world. It is also the Panel's belief that if businesses, individuals and governments can summon the *will*, they can take the necessary steps to create more opportunities for firms to grow and prosper; and for individuals to find challenging and rewarding work. The need for action is urgent because our competitors are not standing still.

We know, for example, that U.S. firms and universities have the resources to search the world for talent.[b] In addition, U.S. state and federal governments are channelling investment into education and university-based, as well as university industry research on an enormous scale and similar investment plans are unfolding within the U.S. private sector. We continue to spend a higher proportion of gross domestic product (GDP) on post-secondary education than other Organisation for Economic Co-operation and Development (OECD) nations do, investing in education, training and skills development. However, university-based scientific and technical research is growing at a faster rate in other countries, particularly the United States, Canada's chief competitor.

The other large Western trading bloc, the European Union (EU), is also moving forward rapidly. The EU and its member nations have also launched large numbers of well-funded university-based research, innovation and education programs, and their post-secondary participation rates are now approaching those of Canada.

[a] See, for example, Richard G. Lipsey, *Economic Growth, Technological Change, and Canadian Economic Policy*, C. D. Howe Institute, November 1996.

[b] As an official of the U.S. Council for Competitiveness put it to us, "When we need skills now and the choice is to 'make' or 'buy,' our firms are aggressively deciding to 'buy.'"

Even though we lack the resources to duplicate the efforts of the Americans and the British, in several of the smaller jurisdictions that were studied (which are peripheral to the European market as Canada is to the U.S. market) the Panel found impressive efforts under way to accelerate and integrate the skills and enterprise development agendas. In other words, these countries appear to view skills development, business growth and the pace of innovation and commercialization as variables within the same equation. These efforts are well funded, although not beyond levels feasible in Canada. It is critically important, however, that they are focussed and supported broadly by business, labour and political leaders with a degree of enthusiasm and commitment that Canadians would find astonishing.[21]

There are steps that Canada can and must take in relation to skills and enterprise development in order to secure our future prosperity. These are detailed in the remaining pages of this report. First, however, it is important to establish the fundamental difference between the old and new economies and how these differences have led us to think about skills in a new and different way.

The New Economic Paradigm

In Canada's old economy, private owners invested primarily in physical capital assets. They teamed up machinery and equipment with a fairly homogeneous supply of labour to produce goods and services. Except perhaps in the defence industries, technological progress was incremental. R&D, although important in its way, was not the driving force it is today; and, in the case of our resource-based economy, with high levels of foreign ownership, we more often "bought" rather than "made" our technology.

The role of government under the old model was to provide a steady supply of basic skills through the educational system and related public services, to make transportation and other infrastructures available directly or through subsidies, and to promote economic and employment growth through a very wide range of micro- and macro-economic policies, including measures to protect Canadian firms from foreign competition.

In the industrial age, schools effectively sifted human capital and nurtured the skills needed for an economy dominated by large, hierarchical organizations or less-skilled agrarian and retailing pursuits. The presumption was that only those few people headed for the executive suite or professional careers required creativity, imagination or leadership skills. Technicians and skilled tradespeople required strong technical skills, but were seldom drawn into strategic decision making. For others – middle managers, and shop floor and office workers – work involved routine tasks and established procedures. For them, basic literacy, numeracy skills and dependability were key requirements. The rest could be learned on the job.

This old model has been under attack for at least 30 years. Scientific and technological advances and the revolution in ICT have had a tremendous impact on the nature of work and on the workplace. Today, more than ever, skills are a critical success factor for individuals, companies, industrial sectors – not only

Government Investment in Higher Education, Canada and the United States, 1980 to 1998

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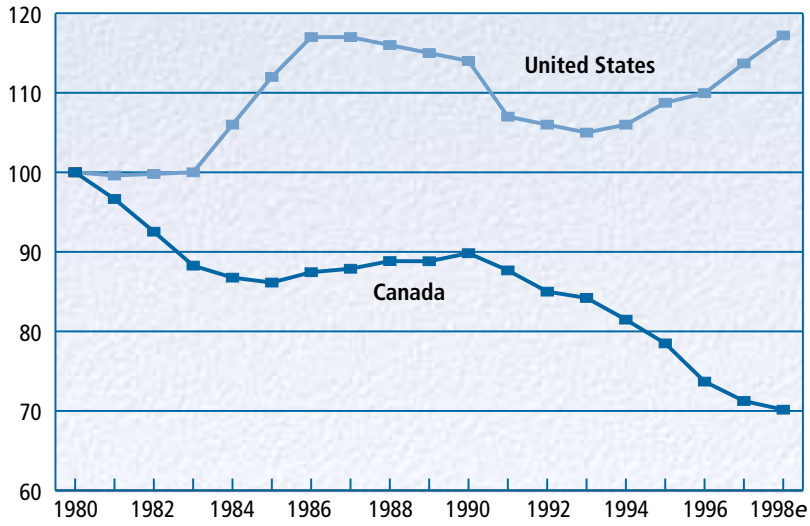
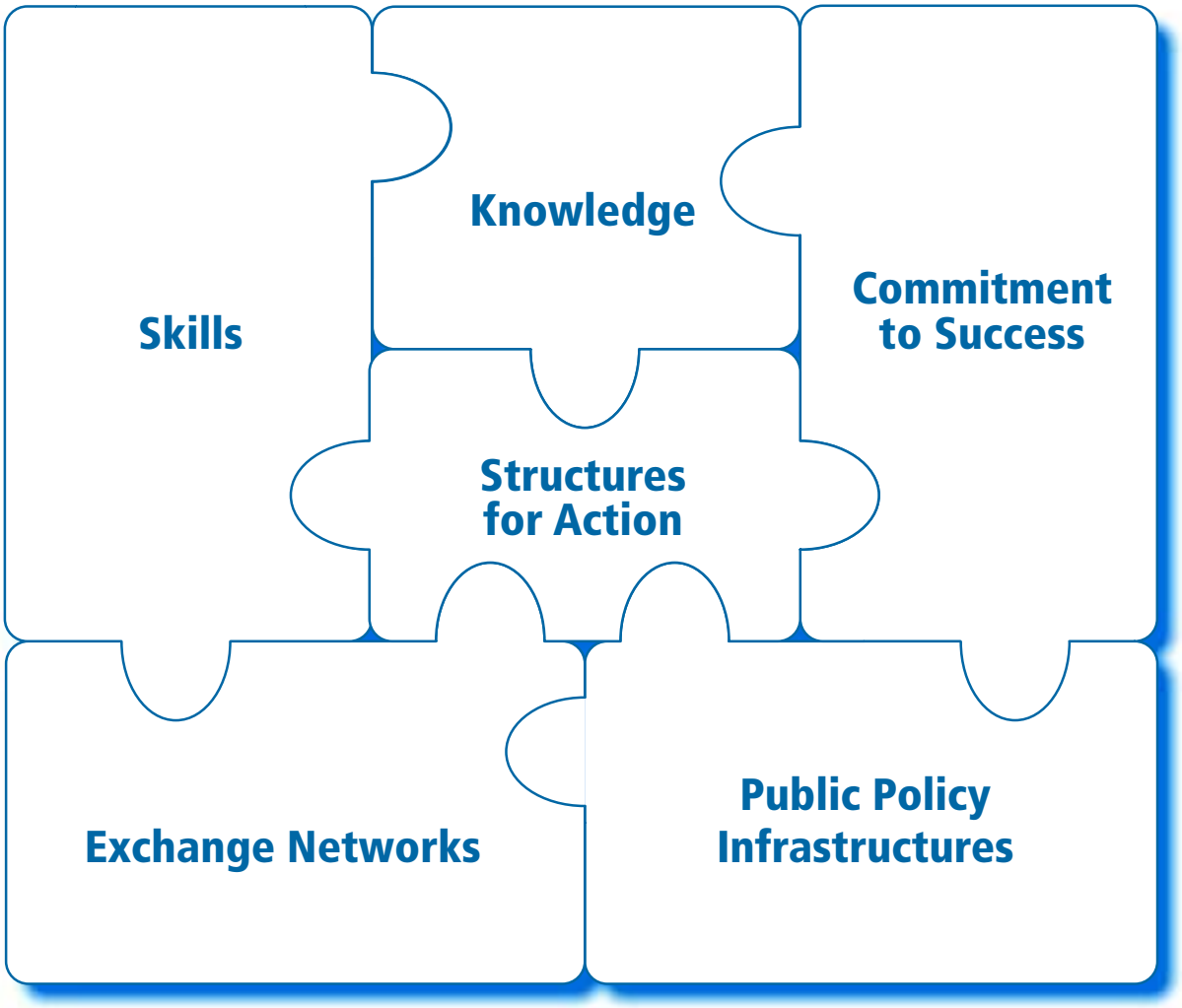


e = estimate

Source: *Trends, The Canadian University in Profile,* Association of Universities and Colleges of Canada, 1999, p. 29.

the high-tech sectors, but all sectors – and countries. In the new economy, people's knowledge must be managed in a synergistic way. Individuals must be able to contribute their particular expertise and work productively with others in order to manage in rapidly changing situations where no one person possesses all of the knowledge required to make decisions. Creating an atmosphere conducive to this kind of high-order teamwork is key to the innovation process in a highly complex environment; it also increases business opportunities and the likelihood of their success.[13] However, as the next diagram illustrates, it makes little sense to think of skills and skills development in isolation from other processes that drive the new economy.

In the new economy, goods, services, capital, people and ideas are simply moving too freely to try to hold the rest of the world constant and focus on one narrow set of issues called "skills". Everything from infrastructure investment and industrial policy, to human resource management practices, to demographics, immigration and the quality of our schools all come into play at some point. All have a significant bearing on the demand for skills, the supply of skills and the way in which employers, sectors, regions, Canada and other countries approach skills and enterprise issues. The Panel views the new economy as an ecological system in which the driving forces or success factors are all interconnected.



Public Policy Infrastructures

Public policy infrastructures include the full range of government policies (taxation, competition, immigration, health, welfare, etc.) that affect economic and social development, wealth creation and distribution, and the overall quality of life in a region or country.

Government is the developer and manager of public policy infrastructures, but must maintain a continuous dialogue with individuals, private industry, interest groups and other organizations, including other orders of government.

Given the Panel's mandate, the focus in this report is largely on public policies that affect the functioning of the labour market.

Knowledge

There are two components to the knowledge infrastructure. One is the stock of knowledge available to Canadians. The other is the systems that create knowledge, for example, basic and applied research, technology transfer, and commercialization. These systems include bricks-and-mortar facilities (research centres, teaching hospitals, laboratories and so on) as well as the programs, resources and services that help companies to develop new products, implement new production processes and bring new ideas to the marketplace.

Government and private industry must both actively invest in the knowledge infrastructure. Universities and colleges are also active players, since they house and manage much of the public sector and private sector investment.

Skills

There are also two components to the skills infrastructure. One is the stock of skills possessed by Canadians. The other includes the learning systems that generate those skills. These include early childhood education facilities, elementary and secondary schools, post-secondary institutions, and private and community-based training facilities. Also included are the linkages among the various components of the learning system (e.g. school boards to teacher training facilities) and between the learning system and the workplace. Programs and resources that improve access to learning (e.g. scholarships and student loans) or help people to make the transition from school to work and work to school are also part of the skills infrastructure.

Individuals, families, governments, private businesses and labour unions are the key investors in the skills infrastructure. Education and training providers are also active players, since they house and manage much of the public and private investment in skills.

Exchange Networks

Exchange networks include transportation facilities, such as highways, ports, railroads and airports that are essential for moving goods and people. Telecommunications facilities, including broadband data transmission systems, are also an increasingly important exchange network infrastructure. They enable the movement of ideas, services and information products, and allow people and organizations to collaborate over distances. Private industry and governments are the key investors and managers of exchange networks.

Commitment to Success

A country or region's commitment to success reflects the attitudes and expectations of its citizens with respect to individual and collective economic success. It also gauges the willingness of all of the players in the economy to share resources, collaborate and focus their efforts in order to set and achieve economic goals such as growth in output, export sales, R&D, employment and incomes. Where there is a strong commitment to success, long-term objectives are less likely to be derailed by short-term political or commercial expediencies. There is an atmosphere of transparency and accountability. Ideally, all of the players are comfortable with the principle of performance management and they are far more interested in real outcomes than in processes that simply "look good".

To be a powerful motivating force, this commitment must be embedded in individuals, firms, governments, trade unions, and education and training providers. There must be visionary champions, in all quarters, who are prepared to lead their constituents toward established goals. Where a strong commitment to success exists, it becomes a defining element of the economic and social culture. History shows that regions or nations where commitment to success is weak or non-existent are not able to maintain, let alone increase, their wealth and standard of living over time.

Structures for Action

Structures for action give the authority, resources and accountability frameworks necessary to make economic and related decisions to the people who are best placed and most qualified. These structures provide vehicles through which the necessary players come together to set goals and work together to achieve them. For example, educational authorities and industry officials require a structure through which to discuss decisions about curriculum. Similarly, firms require a forum to meet with each other and with universities, colleges and governments to establish and manage collaborative R&D programs for their industry sector.

Ideally, structures for action involve minimal hierarchy. They are efficient, decentralized, low-overhead, results-oriented, decision-making organizations that may operate on a local, regional or national basis. They are well suited to the new economy, where a wide range of people, each with different knowledge or expertise, must often work together and make decisions quickly. These structures also provide a forum for continuous data collection and dialogue among all of the stakeholders on a particular issue. In this way, decision makers are made aware of trends as they emerge. Despite the complexity and speed of change in the global economy, they can plan effectively and adapt as required.

Although these forums are cooperative by nature, a fair degree of persuasion may still be required to bring all of the stakeholders to the table. Governments will be key players in some structures for action, to get all relevant actors to take responsibility for advancing their individual and collective interests. Governments may have to provide resources to launch forums as well as aggressive leadership, where necessary. However, even where the government plays a prominent role and there is a clearly definable public interest at stake, the structures for action that the Panel envisions are not driven by government. They operate at some length from the realm of electoral politics. They are a forum in which the stakeholders collaborate to pursue their individual interests and a collective interest at the same time.

Each of the domains in our ecology of the new economy identifies factors and conditions that are necessary for a country, region or sector to grow, create wealth and assure its citizens a high standard of living. However, no one set of factors is sufficient on its own. We can invest huge sums in education to create the world's most skilled work force. However, the money would be wasted if this work force is not supported by a first-rate telecommunications system, on which so much business opportunity depends, and complementary policies to encourage economic and social development. Similarly, governments and the private sector can invest lavishly in R&D; however, if we do not have growth-hungry firms and risk takers to translate R&D into commercial products and launch them into world markets, then the return on our investment will be poor indeed.

The Panel is committed to this understanding of how successful enterprise begins and to the roles and responsibilities needed to sustain this process in a knowledge-based economy that is constantly renewing and honing its stock of skills. We also work from the premise that Canada's skills challenge has as much to do with creating more opportunities to put our knowledge and abilities to work, as it does with developing and maintaining an adequate supply of appropriately skilled workers.

Acting on this understanding in a focussed and dramatic fashion will produce the new opportunities required to secure Canada's economic future and a high quality of life for all labour force participants and their families.

ROLES AND RESPONSIBILITIES IN THE NEW ECONOMY

The hallmarks of the new economy are its complexity and the increasing integration of the public and private sectors. Promoting healthy growth and wealth creation requires the involvement of all players in the economy listed below.

Government is responsible for:

- opening and modernizing markets in order to promote competition, flexibility and innovation in businesses;
- investing in national capabilities in education and research, and promoting a culture of enterprise;
- aggressively promoting collaboration among businesses, employees and labour unions, where present, to generate competitive advantage; and
- promoting a long-term economic and social vision in a world of short-term pressures.

Private industry (including employers and employees) is responsible for:

- identifying, capturing and marketing the knowledge base that drives all products and services;
- supporting college, university and public research facilities by commercializing their scientific and technological achievements;
- providing opportunities for students to be exposed to the world of work and helping would-be entrepreneurs acquire management skills and an understanding of risk;
- forming collaborative partnerships with suppliers, customers, schools, colleges and universities, to promote sectoral growth by stimulating innovation, R&D, commercialization and export marketing; and
- promoting effective human resource management, encouraging continuous learning and supporting employee efforts to develop their skills.

Education and training organizations are responsible for:

- motivating and assisting individuals of all ages to become independent, flexible, and creative learners;
- ensuring that their curricula and teaching methods adhere to the highest possible standards and effectively assist students to develop "essential skills" (at the early childhood, elementary, secondary and post-secondary levels);
- informing individuals about career and employment opportunities (particularly at older elementary, secondary and post-secondary levels); and
- remaining relevant to rapidly changing local and global circumstances and developing effective linkages with industry at the individual company and sectoral levels (especially at secondary and post-secondary levels.

Individuals are responsible for:

- becoming self-confident, self-reliant, continuous learners;
- managing their own lifelong learning and career development, in terms of attitude and, in part, financially; and
- providing information, encouragement and support to other family members, especially children, to help them achieve their full personal and career potential.

The Importance of Making Choices

As Canada has made the transition from the industrial to the Information Age, we have also moved to an open economy in which market forces play a much more prominent role than was the case in the 1950s, '60s or '70s. This shift was essential for Canada to keep in step with developments in the global economy and, on the whole, has had a positive impact on our economic prospects. At the same time, our population and economy remain small compared with the United States, our closest neighbour and largest competitor. As the following schematic maps suggest, apart from a few resource-based industries, Canada will not be a dominant force in world markets. On the other hand, we can be an important player in specialized market segments.

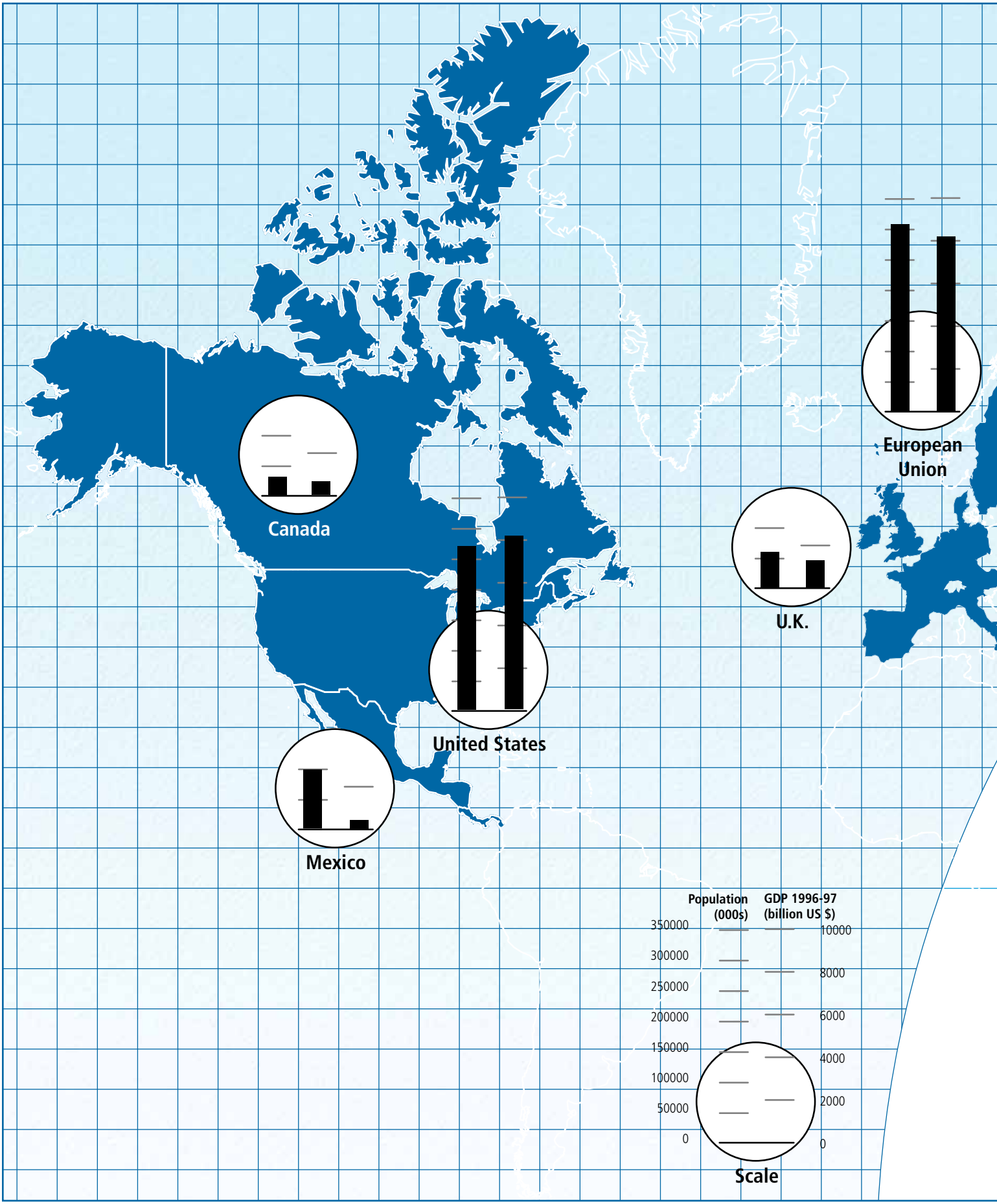
There is nothing wrong with being a "niche player" in the global knowledge-based economy. If we are good at it, we can live very well. As noted in the discussion of the five strategic sectors, there are significant prospects for wealth creation and employment growth – if we act cooperatively and strategically. We can also point to many European nations, such as the Netherlands, Switzerland, Ireland and the Nordic countries, or in Southeast Asia, countries such as Singapore and Taiwan, that have made a science of niche playing and enjoy high living standards as a result. These nations have not succeeded by simply mimicking the policies of larger economic powers. Their recipe for success is substantially market-driven, but it also involves deliberate choices and collective decisions about investing in skills, knowledge creation, exchange networks, and other elements of the new economy. The best niche players know that they cannot be good at everything, and they develop mechanisms for identifying and channelling resources into activities that correspond to their areas of expertise and that offer the highest potential returns. Canada can learn from their experience.

In the old economy, our track record at picking "winners and losers" was mixed at best. This was largely a government-driven process, aimed more at equalizing opportunities across our various regions than at achieving measurable and sustainable growth in activities that produced real wealth. Too often this meant shoring-up losers or protecting inefficient operators. The cost was high and seldom justified by the results achieved.

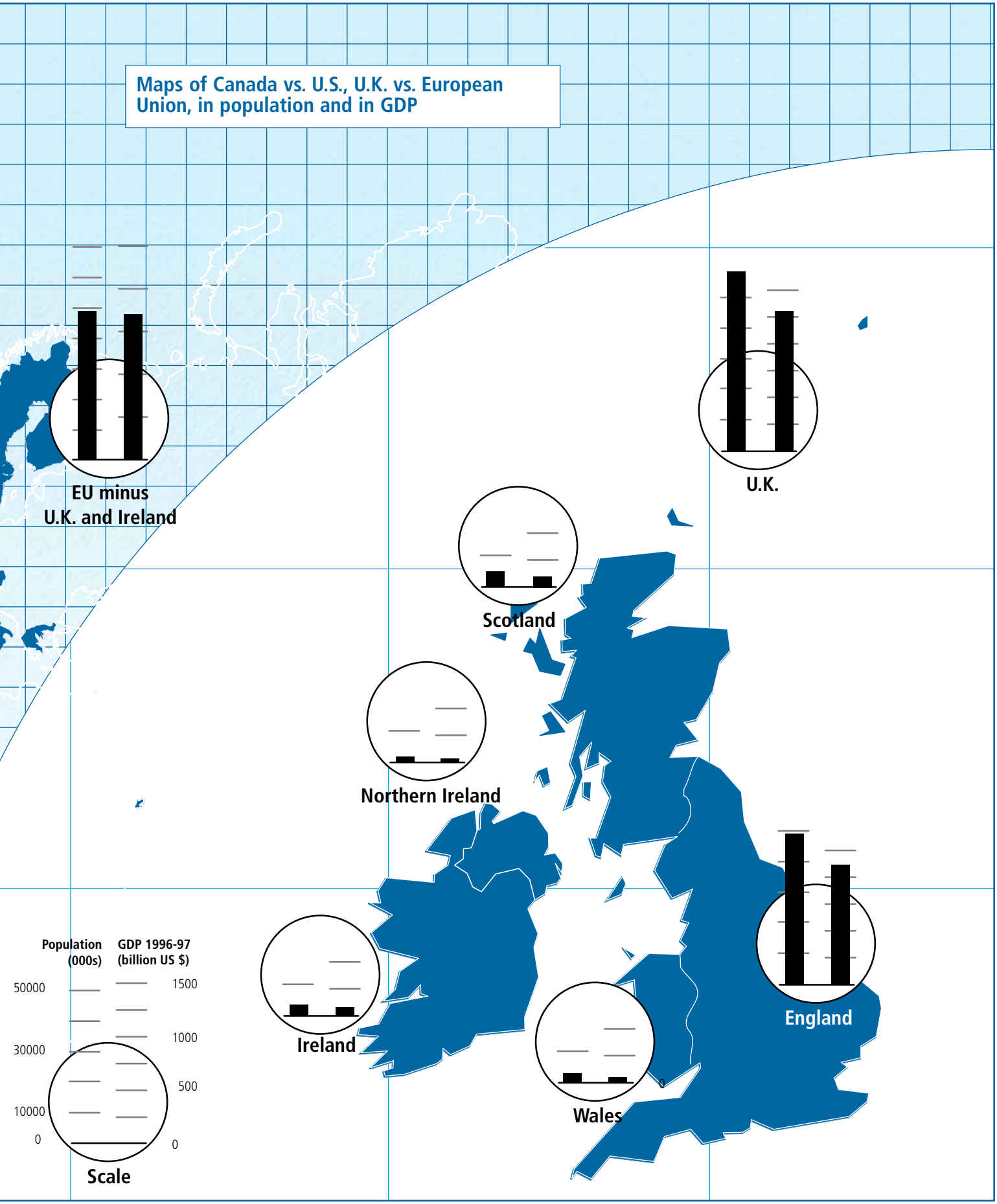
For niche players to succeed in the new economy, they must also make choices at the regional and country levels. But the parameters and variables behind these choices are now very different, and location is no longer the severe impediment it has been in the past. The new economy is not about subsidizing plants or protecting industries. Rather, it involves investing in the R&D, commercialization, human resource management and marketing capacity of industry sectors. It requires better schools, lifelong learning and more efficient "school-to-work-to-school" transitions. It depends on building value-added relationships between companies and university-based research facilities, and developing state-of-the-art research and telecommunications infrastructure, nationally and regionally. It calls for decision-making structures that encompass shared authority and accountability for choosing priorities for action.

In the new economy, government must act but cannot presume to have all the requisite know-how and expertise to make things happen. Instead, the role of government is to create mechanisms to mobilize enterprise and learning system stakeholders and then let them lead the way to achieving chosen common goals.

To succeed in the knowledge-based economy, Canada must become a more effective niche player and we will need all the elements in the new economy ecology to function efficiently and well. We cannot insulate ourselves from the risks imposed by globalization and technological change. However, through collaboration, commitment and smart choices about where to focus our resources and energy, we can certainly develop our fair share of global opportunities. Our recommendations reflect this conviction and our understanding of the new economic paradigm previously illustrated.


Canada
United States
Mexico
U.K.
European Union
Population (000s)
GDP 1996-97 (billion US $)
350000
300000
250000
200000
150000
100000
50000
0
10000
8000
6000
4000
2000
0
Scale

Maps of Canada vs. U.S., U.K. vs. European Union, in population and in GDP



PART V

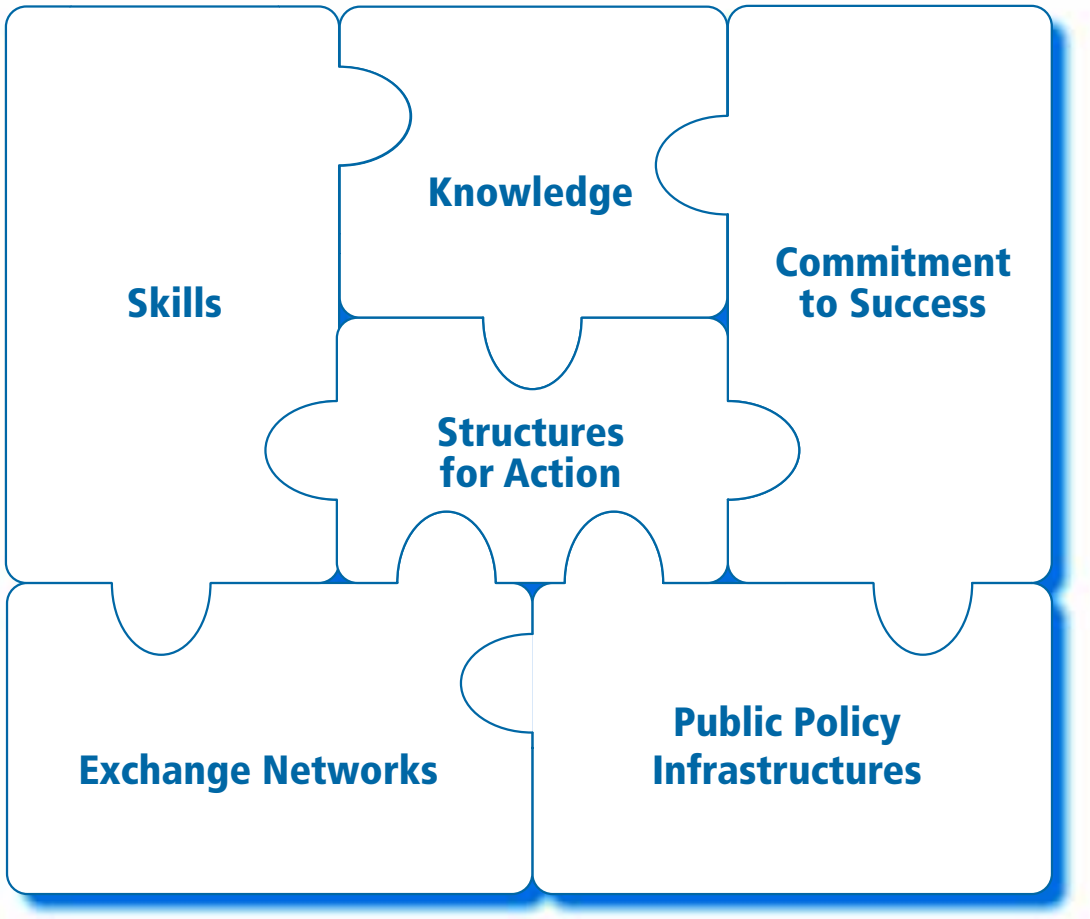
Recommendations: What We Think Should Be Done

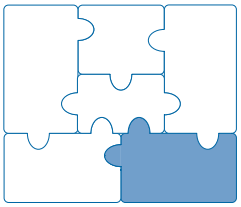
Our recommendations come from our investigations and discussions of the problems, needs and prospects of the five strategic industries, from public consultations, and from broader inquiries into skills and enterprise issues, in Canada and abroad.

Although specific skills challenges may vary from one industrial sector to another, we believe our analysis and recommendations are relevant to a broad cross section of Canadian industry. Although skills issues in the so-called high-tech industries attract the lion's share of media attention, most if not all industries are becoming more knowledge-intensive. Improving our capacity as a country to meet the resulting increase in demand for higher-order *essential, technical* and *management* skills will largely determine the prosperity we enjoy in the future.

In developing our recommendations, we have tried to think carefully through what needs to be done, and who should either carry out the task or get the "ball rolling". In some cases, implementation of the recommendations will appear to be difficult, or may challenge groups of decision makers to act for the common good of Canada rather than on behalf of the special interests of their constituencies.

Our recommendations have been organized according to the elements of the knowledge-economy ecology described in Part IV of this report. The recommendations begin with "public policy infrastructures" because improvements in this area provide an excellent basis for describing the other changes that are needed to keep our enviable Canadian lifestyle. The last section of the recommendations pertains to "structures for action". This variable presents some of Canada's greatest challenges and, in conjunction with the other recommendations, a strong case is made that these structural changes are necessary for future success.





1. Public Policy Infrastructures

The Panel's recommendations under the *public policy infrastructures* element of the knowledge-economy ecology address the challenges posed by increasingly complex and dynamic labour markets. The Panel proposes actions that are aimed at the following:

- **strengthening our capacity to understand labour markets;**
- **making better use of labour market information;**
- **overcoming barriers to labour mobility within Canada; and**
- **improving Canada's ability to compete for highly skilled workers from abroad.**

The Importance of Labour Market Information

It is important to monitor labour markets and produce accurate, timely information because individuals and organizations make important decisions, often with significant cost implications, based on perceptions about work and employment trends, job vacancies, compensation levels and related factors.

When they are effective, labour market information systems can continuously generate the information needed to link government policies, in areas such as taxation, employment insurance and immigration, to actual conditions in the labour market. Monitoring systems can deliver important signals to education and training institutions and help guide their decisions about enrolments, curriculum development, faculty recruitment and investment in physical infrastructures. These systems also allow employers to adopt a more strategic approach to recruitment, retention, training and other human resource management challenges. Finally, accurate information about labour markets is vital for individuals, students and workers, who must plan their own learning and make realistic career choices.

Because monitoring systems help us to use our human resources more effectively, they can be an important source of competitive advantage for Canada. While this monitoring task is more important than ever, it is also becoming increasingly difficult, given the pace of change and growing complexity of labour market variables.[10] [18]

Monitoring Labour Markets in Canada

Canada benefits from a highly sophisticated and complex labour market information system, made up of many components. At the core of our system is a series of regular surveys supplemented by administrative data drawn from the operation of programs related to the labour market, notably employment insurance and immigration. In addition, many specific data sets, special surveys and studies are developed at local, provincial and national levels by governments, sector councils, industrial and professional associations, labour organizations, education and training organizations, and so on.

Information and data from these many sources are combined, analysed and disseminated in a great variety of "packages" that are produced in a number of different formats and made available through a variety of means, including the Internet. The information packages range from occupational projections and career counselling information, to data used for education planning purposes, to electronic placement services, to policy and program analysis and evaluation.

Based on its research and discussions with labour market experts, we concluded that Canada's labour market monitoring systems are among the best in the world.[23] Indeed, other countries come to Canada regularly for advice on developing occupational classification systems, labour market statistics and surveys, and more recently, electronic placement services. The Panel has also been impressed by the efforts of the federal and provincial/territorial governments to coordinate their labour market information and analysis activities. Also, we applaud the efforts of industry sector councils and professional organizations in this area.

INTERNET-BASED RECRUITMENT SERVICE

The *Technology First Work* is an Internet-based placement service run by the Canadian Technology Human Resources Board. It helps technicians and technologists who have recently graduated get their first work experience in their field of study. Graduates are placed with small to medium-sized companies willing to hire a technologist or technician for two to three months. During that period, graduates are hosted by a certified Engineering Technologist who serves as a mentor and helps participants develop an understanding of the realities of the workplace and the profession. Participants can also take advantage of a self-study course focussed on ethics in the workplace for professionals. Companies are free to rehire participants at the end of their term.

http://www.cthrb.ca/1tech/index.htm

Nevertheless, there are a number of features of the current monitoring systems that, if enhanced, would further improve our ability to understand and anticipate labour market developments.

In our discussions with analysts and users of labour market data, concerns emerged over the timeliness and degree of occupational and geographical detail captured in existing surveys. In particular, an emphasis was placed on the need for better provincial and sub-provincial data in view of the devolution of responsibility for many labour market programs from Ottawa to the provinces and territories. The discussions also indicated that our capacity to measure labour market demand is limited by the lack of a direct vacancy-monitoring survey to track vacant positions, required skills, compensation offered and related information.

Addressing issues of detail and timeliness with more frequent and comprehensive labour market surveys would be prohibitively costly. Other approaches, such as making better use of employment insurance and income tax records might be explored, but appear to offer their own procedural and technical obstacles. A number of experts suggested, however, that better use could be made of the data generated in the operation of Internet-based job placement services. Similarly, a higher level of occupational detail could be incorporated into Statistics Canada's new Workplace and Employee Survey (WES) to gather useful information on occupational demand directly from employers.

Strengthening our Capacity to Understand Labour Markets

Occupations and Skills in the New Economy

As discussed earlier, the terms *occupation* and *skills* are closely related, but do not mean the same thing. The bulk of Canada's labour market survey activity is rooted in the National Occupational Classification system (NOC), which provides the common framework and definitions needed to gather occupational data consistently across the country and over time. The NOC has formed the basis for a wide variety of data sets and series that capture quantitative information on the labour market. This has, in turn, underpinned our ability to identify labour market trends and support informed decision making.[10]

There is a strong sense that current occupational classification systems are too slow in capturing and describing new occupations, many of which are connected to emerging technologies in newer sectors. Even with occupational titles that remain constant over time, the duties and skills required of individuals in these occupations are likely to be changing continuously. The statistics on these occupations may not capture very important skill changes unless the skill sets that are integral to various occupations are regularly monitored and updated.

The challenge facing our monitoring agencies is to improve NOC-based data collection by incorporating uniform approaches to identifying and measuring the individual skill levels demanded in different occupations. This is particularly the case for non-technical skills such as management and essential skill sets that, as noted earlier, are increasingly important to employers.

Thus, there is a fundamental need to strengthen our knowledge of the changing skills-occupation relationship and to build our capacity for capturing and disseminating information about how this relationship is changing. In this regard, HRDC's Essential Skills Project and its proposed Extended Occupational Network Project will make very significant contributions.

1.1 The Panel recommends that the Minister of Human Resources Development Canada, in collaboration with the Minister of Industry (as Minister responsible for Statistics Canada), proceed with the highest priority in 2000 to identify and document the essential technical and non-technical skills required in scientific and highly technical occupations.

A Common Language

Due to the slowness in reflecting new occupations and skill combinations, some sectors have moved away from NOC-based monitoring systems and developed their own occupational and skill definitions. To maintain a uniform and coherent approach to labour market monitoring, federal, provincial and private sector stakeholders – including industry associations and sector councils – must approach the collection, analysis, and use of data with a stronger sense of common purpose. The key to this will be the development and sharing of common definitions, and of databases that can be integrated.

1.2 The Panel recommends that the ministers responsible for the labour market (through the Forum of Labour Market Ministers – FLMM) and Statistics Canada, through the new Centre for Labour Market Statistics (*see* recommendation 1.5), in collaboration with the sector councils, commit by 2001 to the development and subsequent use of standard skill definitions, measurements and terminology, and to incorporate these within the following four-year period into the databases that they maintain.

Understanding Trends

Labour market ministers require an ongoing capacity to analyse trends and developments through targeted studies. We believe this need would be best served through the creation of a continuing fund to finance research for this purpose.

1.3 The Panel recommends that the ministers responsible for the labour market (through the Forum of Labour Market Ministers – FLMM) create a federal/provincial/territorial Labour Market Research Fund by 2001. The fund would support research on emerging labour market issues identified through the FLMM.

Research Capacity

We also note some early coordinated efforts by federal and provincial authorities to analyse local labour market conditions, as well as data collection systems that have been established by several of the sector councils. Good data is critical to understanding developments in the labour market, but we also have to know how to interpret the information we collect. Unfortunately, the analysis and interpretation of labour market data has attracted very little attention from university researchers. As a result, this activity has yet to reach its full potential.

1.4 The Panel recommends that the Minister of Industry provide funds to the Social Sciences and Humanities Research Council of Canada (SSHRC) to initiate a five-year program to build capacity within Canada's universities for labour market research and to attract graduate students to this field of study. This program should begin in 2001.

Making Better Use of Labour Market Information

A New Centre for Labour Market Statistics

As important as it is to enhance our labour market monitoring systems, it is equally important to make better use of the data we collect. Labour market variables are complex, and Canada gathers a great deal of data. However, the remaining and perhaps more difficult challenge is to interpret these data and package them in ways that best support decisions and actions by individuals, educators, employers, governments and others in relation to the labour market or the economy in general.

The Panel notes very favourably the collaborative efforts of Statistics Canada, other federal departments and their provincial counterparts to create centres within Statistics Canada to assemble and analyse statistical data in the fields of education, justice and health. Similar collaboration should occur in labour market statistics.

1.5 The Panel recommends that the Government of Canada provide funds to Statistics Canada to establish, no later than 2001 and maintain thereafter, a Centre for Labour Market Statistics. The Centre should operate under the broad direction of the Forum of Labour Market Ministers (FLMM).

Labour Market Information on Industrial Sectors

Statistics Canada, HRDC and its provincial counterparts make important and unique contributions to the development and operation of Canada's labour market monitoring systems. In relatively few instances, however, are these agencies as well placed as sector councils to undertake detailed monitoring of constantly changing

PARTNERSHIP IN DATA COLLECTION

The Canadian Centre for Justice Statistics was created in 1981 as a division of Statistics Canada. The Centre is the focal point of a federal/provincial/territorial partnership for the collection of information on the nature and extent of crime and the administration of civil and criminal justice in Canada. This partnership, known as the National Justice Statistics Initiative, has become the international model of success on how to develop, implement and manage an effective national justice statistics program.

skill requirements at the sector and workplace levels, or to assess the implications of these changes in areas such as occupational standards, education and training. For reasons established elsewhere in this report, the Panel has urged the federal government to encourage the formation of sector councils in all key industries, especially those dominated by small firms. We also note the potential contribution that a broader network of sector councils could make to our labour market monitoring systems.

1.6 The Panel recommends that the Minister of Human Resources Development Canada provide additional resources to the sector councils program for the purpose of establishing and using sector-specific labour market monitoring definitions, processes and tools designed to be consistent with broader systems used in monitoring the labour market, beginning in 2001.

Career and Employment Counselling

The Panel is also concerned that among the users of labour market information are guidance and career or employment counsellors who may not have sufficient expertise in interpreting labour market data for their clients. Counsellors support young people and adults in making very important career and learning choices, yet there is little or no specified training, occupational or certification standards for these positions in Canada's schools, colleges, universities, community and government agencies, or for individuals in private practice. In our view, the professional training opportunities in this area are inadequate in Canada.

1.7 The Panel recommends that the ministers responsible for the labour market (through the Forum of Labour Market Ministers – FLMM), in collaboration with the ministers of education (through the Council of Ministers of Education, Canada – CMEC), develop by 2002 standardized professional certification procedures for guidance and career counselling that are based, in part, on the ability to interpret and use labour market information.

Further, the FLMM should encourage the development of additional training opportunities to meet these certification standards.

Overcoming Barriers to Labour Mobility within Canada

Continuing the Commitment to Prior Learning Assessment and Recognition

Individuals acquire skills and competencies not only in the formal education and training system, but also through informal learning and work and life experience. Since two thirds of the participants in the labour force in 2010 are already in the labour force today, assessing and recognizing learning acquired through these informal channels should assume increasing importance. Prior Learning Assessment and Recognition (PLAR) – a process for identifying, assessing and recognizing what a person knows and can do – can help maximize our use of all available skills and minimize skill shortages.

PLAR evolved in Canada initially as a method for placing mature students in post-secondary courses. Since 1996, the Canadian Labour Force Development Board (CLFDB) has spearheaded efforts to bring PLAR into wider use. The CLFDB has noted that PLAR can minimize duplication of education and training efforts, facilitate labour mobility, enhance labour market services, advance occupational skill and training standards, and assist in assessing the skills of people trained outside of Canada. Simply put, PLAR can make the labour market work more efficiently.

As our work unfolded over the past year, a consulting group commissioned by the CLFDB was conducting an extensive study of PLAR and its potential to improve the supply of skills available to employers in Canada. The report stated the following:

> PLAR can be an effective and powerful instrument for labour market integration, mobility and utilization of the knowledge and skills and talents and abilities of all Canadians. Indeed, PLAR can provide a sustaining link to lifelong learning and at the same time contribute greatly to Canada's global competitiveness by allowing all Canadians to participate in the labour force more fully and equitably.[a]

As the CLFDB will cease operations at the end of 1999, the Panel is concerned that, without clear stakeholder organizational leadership and commitment, the important advances that have been made in PLAR could be lost.

[a] Training and Development Associates et al., *Reaching Our Full Potential: Prior Learning Assessment and Recognition for Foreign-trained Canadians*, June 1999, p.58.

1.8 The Panel recommends that the ministers responsible for the labour market (through the Forum of Labour Market Ministers – FLMM) immediately engage the education and training community, and business and labour to ensure that Prior Learning Assessment and Recognition (PLAR) expertise and services are sustained and further developed in Canada.

The Free Movement of People Across Canada

Worker mobility is a critical building block for a dynamic economy and, in most countries, it is a right of citizenship. Although Chapter 7 of the 1995 Agreement on Internal Trade (AIT) provides for the free movement of people, some Canadian professionals and skilled tradespeople continue to find it easier to cross the U.S. border than to cross provincial borders to pursue work opportunities.[a]

In the 1999 Framework to Improve the Social Union of Canadians, First Ministers committed to a July 1, 2001, deadline to comply fully with the internal mobility requirements of the AIT. The FLMM was given the mandate to oversee the implementation process, and some progress is being made. Many of the larger regulatory bodies governing engineers, technicians and technologists have already agreed to the mutual recognition of credentials, although many of the smaller bodies still have a good deal of ground to cover.

We applaud this resolve to comply with the mobility provisions of the AIT. In our view, it is both unacceptable and inaccurate to talk about the possibility of skill shortages as long as artificial barriers prevent us from making full use of the skills at our disposal.

1.9 The Panel recommends that the ministers responsible for the labour market (through the Forum of Labour Market Ministers – FLMM) continue to place a high priority on meeting the July 1, 2001, deadline for implementation across Canada of the labour market mobility provisions of the Agreement on Internal Trade.

In addition, ministers should consider providing financial support to smaller regulatory authorities that require additional resources to meet the deadline.

Improving Canada's Ability to Compete for Highly Skilled Workers from Abroad

From the earliest days of Confederation, Canadians have relied on a steady inflow of workers from abroad to meet our skill requirements. Immigrants turned the Canadian West into a breadbox for the world. They fuelled Canada's postwar economic boom, and today they are an important source of higher-order skills for the knowledge-based economy.

As a skills channel, immigration offers significant economic advantages to Canada. Although Canadians debate the costs of the so-called brain drain, immigration can be viewed as the brain gain. For instance, census data show that the proportion of recent immigrants who hold university degrees is higher than for the comparable Canadian-born cohort.[31] The fact that between 1991 and 1996, new immigrants accounted for more than 30 percent of employment growth among computer engineers, systems analysts and computer programmers illustrates the value of immigration as a skills supply channel.[b]

In countries around the world, there are highly educated and skilled people who can join our work force with little or no remedial training. We must recognize, however, that Canada competes with other nations for skilled immigrants, particularly the United States, Australia, countries of the European Union, and Israel. In recent years, all of these countries have modified their immigration recruitment legislation and practices to make it easier to attract immediately productive immigrants.[16]

Involving Employers in the Selection of Skilled Immigrants

Since employers often look upon immigration as a supply channel to fill highly specialized positions (permanently or temporarily), it is important for government to work closely with the private sector – including industry sector councils – in designing immigration selection policy. The rapid change in the demand for skills and the continuous emergence of new skill sets means that the present *skilled worker* selection system, focussed as it is on an essentially static list of "occupations in demand", cannot meet the needs of our dynamic economy. The Panel is encouraged at the proposals outlined in the recent White Paper on new directions for immigration and refugee policy reforms, one for a human capital model for skilled worker immigrant selection, and another for a

a See the Web site of the Internal Trade Secretariat at **http://www.intrasec.mb.ca/index.html**

b I.P. Fellegi, "Brain Drain / Brain Gain: What Do the Data Say?" Presentation to the Ottawa Economics Association, June 28, 1999.

redesign of the selection process of temporary foreign workers.[a] These new approaches, by stressing attributes required in our knowledge-based economy and by focussing on the net economic benefits for Canada, would help ensure that immigration continues to serve the needs of both employers and immigrant workers.

1.10 The Panel recommends that the Minister of Citizenship and Immigration ensure that the needs of employers for highly skilled immigrants are satisfied in the development of the new selection system for skilled worker immigration and that the model for the recruitment of temporary workers, recently tested for the software sector, be expanded to other industrial sectors competing for highly skilled foreign nationals.

Further, industry sector councils should play a key role in the implementation of this new approach to the selection and recruitment of skilled workers.

International Recruitment of Faculty

Current immigration regulations, as imposed by Human Resources Development Canada and Citizenship and Immigration Canada, make it difficult for Canadian post-secondary institutions to recruit faculty from abroad. (The exception is Quebec, which has special arrangements.) These measures made sense when they were implemented in the 1970s, as there was a need to "Canadianize" our universities and provide teaching opportunities for Canadian graduates. Changes are needed to existing regulations to allow all post-secondary institutions to advertise simultaneously, rather than sequentially, for Canadians and other nationalities. This will help our colleges and universities to compete with other countries in attracting highly qualified science and technology professors.

1.11 The Panel recommends that the Minister of Human Resources Development Canada and the Minister of Citizenship and Immigration amend current regulations to further facilitate the hiring of foreign nationals to faculty positions in colleges and universities.

International Students

In recent years, on average, some 100 000 foreign nationals enrol in Canadian post-secondary institutions,[b] approximately one third of them in regular study programs leading to a degree or diploma.[c] Members of this latter group, who are already familiar with Canada's economic and social culture, offer an attractive source of skills to Canadian employers. However, the majority of them leave Canada after graduating and may only apply for permanent resident status from abroad. In contrast, the Panel notes that the Australians have recently adopted a "rapid conversion" policy for international students, similar to our recommendation.[16]

Policy changes are needed to assist Canadian employers in recruiting from this talent pool and to make it easier for international students who do not have a scholarship commitment with their home country to qualify for immigration to Canada after completing their studies.

1.12 The Panel recommends that the Minister of Citizenship and Immigration change current regulations under the *Immigration Act to* allow international students, once they have successfully completed a Canadian diploma or degree program and if they do not have a scholarship commitment with their home country, to apply for permanent resident status within six months of graduation, and to allow the applications to be made from within Canada.

Recognizing the Skills of Immigrants

Even though many immigrants have strong educational credentials, most go through an adjustment period as they enter the Canadian workplace. Some have to improve their language skills, and it may take time to build contacts and become familiar with our economic system and culture. We are concerned, however, that many highly trained professionals and technically skilled immigrants, who have been welcomed to Canada, find provincially legislated licensing bodies slow or reluctant to recognize their credentials. In our view, this reticence – which varies among professions and provinces – often cannot be justified on the basis of protecting standards, and amounts to a restriction of the supply of skills and a waste of human potential.

[a] Building on a Strong Foundation for the 21st Century. New Directions for Immigration and Refugee Policy and Legislation, Citizenship and Immigration Canada, 1998.

[b] Citizenship and Immigration Canada, Fall 1999.

[c] Education in Canada, 1998, Table 27, Statistics Canada

It is encouraging to note that government-mandated services are now available in British Columbia, Alberta, Manitoba, and Quebec to evaluate foreign educational credentials in relation to Canadian equivalents. However, some professional licensing bodies may not accept these evaluations alone as proof of competency. Nor is it clear that PLAR techniques are regularly used to assess competencies that immigrants – particularly tradespeople – may have acquired outside of formal education or on the job. Moreover, even if credentials are recognized in one province or territory, they may not be accepted by licensing or accrediting bodies in others.

As noted earlier, licensing bodies are making progress toward harmonizing professional standards and improving the interprovincial portability of credentials. However, this is occurring too slowly in some regulated occupations. To make maximum use of the skills at our disposal and to address or prevent skill shortages, international credential assessment and recognition should be brought into this process now, and licensing bodies – particularly those governing access to trades – should develop PLAR techniques to assess competencies acquired through experience and informal learning.

1.13 The Panel recommends that the ministers responsible for the labour market (through the Forum of Labour Market Ministers – FLMM) require self-regulating professions to establish a "fast-track" process to assess the competencies of immigrant professionals against existing provincial/territorial standards, and move them quickly toward accreditation or identify specific skills that they must upgrade to obtain accreditation. As well, the FLMM should provide information, technical assistance and, where necessary, funding to facilitate the completion of this task by 2001.

1.14 The Panel recommends that the Minister of Citizenship and Immigration ensure that Prior Learning Assessment and Recognition (PLAR) services are made available before immigrants, particularly tradespeople, come to Canada, in order to facilitate credential assessment as part of the immigration application process.

2. Knowledge

The Panel's recommendations under the *knowledge* element of the knowledge-economy ecology address the challenge of overcoming the shortage of opportunities for skilled Canadians. The Panel proposes actions that are aimed at the following:

- **strengthening the research and development (R&D) capacity of Canada's universities and colleges;**
- **improving the return on public and private sector investments in science and technology;**
- **supporting the growth of small knowledge-intensive firms; and**
- **helping small and medium-size enterprises (SMEs) absorb science and technology graduates.**

As we have already emphasized, in a knowledge-based economy, the creation and use of knowledge is inseparable from the continuous development of skills. To put it another way, promoting education and learning is inseparable from promoting employment and enterprise growth.

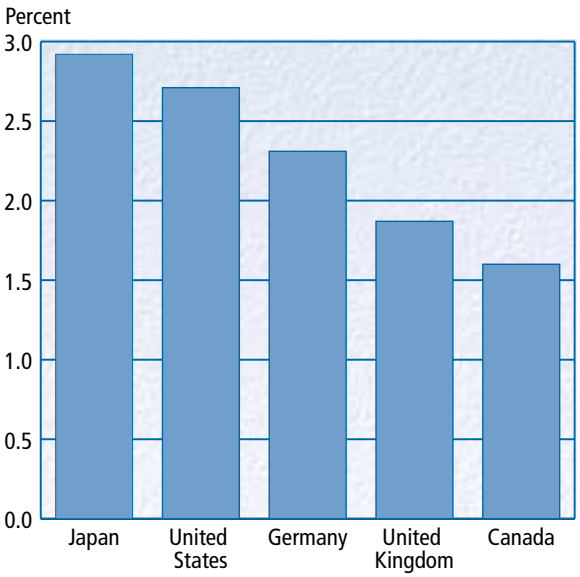
For Canada to succeed in the knowledge-based economy, it will require public and private investment in activities to create, maintain and renew knowledge. This includes basic and applied scientific research, innovation, technology transfer and commercialization. Governments must develop policies that encourage private spending on knowledge creation, but we cannot rely on the business sector alone to provide the level of investment required for Canada to gain a competitive advantage.

For much of the 1990s, the various orders of governments in Canada have been necessarily and quite singularly preoccupied with eliminating deficits. Now, as the decade draws to a close, this prudent fiscal course has led to a dramatic improvement in our public finances. However, another legacy of single-minded cost cutting has been to cast all government spending in a pejorative light. Private sector investment will continue to be important, but we will also have to invest public funds in ways that will ensure our prosperity over the longer term. Otherwise, we will condemn ourselves and our children to a future of foregone opportunities.

Recent federal budgets included some incremental progress in implementing the Science and Technology Strategy unveiled in 1996. Funding for the Canada Foundation for Innovation (CFI) and increases have been allocated to the budgets of the research granting councils (Medical Research Council of Canada – MRC, Natural Sciences and Engineering Council of Canada – NSERC, and Social Sciences and Humanities Research Council – SSHRC). Continuing investments in the Canadian Network for the Advancement of Research, Industry and Education (CANARIE) and in the National Research Council Canada (NRC) are important steps forward, as well as the creation of the Canadian Institutes of Health Research (CIHR). Still, our level of investment in R&D continues to trail behind that of other G7 nations.

Gross Domestic Expenditures on Research and Development, 1996

(R&D as a percentage of Gross Domestic Product)



Source: *Main Science and Technology Indicators* (Number 1), OECD, 1999. p. 16.

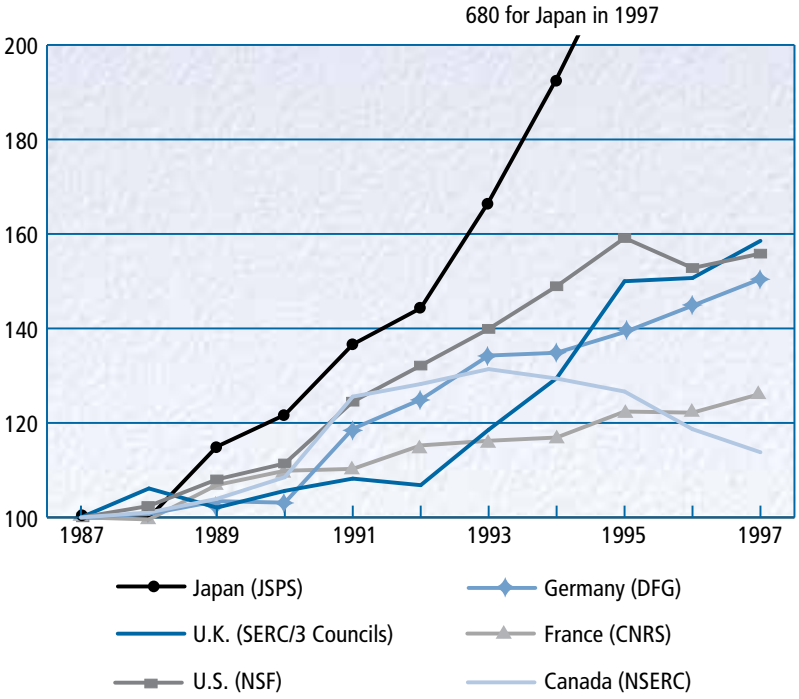
Other countries, such as Ireland and the United Kingdom, have long been champions of conservative fiscal policy, but public sector support for knowledge-creating activities is no longer viewed – from within or outside of government – as a cost factor. Rather, it is seen as a necessary and profitable investment in the future. It is important to note that these countries have developed mechanisms for identifying promising areas for investment in fundamental and applied research, acted upon a willingness to choose strategic priorities in allocating resources, and focussed their efforts on

technology transfer between academic researchers and private firms. The Americans are also moving aggressively to increase their public investments in R&D and related activities. Canada must follow suit.

Strengthening the R&D Capacity of Canada's Universities and Colleges

The right research opportunities, whether in government, the private sector or universities and colleges, will offer challenges that attract the best and brightest scientists, biomedical researchers, engineers and other specialists, and offer an enormous potential commercial and social pay-off. By providing facilities and opportunities that will keep high skilled graduates in Canada, we will maximize the return on our substantial investment in their education.

Index of Budget Trends for Some G7 Research Councils
(1987=100) (in constant 1987 dollars)



Source: *Trends, The Canadian University in Profile*, Association of Universities and Colleges of Canada, 1999, p. 89.

Thanks to federal and provincial government measures, Canada is one of the most attractive places in the world to operate R&D facilities. Despite a recent uptrend, Canada devotes just 1.7 percent of its GDP to R&D, substantially less than Japan, Germany or the United States.

The reasons for this poor performance are not wholly understood. Some point to high rates of foreign ownership in Canadian industry, the legacy of a resource-based economy, and our colonial heritage. Others point down to our risk-averse culture and a shortage of technically trained individuals who want to establish and grow world-class companies. Whatever the reasons, we need a greater commitment to R&D and its commercialization in Canada.

With respect to the government's role, we share the view of the Expert Panel on the Commercialization of University Research, that the budgets of existing funding agencies such as NSERC and SSHRC should be expanded, and granting agencies should continue to favour those applications for R&D funding that integrate skills and human resource development into their business strategies.[a]

Also, we note that in other countries, including the United States, research grants to colleges and universities often cover the indirect costs incurred by the institution to support the research function. In the United Kingdom, the recent Dearing Report strongly recommended the provision of funding for the indirect research costs that universities incur, and some progress has been made.[b]

When the indirect costs of research are not met by public or private external funders and have to be borne by universities themselves, there are two consequences: Canada's primary research infrastructure becomes increasingly limited in its capacity, and resources are drawn away from the classroom. Payment of these indirect costs will motivate and drive the expansion of a quality research agenda.

[a] Advisory Council on Science and Technology, *Public Investments in University Research: Reaping the Benefits*, Report of the Expert Panel on the Commercialization of University Research, May 1999.

[b] *Report of the National Committee of Inquiry into Higher Education*, June 1997 (see the Committee's Web site http://www.leeds.ac.uk/educol/ncihe).

2.1 The Panel recommends that the Minister of Industry and the Secretary of State for Science, Research and Development undertake to secure the additional resources needed to allow the federal granting councils to meet the full indirect costs of the research that they support, by 2004. This change could be implemented incrementally, starting in 2001.

Improving the Return on Public and Private Sector Investment in Science and Technology

Commercially exploitable advances in scientific knowledge are taking place across a broad range of disciplines and applications. The funds available for R&D in Canada are limited, but even if the pool were significantly larger, we would still have to make choices in allocating resources to one area over another. In other words, we need to ensure that these choices are strategic and directed to where the highest returns are likely to be found. A mechanism is required to furnish information that will help individual researchers, private industry and governments to make good decisions, given trends in science and technology and our strengths and weaknesses in scientific research.

In the United States, this mechanism is provided by the President's Committee of Advisors on Science and Technology Policy, the National Science Foundation and other agencies. In the United Kingdom, an agency known as Foresight UK[a] provides this strategic advice. In both cases, the idea is to bring together the best science minds with the best business minds and experts from other fields to examine science and technology trends in particular segments of the economy (advanced materials, micro-electronics, etc.). These expert panels can then engage in casting a 5-, 10- or even 20-year vision for that segment, and suggest a course for R&D investment consistent with that vision. Other advantages of this informed speculation are to bring the worlds of research and business closer together, guide post-secondary institutions in developing curriculums and facilities, and help individuals make long-term career choices. Of course, all choices involve some degree of risk, and neither the British nor Americans would advocate putting all of their R&D "eggs" in the visionary "basket" that these mechanisms produce. Still, they believe, and the Panel agrees, that this multi-party process for targeting a large part of R&D resources is highly worthwhile.

In Canada, the mandate of the Prime Minister's Advisory Council on Science and Technology provides for this kind of continuing, forward-looking strategic advice on allocating R&D investments. To date, however, the resources needed to develop "expert visions" of Canada's science and technology future by sector and to assess the implications for R&D investment have not been provided. We applaud the efforts of Industry Canada through the Technology Roadmaps Initiative,[b] and those of the Partnership Group for Science and Engineering (PAGSE), but we believe it is time to launch a significant initiative in this area.

2.2 The Panel recommends that the Prime Minister's Advisory Council on Science and Technology (ACST) receive the funds necessary to create expert panels to identify and analyse trends in various domains of science and technology, and advise private industry, government, research centres, education and training institutions, and individuals on promising lines of research and development (R&D).

These panels should include representatives from business, the science community, federal and provincial research granting councils, the National Research Council, provincial/territorial science advisory bodies, and others. The ACST should receive the required funding to begin this process in 2000.

Stimulating Growth of Small, Knowledge-intensive Firms

As noted earlier, Canada is a nation of small firms. The business and technical development prospects are significantly improved – and more of them can grow into world-class companies – with ready and affordable access to expert advice and consulting services in areas such as product testing and quality control, technology transfer, commercialization of R&D, regulations and standards, marketing, staff and management training, and so on.

[a] See UK Foresight Web site at **http://www.foresight.gov.uk/default.htm**

[b] See Industry Canada's Strategis Web site (**http://strategis.ic.gc.ca/sc_indps/trm/engdoc/homepage.html**).

In Canada's large urban centres, the sources of business, technical and scientific advice is often more readily available than in smaller cities and regions.[a] This lack of infrastructure leaves smaller centres and regions at a significant disadvantage in the global, knowledge-based economy, where business opportunities may not be as location-dependent as in the "old" economy.

In the United States and the United Kingdom, as in a very small number of Canadian locations, there is a history of success arising from investing in enterprise incubators and their associated supports, housed on university and college campuses.[b] The start-up companies are physically located on campus, where they have access to scientific and technical assistance and can benefit from a variety of business services. New and easier networking opportunities are created. Successful enterprise incubators are well-managed, have clear criteria for participation, and regularly measure their performance against realistic targets.

In Canada, our universities and community colleges located outside major centres possess a generous base of scientific and technical resources. Their faculties of science, engineering and business have the knowledge and know-how that many small firms need to grow. An enterprise incubator on campus can leverage this capacity and provide single-window access to a wide range of affordable services.

Locating enterprise incubators on campuses would increase the return on the investment in regional colleges and universities and give them an additional means to contribute to the economic development of the communities they serve. It would also build on the success of the Industrial Research Assistance Program (IRAP) run by the National Research Council (NRC).[c]

2.3 The Panel recommends that the Minister of Industry, working with provincial/territorial governments, regional development agencies and others, provide the core funding necessary to create 15 to 20 university-based and college-based incubators and resource centres for technology enterprises across Canada. These enterprise incubators – on their own or in cooperation with existing economic development agencies, sector organizations and so on – would provide a wide range of affordable scientific, technical and management services to small, knowledge-intensive firms, particularly in the start-up phase.

The program should be developed to ensure that centres are located in all the principal sub-regions outside of the major metropolitan areas, to stimulate and focus the development of knowledge-economy activity in those sub-regions. The plan should be developed for implementation in 2001.

Science and Technology Skills for Businesses

Recent research by Statistics Canada[13] confirms that enhancing the capacity of small firms to innovate and to use higher-order skills can be a powerful tool for encouraging growth. Many small enterprises are reluctant to hire highly skilled post-secondary graduates. Because they lack experience, recent graduates often cannot "hit the ground running" and do not quickly begin to generate revenues that offset their own salaries and add to the bottom line. This contrasts with the United States, where small employers are more likely to pay a premium for higher-order technical skills, even when not combined with much practical work experience. The fact that Canadian small and medium-size enterprises (SMEs) appear to have less capacity to absorb highly skilled workers contributes to what we call Canada's opportunities shortage. It may also explain why a small number of Canadian graduates, particularly in highly specialized fields, look to the United States to find their first job.[d]

[a] Nevertheless, in a number of smaller communities, local investment organizations have developed that provide business advice – but not technological advice and support or R&D – as well as financing to small businesses, many of them in the high-tech sectors. Depending upon the initiative, all three levels of government may be involved, with the federal government's involvement through its regional development agencies. They often operate in partnership with private sector sources.

[b] See Industry Canada's *Strategis* Web site at **http://strategis.ic.gc.ca/SSG/tf00118e.html**

[c] See the IRAP Web site at **http://pub.irap.nrc.ca/irap/web/irapcomm.nsf/Home**

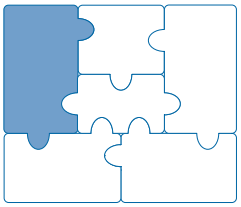
[d] Human Resources Development Canada and Statistics Canada, *South of the Border: Graduates from the Class of '95 Who Moved to the United States,* August 1999.

Across Canada, various government agencies and sectoral organizations have tried to address this problem through internships and other programs that subsidize salary costs to make recent graduates more attractive to small employers. Many of these initiatives have been aimed at reducing youth unemployment, as opposed to meeting the development needs of small firms. Moreover, few have received enough funding, or been provided salary support of sufficient duration and amount to have much impact on this pattern of low innovation absorption. Would more resources make a difference? Experience in the United Kingdom indicates that the answer is "yes".

A United Kingdom government initiative known as the Teaching Company Scheme (TCS) has successfully addressed this problem of small firm innovation since the mid-1970s.[21] There are at least three elements that set TCS apart from anything that has been systematically tried in Canada. First, master's and PhD students are paid a market-based salary (up to $84 000 per year for post-doctoral participants), instead of the equivalent of a welfare supplement, and this support may continue for up to two years while they work on firm-related research and innovation projects as part of their thesis work. Second, universities and colleges are fully compensated for the cost of designing and supervising placements to ensure that expected outcomes are achieved by employers and employees alike. Finally, TCS includes a continuing education component. Participants are brought together four times a year for intensive, week-long business and management training courses. Not only do they learn from business faculty, but they also build networks with other participants. From all indications, it works – with very high levels of hiring and retention in the study firms after the program ends.[a]

2.4 The Panel recommends that the Minister of Industry and the Minister of Human Resources Development Canada develop, in 2001, a program – closely modelled on the British initiative, Teaching Company Scheme – to help small and medium-size enterprises (SMEs) absorb recent graduates in science and technology and allocate the resources to provide for 300 participants per year by 2004.

[a] See the Teaching Company Directorate's Web site at **http://www.tcd.co.uk/tcd/index.hts**



3. Skills

The Panel's recommendations under the *skills* element of the knowledge-economy ecology address the challenge of relieving stress on our learning systems. The Panel proposes actions that are aimed at the following:

- **strengthening learning opportunities for children and youth;**
- **improving the capacity of post-secondary institutions to meet the skill needs of students and employers; and**
- **upgrading skills in the existing work force and making lifelong learning opportunities accessible to all Canadians.**

In the knowledge economy, the speed of economic and technological change demands increasingly higher and higher technical and scientific competence and, as we learned from our interviews with industry officials, a broad and evolving set of *essential* and *management* skills, often called "soft skills". The skills development process must start early in life and last for life, and everybody has to be a part of it.

Skills are one of the linchpins of the new economic model. Without skills, nothing works. At the same time, a skilled work force on its own is not sufficient. The other elements in the new economic paradigm influence the demand for skills, and provide the motivation and organizational dimension that is critical for developing skills and, just as importantly, the opportunities for skilled people to put their talents to work.

The Panel offers a number of recommendations in relation to skills development to individuals, governments and organizations, and to the learning system itself. The recommendations are directed at both orders of government, education and training providers, and private industry.

We also stress the relationship between our recommendations on skills issues and those made about labour market information and structures for action. First, however, it is important to be clear on the demographic context against which the skills development challenge takes place.

The Demographic Context

Demographics will have a large and fairly predictable influence on how we meet the demand for skills in the knowledge-based economy. The Canadian demographic picture over the next decade is one of an ageing population with fewer school-age people and increasingly large numbers of people reaching retirement age. The under-15 population (6 million), which represented 20.2 percent of the total population in 1995, will fall to 16.9 percent by 2010 (5.8 million). At the same time, the share of the total population represented by people between the ages of 45 and 64 will grow from 20.9 percent to 26.8 percent (6.2 million to 9.7 million).[28]

A relatively small youth cohort and an ageing work force suggest that, although our educational system will remain a vitally important source of new skills, other channels – including immigration and self-directed or employer-sponsored initiatives to upgrade the skills of the existing work force – must become increasingly significant within the overall skills picture. In the aerospace and automotive sectors, a significant proportion of the skilled trades work force will reach retirement age within the next decade. At the same time, across the whole spectrum of industry, a real challenge will be to replace the non-technical skills – often the product of experience and maturity – that will disappear from the work force as older workers retire.

Another significant demographic trend becomes apparent in the composition of the youth cohort. In 1996, 4.6 percent of the population under the age of 15 were of Aboriginal origin, almost twice as much as the proportion of the Aboriginal people in the total Canadian population (2.8 percent). In Manitoba and Saskatchewan, one in five children under 15 are of Aboriginal origin. Measures to improve access to post-secondary education and increase participation for Aboriginal youth will take on added significance.

Strengthening Learning Opportunities for Children and Youth

The Early Years

During the first 18 years of their lives, young people can and must acquire essential skills – reading, writing, calculating, computer literacy, reasoning, problem-solving and oral communications. We will do our diminishing number of young people a disservice if we do not look upon essential skills as the foundation for the development of higher-order skills for the knowledge age.

The Panel was struck by the wisdom of the *Early Years Study* commissioned by the Government of Ontario. The data led the authors to conclude that children's learning habits and the foundations for teamwork, communications and other essential skills are built in early childhood.[a] We also believe that concepts such as innovation, risk analysis, and economic and commercial literacy can be integrated into elementary and secondary school programs in ways complementary to existing curricula.

3.1 The Panel recommends that premiers carry their recent discussion of the *Early Years Study* further and, in consultation with the National Children's Agenda partners, identify key objectives and an implementation schedule for achieving them, especially those relating to the "infrastructures" required at local and regional levels to enable families, communities, educators and businesses to better address the learning needs of young children.

A Curriculum for the Knowledge Economy

The Panel believes there is a need for closer linkages between the world of business and the world of education. Our discussions with employers confirm the view that the quality of the technical skills and knowledge of Canadian university and college graduates is very high. However, as noted earlier, employers often complained that new recruits lack the essential skills needed even for entry-level, let alone more senior positions.[8] This is a clear but difficult challenge to Canadian schools. Revising curricula once again, especially with limited resources, may seem daunting. However, in our view, this is necessary.

EDUCATION AND WORK LINKAGES

The Centre for Applied Academics in British Columbia runs the Applications of Working and Learning (AWAL) project, to assist educators in connecting the curriculum they teach in the classroom with how that curriculum is used in the workplace. Teachers interview employers and employees, pool the information they collect, and then reflect on essential skills and knowledge across a wide variety of occupations. Using what is learned in a variety of workplace environments, participants develop relevant classroom activities. At the same time, employers and employees learn more about the content and practices of schools.

http://www.bced.gov.bc.ca/careers/aa/welcome.htm

NEW INTERNSHIP OPPORTUNITIES

Some 450 high school students across Canada have participated in a pilot project designed by the Canadian Aviation Maintenance Council. They were offered an introduction to aviation maintenance as well as 150 to 200 hours of work-based experience. The program was created to build bridges between education and the world of work, develop positive work experience and enhance the employability of the participants. The experiment was also used to test a new aviation maintenance orientation program before its full implementation.

http://www.camc.ca/camcenglish/index.asp

Despite recent growth in co-operative education and "experience-with-work" programs in the elementary, secondary and post-secondary systems, young people still have too few opportunities to learn about the world of work. Most high school students study social, health and family life issues to prepare them to become responsible citizens. Oddly, however, only a fortunate few learn directly about the forces and factors that will shape their ability to earn a living. The Panel does not accept the argument that schools should content themselves with developing young minds and nurturing a capacity for critical thought. Schools should also be preparing young people, quite explicitly, for their work lives. The Panel also believes that the two orientations are not unrelated in the new economy.

Young people who learn about work and are exposed to different workplaces through their school years will fare better when they join the paid work force as employees and as entrepreneurs. They will acquire a sense of what they are good at, of what they like doing, and about the technical and other skills they will require to indulge their talents and preferences, while supporting themselves and their families. By introducing children and youth to the world of work and showing them how seemingly dry academic or textbook concepts can have practical workplace applications, we can motivate them to stay in school and help them to make more informed career choices.

Since Canada's response to the skills challenge so clearly rests on the strengths of our schools, we are very encouraged to learn of innovations in the elementary, secondary and post-secondary systems across Canada that introduce work-related concepts alongside other essential elements of the curriculums. The Panel is aware that ministers of education have discussed the

[a] F. Mustard and M. Norrie McCain, *The Early Years Study. Reversing the Real Brain Drain*, The Canadian Institute for Advanced Research, April 1999.

need to better prepare young people for the transition from school to work.[a] The Panel applauds this and suggests they go further. Unfortunately, Canadian school boards and administrators have had difficulty duplicating best practices from one place to another and introducing new insights about learning into the mainstream of our education system.

3.2 The Panel recommends that the ministers of education and school boards (through the Council of Ministers of Education, Canada – CMEC), in collaboration with business and industry (e.g. sector councils, chambers of commerce, and the Canadian Federation of Independent Business and so on) develop a concerted strategy for sharing best practices and for progressively incorporating "work studies" and experience-with-work programs as core elements of elementary and secondary curricula. A plan should be developed by 2002.

The federal government should play an enabling role by providing funds to business groups and, where appropriate and requested, to provinces, territories, and First Nations schools to assist in planning, experimentation and implementation.

3.3 The Panel recommends that the ministers of education (through the Council of Ministers of Education, Canada – CMEC) extend the School Achievement Indicators Program to regularly measure the acquisition of *essential skills* (as defined in this report) by elementary, secondary and post-secondary students and report to Canadians on the levels of achievement in these key learning areas.

Teacher Education and Professional Development

Because Canada's response to the skills challenge rests on the strengths of our schools, it also rests squarely on the shoulders of our teachers and on individuals and families. If the development of essential skills is to become a core element in elementary and secondary curriculums, new approaches to teacher education, certification and professional development will certainly be required. During their initial training, teachers must be immersed in work and skills issues and in the techniques for tapping a wide range of sources for labour market and career information (including many of the Job Futures materials currently produced by HRDC).[b] They must also learn to tap into the employer community, to stay abreast of changing work and skill requirements. This will better equip them to demonstrate the practical applications of what they teach, integrate co-op and experience-with-work programs into the curriculum, and help students returning from work assignments to reflect upon and internalize their experience.

3.4 The Panel recommends that the ministries of education (through the Council of Ministers of Education, Canada – CMEC) develop and adopt, by 2002, licensing guidelines to ensure that new teachers will be well prepared to deliver essential skills education and training in elementary and secondary schools. As well, ministries should, by 2002, develop a strategy to ensure that the teaching of essential skills becomes an integral part of in-service professional development for licensed teachers currently teaching at elementary and secondary levels.

Stronger Links Between Schools and the World of Work

As their careers unfold, high-school teachers should also return periodically to the non-academic workplace to keep abreast of changing work and skill requirements. We realize that this would raise compensation and scheduling issues. However, it is hoped that both employers and teachers will see this policy direction as a benefit to both students and teachers and that school board officials, employers and business associations would become active players in this process.

Ministries should also work with businesses to establish formal channels to encourage a two-way flow of people and ideas between secondary schools and firms. These channels would help teachers to find workplace assignments and might also offer "job shadowing" or other programs that would expose business executives to the learning environment and build connections that would open up classrooms to the world of work. It is essential that employers gain a fuller appreciation of the complexities and challenges involved in preparing young people for the labour market.

[a] See, for example, Council of Ministers of Education, Canada, *Learner Pathways and Transitions*, January 1999 (**http://www.cmec.ca**).

[b] See HRDC's Web site at **http://www.hrdc-drhc.gc.ca/JobFutures/english/index.html**

3.5 The Panel recommends that ministers of education give high priority to enabling secondary school teachers to become more familiar with the new world of work, and through the Council of Ministers of Education, Canada (CMEC), collaboratively develop the means to measure progress towards that objective.

In addition, working with school boards, faculties of education, teachers' organizations, industry organization and others, ministers of education should adopt strategies and implement measures to ensure that teachers are appropriately equipped to help their students understand and appreciate the technical and non-technical skills needed in the knowledge economy (e.g. new teaching tools, periodic placements or internships in non-academic workplaces, and financial and non-financial incentives). Provincial strategies should be in place by 2002.

3.6 The Panel recommends that industry organizations (such as sector councils) and business associations (such as chambers of commerce and the Canadian Federation of Independent Business) work with ministers of education and with school boards to develop programs that enable business executives to experience and better understand the educational system and the classroom setting. These programs should be implemented across Canada no later than 2003.

The Special Needs of Mathematics, Science and Technology Teachers

In our discussions with educators across the country[24] and among Panel members themselves, concerns were raised about a current shortage of *qualified* science and technology teachers for elementary and secondary schools. This impairs our efforts to equip young Canadians with adequate skills for the knowledge-based industries.

3.7 The Panel recommends that the Canadian Alliance of Education and Training Organizations (CAETO) conduct a thorough assessment of the current and anticipated pool of teachers in mathematics, science and technology at elementary and secondary levels.

Ministries of education, working with school boards, faculties of education and teachers organizations should develop programs – including summer institutes, courses and learnware – to help current teachers in elementary and secondary schools to upgrade their mathematics, science and technology skills. These programs should be ready for implementation in 2002.

As well, ministers of education through the Council of Ministers of Education, Canada (CMEC) should develop and implement, by 2001, a strategic plan for attracting more science graduates into the teaching profession. This effort should involve the CAETO and its network of contacts to mathematics, science and technology teachers in all learning systems.

Apprenticeship

As noted earlier, over the next five to 10 years, the automotive and aerospace industries anticipate a significant retirement of journeymen in industrial trades such as industrial electricians, millwrights, machinists, and tool-and-die makers. It is not at all clear, however, that the number of journeymen completing their apprenticeships will be sufficient to replace these retirements. In 1997, for example, 16 383 people completed their apprenticeships in Canada, which is 5 percent fewer than 10 years earlier.[a]

RENEWING APPRENTICESHIP

CAREERS: The Next Generation is an Alberta industry-sponsored foundation. It works with high-school students in the development of employability skills in trades and technologies, primarily through work-site learning. The province's Registered Apprenticeship Program allows high-school students to gain apprenticeship hours, high-school credits and wages by learning on the job. At the same time, CAREERS adds value by conducting career exploration workshops with students, offering a summer internship program, and finding suitable employers for qualified students. CAREERS operates in 42 communities.

http://www.nextgen.org

[a] Registered Apprenticeship Training Survey, 1997, in *The Daily*, Statistics Canada, August 4, 1999.

The Panel is also concerned that the anticipated retirement of these tradespeople will come at a time when demographic factors will be limiting the size of the younger age group from which apprentices are traditionally drawn.

Finally, it is also apparent that the duration of apprenticeships remains at more than three years on average, and the average age of individuals entering an apprenticeship program is about 25.5 years.[a] For people in their mid-twenties who may have family commitments, it can be difficult to complete a long apprenticeship at low rates of pay and with the potential of layoff. Moving from journeyman status to that of a technician/technologist or even engineer is even more difficult. As a result, the trades are often not viewed as careers with further development potential.

It was evident to the Panel that this situation has persisted, with little change, for many years. These issues have also been the subject of continuing discussion and consultation, through such vehicles as the National Apprenticeship Committee (NAC), which was established in 1991 by the CLFDB to develop a strategic direction for apprenticeship training. In particular, in a 1996 position paper, the NAC expressed concern about a number of fundamental apprenticeship-related issues, including the following:

- funding (following the federal government's withdrawal from the purchase and support of training, including apprenticeship);
- the use of new technologies in delivering apprenticeship training;
- Canada's ability to produce qualified tradespeople who meet industry standards, in the absence of national examination standards in the trades;
- the absence of a strong industry (i.e. employer and worker) role in apprenticeship training, and national-level vehicles for providing advice to provincial governments; and
- the need to improve the image of vocational and technical training, not only among students, but also among employers, parents and guidance counsellors.

In the Panel's view, fundamental issues such as these continue to mark discussions of apprenticeship at a time when, as noted, demographic pressures threaten to significantly increase the requirements for qualified tradespeople while at the same time reducing the supply of apprentices. It is clear, as a result, that efforts to promote the participation of women and equity groups in apprenticeships have a vital role to play in addressing this issue.[b]

3.8 The Panel recommends that the ministers responsible for apprenticeship adopt a key objective to ensure that apprenticeship training can be well-started within the secondary system. An implementation plan should be ready no later than 2002.

Ministers responsible for apprenticeship also instruct the Canadian Council of Directors of Apprenticeship, in consultation with stakeholders, to address on an urgent basis the issues of attracting new apprentices and retaining them through program completion. A plan should be prepared for ministerial approval in 2000.

Against this backdrop of urgent apprenticeship issues, it is of significant further concern to the Panel that, with the termination of the CLFDB, the continuation of the National Apprenticeship Committee itself or some other national-level forum of apprenticeship stakeholders is far from certain. In the Panel's view, the absence of such a body would seriously impair Canada's capacity to develop a coherent national apprenticeship strategy.

3.9 The Panel recommends that the Minister of Human Resources Development Canada place a high priority on the continuation of a national-level apprenticeship forum as an essential component of the development of a national apprenticeship strategy.

[a] P. Stoll and A. Baignee, *The National Apprenticed Trades Survey: An Overview of the Apprenticeship Experience,* Human Resources Development Canada, June 1997, Table 2.1 and Table 8.10.

[b] The Panel notes the strong efforts of the Women in Trades and Technology National Network, a cross-sectoral council, in this regard. See **http://www.wittnn.com/index.html**

Improving the Capacity of Post-secondary Institutions to Meet the Skill Needs of Students and Employers

Although skilled workers reach the labour force from a number of sources, the most critical channel is our schools. The size and quality of the cohort coming out of our schools will, in the simplest terms, depend upon enrolment and graduation rates in post-secondary education and the capacity of our colleges and universities to equip students with the skills needed in the knowledge-based economy. In this regard, the Panel notes the following trends that are of concern in post-secondary education.

University and College Financing

Since 1993, the real level of government support for Canadian universities has fallen by 20 percent. Although there have been substantial increases in tuition fees in most provinces, these added revenues have offset only half of the loss of government funds. On a constant dollar basis, government support for colleges and universities in Canada has decreased from slightly more than $11 000 per student in 1978 to less than $7000 per student in 1998, a decline of close to 40 percent.[a] In comparison, since the late 1970s in the United States, total per student resources have grown steadily throughout all types of universities and colleges, to the extent that today, *per student funding in the large U.S. public universities is likely double the revenue base in Canada, and revenues in the large private U.S. universities are now likely three times as great.*[b] Canada is falling behind in terms of its investments in higher education and the funding gaps are growing.

The Panel recognizes that all major components of federal and provincial budgets have come under pressure as deficit reduction became the singular priority for fiscal policy makers through the 1990s. Now, with the fiscal situation much improved, the question of post-secondary spending must be thoroughly examined with broader economic and social priorities in mind. Certainly, shrinking real budgets in our post-secondary education system are not consistent with the longer-term goal of building a learning culture in Canada.

It is difficult to put a precise dollar figure on the investment required to maintain high-quality teaching and research institutions at the post-secondary level. Certainly, the cost of training post-secondary students to the standards required in the knowledge-based economy are higher than in the past. Moreover, under the pressure of budget cutting, the physical plant and equipment of many colleges and universities have not been adequately maintained. In response to the question of whether or not our schools will produce the skilled people we need over the next five to 10 years, the Panel suspects that, at current levels of financing, faculty and infrastructure, the answer will be "no", in anything beyond a slow-growth economic scenario.

3.10 The Panel recommends that the First Ministers and their ministers of finance commit to a national plan to increase operating funds available to colleges and universities by at least 20 percent over the next three fiscal years, particularly in science- and technology-related programs.

However, institutions should be eligible to receive these increases in funding only by developing strategic plans for addressing the following key issues: improving their research and development (R&D) capacity; improving the recruitment of students and their retention through to graduation, particularly in science and technology-related programs; expanding experience with work opportunities; renewing faculty in priority disciplines; and retraining of the adult work force.

Recognizing that many provinces and territories will not be able to support these increases in targeted funding solely through their own resources, the Panel recommends that the federal government be a funding partner in achieving this goal.

The Panel commends the Government of Canada for the investments in university- and college-based research infrastructure that it has made available through the CFI. At the same time, capital assets associated with non-research functions have been allowed to deteriorate significantly over the past two decades.

[a] Association of Universities and Colleges of Canada, *Trends: The Canadian University in Profile*, 1999, p. 21.

[b] *Ibid.*, p. 34.

3.11 The Panel recommends that premiers and their ministers responsible for post-secondary education commit to developing and funding a continuous investment program to restore and renew the physical plant and equipment of colleges and universities, and that such a multi-year plan be in place by 2001.

Enrolment and Graduation

Although population projections can be made relatively easily, projecting enrolments is a complex process that uses both the demographic projections and projections of the youth group's rate of participation in post-secondary education. It is evident from past patterns of enrolment growth that participation is affected by a variety of factors including rates of economic growth, family incomes and savings rates, the perceived value of a degree or diploma, tuition costs, and the nature and extent of student financial assistance. Forecasting the impact of these factors on future participation rates is very difficult, and different assumptions can lead to varying enrolment forecasts.

The Panel encountered divergent university enrolment forecasts (and no college data). At one extreme, forecasts of significant enrolment growth have implications regarding government support of universities – in terms of both staff and infrastructure. At the other extreme, forecasts of relatively slow enrolment growth, in a period marked by increasing retirements from the labour market, increase the possibility of potential skill shortages.

The difficulties of forecasting overall enrolments are compounded by efforts to forecast enrolments in particular disciplines of interest. The Panel reviewed recent enrolments in fields relevant to the difficult-to-fill jobs in the five strategic sectors, such as computer science, engineering, and other science specialties.[30] This review has identified a shift towards computer science and some engineering specialties that, if maintained in future, would increase the supply relative to other disciplines. But recent shifts in the composition of enrolments may or may not continue into the future. The Panel notes further that these shifts would not guarantee equivalent increases in the flow of graduates into high-demand occupations, since surveys show that graduates of individual fields disperse into a variety of occupations when they enter the labour market.

However, there are concerns about insufficient numbers of graduates in many science and technology programs at both college and university levels. This is due in part to difficulties in attracting and retaining students in these programs.[a] Moreover, many of the programs are already quite strained because of their high requirements in terms of teaching and research staff, and equipment and facilities.

3.12 The Panel recommends that the ministers responsible for post-secondary education work with the Councils of Deans of Engineering, Science and Technology – and other similar organizations – to examine and systematically assess different strategies to facilitate the recruitment of students and their retention through to graduation, as well as to enhance the staff and infrastructure resources available to college and university programs in science and technology. Provincial plans should be ready for implementation in 2002.

Faculty

Although the student population in Canadian universities has been fairly constant since 1992, full-time faculty numbers have declined by 11 percent, with decreases experienced in every discipline.[b] In this respect as well Canadian trends differ sharply from those of other countries. Through the 1990s, for example, faculty in France grew by 27 percent and by 8 percent in Germany. In the United States, growth was in the 5-percent range.

Coincident with this decline, an ageing teaching faculty is now an issue for most post-secondary institutions. As professors have retired or left, only half have been replaced by younger staff. The Panel notes that ageing is less of a concern in university programs – including biological sciences, engineering and computer science – where faculties were able to replace relatively more professors in the early 1990s.[c] The Panel also notes with concern that mid-career attrition is a particular issue for the faculties of computer science, engineering, and other sciences, many members of which leave academia completely. On the other hand, for those faculty members who leave Canada for faculty positions elsewhere, the main attractions are higher salaries, better research resources and infrastructure, and a reduced teaching load.

[a] See, for example, Conseil de la science et de la technologie, *Des formations pour une société de l'innovation. Avis*, Gouvernement du Québec, June 1998.

[b] Data in this section from the Association of Universities and Colleges of Canada, *Trends: The Canadian University in Profile*, 1999, pp. 40-43.

[c] See also Natural Sciences and Engineering Research Council of Canada, *Highly Qualified Personnel*, May 1997, pp. 45-58.

Not surprisingly, the relative growth of faculty in the fields of engineering, computer science and related sciences parallels some of the shifts in student enrolment noted earlier. Broadly speaking, this would augur well for future enrolments and graduations in these critical fields. However, the overall level of university resourcing may continue to pose a problem, particularly if university participation rates increase in the future.

3.13 Notwithstanding uncertainties in predicting enrolment, the Panel recommends that the Canadian Alliance of Education and Training Organizations (CAETO) undertake, in 2000, a human resource study of the education and training sector at the post-secondary level. This would allow for more focussed sectoral human resource planning and help avoid an under-supply of faculty for colleges, universities and private training institutes for the next decade and beyond.

Stronger Links Between Post-secondary Institutions and Employers

The Panel believes that university and college study programs in science, engineering and technology should explicitly involve business management training and make students aware of the importance that employers place on *essential* and *management* skills. In the humanities and the social sciences as well, it is possible – and beneficial – to connect programs to the workplace and to employers who hire these graduates, including cultural industries, community services, the Information Technology sector and governments.

ENGINEERING AND COMMERCE

The Engineering and Management Program at McMaster University was first accredited in 1975 and is the only discipline-specific, joint engineering and business degree available in Canada. The program's objective is to teach students to understand engineering in the greater context of business. Students are required to broaden their scope and explore beyond the engineer's traditional concerns.

The four-year degree requirements of engineering are combined with the core requirements of a commerce degree. The result is a five-year combined degree program, offered in eight disciplines and administered jointly by the School of Business and the Faculty of Engineering.

http://www.eng.mcmaster.ca/engandmgt

Although the Panel accepts that some of the "softer" essential skills may be acquired through elements of the curriculum involving experience with work, it remains sceptical of arguments that essential skills can be taught incidentally or that classroom or thesis work is entirely adequate for that purpose.[8] There is room for a stronger focus on these skills, but there will be implications for staff and resources.

The Panel was encouraged to learn in its discussions with university representatives about new interdisciplinary approaches to basic and applied science programs, involving formal instruction in economics and management.

Many post-secondary institutions have also set up advisory committees for academic programs in which business and industry representatives take part. This can provide the basis for stronger links between the classroom and the workplace.

3.14 The Panel recommends that ministers responsible for post-secondary education encourage colleges and universities to establish advisory committees of representatives from industry and other appropriate stakeholders, for programs in science and technology, business and administration, and all other program areas that could benefit from closer links with the world of work (e.g. applied arts, social sciences and humanities). Progress on this objective should be measured and reported publicly in 2001.

Encouraging Contributions from Individuals and Corporations

The Panel recognizes that significant increases in the contributions by corporations and individuals to Canadian colleges and universities are not easily accomplished. However, the Panel notes that such donations currently occur disproportionately to institutions in Ontario, Alberta and British Columbia. We are also concerned that current tax measures, such as the capital gains treatment of real property and stock donations, significantly impede private giving to post-secondary institutions, particularly but not exclusively in non-metropolitan areas.

3.15 The Panel recommends that First Ministers and ministers of finance examine, in 2000, options for encouraging businesses and individuals to contribute to capital campaigns of universities and colleges by removing capital gains assessments on real property and stock donations.

3.16 The Panel recommends that ministers of finance develop measures to smooth the current strong regional bias in corporate and individual giving to post-secondary institutions occasioned by the geographic location of most corporate headquarters in central Canada, and encourage corporations with major giving programs to take a more national perspective in those programs, in recognition of the fact that skilled workers and knowledge come from all regions of the country. These measures should be implemented by 2002.

Upgrading Skills in the Existing Work Force and Making Lifelong Learning Accessible to all Canadians

The Pace of Change and Its Effects

The pace of change and its impact on skills is one of the defining differences between the industrial age and the new economy. Technical skills, in particular, must be continuously renewed. In addition, the labour market has become a very turbulent place. The notion of "a job for life" or that of a steady, orderly climb up the ladder of one organization have almost become relics of our industrial past. Today, security comes from anticipating and adapting to new circumstances and from knowing how to acquire needed skills throughout one's life.

The largest pool of talent available to Canadian employers, although an ageing one, is clearly the existing work force. Yet there is conflicting evidence on whether or not employers view upgrading the skills of their existing work force as a viable option for dealing with actual or anticipated shortages. Research commissioned by the Panel showed that in areas in which skills are perceived to be in the shortest supply, such as high-technology design and manufacturing, employers generally meet their needs through immigration, as opposed to the retraining of currently employed workers.[15] However, the Panel's interviews with other industry officials revealed that training existing staff was among the common responses to skill shortages.[8] More than anything, these conflicting results may reflect the transitions that are occurring as old sources of supply become less reliable.

Employers in the five sectors stressed the importance of continuous training to keep technical skills current in the face of advancing science and technology and a changing regulatory environment. Data show that engineers, technicians and technologists, and managers receive more training than other less skilled workers,[14] so it could be expected that employers in the five sectors overall would provide extensive training to their top technical staff. Larger firms, in particular, organize and deliver technical training in the workplace or in conjunction with industry associations, community colleges, or equipment and machinery suppliers. In some sectors, this is particularly understandable, given the consequences of allowing technical skills to become obsolete. Less understandable, however, was a more passive attitude on the part of many employers toward upgrading business and essential skills that, as noted earlier, are the most difficult to recruit. In most instances, the Panel's interviews suggested that training in these skill areas is employee-initiated (although often subsidized by the firm, but not as part of a specific training plan or strategy).[8]

To effectively increase the volume and availability of workplace learning will require the cooperation of a number of players, including businesses, other employers, individual workers, trade unions, governments, and education and training providers. It will also require sector-specific leadership and direction. In the Panel's view, this will require new structures and strategies for action, which are described in the section, "New Structures for Action".

Getting Serious About Lifelong Learning

In recent years, Canadians have been bombarded with messages about lifelong learning. We hear continually from educators, economists, business leaders and governments about the need to upgrade our skills continually, invest in learning, build learning organizations and nurture a learning culture in Canada. Although few will dispute this close connection between skills and success for individuals, employers, and the country as a whole, it is not so clear that all skills stakeholders are moving forward in the same direction.

We must accept that taking action toward lifelong learning will require incremental investments at all points on the learning continuum, as well as policy consistency and complementarity within and across jurisdictions. In some cases, this will not be cheap. In many cases, it will not be easy. For example, providing a safer, more secure and healthy learning environment for Canada's estimated 1.5 million children living in poverty, or meeting the special learning needs of Aboriginal communities will be very expensive. However, to say that these goals are unaffordable is to admit that building a learning culture is not really a priority. It is tantamount to saying that we cannot afford to do the things that will be beneficial in the longer run.

Canada's federal and provincial governments are emerging from a decade or more of deficit fighting. The federal government and many of the provinces are now recording budget surpluses, while others soon expect to reach this goal. Each has employed a different "tool box" of spending and revenue measures to bring their books more or less into balance. Now, with public finances vastly improved, it is time to take a close look at how the financial turmoil of the past 10 years has influenced accessibility to education and training and the capacity of our public institutions to meet the learning needs of Canadians.

We are concerned about several policy inconsistencies. Changes in provincial tuition-fee schedules, coupled with changes in the Canada Student Loans Program, appear to have reduced the affordability of part-time study in Canada. There are ambiguities in the treatment on a case-by-case, idiosyncratic basis of employer-financed training expenditures under the *Income Tax Act*, which may deter people from upgrading their skills. A lack of affordable child-care facilities presents insurmountable barriers to training and skills development for many single parents. A worker can use employment insurance to support maternity leave but cannot use it to leave the labour force temporarily to update her skills. In most jurisdictions, an unemployed person who is not eligible for employment insurance is also not eligible for any kind of supported education or training. Some provinces have discontinued support programs that enabled social assistance recipients to participate in post-secondary education. The list goes on. All of this persists at a time when we need to encourage continuous, part-time learning for individuals.

On the plus side, the Panel commends the federal government for the establishment of the Canada Education Saving Grants (CESGs), while cautioning that these benefit only those who earn sufficiently to contribute.

If building a learning culture is truly an overall objective for Canada, there should be a coherent system of incentives to encourage *all* Canadians to invest time and resources in developing their skills. Clearly, a true national commitment to a more adaptable and highly skilled country requires consistent policies from federal, provincial and territorial governments.

3.17 The Panel recommends that First Ministers state clearly in 2000 that *building a strong lifelong learning culture in Canada* is a high priority, and that they establish a small Audit Commission of distinguished Canadians to review federal, provincial and territorial government policies related to education and training, to identify those that are in conflict or create barriers, and to recommend specific corrective measures. Technical support to this audit committee should be provided by the federal and provincial Auditors General. This report should be tabled for discussion and action no later than 2002.

Excellence in People

How can we encourage Canada's firms, especially SMEs, to focus on human resource development activities, in order for them to enhance their capacity to innovate, grow and manage effectively in highly competitive regional and global markets? Canadian governments have spent considerable resources over the past 15 years trying to find easy, accessible and inexpensive "fixes" to this problem, but with little success. Have any other governments been more successful in assisting SMEs to perform better? The answer is "yes". Although that effort has been government-funded, it has not been government-led, and it requires time and money. However, the payoffs have been substantial for small firms in terms of start-ups, growth, improved employment, capacity to innovate and wealth creation.

In the United Kingdom, there is an effort of this type, known as "Investors in People";[a] in Ireland it is called "Excellence through People",[b] 21 Both are operated by non-profit corporations, but funded and utilized by governments and their economic development agencies in their work to enhance the management of SMEs. These programs set a nationally recognized standard of good practice in employer-led human resource development. The standard – similar to the ISO standards awarded by the International Organization for Standardization – provides a framework for linking individual training plans to an organization's core objectives. The process, which involves a detailed assessment of skill gaps and may take up to 18 months, requires a high level of commitment on the part of managers and employees alike. In Scotland, Ireland and Northern Ireland, where it has been most successfully implemented in small firms, governments and their enterprise agencies have strongly encouraged its use as part of other support strategies, such as export marketing assistance or R&D funding.

The Panel believes an initiative of this type – if similarly funded, organized and managed – would have very positive impacts in Canada. Given our dependence upon the development and healthy growth of small firms, particularly in high-technology sectors, Canada needs this additional lever for success in turning the attention of firms to the critical importance of strategic and planned human resource development. The Panel notes that "Investors in People" now has nearly 10 years' experience in successfully implementing its programs, and that it now offers "franchise-type" assistance outside of the United Kingdom.

3.18 The Panel recommends that the ministers of Industry and Human Resources Development Canada initiate the appropriate processes to implement in Canada, by 2002, a program closely modelled on the highly successful British "Investors in People" program, designed to help firms adopt high standards and good practices in the management and development of their employees and managers.

Learnware

The Panel believes that the new learning tools – utilizing on-line and multimedia platforms – add considerable power and value to the education and training programs offered through distance education and the Internet, as well as supplementing on-site learning. In particular, these new tools enable "just-in-time training", giving much greater control over the learning process and content to both learners and firms.

There are several initiatives in this field. At the national level, for example, Industry Canada recently financed the creation of the Tele-learning Centre of Excellence to help bring together expertise from across the country. The Department also supports the SchoolNet caching project and other connectivity programs to aid learnware use. Through its Office of Learning Technologies, HRDC supports the expansion of innovative learning technologies through the research, testing and sharing of best practices. The Canadian Network for the Advancement of Research, Industry and Education (CANARIE) will soon be initiating collaborative R&D projects to demonstrate new approaches to learnware that will eventually run on commercial, high-bandwidth networks.

[a] See the Investors in People Web site at **http://www.iipuk.co.uk/**

[b] See the Web site of the Irish Training and Employment Authority (FAS) at **http://www.fas.ie/contentres3.asp?left=busimenu_nocode.htm&main=exelence.htm&footer=E**

However, the Panel shares the view expressed by the experts who attended the seminar held in Edmonton[22] that these efforts have to be better coordinated around key strategic priorities. The Panel also agrees with the Expert Seminar participants that these priorities should be the following:

- to augment the demand for new learning technologies among individuals and organizations;
- to develop a more comprehensive supply infrastructure, including the adoption of interoperability standards that facilitate use and export and allow small firms to participate in the learnware market;
- to improve collaboration across jurisdictions; and
- to increase our know-how in adapting generic products to specific needs.

3.19 The Panel recommends that the ministers of Industry and Human Resources Development Canada, following appropriate consultations with private and public stakeholders, develop by January 2001 a national strategy to make Canada a world leader in the use and development of new learning technologies ("learnware"). The federal government should indicate immediately that it is prepared to play a leadership role in developing such a strategy and to make a substantial investment in its implementation.

3.20 The Panel recommends that the Canadian Network for the Advancement of Research, Industry and Education (CANARIE), in cooperation with key stakeholders in Canada and abroad, develop interoperability standards for learnware, thereby establishing a lead market position for standards and facilitating the growth of small Canadian firms in the ICT sector, for implementation no later than 2001.

Aboriginal Peoples' Special Learning Needs

By virtue of geographic location, economic status and other barriers, many of Canada's Aboriginal people do not have access to sufficient learning opportunities to participate fully in the knowledge-based economy. At the same time, demographic trends and emerging skill needs clearly indicate the importance of nurturing the intellectual potential of a growing cohort of Aboriginal youth. These issues are particularly important in Manitoba and Saskatchewan where, by 2010, nearly 20 percent of the youth cohort entering the labour market is expected to be from the Aboriginal community.

The special needs of Aboriginal peoples and their communities for training, education and connectivity were raised in the Expert Panel's consultations. Among the five industries we examined, the Manitoba Aerospace Human Resources Committee, the Canadian Council for Human Resources in the Environment, and the Software Human Resources Council have made efforts to include Aboriginal peoples in special training programs that meet the skill needs of their respective industries. In addition, the Aboriginal Human Resource Development Council, formed early in 1998, has indicated an interest in promoting the participation of Aboriginal people in apprenticeship programs.

The Panel considers the 1996 report of the Royal Commission on Canada's Aboriginal People to be an eloquent and rich exploration of the skill development needs of Aboriginal people.[a] The Panel is encouraged that some recommendations of the Royal Commission have been implemented, but much more needs to be done.[b]

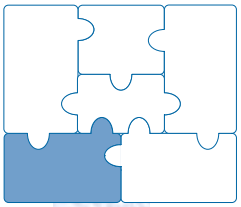
[a] *People to People, Nation to Nation*, Highlights of the Report of the Royal Commission on Aboriginal People, at **http://www.inac.gc.ca/rcap**

[b] See the Web site of Indian and Northern Affairs Canada at **http://www.inac.gc.ca/strength/index.html**

The federal government's Aboriginal Human Resources Development Canada Strategy, with $1.6 billion in funding over the next five years, creates the opportunity for Aboriginal communities to make a real difference in the economic future of hundreds of thousands of Aboriginal Canadians. Although Aboriginal communities will take the lead in delivering programs, they will require the support of partners among provincial and federal ministries and agencies, private sector business and labour organizations and education and training providers to deliver much-needed skill development programs and labour market opportunities.

3.21 The Panel recommends that the Minister of Indian Affairs and Northern Development, the Minister of Human Resources Development Canada and the Minister of Industry instruct their officials to work with the Aboriginal Human Resources Development Council to develop special programs to ensure that Aboriginal youth become comfortable users of information and communications technologies (ICTs) and are encouraged and equipped to pursue careers in science and technology. A multi-year implementation plan should be in place no later than 2002.

3.22 The Panel recommends that industry sector councils and private industry work actively, beginning now, with the newly formed Aboriginal Human Resources Development Council to develop the capacity of Aboriginal communities to meet the skill needs of Canada's growing knowledge-intensive industries.



4. Exchange Networks

The Panel's recommendations under the *exchange networks* element of the knowledge-economy ecology address the challenge of harnessing Information Technology to make learning opportunities accessible to all Canadians. The Panel proposes actions that are aimed at the following:

- **making Canada first in the world in connectivity and on-line learning; and**
- **providing access to learning opportunities for all.**

Effective exchange networks to move people, ideas, information, goods and services play a vital role in the new economy, as they did in the old. Much of the exchange infrastructure that we built in the industrial age – railways, ports, roads, airports and telecommunications networks – continue to pay dividends today. However, with the explosive growth in ICT, the capacity to transmit vast quantities of data, particularly via optical broadband networks, to all parts of the country and the globe has become a vital factor in competitiveness.

Canada has an enviable record in the planning and building of exchange networks; our geography has given us little choice in this matter. In the past century, building the transcontinental railway was synonymous with building our nation. As this century draws to a close, we will have completed the world's first national fibre-optic network, known as CA*net 3. Moreover, the federal government's "connectivity" drive and initiatives such as SchoolNet, VolNet, the Community Access Program (CAP), and more recently CanConnect, are moving technology-enabled learning and other services into the mainstream of Canadian life. The federal government has shown vision and leadership in building the foundation for Canada's digital information exchange system. However, with the changing nature of production and consumption in the knowledge-based economy, we cannot rest on our laurels.

CANCONNECT

Industry Canada, with the endorsement of several national organizations and companies, is coordinating a strategy – CanConnect – to increase the number of youth educated and trained for occupations in industry sectors where information and communication technologies (ICTs) play an important role. This partnership includes six main action areas: Connectivity, to increase access to the Internet for schools and communities; Content, to provide students and teachers with a greater choice of on-line learning activities; Competency, to increase awareness of ICT skills requirements; Careers, to provide career information to youth, parents and teachers; Coaching, to increase the number of volunteers and mentors; and Celebration, to showcase achievements.

http://canconnect.ic.gc.ca

Making Canada First in the World in Connectivity and On-line Learning

Large numbers of Canadians now work from their homes or suburban, rural and northern locations and need to tap into databases and link with other people who may live down the street or across the world. As consumers, more and more of what we want – from recreation and entertainment, to learning, health and government services, and commercial products and services (business-to-business or business-to-consumer) – can be ordered from home and often delivered over a wire or optical fibre, or by satellite. Experts predict that North American electronic commerce transactions will grow from $2.8 billion in 1996 to $1.3 trillion by 2003. While our national networks are up to the task, are our regional and local connections similarly capable?

Building the regional and local data transmission networks needed to meet the growing demand is essential for ICT-enabled activities to continue to flourish in Canada. The knowledge-based age is driven by on-line connectivity and the need to increase bandwidth to utilize the potential of the medium as a learning, commercial and entertainment tool. Canada could become the first country in the world to link every home, business, school and community institution with high-speed, affordable bandwidth and Internet connections. Achieving this would create enormous learning and enterprise opportunities in all regions of Canada. It would give Canadians the opportunity to become the world's most effective learners and most innovative users of ICT. It would enhance our capacity to attract foreign direct investment in ICT, and give us a competitive edge in exporting ICT products and services. It would also help us keep our individual and collective skills at the cutting edge.

Very early on in this report, it was noted that, in the Panel's view, a large part of Canada's problem was not a lack of skills, but a shortage of opportunities. This introduction of high-speed bandwidth is a last link in building a larger – and unique – opportunity base.

When Canada needed a transcontinental railway, the private sector had the human and technical but not the financial resources to undertake such a massive project. Today, the same is true for our telecommunications companies, cable operators, wireless carriers, and "fibre condominium" contractors, particularly outside major urban centres. Similarly, Canada's non-metropolitan regions do not have the financial capacity to build this essential infrastructure for their future prosperity.

"The last digital kilometre" can be completed in one of two ways: Canada can be the leader today, or we can be one of many followers tomorrow. The Panel fully realizes that building the last kilometre of connectivity would involve a substantial financial commitment from all of the stakeholders in both the private and the public sectors. But the Panel believes that there would be a tremendous competitive advantage to being first in the world in this respect, as Canada has enjoyed being first in other connectivity goals.

4.1 The Panel recommends that the Government of Canada commit to making high-speed, affordable bandwidth available for "the last kilometre" to every home, classroom, business and Community Access Program (CAP) site in Canada by 2003.

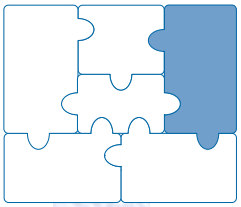
4.2 The Panel recommends that the Prime Minister bring together representatives of all of the stakeholders to develop a strategy to implement "the last digital kilometre", including the specific roles and responsibilities of the different key players in the private and public sectors, and creative means for sharing the cost of investment among them.

Providing Access to Learning Opportunities for All

Canada's Community Access Program (CAP) has established thousands of local community sites for individuals and businesses to access and learn about the Internet as a tool. This program is a considerable achievement by the Government of Canada – and a goal that the United States and the United Kingdom are now trying to match.

However, once they are established, CAP sites require care and nurturing. There are currently not enough resources to keep these sites open and technically well-maintained, or to enable them to grow to meet their potential as community learning and resource centres. This latter function is especially important in rural and northern communities, many of which have little other traditional community infrastructure. To achieve this goal, CAP sites must have ongoing core funding resources to fund facilitators and tutors, to offer or link to career counselling and on-line curriculums, and provide on-site support services such as child or elder care.

4.3 The Panel recommends that the ministers of Industry and Human Resources Development Canada provide ongoing core funding for Community Access Program (CAP) sites, particularly in rural and northern locations, to create learning centres that will provide the appropriate support to individuals, families and communities.



5. Commitment to Success

The Panel's recommendations under the *commitment to success* element of the knowledge-economy ecology address the challenge of changing public attitudes toward success and the marketplace. The Panel proposes actions that are aimed at:

- **encouraging the development of a more innovative, entrepreneurial culture.**

Attitudes make a difference in the economic prospects of nations and regions. Over the long term, we can expect growth to be stronger in regions that value individual and collective achievement and view risk taking as a fundamental aspect of life. Where does Canada fit into this picture? We see ourselves, as do others, as fair and caring people, committed to balancing economic progress with broadly accepted principles of social justice. Let us recognize, however, that we acquired this admirable image during very different times: when our manufacturing, service and communications sectors were protected, and when much of our wealth flowed, to a great extent, from pumping resource products into hungry world markets.

Even though globalization and technological advances have dramatically changed the economic landscape, our values and beliefs have changed more slowly – many would say "much too slowly". First, we remain fundamentally risk-averse in our national character. Unfortunately, this attitude persists at a time when innovators and entrepreneurs are needed to generate the employment and wealth required to finance our national lifestyle. To innovate – to do new things or to do old things in new and improved ways – requires us to trade off the risk of failure and loss against the potential for success and gain.

Second, we are ambivalent in our attitudes toward successful people and those who fail. We generally wish people well (but not too well) and feel compassion for those who fail (but are stingy in extending our grace for them to try again). We are uncomfortable with the notion of conspicuous wealth or success, and have difficulty with the notion that equal access to opportunities does not necessary lead to equal outcomes. We are equally uncomfortable with those who make mistakes or fail. As one Panel member stated during a discussion of the ICT sector: "If you go bankrupt in Canada, you are marked for life. In California, it's more like a badge of courage." We require people who are driven to succeed and who, in the process, create employment and demands for goods and services from others. Without these people – most often called "entrepreneurs" – our standard of living would decline.

Third, although we have worked together to minimize the impacts and costs of failure or misfortune (through medicare and social programs, for example), we have not collaborated to the same extent to reap the benefits of success by working together in the same strategic directions. Perhaps this is a reflection of our geographical spread and regional sensitivities. We are often most concerned about process, with little commitment to actions and outcomes. On the whole, Canadians have applied their creative talents and energies to fashioning the cooperative and collaborative institutions that minimize the effects of failure, but not those that help us to maximize our success in global markets.

To prosper and grow in the new economy, employers, education and training providers, governments, and others must be committed to success. They must be prepared to work for it and to work together, even if that means discarding long-standing assumptions about who should assume responsibilities and who should provide funding.

If we want to maintain our ranking as the world's number one country in which to live, Canadians are going to have to start thinking differently. We must become much more accepting of risk, more willing to celebrate and reward successful innovators and risk takers (and encourage those who fail to try again), and cooperate locally, regionally and nationally in order to compete globally.

ENTREPRENEURSHIP IN SCHOOLS

The Canadian Foundation for Economic Education, founded in 1974, is a non-profit organization dedicated to increasing the extent to which Canadians assume their economic roles, and make economic decisions, with competence and confidence. It is involved in a wide range of activities including resource production, research, curriculum development, seminars, workshops, conferences, and strategic planning/advisory services. One of its main projects is *Entrepreneurship for Canadians*, a series of six half-hour video programs (and a user's guide) which have been distributed to all Canadian high schools. Another is *The Entrepreneurial Adventure Program*, which helps elementary schools to design and operate entrepreneurial class ventures in collaboration with business and community partners.

http://www.cfee.org

Encouraging the Development of a More Innovative, Entrepreneurial Culture

Canadians have an abundance of good ideas, but we are not as good at translating our ideas into world-scale enterprises. There are exceptions, of course, but history has often shown that we prefer to leave that risk taking to others.

Those countries and regions that nurture innovators, attract risk takers and bring new products and services to market the most rapidly will prosper and create opportunity for their citizens. Thus, the important question for Canadians is not why we are the way we are, but whether or not we can change our attitudes toward risk. Can we become more assertive innovators? And can we make these changes while maintaining the commitment to the fairness and social equity that has given us such enviable living standards and lifestyles? The Panel believes the answer is "yes".

Ultimately, only individuals can change their own attitudes. However, families, mentors and role models, media, governments, and formal learning systems can influence and hasten attitudinal change. For example, our schools can become places that develop positive attitudes toward risk taking and innovation. These values should be embedded across the curriculum and in all pedagogical styles.

5.1 The Panel recommends that the Council of Ministers of Education, Canada (CMEC) establish a task force to identify best practices (e.g. exposure to role models, problem-solving challenges, understanding risk taking, mentoring) and develop methodologies and curriculums to orient young people toward innovation and entrepreneurship over the course of their elementary, secondary and post-secondary education. The plan should be implemented no later than 2002.

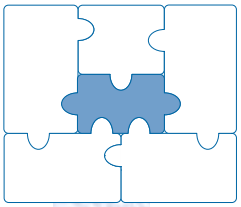
Although governments cannot decree attitudinal changes, they can help increase awareness of issues and their effects, and highlight the need for change. Building a more innovative culture in Canada is an issue of sufficient importance to warrant the attention of First Ministers, both for the value of the input they can provide and for the media attention their interest will attract, which will assist in making Canadians more aware of this issue and its importance.

5.2 The Panel recommends that First Ministers discuss the challenge of building a more innovative culture at their annual meeting in 2001, and consider articulating a clear national vision of an economy and society in which innovation and entrepreneurship are broadly accepted as positive Canadian values.

5.3 The Panel recommends that the Minister of Industry launch a national "ParticipAction-style" campaign to celebrate the achievements of Canadian innovators and entrepreneurs and to emphasize the advantages of building a more enterprising culture.

ENTREPRENEURSHIP IN COLLEGES

The Atlantic Colleges Committee for Entrepreneurial Development Inc., created in 1996, is a grass-roots initiative launched by educators and administrators to promote entrepreneurship training and education in the community colleges of the Atlantic. The Committee facilitates the exchange of ideas among practitioners, governments and industry at local and regional levels. One of its objectives is to promote the development of programs that would allow post-secondary students and instructors to work with high-school students and teachers, in partnership with private business.



6. New Structures for Action

The Panel's recommendations under the *structures for action* element of the knowledge-economy ecology address the need to replace industrial-age decision-making mechanisms that have become outdated. The Panel proposes actions that are aimed at the following:

- **establishing a new agency to spearhead and coordinate the implementation of the recommendations contained in this report; and**
- **keeping skills and enterprise development issues front and centre on the Canadian public and government agendas.**

Throughout this report, the Panel has described the ways in which it believes our economic world has changed in the past 30 years, and the impact these changes are having upon Canada's skills challenge. In any economic ecology, there must be the means for making decisions efficiently and effectively in order for a country or region to prosper. The current structures for action in Canada, not only for government, but also for business and for education and training providers, are structures we inherited from the past. They were designed to support an industrial-era economy and, on the whole, they were effective. However, in the knowledge-based economy, many of these structures for action are inadequate, and we must find new mechanisms for making the cooperative and collaborative decisions necessary for us to maintain our high standard of living.

In part, this conclusion comes from the knowledge and experience of the Panel. But, in larger part, it comes from the hundreds of stakeholders with whom the Panel consulted during the past year.[24] [25] [26] [27] High levels of frustration were expressed by business, education, and community leaders alike. They are aware of barriers that must be overcome in order for our learning and enterprise systems to work better. They understand and support many of the solutions, and are surprised that governments are slow to act and that, when they do act, their responses are often not coordinated. A central theme of comments heard by the Panel across the country concerned the need for partnerships – a recognition that single actors, on their own, could not successfully address the issues we collectively face.

Governmental Structures For Action

The Panel believes that today's structures for action in government – which involve a rigid division of roles and responsibilities among departments and orders of government – are suited more to the industrial age than to the Information Age. In simpler times, when the learning and enterprise systems were less integrated, these divisions made good sense. They reduced the probability of duplication, inefficiency and confusion of purpose. Budgeting and financial management systems, personnel and performance measurement systems were designed to match these organizational structures.

As in other organizations, policy and management systems in government have evolved considerably in response to economic and technological change over the past two decades. The Panel does not believe, however, that they have moved fast enough or far enough to match the growing interdependence – indeed, the inseparability – of learning, skills and enterprise development issues. Budgeting practices and reward systems for government managers remain closely tied to the objectives of individual departments – such as education, industry or human resources – when the economy and labour markets call for collaborative, cross-departmental and intergovernmental initiatives. Even though departments and managers are held accountable for their program results, there is no focal point of accountability for performance across departments and jurisdictions, and there is no attempt to measure overall performance. Despite the sense of urgency and the appetite for risk and innovation that the Panel discovered among a multitude of skills stakeholders, few incentives were found for action and coordination at the national level.

Many of these organizational barriers and behavioural results apply as well to intergovernmental initiatives as they do to projects contained within one order of government. Other aspects of government complicate matters further. The budgeting cycle and control functions demanded by Parliament, legislatures and Auditors General make it difficult for departments to engage in mid-term and long-term planning or to shift resources quickly from one activity to another to meet market-driven changes in priorities. More importantly perhaps, government departments may consult with outside groups on policies and expenditures, but few real partnerships have evolved in Canada in which power and decision making is shared with external stakeholders.

In recent years, senior officials in Ottawa and the provinces have worked very hard to overcome traditional boundaries in order to make progress on issues that cut across departmental and jurisdictional lines.[a] A variety of cross-departmental and intergovernmental experiments have been initiated, in areas as diverse as sales tax collection, anti-poverty measures, Aboriginal and youth issues, food inspection, and science and technology. In the area of skills and learning, however, where jurisdictional issues are very complex and the arena crowded with many players, decision-making structures that feature genuine sharing of responsibility and accountability have yet to emerge. New mechanisms will be needed to overcome these barriers to change and progress.

The structures for action the Panel envisages should more fully involve and even be led by non-governmental partners. These new structures must give us a competitive advantage in addressing the scientific and technological changes that constantly reshape skills issues. And they must focus on redressing emerging skill gaps rather than simply continuing to meet the dictates of respective financial administration acts. While skills priorities would certainly shift over time, the goal would be to create incentives for government and non-governmental stakeholders alike to act, collaborate and be accountable for longer-term planning in R&D, learning, skills and enterprise development. This suggests there must be means for including other stakeholders in planning and monitoring activities so that a range of sound options is considered and that all the parties involved are committed to the same goals.

The Canadian government has recently taken a stronger interest in improving accountability through performance reporting[b] and the First Ministers committed to "monitor and measure outcomes" of social programs as part of the Social Union Framework Agreement. Elsewhere, the New Zealand government has identified key results areas that transcend the boundaries of any one department, government or sector. And in the United Kingdom, the government has adopted specific national learning targets.[c] The Panel believes this new approach should be applied at the national level in Canada for stimulating action and monitoring progress on skills development programs, and should be complemented by discussion, leadership, and review at the national level that would include external stakeholders. It will take time for Canadian governments to become fully comfortable with such processes, but the Panel believes the recommendations outlined below constitute essential steps for Canada if we are to retain and improve our competitiveness and prosperity in the years to come.

Business and Industry Structures for Action

Dysfunction of the sort described above is not limited to governments, however. In the industrial era, business and industry developed their own rigidities. Since markets were assumed to be mostly local, regional or national, there was little point in cooperation among firms to gain a competitive advantage for a larger market, even in their own industrial sectors. When they did come together, it was for the purpose of lobbying governments for tax and competition policies that would protect markets from imports or subsidize production and distribution costs. There was little reason for firms or industry sectors to interact with the education and training systems, because most workers required few skills beyond what the elementary and secondary systems were designed to provide them, and because few industries engaged in home-grown R&D.

In a global, knowledge-based economy, the situation is changing dramatically. Business and industry still expect government to provide the policies that will encourage economic growth, but those policies are now more complex, interactive with those of other nations and international groupings, and must change more frequently to match changing market conditions. In sectors composed principally of smaller firms, companies must now cooperate nationally to compete internationally. They need sectoral strategies to assure an ongoing supply of skills, not only at the entry level, but for the purposes of upgrading the skills of those currently employed. They must maintain human resource systems that retain skilled workers, and design collective data-gathering systems to monitor the labour market in their sector. They need to pool their resources for leading-edge pre-competitive R&D work. Moreover, they must together examine the niches in the global marketplace that small Canadian firms in their sector can develop and occupy through collaboration.

[a] See for example: the Web site of the Treasury Department of the Government of Alberta at **http://www.treas.gov.ab.ca/comm/perfmeas/index.html** or the Leadership Network Web site of the Government of Canada at **http://leadership.gc.ca/static/info/tln-lrl/menu_e.shtml**

[b] See the Web site of Canada's Treasury Board Secretariat at **http://www.tbs-sct.gc.ca/rma/rma_e.html**

[c] See the U.K. Department for Education and Employment's Web site at **http://www.dfee.gov.uk/nlt**

Education and Training Structures for Action

The Panel further concludes that education and training providers' structures for action are also inadequate for the needs of the knowledge-based economy and global marketplace. Universities are independently constituted, even within the same provincial jurisdiction. Community colleges may be more linked within a province, but have difficulties achieving many common operating functions across provincial lines. Private-sector trainers may be provincially licensed, but operate mostly apart from the public post-secondary system and with few links to it. Community-based trainers now are provincially funded, and so starved for resources that networking outside their own community is often difficult. The elementary and secondary systems are provincially based, with school boards having some authority in several provinces.

It is no small wonder that, with such structures designed for a former era, education and training providers are often seen by governments and business as unwilling or unable to respond on a timely and coordinated basis.

Education and training providers experience barriers to cross-sectoral dialogue and cooperation. Although there are many individual stories of local or sectoral cooperation – and more each year – they are still too few to meet labour market needs for timeliness in curriculum development, flexibility in delivery, transferability of credits, credibility of remediation and bridging programs, and consistency in assessment and recognition of prior learning.

The leading national associations of education and training providers are to be commended for their recent decision to found the CAETO, specifically to develop a flexible platform for work on projects and programs of interest to more than one education and training sector. The Panel also commends the Government of Canada for its leadership in financially assisting this sectoral development. As experience with this platform increases, it should become easier to approximate "one-stop shopping" for business and industry, national community organizations, and governments.

Industry Sector Councils and More

Identifying barriers and dysfunctions is only the first step toward resolving them. Complete answers are well beyond the mandate and capabilities of this Panel. This Panel was charged with analysing and making recommendations with respect to Canada's skills challenges. We cannot meet the *skills and opportunities* challenges outlined in this report without bold action to fundamentally change how we think about, and decide on, issues and priorities.

The Panel further believes that it is within the mandate and the responsibility of the federal government to take innovative, imaginative and, ultimately, bold action to position Canada to meet our learning and enterprise requirements in the early years of the new millennium. The good news is that part of that task is already begun. The challenge is to develop sufficient will and allocate the resources necessary to follow through.

As discussed earlier in this report, the Panel has been impressed by several of the industry sector councils encountered in the course of its investigations. The sector councils are playing an active role in identifying and addressing the human resource issues in their sectors.[a] They have demonstrated their capacity to work together toward a common goal, and to collaborate with other stakeholders (e.g. governments and educational institutions) to accomplish their work. They have assessed skill needs, developed occupational standards, and innovated internship and apprenticeship-style programs. Some have developed databases to provide them with ongoing labour market information. The Panel believes the sector councils play an important labour market role that governments are not equipped to play, but that helps governments to identify skills issues, future training needs, and so on. Several of the councils have been very successful in encouraging the participation of smaller firms in their sector in human resource development issues. Some of them are even marketing their expertise internationally.

The federal government facilitates the development of national sector councils. The Panel commends that initiative – understanding that it is slow, and often arduous developmental work – and believes it should be expanded and funded on a continuing basis to encompass all industry sectors of strategic economic importance to Canada. The Panel recognizes that the long-term

[a] See also M. Gunderson and A. Sharpe (eds.), *Forging Business-Labour Partnerships: The Emergence of Sector Councils in Canada,* University of Toronto Press, 1998.

success of the sector councils may require some consolidation of existing sector councils to achieve a reasonable critical mass of firms with shared common interests. It may also involve the development of new sector councils to improve global competitiveness or meet national requirements within sectors.

Although federal financial support is critical, it is also important to have the financial participation of firms within the respective sectors to lead and "own" the council's activities. In the Panel's view, funding for sector councils should come from four sources.

- Core administrative funding from the federal government is necessary at the outset, and usually for many years as council structures develop and products and services evolve. In the case of some large and profitable industry sectors, self-sufficiency may be expected within five to seven years. In less profitable sectors, populated by small firms with low profit margins, full administrative self-sufficiency for sector councils might never be a realistic expectation but, subject to favourable performance evaluations by sectoral businesses, that core funding should continue to be provided by government.

- Sector councils are likely to develop products and services that can be sold to their members or even exported to other sector councils or abroad. However, it should be recognized that the size of the firm matters when prices of such products and services are set. In parts of the United Kingdom and Ireland where similar problems have been faced by sector-like organizations, prices have been set on sliding scales related to the size of the firm (usually determined by the number of employees). For example, a firm with fewer than 20 employees might pay 20 percent of the service cost, with 80 percent being provided by government, and a firm with more than 500 employees might pay full or near-full cost. In all cases, however, firms should pay some percentage of product and service costs as benefiting stakeholders.

- Governments may choose to deliver programs through sector councils, by setting out broad strategic goals and purposes and providing a sum of money. The sector council would then determine how to meet those broad goals and set specific program targets to be met (with future funding levels dependent upon performance). For example, grants might be made for collaborative, pre-competitive research programs or for the provision of business development services to SMEs in the sector.

- Governments and sector councils might engage in fundable project work. For example, governments may seek to improve the employability skills and experiences of members of disadvantaged groups, and provide funding for projects that meet specific social policy goals, where it would otherwise not be economical for firms or industry sectors to participate.

In short, the ability to better *collaborate nationally in order to compete internationally* in business and industry sectors is both a public good (i.e. improved economic benefits for the country and its citizens or increased participation in the labour market by historically disadvantaged groups) to be funded by government, and a private good (i.e. improved profitability and long-term survival of the firm and the sector) to be funded by firms.

Based on its work on the five sectors within its specific mandate, the Panel believes that there is a clear need for such a sector council to address human resource and other issues in the automotive industry.[3] While the automotive retail and repair services sub-sector has a very effective sector council, none currently exists for automotive assemblers and parts makers, despite their obvious importance to Canada's economy.

Many lessons have been learned in the past decade of sector council work, and these lessons should be applied in expanding their number and role. To maximize Canada's future economic opportunities, sector councils should develop the following complementary roles:

- human resource management and planning including training, the development of occupational standards, electronic labour exchanges, internships and apprenticeships, marketing careers in the sector, and the sharing of best practices;

- business development services, including the commercialization of R&D and collaborative export marketing among smaller firms; and

- collaborative, pre-competitive R&D.

Because sector council work can also address broad-based issues, it is important to have a strong Sector Councils Steering Committee, appropriately staffed and funded to work on matters of concern to several or all sectors.

The argument put forward by the Panel about interactivity among all the stakeholders and variables in the knowledge-based economy is illustrated in the principal frustrations experienced by sector councils in recent years. Government funding to assist in the formation and development of sector councils has been tightly time-delimited. Moreover, in many sectors populated primarily by smaller firms, there is limited firm capacity to assume funding responsibilities in the short term or medium term (and possibly, the longer term). The small and limited resources of most current sector councils have made it difficult to work with education and training providers separated by level of instruction, type of funding and jurisdictional location. And conflicts among orders of government about whether or not sector council projects, programs and funding fit within neat geopolitical boundaries have sometimes impeded progress, or resulted in progress in some jurisdictions but not others.

Earlier, we recommended that the CAETO be utilized to conduct a human resource study of the education and training sector to provide better information about future skills and needs for teachers, instructors and professors. In addition, to facilitate and foster improved relationships between education and industry, we believe it would be valuable for the CAETO to be represented on the Sector Councils Steering Committee.

A New Structure, with More Freedom to Innovate

Sector councils, although effective, are not enough to provide Canada with new structures for action on skills and enterprise. This report has already discussed the inadequacies of the current structures for action that were designed for the industrial era. In its fact-finding, the Panel discovered other national and regional structures better designed for the new economy, offering more freedom and flexibility of action, and retaining the essential elements of real accountability to parliaments and to individual citizens.

These structures exist in Scotland, Ireland, Northern Ireland and Wales – all of which, as noted earlier, have several similarities to Canada in their geographic, demographic, economic and regional employment issues. Like Canada, they have outstanding natural heritage and resources, good telecommunications infrastructure, and a strong cultural affinity for learning. Historically more disadvantaged than their English neighbours, these jurisdictions have taken actions to dramatically improve the performance of their economies including higher employment levels (now comparable with or better than those in England), increased R&D, skills enhancement, improved foreign direct investment, more and stronger indigenous firm development, and policy and physical infrastructure investments.[21]

Typically, these structures have a legislated mandate to create prosperity and well-being through initiatives that strengthen communities, develop skills and help sus-

SCOTTISH ENTERPRISE, established in 1990, is the economic development agency for Lowland Scotland, covering 93 percent of Scotland's population. It is an "executive agency", which, by legislation, has responsibility to promote industrial efficiency and competitiveness, enhance skills and develop employment. It operates through a network of 13 local enterprise companies (LECs). It is accountable to the Scottish Parliament, but is private sector-led through its Boards of Directors, which set annual and specific performance targets, the outcomes of which are measured independently and reported.

Scottish Enterprise has responsibility for the network of LECs as a whole, including overall strategic planning, resource allocation, accountability and the provision of specialist services. Its 12 Board members, representatives of business, labour, education and the voluntary sector, are appointed by the Secretary of State for Scotland.

LECs operate under contract to Scottish Enterprise. They deliver a wide range of business development initiatives as well as training services. Their activities reflect both the national strategy and local circumstances. LEC Board members represent a cross section of their communities.

The total budget of Scottish Enterprise in 1998-99 was £467 million (approximately $1.1 billion), 89 percent of which came from the U.K. government. The main categories of expenditures were skills and knowledge (21 percent), physical business infrastructure (23 percent) and business competitiveness initiatives (14 percent).

Scottish Enterprise is unique in a number of ways. Its status at arm's length from the government enables it to consider the longer term and to take more risk than a standard government department can. It integrates complementary capabilities – economic development, skills enhancement, property, equity finance, exports and inward investment – that are usually handled by different institutions. Its network allows for the implementation of local strategies within a nationwide strategy. Its Boards of Directors at the national and local levels provide a vast pool of the right kind of expertise and experience from both the private and the public sectors.

tainable businesses to grow (e.g. through better management practices, innovation, commercialization and technology transfer). One good example is Scottish Enterprise, which is discussed on the previous page.

The Panel believes that this kind of cross-cutting agency structure – which is able to focus across the "old" boundaries on all the variables of the new-economy ecology – is required for Canada. It would drive necessary action at both national and local/regional levels, and would engage the energies of the private sector and education and training providers in shared decision making on common and specific goals. As informed by governments (and by the agencies themselves) in the jurisdictions studied for this report, it is critical that such an agency be at arm's length from government in order for stakeholders to be involved and committed, and for focussed action to take place. In the Panel's view, Canada currently has no national or major regional structures for action that can effectively address skills and enterprise issues on an integrated basis, fully engage the involvement and commitment of other needed stakeholders in business/industry and the education/training sectors, and make decisions that are appropriately and consistently "matched" to the key components of the new economy's ecology.

The responsibilities of an Enterprise Canada could include the following:

- **Sector Council Support:** ongoing support for Industry Sector Councils as well as start-up and developmental funding for the establishment of new Sector Councils;
- **Sector Councils Steering Committee:** support for overall strategic planning and coordination, as well as for common initiatives and technical services;
- **Excellence in People:** the promotion of and support for the adoption and implementation of a national standard for employers' human resource development activities (similar to an ISO standard), possibly modelled after the United Kingdom's renowned Investors in People program;
- **Regional Enterprise Incubators:** support for the establishment and ongoing operations of some 15 to 20 enterprise incubators across Canada's economic sub-regions; incubators would be located within a university or community college and managed by a local board representative of the private and public sectors; and
- **Skills for Business:** a significant cost-sharing program, modelled on the highly successful TCS Program in the United Kingdom, that would allow high-calibre M.Sc. and PhD students to complete their study program while working for an SME on an important technology transfer project; supervision would be jointly provided by the company and the university; participants would also receive formal training in managerial skills.

6.1 The Panel recommends that the ministers of Industry and Human Resources Development Canada encourage, in the strongest possible way, Canada's automobile assemblers, parts makers and Canadian Auto Workers (CAW) to establish a sector council for their industry no later than 2001.

6.2 The Panel recommends that the ministers of Industry and Human Resources Development Canada, in 2000, provide administrative support to national sector councils as needed; startup funding for new sector councils (or consolidation of existing councils), as required and appropriate; and core administrative funding for activities of the Sector Councils Steering Committee (including their liaison with the Canadian Alliance of Education and Training Organizations – CAETO).

6.3 The Panel recommends that the Government of Canada establish and appropriately fund, by 2001, an arm's-length and private sector-led executive agency, Enterprise Canada, with the mandate to aggressively address skills and enterprise challenges at the national and sub-regional levels.

6.4 The Panel recommends that the Government of Canada, through Enterprise Canada and its partners, establish and fund the following:

- ongoing administrative support for sector councils and the start-up and development of new sector councils, as required and appropriate;
- ongoing core administrative support for the Sector Councils Steering Committee (to include their liaison with the Canadian Alliance of Education and Training Organizations – CAETO) to undertake strategic planning and coordination of common initiatives and technical services for sector councils;
- ongoing core administrative support for the establishment and operation of approximately 20 enterprise incubators on university or college campuses across Canada, particularly outside of the major metropolitan areas;
- ongoing support for a private sector-led employers' human resource development initiative, i.e., the implementation and operation in Canada of a program modelled on the British Investors in People program; and
- ongoing support for a program, similar to the British Teaching Company Scheme, to help SMEs absorb recent graduates in science and technology.

The Panel wishes to re-emphasize, the importance of developing decision structures for action, as discussed and recommended in this report. Without such evolution, it is doubtful that progress can be made on the urgent agenda for Canada to build a prosperous and sustainable future as a peripheral, niche player in the global marketplace.

For Enterprise Canada to become a reality, a senior member of the federal Cabinet must be charged as its champion, and given the authority and accountability to accomplish the job.

6.5 The Panel recommends that the Prime Minister immediately designate a senior member of Cabinet to develop and lead the implementation of Enterprise Canada at the federal level, with the appropriate authority, resources, accountability and leadership support to accomplish that task by 2001.

The Final Word: Leadership

The remaining concern is to identify the mechanisms needed to move forward on the recommendations of this report. Several of the Panel's recommendations cross stakeholder and jurisdictional boundaries, and responsibility for the issues raised in this report is distributed among numerous departments and agencies at both federal and provincial/territorial levels. It is not at all clear what authority is responsible for 1) initiating processes for these changes, or 2) monitoring implementation and reporting progress to government and other stakeholders. The Panel believes it is important that an individual of stature and credibility to government, business and educational stakeholders be given the mandate by the principal government authorities and appointed and supported by the Prime Minister, to assume these two tasks over the next few years.

6.6 The Panel recommends that the Prime Minister appoint, for a four-year term, a senior individual to serve as "Ambassador for Skilled Enterprise", with the mandate to initiate processes to implement this report's recommendations and to report progress annually to governments and involved stakeholders.

The Ambassador for Skilled Enterprise should be selected conjointly by the Minister of Industry, the Minister of Human Resources Development Canada, the Forum of Labour Market Ministers (FLMM) and the Council of Ministers of Education, Canada (CMEC). There should be close cooperation and coordination between the Ambassador for Skilled Enterprise and Enterprise Canada.

APPENDIX

Supporting Material

The following reports were prepared for the Expert Panel on Skills. Copies may be found in the CD-ROM provided with the report, or at the Panel's Web site (**http://acst-ccst.gc.ca**).

Terms of Reference of the Expert Panel on Skills

1. "Expert Panel on Skills Established to Advice on Critical Skills in Knowledge-Intensive Industrial Sectors", Advisory Council on Science and Technology, Press Release, September 18, 1998.

Skills Profiles of the Five Industrial Sectors Under Study

2. Profile of the Aerospace Sector
   Dan O'Hagan and Laval Lavallée
3. Profile of the Automotive Sector
   Dan O'Hagan
4. Profile of the Biotechnologies Sector
   Gary Fletcher and Bert Pereboom
5. Profile of the Environmental Technologies Sector
   Chris Parsley
6. Profile of the Information and Communications Technologies Sector
   Timothy Denton and Bert Pereboom
7. Report of the Web-based Consultation on the Skills Profiles
   Woody Huizenga, Infolink Consultants
8. Critical Skills in Five Canadian Industries: A Report on Sectoral Interviews
   Derwyn Sangster, Canadian Labour and Business Centre

Background Studies

9. A Study on Education and Training: Barriers and Incentives
   Bill Ahamad, Ahamad Consultants Inc.
10. Monitoring Critical Skills
    Margaret Roberts
11. Checking the Brain Drain: Evidence and Implications
    John F. Helliwell
12. Excelling at Recruiting and Retaining Skills in High Demand: The New Key to Productivity, Competitiveness and Growth
    Jean-Pascal Souque, (formerly with the Conference Board of Canada)
13. Innovation, Training and Success
    John Baldwin, Statistics Canada
14. Training for Critical Skills
    Costa Kapsalis, Data Probe Economic Consulting Inc.
15. Barriers and Incentives to Training
    Graham Lowe and Kathryn McMullen, Work Network, Canadian Policy Research Networks
16. Canadian Migration Legislation, Policies and Practices
    Don J. DeVoretz, Simon Fraser University
17. Scientific and Technological Clusters: A Synthesis of the Scientific and Institutional Literature
    Yvon Martineau, Claire Poitras et Michel Trépanier, Institut national de la recherche scientifique – Urbanisation, Université du Québec
18. Critical Analysis of the Current Methods of Monitoring the Supply and Demand of Highly Qualified Personnel
    Marcel Boyer, École Polytechnique et Centre interuniversitaire de recherche en analyse des organisations (CIRANO); Claude Montmarquette, Université de Montréal et CIRANO; Véronique Le Gallo, CIRANO
19. An Inventory of Relevant Public Policy Advice, Policies and Recommendations Concerning Skilled Science and Technology Personnel in Canada
    J. Adam Holbrook, Simon Fraser University
20. Skills Development in Quebec – Highlights
    Pierre Doray, Le Collectif de travail en science, technologies et société, Université du Québec à Montréal

International Data

21. The Skills Agenda in the United Kingdom and Ireland in 1999
    Jacquelyn Scott and Gilles Jasmin

Expert Seminars

22. Report of the Expert Seminar on New Information Technologies for Continuing Education and Training in Strategic Sectors of the Economy, Edmonton, Edmonton, April 16 and 17, 1999
    Tom Carey, University of Waterloo

23. Report of the Expert Seminar on Labour Market Information and Monitoring, Ottawa, April 23, 1999
    Derwyn Sangster, Secretariat of the Expert Panel on Skills

Consultation Workshops

Consultation Workshops on Critical Skills in Strategic Industry Sectors of the Canadian Economy

24. British Columbia, in Vancouver, April 27 and 28, 1999

25. Ontario, in Toronto, May 3 and 4, 1999

26. The Prairies, in Winnipeg, May 27 and 28, 1999

27. Atlantic region, in Moncton, June 3 and 4, 1999

Background Data

28. A Note on Demographic Factors and Implications for Skill Development
    Bert Pereboom, Peartree Solutions Inc.

29. Compensation Trends in the Information and Communications Technology and Biotechnologies Sectors
    Chris Parsley

30. Occupational Outlook for Key Occupational Groups in 2001
    Human Resources Development Canada, Job Futures, Volume 1

31. Immigration and Education Levels in Canada
    Statistics Canada, special tabulation based on the censuses of 1981, 1986, 1991 and 1996

32. Critical Skills: Hitting a Moving Target
    Paul Gallagher, with contributions from John McLennan and Geoff Poapst