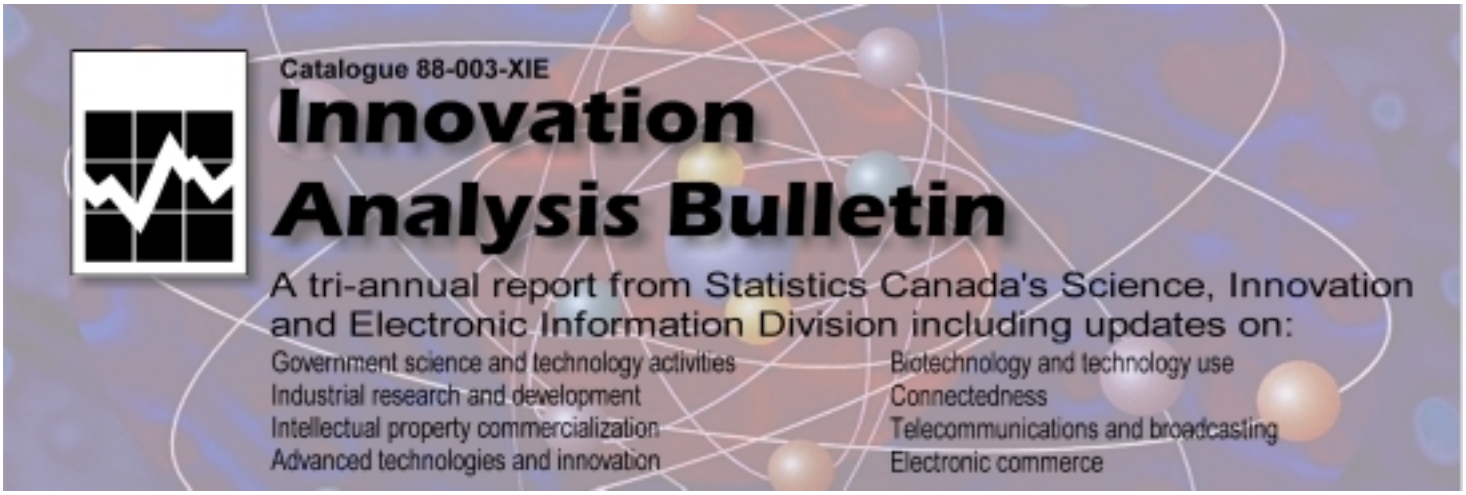

Innovation Analysis Bulletin
Vol. 1, No. 1, (1999)

Catalogue Number 88-003-XIE

Welcome to the first Innovation Analysis Bulletin

Welcome to the first Bulletin of the Science, Innovation and Electronic Information Division (SIEID). SIEID develops statistical measures of science and technology (S&T), and of the information society. This Bulletin is a way of telling you what we are doing and encouraging your comments and collaboration.

Science and technology and the information society are intertwined. The objective of SIEID is to improve our understanding of both—and of their interactions. This is done through the development of new indicators—which is a challenge in any field—and it is one that invites the widest possible collaboration across disciplines.

The practice of SIEID is to develop *useful* indicators. As resources are scarce, there is little speculative activity and the development of a new statistical measure requires the active involvement of a community of users, with the capacity to apply the information derived from the resulting indicators. SIEID, with a great deal of help from the Statistics Canada *Advisory Committee on Science and Technology Statistics*, developed a framework to tie the indicators together into a *coherent picture*. The framework is a useful tool for indicator development, whether for the information society or the S&T system.

The framework is described in this issue. It takes a systems approach to the development of indicators and looks at the

- **actors** (people, firms, public institutions, etc.),
- **activities** (Research and Development, invention, innovation, technology use, human resource development, etc.),
- **linkages** (sources of innovation, commercialization of intellectual property, flow of graduates to industry, etc.) and
- **outcomes** (jobs, skill levels, organizational change, social change, etc.).

In the longer term, the objective is to address, through cross-disciplinary research, the economic and social impacts of these activities.

For S&T, the new measures are also classified as indicators of the generation, the transmission or the use of S&T knowledge. The work on the information society is broader in scope. Still, it uses the same approach to improving our understanding before attempting a statistical description of the knowledge-based society.

A measure of relevance to the information society is access to electronic communications. It is important to know where people are getting onto the "information highway" and that is also discussed in this issue. Once people and businesses are using electronic communications, the key questions are the purposes of the use. Electronic commerce, electronic information gathering, telebanking and e-mail are examples of uses and they have far-reaching social and economic consequences for Canadians.

This tri-annual bulletin, to be published in January, May and September of each year, summarizes and highlights the many publications, research papers and working papers that we are producing and invites your comments and your participation.

Fred Gault, Director
Science, Innovation and Electronic Information Division

In this issue

Innovation Analysis Bulletin

ISSN 1488-433X

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*The **Innovation Analysis Bulletin** is an occasional publication of the Science, Innovation and Electronic Information Division of Statistics Canada. It is available, free of charge, on the Statistics Canada Web site (http://www.statcan.ca) under Products and Services, in the area Downloadable publications (free), under the category **Science and Technology**.*

Special thanks to the contributors, Mark Foss (Writer) and Janis Camelon (Editorial Service).

Published by authority of the Minister responsible for Statistics Canada

Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, it businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

Definitions

Specific technical terms are defined in the articles. For easy reference, here are some concepts that arise frequently in the articles.

Framework - A framework is a structure into which contents can be put. In the case of a Framework for a Statistical Information System, both the structure and the contents are a necessary part of communicating how statistical information is developed. This includes information on the evolution of science and technology and its interactions with the society, the economy, and the political system of which it is a part.

Indicator - A statistic, or combination of statistics, which provides information about an activity. An indicator of invention is the number of patents applied for by domestic inventors. A composite indicator of the resource allocation to research and development is the ratio of the gross domestic expenditure on R&D (GERD) to the gross domestic product.

Information - Information is data in context. For example, the NAICS (see below) provides the context to transform the data on the number of firms in NAICS industry 51332 into information about the industry which provides wireless telecommunication services (except by satellite).

Innovation - 1. Innovation is the commercial use of invention. In surveys, it is identified by questions like the following. 'Did your firm offer new or improved products (goods or services) to your customers during 1994-1996?' 'Did your firm introduce new or improved processes in your firm during 1994-1996 for the supply of products (goods or services)?' 'Did your firm introduce any significant improvements in terms of organizational structure or internal business routines in 1994-1996?' **2.** In a broader sense, innovation is the process of change and adaptation of society and the economy.

Knowledge - Knowledge is a familiarity gained by experience. It may be written (codified knowledge) or possessed by individuals or groups (tacit knowledge). In the text, it refers only to knowledge of science and technology and it is assumed to convey a capacity for action. For example, the knowledge that changing the level of the tax credit available to the industries in NAICS industry 51332 alters the number of firms in the industry, provides the government with a capacity to act.

NAICS - The North American Industry Classification System (Statistics Canada Cat. No. 12-501-XPE).

R&D (Research and Development) - Research and experimental development comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of people, culture and society, and the use of this stock of knowledge to devise new applications.

S&T (Science and Technology) - Science and technology activities comprise systematic activities that are closely related to the generation, advancement, dissemination and application of scientific and technical knowledge in all fields of science and technology. These include such activities as R&D, scientific and technical education and training (STET) and scientific and technical services.

New framework helps measure activities and outcomes of Science and Technology knowledge

A new framework developed by Statistics Canada's, Science, Innovation and Electronic Information Division classifies the science and technology (S&T) process into activities—the generation, transmission and use of knowledge—as well as linkages and outcomes. By asking some essential questions, the framework can help us better understand the relationship between science and technology and other activities and, ultimately, its impact on society.

While analyzing data from a company-wide survey, Jane Smith learns that her employer, ABC Limited, was not as prepared for Y2K as it thought. She shared this new information with colleagues and management at a staff meeting. Based on Jane's assessment, ABC Limited hired Bradley Jones, a recent college graduate, on a short-term contract. Within a month, Bradley was able to address all of ABC's problems.

In the above scenario, S&T knowledge gets generated (the survey analysis), gets transmitted (the staff meeting), gets used (the hiring of an expert) and produces an outcome (the solution to the problem).

This kind of analysis is part of a new framework developed by Statistics Canada to measure and understand how science and technology interacts with the economy and society.

Science and technology generates knowledge in different ways—through new products, processes and practices, as well as through people who have gained expertise through education and experience.

Once generated, knowledge is transmitted by a variety of means, such as the publication of an article in a technical journal, a conference, a staff meeting, or even an informal chat around the photocopier. If recipients of this new S&T knowledge can understand and assimilate it, they will put it to use. Ultimately, the use of knowledge will generate an outcome—the direct result of an S&T activity.

This process, however, is not a simple one. A scientist may generate knowledge without a full sense of its potential usefulness. Knowledge transmission may take time as well. In addition, the process may have unexpected outcomes, which also take time to unfold. In the scenario above, for example, ABC Limited may ultimately hire Bradley Jones to join its information technology department—an unforeseen event that produces still more outcomes down the road.

The indirect nature of S&T statistics and indicators isn't likely to change. However, the new framework gives us a model to understand these indicators more systematically. As well, it helps us see gaps in our knowledge that must be addressed.

While the framework is not an evaluation tool, it does allow us to classify long-term impacts—the consequences of outcomes for social, economic, political and environmental systems, and for science itself.

"We have measured some S&T activities like research and development (R&D) for a long time, and we've done it well. Now, we're measuring more activities, and more importantly, we're measuring linkages and outcomes," explains Fred Gault, Director of the agency's Science, Innovation and Electronic Information Division. "This helps us to better understand the whole S&T system—that's the goal."

Components of the framework

These generic questions can be asked for each stage of the S&T process (generation, transmission and use of knowledge):

- **Activities**
  - Who are the actors (firms, government, universities, etc.)?
  - What is the nature of the activity? (R&D, etc.)?
  - Where does the activity take place (geographically, sectorally, etc.)?
  - What are the objectives (increase competitiveness, reduce cost, improve product, etc.)?
- **Linkages**
  - What resources are committed?
  - What are the resources and where do they come from?
  - What are the linkages between the actors?
- **Outcomes**
  - What is the result?

The full text of the paper, titled **Science and Technology Activities and Impacts: a framework for a statistical information system** *(Cat. No. 88-522-XIE) can be downloaded from the Statistics Canada Internet site under Products and services, Downloadable publications ($) under the category Science and Technology.*

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Getting connected, staying unplugged: the Information Highway

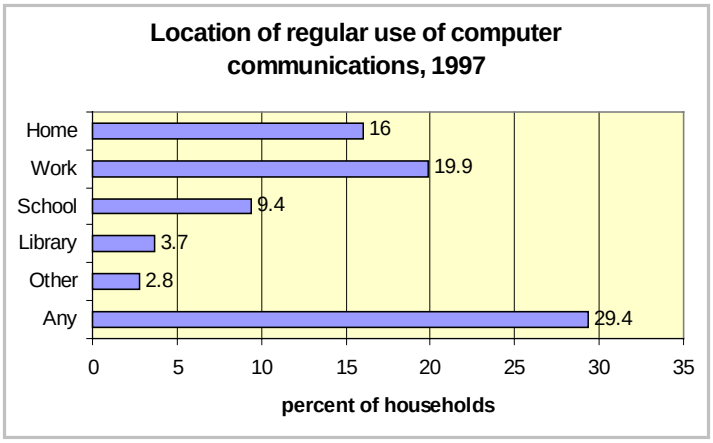
When two researchers looked at the Canadians' use of computer communications, they discovered that even though more and more households are getting connected, a significant number of Canadians with home computers remain unplugged.

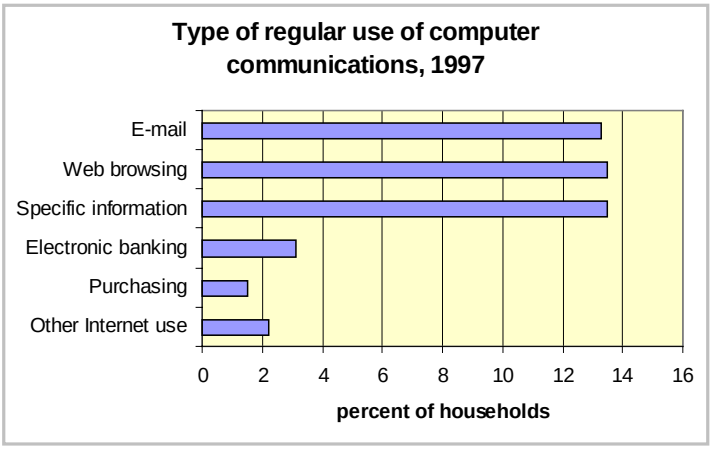
More households are hooking up to the Information Highway than ever, but these still represent a minority of households in Canada.

In a paper that builds on previous research on information and communication technologies (ICTs), Paul Dickinson and George Sciadas uncover the nature of ICT use in Canada. In particular, they focus on the use of computer communications such as electronic banking, e-mail and the Internet. In addition, the paper also sheds light on the frequency of use, the reasons for use, and the factors that influence use. Data draw on Statistics Canada's 1997 Household Internet Use Survey.

"Access to the Information Highway is critical to Canada's success in a knowledge-based world", says Mr. Sciadas "but this paper confirms that despite the continuing increase in the overall 'connectedness' among households, most Canadians are still not connected". For that reason, he continues, "we will continue to monitor the situation closely".

In all, some 38% of Canadian households have one or more members that have used computer communications at some time.





Nearly 30% have at least one regular user. Regular users are more likely to connect from the workplace than from home.

Usage varies considerably from province to province. In four provinces, more than 30% of households regularly use computer communications: Alberta (34.5%), British Columbia (33.6%), Ontario (33.2%) and Nova Scotia (32.2%). Quebec, with only one-fifth of households hooked up, has the lowest usage rate of any province.

Between 1996 and 1997, the number of users increased across the board. Indeed, lower-income households are getting connected at a faster rate than higher-income households. "In this sense, the gap between the 'haves' and the 'have-nots' is closing," says Mr. Sciadas. Still, in absolute terms, higher-income households are more likely to use the Internet or e-mail.

Regular use of electronic communications also rises with education. Although only 16% of households have members with a university degree, for example, they comprise almost two-thirds of households that use the Internet both at home and at work.

Age, too, is a factor. Together, Canadians below the age of 35 or between the age of 35 and 54 are the most frequent users. In fact, Canadians in these two age groups are almost twice as likely to use computer communications as those aged 55 to 64. As well, single-family households with unmarried children under the age of 18 use computer communications significantly more often than single families without children.

Interestingly, nearly one-quarter of households with a home computer do not regularly use electronic communications. What would it take for them to jump on the Information Highway? Some 42% suggested that lower fees might spur them on to get connected. Another 13% wanted easier access while 10% sought better service. More than one-quarter of households with computers are simply not interested in electronic communications, no matter what the price or service.

The full paper, titled **Canadians Connected** *was published in the February, 1999 issue of the Canadian Economic Observer. (Cat. No. 11-010-XPB). A new paper, titled* **Getting Connected or Staying Unplugged: The Growing Use of Computer Communications Services**, *containing 1998 updates and 1997-1998 comparisons will be published in July, in Services Indicators (Cat. 63-016-XIB).*

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Volume and scope of scientific papers help measure Canada's knowledge

To gauge the scope of Canadian contributions to global scientific knowledge, researchers turned to bibliometrics—the science of measuring published material. They found interesting patterns at work in Canada, both in terms of subject matter and the nature of our collaborations.

In 1995, Canada produced nearly 26,000 scientific publications, an increase of some 61% since 1980. Canada ranked sixth in the world as a major producer of scientific knowledge.

These data are part of a working paper called ***Knowledge Flows in Canada as Measured by Bibliometrics,*** which was commissioned by Statistics Canada to support the development of science and technology indicators. The paper was written by Benoît Godin, Yves Gingras and Louis Davignon at the Observatoire des Sciences et des Technologies.

Using science citation data, the paper profiles scientific publications in 1995 to measure the state of knowledge production in Canada by province and sector, and to identify the major players in Canada's research system.

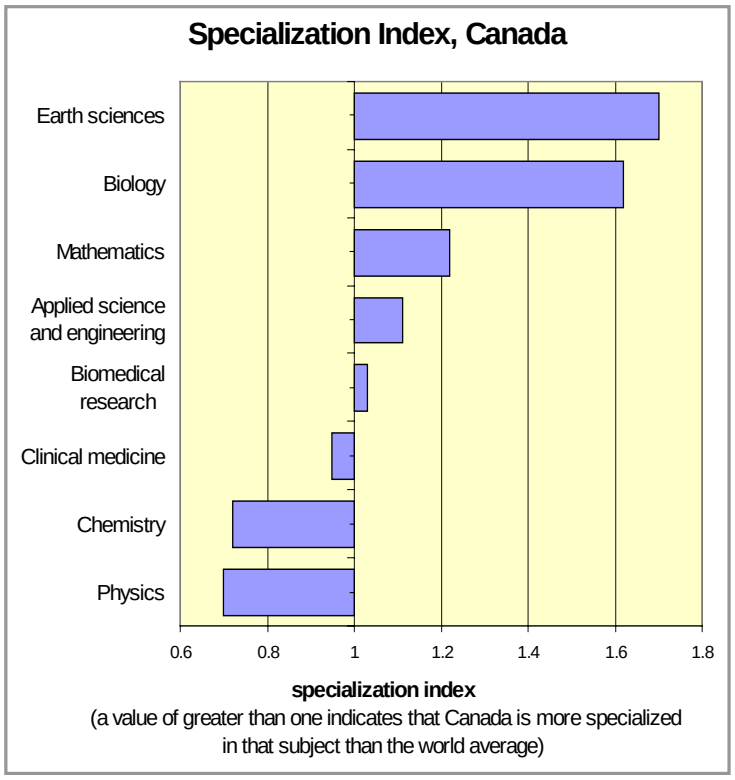
"The project is important because it provides concrete information for policy-makers, allowing them to understand Canada's scientific strengths and weaknesses," notes Frances Anderson, Chief of Indicators Development for Statistics Canada's Science, Innovation and Electronic Information Division. "Universities are particularly interested in profiling the publications of their researchers.

"There was a lot of anecdotal evidence about knowledge," she adds "but without hard data, you can't develop an overview of the situation."

The paper reveals interesting patterns of knowledge production in Canada. In terms of numbers, the bulk of Canada's publications (28%) are in the field of clinical medicine—everything from allergies to urology. However, a "specialization index" that compares scientific output worldwide tells us that Canada actually produces fewer publications in this field than the world average. In contrast, while only 8.5% of Canada's publications focus on earth sciences such as astronomy, geology and astrophysics, this figure is still higher than the world average, making earth sciences Canada's true specialization.

The paper also breaks down the data by province. While the four Atlantic provinces, along with Saskatchewan and Manitoba have high indexes in biology, for example, they produce far fewer biomedical research publications. The provinces with the most publications (Ontario and Quebec) are also the most diversified.

Although many different sectors produce scientific knowledge, universities dominate, producing 65% of the country's scientific publications. Still, between 1974 and 1995, hospitals increased their contributions from 9.9% to 14.9%. Publications from provincial government and corporations also increased during the same period.



Between 1985 and 1995, there was increased collaboration between scientists and researchers around the world on their publications, particularly in the field of chemistry. Canada, like many smaller countries, collaborates frequently on an international level. In mathematics, for example, some 45% of Canada's publications are co-authored—more than the twice the world rate. It's interesting to note that 39% of Canadian collaborations had American co-authors.

As part of the project, workshops were organized in several cities to present the data and to discuss possible uses of that database that is now available at the Observatoire.

"The whole idea was to have direct contact with the users and to help them understand the data," says Anderson. "It was interesting for people to see knowledge production in their own province. We're trying to develop a user community, helping people to use the data in their policy and decision-making."

Such a community is already emerging. Statistics Canada's initial funding for the project ended in 1999. A number of universities, government departments and companies are now contributing financially to the project. These partners receive specialized reports from the Observatoire.

The full text of this document (Cat. No. 88F0006XIB98010) is available free of charge from the Statistics Canada Internet site. See the download instructions for Research Papers on page 7.

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A snapshot of market share and performance in telecommunications

A new study uses official statistics for the first time to analyse market share in Canada's fast-growing telecommunications industry. By breaking down data from a 1997 survey by industry, type of supplier and firm size, the study provides invaluable information about the industry's players and reinforces its importance to the Canadian economy.

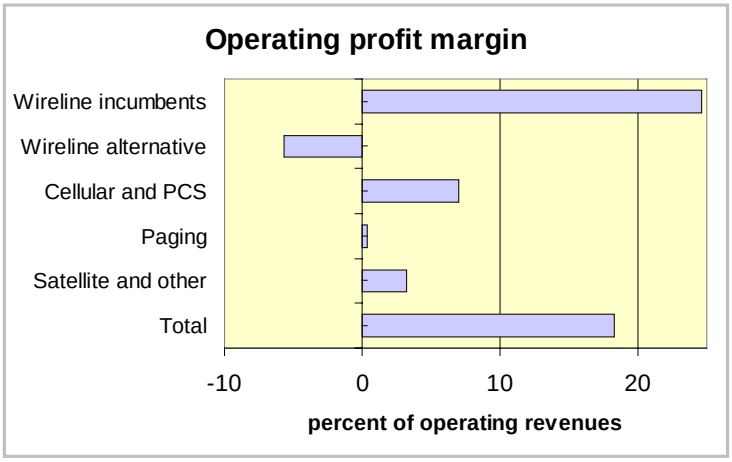
Fifteen years ago, there was really no such thing as a wireless industry in Canada. The industry mushroomed between 1987 and 1997, growing 15 times larger in just 10 years. By 1997, wireless carriers—whose services permit cell phones and pagers to operate—had become the second largest industry in the telecommunications group, employing more than 10,000 people.

These dramatic changes are captured in a new report called ***The Canadian Telecommunications Services Industry: Market Shares and Performance, Facts and Figures.*** Drawing on data from the 1997 Annual Survey of Telecommunications Service Providers, the report analyses information collected from all types of service providers. For the first time ever in Canada, official statistics are used to assess market share of both large firms and small and medium-sized enterprises (SMEs). In addition, the report examines the long-distance and paging markets, two of the most competitive in the industry.

"Telecommunications is one of the most fast-paced industries in Canada," says Daniel April, the study's author. "It's astounding to think that, 15 years ago, no one had cell phones. Today you see them everywhere."

The wireless industry is one of five related industries in the Canadian telecommunications industry group. Despite the wireless industry's phenomenal growth, the Wired Telecommunications Carriers industry, which includes long-distance and local telephone carriers, is still the largest industry by all available measures. In 1997, wired carriers had an average profit margin of close to 22%, almost three times the rate of wireless carriers. Not surprisingly, more than 90% of wired carriers reported a profit.

The other three industries are small in comparison, accounting for less than 5% of the sector's revenues and employment. In 1997, for example, the Telecommunications Resellers industry—a relatively new addition to the sector—employed nearly 2,500 people. This industry buys access and network capacity and then resells telecommunications to businesses, institutions and households. In 1997, fewer than 6 out of 10 of these firms were profitable. The final two industries—Satellite Telecommunications and Other Telecommunications—were even smaller. Together, they employed just under 1,200 people.



The impact of competition

By analysing the telecommunications industry by type of supplier, the report reveals the impact of competition on the various players. In the scramble for market share, for example, those firms already in the marketplace often see their profit margins decline. New companies are often faced with relatively small profits compared to their more established competitors.

In 1997, the wireline segment, which is split between incumbent carriers and alternative providers, generated $19.1 billion in revenue. Despite added competition, the so-called wireline incumbents had profit margins approaching 25%, an increase over the previous two years. While alternative long-distance providers managed to obtain 13% of the wireline segment market, 4 out of 10 firms declared a loss.

The wireless segment of the market, which includes cellular phones and personal communication services (PCS), pagers and satellite services, continues to grow. In 1997, it accounted for 16% of the telecommunication sector's revenues—more than twice the share of revenue reported five years earlier. All subsegments enjoyed a profitable year.

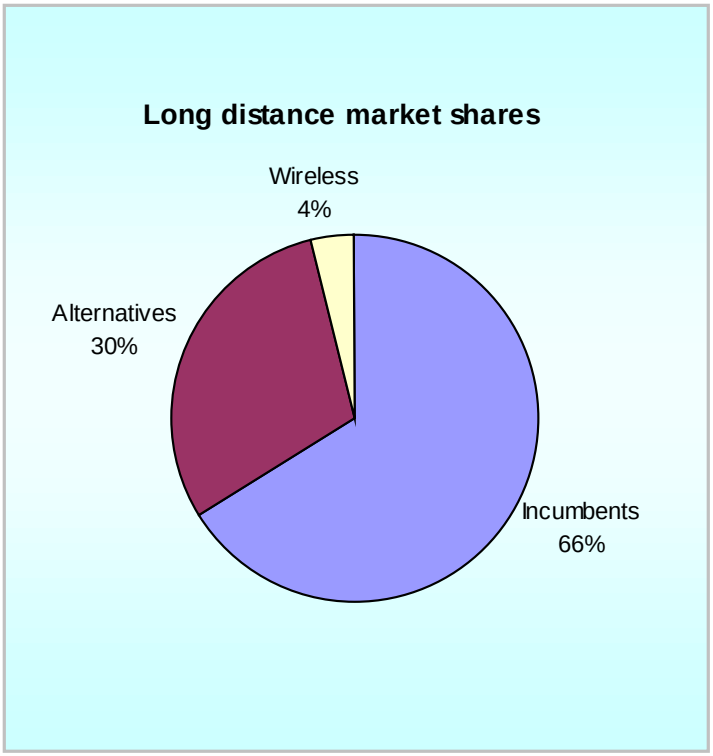
Firm size and market share

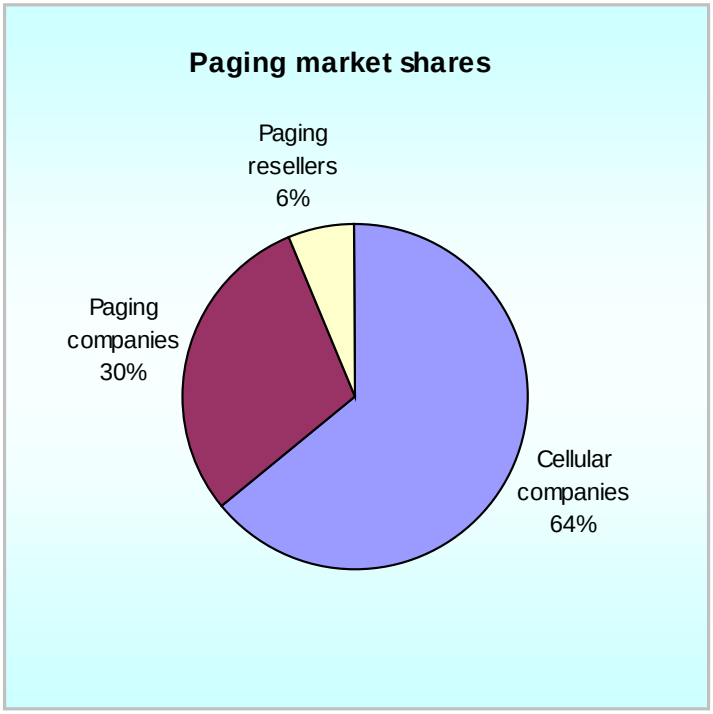
As in many countries, Canada's telecommunications industry has traditionally been dominated by large service providers that held monopolies in certain provinces or regions.

In the more competitive environment of the 1990s, small and medium-sized firms have a chance to play a more prominent role. In fact, 9 out of 10 firms in the telecommunications industry

were SMEs—the majority being made up of independent local telephone and paging companies, as well as resellers of wireline and satellite services.

Despite their large numbers, SMEs employed less than 9% of the sector's workforce. Moreover, they struggled to make a profit. In 1997, while nearly 96% of large firms declared a profit, less than 66% of small firms were profitable. As a group, SMEs suffered a loss equal to 25% of their operating revenues.





The long-distance and paging markets

Long-distance services remain at the heart of the new competitive environment in telecommunications. Before 1992, wireline local telephone companies controlled most of the market. By 1997, this share had dropped to 66%. Alternative wireline service providers claimed a 30% share while wireless service providers held the remaining 4%. In 1997, the total long-distance market was worth $7.5 billion, representing close to one-third of all revenues earned by telecommunications services providers.

The Canadian paging market, worth $224 million in 1997, was served by three types of providers: cellular companies (64%), independent facilities-based paging companies (30%) and paging service resellers (6%).

Further information: Daniel April, Chief, Telecommunications Section, Statistics Canada, (613) 951-3177, Daniel.April@statcan.ca

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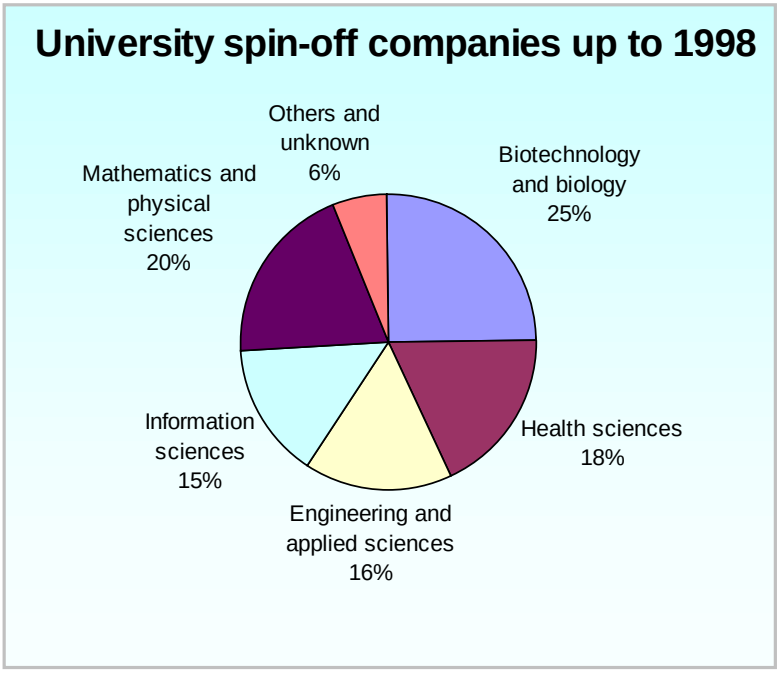
Patent or perish? Universities are more inventive than ever

Twenty years ago, it was rare for a university to patent an invention, create a spin-off company or license a technology—the priority was to "publish or perish." But according to the results of a new pilot survey, the catch phrase might well become "patent or perish." In 1997–98, Canada's universities registered 143 new patents and licensed 243 technologies, bringing in almost $16 million in royalties.

In the first-ever Survey of Intellectual Property Commercialization in the Higher Education Sector, Statistics Canada examined the management and commercialization of research results—or, intellectual property (IP). The pilot survey, conducted during the summer of 1998, covered all major universities, as well as most medium and small ones. In total, 81 universities participated, reporting on their IP activities over the previous five years.

In simple terms, intellectual property is any creation of the human mind that can be protected by law. This includes inventions; books and papers; works of art, music and drama; software and databases; educational and multimedia materials; trademarks, industrial designs; know-how and new plant varieties.



Universities are developing strategies to ensure their intellectual property gets noticed, and that they reap some of its benefits. One way they are doing this is by patenting technologies and then licensing them to companies. In 1997–98, universities received 143 new patents, nearly half of which were in the field of health sciences. All told, Canadian universities hold 1,252 patents, including 264 in Canada and 635 in the United States.

At the same time, universities manage 788 licenses, 243 of which began in 1997–98. These licences bring in $15.7 million per year in royalties.

If their creations are not ready for the market, some universities will create a spin-off company to develop the technology further. Universities reported creating more than 366 spin-off companies; 253 (or about 70%) of these are still active. The statistics cover only those spin-off companies that have a contractual arrangement with the university. However, many other companies have been created with less formal university support.

Since many spin-off companies don't have the capital to pay licensing fees, universities often accept company shares in return for the licence. Universities hold over $22.5 million in equity in spin-off companies.

Spin-off companies work in all technology sectors (see accompanying pie chart). To manage all the activity, most universities have created special administrative groups called technology transfer offices, industry liaison offices or business development offices. In fact, the Association of University Technology Managers (AUTM) reports that these kinds of offices were created as early as 1980. Universities reported that, in 1997–98, technology transfer offices employed a total of 186 persons (full-time equivalents) and had budgets of over $17.6 million.

Most areas of intellectual property management are dominated by Canada's 12 largest universities: the University of Toronto, Université de Montréal, the University of British Columbia, the University of Alberta, McGill University, McMaster University, the University of Western Ontario, Université Laval, the University of Calgary, the University of Guelph, Queen's University and the University of Ottawa. Together, these 12 universities accounted for 77% of new invention reports, 68% of new patent applications and 73% of active licences.

A report (Cat. No. 88F0006XIB99001) is available free of charge on Statistics Canada's Internet site. See the download instructions for Research Papers on page 7.

For further information, contact Michael Bordt, Chief, Knowledge Indicators Section, (613) 951-8585, Michael.Bordt@statcan.ca

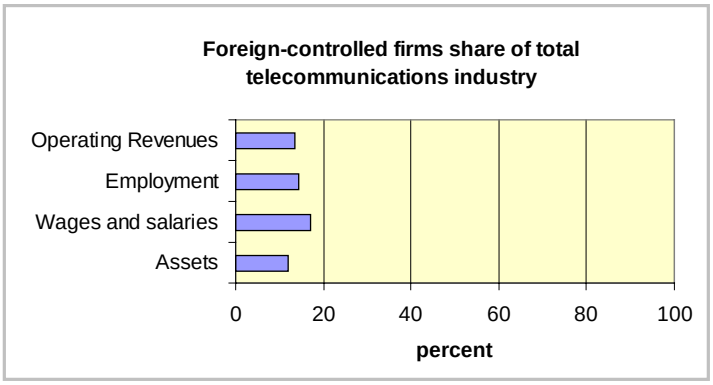
Foreign-owned telecommunications companies are few in number but prominent in reselling

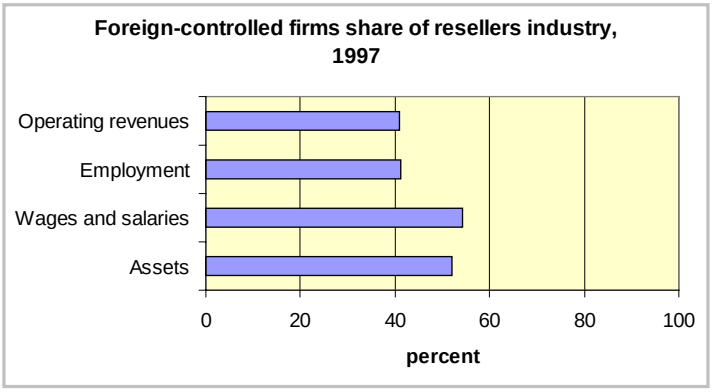
Foreign ownership in telecommunications—always a sensitive issue for Canada—is likely to become even more important for policymakers to follow in the future, as globalization leads to increased competition. A new paper from Statistics Canada sheds light on the make-up of the industry, comparing the performance of foreign- and Canadian-controlled firms.

Although there are relatively few foreign companies operating in Canada's telecommunications industry, they make a significant contribution. In 1997, for example, while less than 8% of telecom firms were foreign-owned, they accounted for more than 13% of industry revenues and 17% of wages and salaries.

These data were gleaned from the 1997 Annual Survey of Telecommunications Service Providers, which collected information on foreign ownership for the first time. A recent paper, ***Foreign Ownership in the Canadian Telecommunications Services Industry: Facts and Figures*** draws on the results of the survey. It profiles foreign-controlled firms, measuring their economic importance and comparing their performance with that of Canadian-controlled companies.

Most foreign-controlled firms are small. For example, three out of four employ 125 or fewer employees, and two out of three have annual operating revenues of less than $15 million.





"Even though foreign firms are small in number, they nevertheless play an important role in the industry," says Daniel April, the study's author. "They paid wages and salaries that were 20% higher than the industry average and, as a group, their profits are also above the industry average."

In accordance with Canadian law, foreign controlled firms are largely limited to the reselling business. Not surprisingly, they are major players in this segment of the industry, accounting for more than 41% of operating revenues, 54% of wages and salaries, and nearly 54% of the assets.

Foreign-controlled firms may well make their presence felt in other aspects of Canada's telecommunications industry in the future. In February 1997, the World Trade Organization (WTO) reached an agreement that will likely open up the telecommunications industry to greater competition worldwide. Foreign ownership in this sector has always been a sensitive issue, and future surveys will continue to help Canadian policymakers keep track of trends.

Further information: Daniel April, Chief, Telecommunications Section, Statistics Canada, (613) 951-3177, Daniel.April@statcan.ca

Determining foreign ownership

To determine whether or not a company was foreign owned, we asked the following questions:

a) What percentage of this company's common (voting) shares was foreign owned at year-end?

b) What percentage of this company's parent company's common (voting) shares was foreign owned at year-end?

If more than 50% of the company's or parent company's common (voting) shares was foreign owned, the company was considered foreign owned.

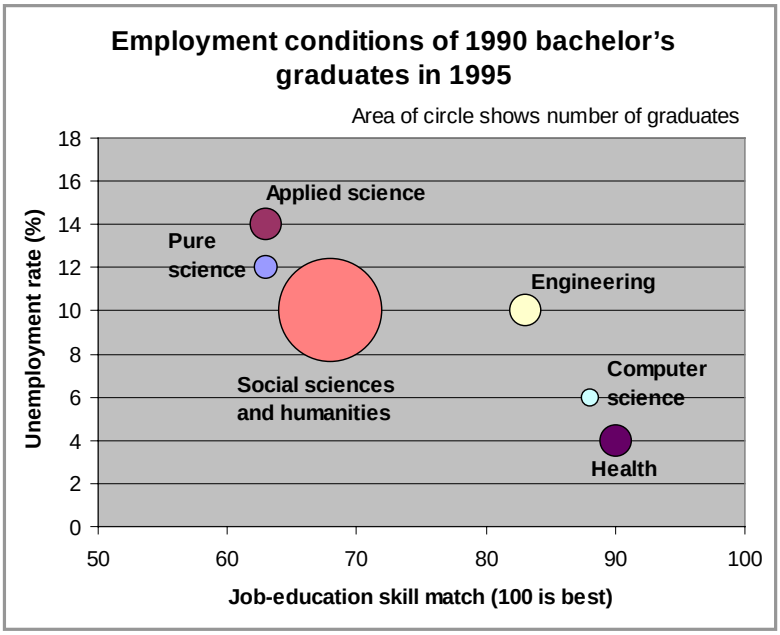
Graduates in computer and health sciences are most successful

The growth of the Canadian economy depends largely on scientific and technological innovation in its knowledge-based industries. Research and development in the aerospace, environmental technology, information technology, biotechnology and telecommunications industries requires a highly qualified labour force with the right skills. A new paper reveals how well we're doing matching skills to demand.

While there is no question that Canada needs recent science and technology graduates to produce new knowledge in our economy, a stable stock of graduates is not in itself enough to stimulate growth. For growth to occur, the skills of graduates must fill a defined need.

By examining the school-to-work transition and early careers of recent graduates, a new paper commissioned by Statistics Canada helps illuminate the processes that transform investments in science and technology into economic growth.

Prepared by Marie Lavoie and Ross Finnie, ***A Dynamic Analysis of the Flows of Canadian Science and Technology Graduates into the Labour Market*** uses data from Statistics Canada's National Graduate Survey to provide insight into the recent record of matching skills with demand.



Many factors influence the demand for skills, including growth in specific industries and the level of government investment in research and development.

Specific programs exist to stimulate growth in knowledge-based industries. Often public/private collaborations, these programs focus on developing technology (for example, Technology Partnerships Canada) and enhancing communications between businesses and experts (for example, the Canadian Technology Network and Industry Canada's Web site, Strategis).

On the supply side, universities and colleges, as well as their students, factor the current needs of the job market into their decision making. Governments, educational institutions and the private sector have often collaborated to help graduates gain appropriate skills through programs such as SchoolNet, the Network Centres of Excellence and the Canada Foundation for Innovation. As well, facilities such as the National Graduate Register promote the exchange of information between students seeking employment and employers with job openings.

The study revealed that graduates from some disciplines have indeed been rewarded with stable employment, as well as higher earning levels and rates of job satisfaction. The more "successful" disciplines include computer scientists and health care professionals at the Bachelor's level, and Ph.D. graduates in pure and applied sciences. In contrast, Bachelor's graduates in pure and applied sciences and Master's graduates in all disciplines have met with higher unemployment rates, lower salaries, lower job satisfaction and fewer appropriate jobs than the other disciplines. The large contingent of graduates in the social sciences and humanities generally fared somewhere between the two extremes.

In addition, the study noted that graduates with Master's degrees, except for those in the health care field, have the highest levels of "overqualification" for their jobs. This raises questions about the benefits of obtaining a Master's degree.

Many graduates with Bachelor's degrees have found jobs in the business services sector. This reflects the sector's high rate of growth, as well as the overall transformation towards knowledge-based work such as consulting engineering, Although the jobs are lower-paid than in the goods-producing sector, the business sector does provide the highest salary increase two to five years after graduation.

The full text of the paper (Cat. No. 88F0006XIB98004) is available on the Statistics Canada Web site free of charge. See the download instructions for Research Papers on page 7.

For further information, contact Michael Bordt, Chief, Knowledge Indicators Section, (613) 951-8585, Michael.Bordt@statcan.ca

What's new?

Recent and upcoming events in innovation analysis.

Science and Innovation

S&T Activities

Federal and provincial S&T

Federal science expenditures for 1999 and budget intentions for the year 2000 will be available during the summer of 1999. We will release a service bulletin, a working paper and the annual publication (Cat. No. 88-204).

A service bulletin on provincial government S&T estimates was recently released. The accompanying working paper will be released in late June or early July.

University R&D expenditure estimates and personnel

We are developing a new approach to fill an important gap in the measurement of Health Gross Expenditures in Research and Development (Health GERD). Until now, health research by hospitals has been incompletely accounted for. A service bulletin and working paper with new estimates of Health GERD will be released during the summer.

Gross expenditures on research and development (GERD)

The complete estimates of Canada's GERD with values to 1999 are expected to be released this fall. This is the authoritative source for statistics on Canada's research and development expenditures.

R&D personnel in Canada

A service bulletin and working paper will be released in late summer.

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Industrial R&D

Research and development in Canadian Industry

A service bulletin on R&D in Canadian Industry, 1996 will be released in June. Estimates for 1997 are expected in the fall.

Private non-profit organizations

A service bulletin on R&D expenditures in private non-profit organizations will be released in November.

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Human Resources and Intellectual Property

The higher education sector

The Survey of Intellectual Property Commercialization in the Higher Education Sector is now covering teaching hospitals. The questionnaires were mailed out in early May and preliminary results are expected by October.

Federal government research establishments

We will conduct the survey of Intellectual Property Management again this year as an annex to Federal Science Expenditures and Personnel survey. The questionnaire will be in the field by September.

Human resources in Science and Technology

In late May, we released a new working paper that examines the educational attainment, field of expertise and industry of employment of S&T knowledge workers. The paper is entitled *An analysis of Science and Technology Workers: Deployment in the Canadian Economy***.** This was a collaborative effort with Industry Canada and the Maastricht Economic Research Institute on Innovation and Technology (MERIT).

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Advanced Technologies

Innovation and advanced technologies and practices in the construction and related industry

This project is the result of collaboration with the NRC's Institute for Research in Construction. Data collection for the survey will be completed in early summer. Results are expected in the fall.

Advanced technologies in natural resource industries

We are developing a survey in co-operation with Natural Resources Canada.

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Innovation

Innovation in manufacturing

The survey will cover all manufacturing industries except food and beverage industries. The questionnaire is being finalized, in partnership with the National Research Council, Industry Canada and Natural Resources Canada, over the summer and will be mailed out in early September. The first results are expected by January 2000.

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Innovation in services

A study examining the diffusion of Internet technology and electronic commerce in the Canadian financial services industry is underway. It will be released in July 1999.

Another study analyzing the relationships between skills and innovation in the Canadian consulting engineering industry will be released in July 1999.

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Biotechnology and Technology Use

Canadian biotechnology statistics

A sourcebook of biotechnology statistics was recently published. Copies can be downloaded from:

http://www.strategis.ic.gc.ca/cbs

Federal government expenditures and personnel: biotechnology

The Biotechnology annex to the Federal Science Expenditures and Personnel Survey will be conducted again this year. A service bulletin on the results will be released in the fall.

Biotechnology firm survey

This survey was the basis of an analytical report entitled ***Canadian Biotechnology 98: Successes from Excellence***, recently published by BIOTECanada. Copies can be ordered from their web site at:

http://www.biotech.ca

Advanced technology in Canadian manufacturing

The survey was conducted in early 1999 and a report will soon be released.

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Telecommunications, Broadcasting and Electronic Commerce

Connectedness

A new project started on April 1, 1999 in partnership with Industry Canada to produce socio-economic indicators of connectedness and related analysis. Work is planned around the following areas:

- economy-wide activities, to close the information gap on the use of Information and Communication Technologies (ICTs) and electronic commerce by businesses, and to enhance the Household Internet Survey,
- key specific industries—telecommunications, cable, computer services and on-line services, and
- analytical reports, compendia and special studies.

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Telecommunications

Annual survey of telecommunications services

This survey was thoroughly redesigned to reflect the new realities in the industry, as well as to cover the new industry classes in the North America Industry Classification System (NAICS). It covers both wireline and wireless telecommunications. Results from the first survey for reference year 1997 have been released, while the 1998 survey is currently underway.

Quarterly telecommunications statistics

A new quarterly survey was launched earlier this year to collect vital industry statistics. Results for the first quarter of 1999 are expected in late summer.

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Broadcasting

Annual surveys of cable, radio and television

Data on cable, radio and television from the 1997 surveys have been released. A service bulletin containing data from the 1998 radio and television survey is scheduled for June 1999.

An annex is under development for the 1999 mail-out of the cable survey to address the issue of Internet service provision by cable companies.

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Electronic Commerce

Annual household Internet use survey

The household Internet use survey will be conducted again in November 1999. It will continue to provide updated estimates for household use of computer communications by location of use, province, purpose, frequency and intensity of use. In addition, a new module is under development to address consumer purchasing habits on-line.

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Annual survey of information and communication technologies and electronic commerce

A new economy-wide business survey to shed light on the use of Information and Communication Technologies (ICTs) and the conduct of electronic commerce among Canadian business is being developed. The survey is scheduled to be carried out in the fall of 1999 and will provide estimates by industry (NAICS), province and firm size. Preliminary results are expected before the end of March 2000.

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