

A Report on the Knowledge-Based Economy

Prepared for the
Northern Labour Market Information Clearinghouse

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A. Introduction

This Northern Labour Market Information Clearinghouse Report focuses on the topic of the knowledge-based economy. It begins by defining what the knowledge-based economy is, offers an overview of the research done on the knowledge-based economy, and identifies some of the key findings of the research. It then discusses the responses of the federal government, Alberta government, and the Canadian business sector to the evolving knowledge-based economy. The implications of the knowledge-based economy on Canadian urban and rural areas are then examined. This leads to a discussion of knowledge based workers, the skills required in the knowledge-based economy, and the situation facing low skilled workers in an increasingly knowledge-based economy. The report concludes by examining the Alberta SuperNet in terms of providing an overview of the project, describing the major benefits it offers, and discussing any training implications for Albertans wishing to utilize the Alberta SuperNet.

B. Background on the Knowledge-Based Economy

The term “knowledge-based economy” has been widely used, but seldom defined, in numerous reports and studies since the mid-1990s. An early definition of knowledge-based economy put forward by the Organization for Economic Development (OECD) was “an economy in which the production, use, and distribution of knowledge and information are critical to the process of economic growth.” (OECD, 1996) A more recent definition of knowledge-based economy presented in a joint study by the World Bank and the OECD (2002) is “an economy in which knowledge is created, acquired, transmitted and used effectively by organizations, enterprises, individuals and communities.”

A related term that is often used interchangeably with “knowledge-based economy” is the “New Economy”. According to a recent Statistics Canada research update report (2003), the New Economy is defined as “a fundamental shift in the competitive system, driven by the impact of new information and communication technologies on many business models and production routines.” The knowledge-based economy is viewed in this research as a subset of the New Economy:

The idea of the New Economy is multidimensional: We not only find ourselves in a New Economy, but also in a knowledge-based economy, a digital economy, an information economy, an Internet economy, an innovation, economy, a high-tech economy, a real-time economy, and a global-economy.

Another term that also appears to be used interchangeably with knowledge-based economy is “information economy.” According to Lavoie and Roy (1998),

“Information is basically an asset which is costless and easy to transfer. In other words, exchanging information implies that the receiver and the sender share the

same capacity to understand the content of information. Knowledge diffusion or even a change in the state of knowledge implies something costly and more complex. ...To sum up, information is easily acquired while knowledge which is a learning process is often long term and costly given that the production of knowledge is in a state of flux.”

The predominant focus of research and studies written about the knowledge-based economy and the New Economy has been on the information and communication technologies (ICT) sector. These are defined as industries that develop, deliver and support many of the products and services at the heart of the technology revolution (Gellatly, 2003). Statistics Canada subdivides the ICT sector as a whole is into three distinct sub sectors:

- Core ICT services (e.g. computer services and telecommunications)
- Other ICT services (e.g. cable television and ICT distributive trades)
- ICT manufacturing (e.g. electronic products industries)

A number of research studies (OECD, Gellatly, etc.) contend that the shift to a knowledge-based economy involves more than strictly ICT industries as the sole source of industrial innovation. Gellatly (2003) argues that the larger set of science-based industries sector also contributes to industrial innovation. Science-based industries are defined as “ those what make contributions to industrial innovation via relatively large investments in research and development and human capital”. While nearly all ICT industries are science-based, Gellatly (2003) shows that the science-based sector also includes a number of Research and Development-intensive and skill-based industries beyond the boundaries of the technology sector. These include 28 science-based goods industries (e.g. aircraft industries, industrial chemicals, and pharmaceuticals) and nine science-based services (e.g. architecture, engineering and technical services industries).

C. Research Undertaken on the Knowledge-Based Economy

Considerable research has been undertaken internationally, nationally, and regionally examining the impact, benefits, skills development needs, and employment implications of the knowledge-based economy. Conducting an Internet search on the topic of knowledge-based economy provide the following listings:

- Over four million sources for the term “knowledge-based economy”;
- Over one million sources for the term “Canadian knowledge-based economy”;
- and,
- Almost 6,500 sources for the term “Canadian knowledge-based economy, 2000-2003.”

The University of Laval's Réseau Innovation Network, an web-based innovations-focused research source, identified over 30 published research studies on the topic of the knowledge-based economy, many of them Canadian sources.

D. Key Findings on the Knowledge-Based Economy

Beginning with the initial 1996 OECD study, the research on the knowledge-based economy has built upon the following key findings:

- OECD economies were increasingly based on knowledge and information. According to the OECD (1996), “Knowledge is now recognized as the driver of productivity and economic growth, leading to a new focus on the role of information, technology, and learning in economic performance.”
- Employment in the knowledge-based economy has been characterized by increasing demand for highly skilled workers. The OECD (1996) reported: “Changes in technology, and particularly the advent of information technologies are making educated and skilled labour more valuable, and unskilled labour less so.”
- There is a growing awareness that government policies must focus on individual skills upgrading and increasing capacity to learn.
- The science system, essentially public research laboratories and institutes of higher education, carries out key functions in the knowledge-base economy, including knowledge production, transmission and transfer.
- The attributes identified for success in the knowledge-based economy include:
 - Strong economic fundamentals
 - A skilled and innovative workforce
 - An appropriately large technological infrastructure.
- In their research into knowledge workers in Canada's economy 1971-2001, Baldwin and Beckstead (2003) concluded that the shift toward a more highly-skilled workforce concentrated in a narrow range of occupations and associated with greater levels of formal educational training across a wide variety of industries has been a gradual process, occurring since at least 1971. They contend the increase has been experienced to some extent across all sectors of the Canadian economy. However, the level of knowledge intensity (the proportion or percentage of knowledge workers within a given class or category of the employed labour force) is highest in the public sector.

E. Government and Business Response to the Knowledge-Based Economy

Federal government

The Government of Canada introduced the *Canada Innovation Strategy* on February 12, 2002 with the intent of transforming Canada's economy into a knowledge-based economy. This 10-year strategy "aims to move Canada to the front ranks of the world's most innovative countries." Working together with other jurisdictions, key stakeholders, and citizens, contributors to the strategy put forward a preliminary set of actions with the commitment to systematically follow up to measure progress.

The Innovation Strategy released two companion documents entitled, *Achieving Excellence: Investing in People, Knowledge and Opportunities* (2002) and *Knowledge Matters: Skills and Canadians* (2002). One of the central themes of *Knowledge Matters* is that knowledge-based economy means an ever-increasing demand for a well educated and a skilled workforce in all parts of the economy and in all parts of the country.

In addition to the Canadian Innovation Strategy, Industry Canada (1999) outlined other initiatives the Federal Government has introduced to facilitate the transition to the knowledge-based economy:

- Under the Community Access Program, public Internet sites have been set up in thousands of rural and remote communities.
- SchoolNet has worked with the provinces and businesses to connect schools and libraries to the Internet.
- First Nations SchoolNet provides schools with an affordable, high-speed connection to the Internet via Direct PC satellite terminals.
- A National Broadband Task Force was established in 2000 to advise the Federal Government on how to best make high speed Internet available to communities, which, without government involvement, would not likely gain access to private sector delivered high speed services.

Alberta government

Alberta Innovation and Science is the Alberta government department responsible for advancing Alberta's research and innovative agenda in order to help diversify and strengthen the Alberta economy.

Working together with its partners, Alberta Innovation and Science has sought to create a unified provincial focus in three strategic areas:

- Life sciences
- Information and communication technology
- Energy research.

According to the *2002-2003 Alberta Innovation and Science Annual Report*, the purpose of these activities is to “build a critical mass of research excellence that is helping to create an environment that attracts skilled people and investment to the province, and is a foundation for business growth, job creation, a sustainable economy, and a better quality of life for Albertans.”

The most high profile and, ultimately, most widely felt action to support the knowledge-based economy is the following Alberta Innovation and Science’s business goal (*Alberta Innovation and Science Annual Report*): “To strengthen the Alberta Advantage by maximizing the opportunities presented by a province-wide high speed information and communications technology (ICT) capability through Alberta SuperNet.”

The Alberta SuperNet is discussed more fully beginning in Section J of this report.

Business

According to major research conducted on the New Economy (Statistics Canada), Canadian businesses have dramatically increased their investment in major ICT products (computers, software, telecommunications equipment). These investments grew at an average annual rate of 16% from 1981 to 2000. The cost of purchasing these ICT products, after accounting for quality improvements, has declined by 9.3% per year.

At a business firm level, differences in ICT have been correlated with performance outcomes. Those manufacturing firms that have invested in advanced communications technology, or have combined ICT capital with other advanced technologies, have seen higher relative gains in productivity and market share. Skills development has also been correlated with the technological competencies that businesses develop. Technology-based firms are more likely to train their workers than other businesses.

F. Implications of the Knowledge-Based Economy

Implications for Urban Communities

In examining employment growth in the information and communication technologies (ICT) sector and science-based industries across Canada for the period 1990 to 2000, Beckstead and Gellatly (2003) found that ICT employment growth was primarily contained to major urban centres. Industry Canada (1999) identified the same phenomenon, whereby 83.8% of high-knowledge employment was found in urban areas and just 16.2% in rural areas.

Beckstead and Gellatly identified that during the 1990s ICT employment was particularly strong in Canada’s large cities, such as Toronto and Montreal. By 2000, the Ottawa-Hull region ranked above other urban areas in the percentage of local workforce employed in

ICT industries. For most cities, employment growth in non-ICT science industries was more modest. Calgary, Edmonton and Montreal saw the greatest gains in science industries over the period 1990 – 2000. Many other cities saw low or negative employment growth in non-ICT science industries during the 1990s. The analysis seems to suggest that community size is an important determinant of employment growth in ICT and science-based industries in Canadian cities.

Implications for Rural Communities

For the purpose of their study on the knowledge-based economy in rural Canada, Industry Canada (1999) defined rural as “areas with a population of less than 10,000 which are outside of commuting zones for small cities or Census Metropolitan Areas.” Industry Canada identified the following factors related to success in the knowledge-based economy: education, skill training, connectedness, and innovation. It then applied these factors to rural Canada and arrived at the following findings:

- On average, Canadians in rural areas were less educated than those in metro areas. Some of this may stem from rural communities in Canada having an older population that also tends to be less educated.
- A smaller share of rural adults took part in job related training activity during 1997 in all provinces except B.C.
- Training rates among those of working age (25-54 years old) and highly educated individuals were higher in urban areas for most regions.
- More than half of residents outside of metro areas were using computers. However, someone coming from a city of at least 500,000 was about 1.5 times as likely to have used a computer in the past three months as someone coming from a town with a population of less than 1,000.
- The vast majority of Canadians were able to gain access to the Internet through basic telephone service. However, high-speed Internet access could be an issue for rural Canada.
- Smaller size of rural firms may be a barrier to technology adoption that tends to increase with firm size.
- Rural firms were seen as less able to benefit from technology adoption. Adoption of technology is higher in foreign-owned firms than in domestically owned firms. Such firms are largely concentrated in metro areas. Industry Canada (1999) cited 1991 data that indicated that foreign subsidiaries were heavily concentrated in Ontario.
- Rural firms tended to be concentrated in less innovative industries.

G. Knowledge Workers in the Knowledge-Based Economy

Peter Drucker first coined the term “knowledge worker” in his 1968 book *The Age of Discontinuity*. Drucker argued that a fundamental shift had occurred from old industrialism (with a focus on things and products) to a new industrialism (with a focus on ideas and information). With this fundamental shift he concluded, “for the first time in human history, we could employ large numbers of educated people productively.”

While the term “knowledge worker” has entered everyday usage, research into what constitutes a knowledge worker has evolved. Baldwin and Beckstead (2003) focused their research on Canadian knowledge workers on “knowledge intensive occupations.” Knowledge intensive occupations are divided into three broad classes:

- Professional occupations characterized by high relative wages and a high proportion of people with university-level education.
- Management occupations are characterized by high relative wages but a lower proportion of people with university degrees.
- Technical occupations which are those with lower wage rates but a high proportion of people with postsecondary education or higher.

In 1971, about 14% of Canada’s workforce worked in high knowledge occupations. By 2001, 25% of the Canadian workforce worked in high knowledge occupations. The occupation class with the highest growth was professional occupations that grew from 9% of the Canadian workforce in 1971 to more than 14% in 2001.

A number of sources (Baldwin and Beckstead, Government of Canada, etc.) point out that Canada’s skilled workers are spread widely across all sectors and regions of Canada, not just confined to a few high tech industries. Some of the distribution of knowledge workers included:

- Faster growth in the proportion of knowledge workers in service industries as opposed to growth industries during the 1990s.
- Large concentrations of knowledge workers in business services (66%) as well as finance and insurance (42%) in 2001.
- The proportion of knowledge workers in the mining and oil and gas sector grew from 14% in 1971 to 26% in 2001.

According to *Knowledge Matters* (2002), “The knowledge-based economy places an ever-increasing demand for a well-educated workforce in all parts of the economy. The skills required for many conventional occupations are changing rapidly, and many skills are quickly becoming dated as new jobs, new technologies, and new industries emerge.” Baldwin and Beckstead (2003) identified that the proportion of workers in knowledge-based occupations with a university degree increased from 34% of all knowledge workers in 1971 to 52% of all knowledge workers in 2001.

H. Skill Sets Needed in the Knowledge-Based Economy

Masse, Roy and Gingras (1998) and Human Resources Development Canada et al. (1999) described the importance of technical and/or process skills and general or so-called “soft skills” in the knowledge-based economy. The specific technical skills identified included:

- Literacy requirements of jobs are increasing in many sectors as a result of technological and organizational change
- Numeracy
- Digital literacy skills, that is, familiarity with computers and networks and the ability to use them.

The general skills identified and seen as being at least as important as technical skills in determining an individual’s ability to operate in the knowledge economy were:

- Cognitive skills
- Problem solving skills
- Communication skills
- Organizational skills
- Ability to work in teams.

A course offered by Florida Community College entitled “Living and Learning in the Knowledge-Based Economy” includes some of these skills and others in its list of course topics it offers. These include:

- Goals and priorities
- Voice mail and e-mail etiquette
- Maintaining commitment
- Dealing with success and failure
- Communicating with superiors, subordinates and peers
- Verbal and non-verbal communication skills
- Teamwork and decision making
- Learning skills
- Conflict management and resolution
- Leadership styles and skills
- Long term planning for career, education and wellness.

I. Those with Low Skills in the Knowledge-Based Economy

In knowledge-based economies where skill levels are increasing and production activities are more sophisticated, those with few skills are likely to experience difficulty gaining employment. Gingras and Boothby (1998) point out that the labour market situation of the least educated (those with zero to eight years of schooling) is worsening for most age groups in Canada. Particularly vulnerable are older workers, as the poorly educated are concentrated in this group.

Of significance is also the level of literacy required for the lowest skilled jobs. According to Masse, Roy, and Gingras (1998), nearly 75% of young Canadians between 16 and 25 years of age possessing a high school diploma have attained the level of literacy required to perform at least the lowest skill level jobs. The remaining 25% of young Canadians falling below this literacy level face reduced job and learning opportunities. Those with low-level literacy skills are also less likely to have access to adult education and training opportunities.

Masse, Roy and Gingras (1998) indicated that their research did not show serious deterioration in the labour market situation of low skilled workers relative to those of higher skilled workers. However, the economy is increasingly demanding in terms of minimal skill requirements. They contend that a high school diploma appears to now be required to gain access to stable jobs and income.

Skills Development in the Knowledge-Based Economy (1999) identified what it called a gap between the “knows” and the “know-nots” as growing. Other studies (Government of Canada, Gingras and Boothby, etc.) have also identified the importance of finding ways to expand labour force participation among under-represented groups in the knowledge economy: Aboriginals, immigrants, older workers, etc.

In *Knowledge Matters* (2002), the Federal Government (Knowledge Matters) acknowledges the importance of meeting the needs of less skilled Canadians. The goal set for the adult labour force as part of the Innovation Strategy is: “To ensure Canada’s current and emerging workforce is more highly skilled and adaptable.”

While indicating that a variety of proposed actions will be discussed with provincial/territorial governments and stakeholders, the Federal Government proposes to:

Encourage the participation of those facing barriers to labour market participation (by) considering, in cooperation with provinces and territories and other partners, targeted skills development initiatives to help persons with disabilities, Aboriginal people, visible minorities, individuals with low levels of literacy or foundation skills, and others facing particular barriers to participation in the labour market.

J. Overview of the Alberta SuperNet

The Alberta SuperNet is a high-speed, high capacity broadband network that, upon its completion in 2004, will link 4,700 government offices, schools, and health care facilities in 422 Alberta communities. According to Cherry (2004), the Alberta SuperNet will not be an Internet service provider. Instead, it provides the raw network connectivity via the Internet protocol. Telecommunications companies and Internet service providers can also tap into the Alberta SuperNet network. By doing so, service providers can offer high-speed services to areas that, until now, were too expensive or difficult to reach. Internet service providers will be able to connect to it with excellent rates; it will be no less expensive than the price paid for broadband connection in urban areas.

By design, the Alberta SuperNet website states that the Alberta government required as part of the criteria for the SuperNet Request for Proposal that all schools, libraries, provincial health facilities (including all facilities of this type on First Nations and Metis Settlements) will be connected to the SuperNet.

K. Implications and Benefits of the Alberta SuperNet

The benefit of the Alberta SuperNet will be experienced particularly in rural Alberta, where small numbers of customers do not justify installing costly broadband telecommunications infrastructure. The Alberta SuperNet, according to its website will “eliminate this digital divide that separates urban high speed users from rural have-nots, providing all Albertans with the opportunity to participate and prosper from the knowledge economy.”

Specific implications and benefits of the Alberta SuperNet include:

- Improved, new access to high speed broadband in Alberta rural schools, hospitals, doctor’s offices, local libraries, provincial government offices, registry offices, municipal town halls, homes and businesses.
- Bray (2003) says that businesses will enjoy greater freedom of location, greater savings and efficiencies in corporate communications and skills training. Real time video will enable employees in remote locations to participate in the same meetings as their head office colleagues. This eliminates travel time and reduces expenses. High speed Internet service also streamlines business activities, eliminates paper, cuts down on postage and saves time. The Alberta SuperNet could also enhance Alberta’s strategic advantage by making it more attractive to venture capitalists interested in start-up companies.
- According to Cherry (2004), the Alberta SuperNet will greatly benefit the health care field by enabling rural hospitals to send x-rays to doctors in Edmonton and

Calgary instantly or for an obstetrician in Edmonton to watch a high definition ultrasound image in real time, even if the patient is hundreds of kilometers away.

- Cherry (2004) also reports that the Alberta SuperNet already connects six schools in the Fort Vermilion School division for distance learning opportunities. One teacher can be linked with up to four classrooms through cameras, television monitors, and an electronic whiteboard.

L. Skill Requirements to Utilize the Alberta SuperNet

The skills needed to utilize high-speed broadband are “digital literacy skills”, that is, familiarity with computers and networks and the ability to use them. Those who have been using dialup modems to access the Internet already possess the requisite knowledge and skills to access the high-speed broadband network. They will greatly appreciate the significantly faster speed with which Internet sites can be accessed and web pages downloaded for reading or printing.

Those who have had no prior knowledge or experience using the Internet, can likely access the benefits of the Alberta SuperNet with minimal instruction through an experienced Internet user or by taking an introductory Internet course offered through their local adult learning council or college.

M. Implications of the Report Findings for Northern Alberta Colleges

1. The findings of this report suggest that the knowledge-based economy requires workers with a range of both technical skills (literacy, numeracy, and digital literacy) as well as general skills (cognitive, problem solving, communication, organizational, and teamwork). The Northern Alberta colleges already offer programming that imparts many of these skills.
2. The Alberta SuperNet will be used in Alberta communities and learning centres such as colleges to the extent that Albertans are knowledgeable about its existence and able to utilize it as an information access tool.
3. To effectively utilize the Alberta SuperNet, the Northern Alberta colleges will need to ensure that the necessary capital equipment is available and in place to support broadband high-speed networks.
4. The growing public awareness of the benefits and potential uses of the Alberta SuperNet as it nears completion may result in increased demand on the Northern Alberta colleges to offer Internet in-service training.

5. Growing public awareness of the Alberta SuperNet may lead to the demand for web-based Internet distance delivery curricula.

N. Recommendations for Consideration by the Northern Alberta Colleges
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1. Prepare and offer in-services to Northern Alberta college faculty and student advisory staff on the growth of the knowledge-based economy, its important features, and its implications on future learning and skill development of faculty, students, employers, and employees.
2. Develop a course similar to that of Florida Community College's "Living and Learning in the Knowledge-Based Economy". Once developed, such a course that could be marketed to the general public as well as employers. It could also be offered in a short course format to youth to assist them in gaining entry into the workforce or assisting in career advancement.
3. Review all accredited occupational programs to ensure they address digital literacy skills as well as those skills outlined in the Florida Community College course described in this report.
4. Establish contracts with Northern Alberta employers to upgrade the basic literacy and numeracy skills of their less educated employees, in order to give them the foundation skills needed for the lifelong learning necessary to participate fully in the knowledge-based economy.
5. Make contact with other Northern Alberta colleges or public organizations to identify potential cost savings that might be realized from higher volume purchases of capital equipment to support broadband high-speed Internet connections.

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