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Innovation Analysis Bulletin

A tri-annual report from Statistics Canada with updates on:

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- **Industrial research and development**
- **Intellectual property commercialization**
- **Advanced technology and innovation**
- **Biotechnology**
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- **Telecommunications and broadcasting**
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Besides the articles to which we refer in this bulletin, Statistics Canada's Web site provides a wealth of statistics, facts and research papers on a variety of related topics. As well, most of the questionnaires we have used to collect the information are available for research purposes.

As of October, 2004 there were:

- 11 publications for sale
- 12 free publications
- 12 research papers
- 110 working papers, and
- 25 questionnaires.

Symbols

.	not available for any reference period
..	not available for a specific reference period
...	not applicable
p	preliminary
r	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
e	estimated figures
E	use with caution
F	too unreliable to be published

Innovation and productivity growth, 1988 to 1997

A new study confirmed that innovation is a main factor contributing to labour productivity growth, gains in market share and survival in Canadian manufacturing plants. The study also found that research and development (R&D) investment, competencies and past innovation activities are the three main factors affecting innovation outcomes of Canadian manufacturing firms. Higher productivity, as measured by production per hour worked, occurs when output increases faster than hours worked. Productivity growth is the main determinant of the prosperity and standards of living in the long run.

Differences in the effects of process innovation and product innovation

Product innovation and process innovation have different effects on plant performance and plant survival. Process innovation is more important than product innovation for labour productivity growth. The research found that process innovators had an annual labour productivity growth that was 3.6 percentage points higher than non-process innovators from 1993 to 1997.

In contrast, product innovation had a positive but statistically insignificant effect on labour productivity growth. This is consistent with the view that new products tend to disrupt established production processes and productivity growth is unlikely to show significant improvement as a result.

Process innovation is associated with higher plant survival rates while product innovation is related to lower survival rates. Firms that introduced process innovations between 1989 and 1991 had survival rates in the subsequent 1993 to 1997 period that were 6 percentage points higher than those that did not. In contrast, the average survival rate of plants with product innovation was lower than those without product innovation.

This suggests that these different types of innovators are at different phases of the product life cycle. Product innovation dominates the early stages of the life cycle when turnover is high. Process innovation occurs later when market shake outs have already occurred. At this point, competition no longer depends so heavily on providing unique product characteristics but rather emphasizes price advantages because products have become more homogeneous.

The importance of process innovation to productivity growth confirms findings from other research studies that show how technology use is related to faster productivity growth. These technologies include robots, advanced manufacturing cells, automated process control and many similar state-of-the-art technologies, all of which are integral to new processes.

Many of these advanced technologies were introduced in conjunction with process innovations. Together, the results stress the importance of process innovation for productivity growth.

Innovation is also related to market share growth through its positive effect on productivity growth. The plants that introduce process innovation have faster productivity growth that in turn leads to gains in market share.

Three main factors affecting innovation outcomes

Investment in R&D competencies and past innovation activities are the three main factors affecting innovation outcomes of Canadian manufacturing firms. R&D investment is an important determinant of innovation. Continuously performing R&D is closely related to innovation of most types—though it is more important for the most novel than the least novel innovations. The location of R&D activity is less important, that is, having a separate R&D department is not as critical as the presence of continuous R&D.

The second factor affecting innovation outcomes is technology competencies of firms. Firms placing more emphasis on technology strategies are more innovative. While the commitment to R&D is important for innovation, the technological competencies that are accumulated over time are just as important.

The third factor affecting innovation outcomes is past innovation activities. The use of patents and trade secrets, which is associated with past innovation, is a strong predictor of being an innovator.

Firms that have obtained patents or used trade secrets to protect their intellectual property in the past have innovation rates that are 23 percentage points higher than those with no intellectual property rights. The difference is 23 percentage points for process innovations, 18 percentage points for product innovations, 2 percentage points for world-first innovations, and 15 percentage points for non-world-first innovations.

Differences in innovation outcomes by firm size and firm ownership

Firm size is found to be more closely related to process innovation than product innovation. Large firms have process innovation rates that are 14 percentage points higher than small firms. But there is no difference in product innovation rates between them. Large firms are more likely to be at that stage of the life cycle where process innovation is important for both survival and growth.

While most closures occur in smaller plants, failing to innovate will lead to the closure of even the larger plants. Finally, it should be noted that innovation for large plants tends to offset the inexorable dynamics of decline. Larger plants have higher productivity and plants with higher productivity tend to show a decline in relative productivity compared with small plants. Process innovation can reduce the amount of this decline.

It is also the case that foreign-controlled firms have innovation rates that are about 10 percentage points higher than their domestic counterparts. The higher innovation rates of foreign-controlled plants are a result of their larger size, higher export participation rates, technology competencies, and past innovation activities. After controlling for these firm characteristics, the nationality of a firm is not significantly related to innovation.

*The research paper **Innovation, Survival and Performance of Canadian Manufacturing Plants**, (11F0027MIE2004022, free) was released in the Statistics Canada Daily on September 21, 2004.*

John Baldwin, Micro-economic Analysis Division, Statistics Canada

Effect of changing technology use on plant performance in the manufacturing sector

According to a recent study covering the period 1993 to 1998, manufacturing companies that increased their use of advanced technology during the mid-1990s also experienced greater growth in labour productivity during the same period. The research also found advanced technology use led to growth in labour productivity, which in turn led to growth in market share.

Productivity growth measures the efficiency with which labour is employed in the production process. Over time, it is an essential contributor to the prosperity of Canadians. The research investigated the extent to which the adoption of advanced technologies by manufacturing plants between 1993 and 1998 was associated with superior growth and productivity performance.

Investment in advanced technology key for productivity growth

Growth in capital intensity was the single most important factor contributing to growth in labour productivity between 1993 and 1997, which is consistent with previous studies. The more capital-intensive a firm is, the greater the productivity growth. However, this was partly the result of the ever-increasing share of capital coming from investments in information and communications technologies (ICTs). Plants that had invested heavily in advanced technologies were more likely to enjoy higher productivity growth.

Between 1993 and 1998, the use of advanced manufacturing technologies in Canadian manufacturing plants increased dramatically. Plants using network communications technologies increased from 18% to 47% of the population. Plants using integration and control technologies increased from 24% to 49%. Canadian manufacturing plants that increased their use of these advanced technologies during this period had higher productivity growth than those plants that did not increase their technology use.

Use of ICTs during production ordering process leads to productivity gains

This study also uncovered how ICTs contribute to success. Highest growth was in the adoption of network communications technologies (local area networks, company-wide networks and inter-company networks). Information and communications equipment can be used for a variety of purposes, such as keeping databases for analysis, engaging in financial transactions, selling products over the Internet and facilitating the ordering process. Of note, firms that used their electronic communications networks to improve the efficiency of their ordering processes were more likely to have improved their productivity.

Growth in labour productivity key factor behind market-share growth

Over the period studied, plants exchanged substantial amounts of market share as some plants grew and others declined. About 15% of market share in an average industry was transferred from continuing plants that lost market share to plants that gained market share. At the beginning of the period, plants that subsequently increased their market share were 16% less productive than those about to lose market share; by the end of the period, they had become 17% more productive.

Growth in market share is strongly linked to growth in labour productivity. Firms with greater labour productivity growth typically experienced increases in their market share.

Technology growth was found to have both a direct and an indirect effect on market-share growth. First, it was linked to productivity growth, which in turn has strong positive ties with market share growth. In addition, technology growth has direct effects on market-share growth, most likely because of its impact on product innovation. By the end of the period, the market rewarded those who managed to improve their efficiency or the quality of their product and hence their labour productivity, with an increase in market share.

Research and development important for market-share growth

Complementary investments in firm competencies were also shown to be important. Firms did particularly well if they stressed a strategy that focussed on the use of advanced technologies. Research and development was also found to be related to the growth of a plant's market share. Research and development strategies, as well as advanced innovation strategies, are complementary factors that contribute to the development of new products.

The economic analysis study ***The Effect of Changing Technology Use on Plant Performance in the Canadian Manufacturing Sector*** *(11F0027MIE2004020, free) was first released in the Statistics Canada Daily on July 27, 2004.*

David Sabourin, Industrial Organization and Finance Division, Statistics Canada

What's up, docs?

Where do graduates go after they get their doctorate degrees? Until recently, we only caught up with them two years after graduation. By then, some had moved out of the country or had gone through career changes. A new survey by Statistics Canada promises to provide current indicators of post-graduation plans of recent doctorate recipients.

The need for information

Every year, about 4,000 doctorates graduate from Canadian universities. Some of them return to post-doctoral studies, some find employment as industrial researchers in Canada or abroad. Yet others may have difficulty in finding appropriate employment. Statistics Canada's Survey of Earned Doctorates promises to illuminate the early career choices of some of Canada's most highly qualified personnel.

The Survey of Earned Doctorates

Modelled after the survey of the same name conducted in the US by the National Science Foundation, the Canadian ***Survey of Earned Doctorates*** was run as a demonstration with the University of Toronto and l'Université de Montréal (including HEC Montréal and École Polytechnique) in 2002-03. Results from this demonstration indicated that almost a third of the graduates (30%) planned post-doctoral studies while over half (55%) planned to immediately enter the labour force (Table 1).

More than one quarter (28%) of the graduates planned to leave the country—mostly to the US (17% of all graduates). This is a much higher proportion than the 12% measured in 1999 in the follow-up of the 1995 graduating cohort (Statistics Canada, 1999). The proportion of graduates planning to leave the country was highest for the humanities (38% of all graduates) and life sciences (35%).

Whether this increase is real or due to the selection of two universities will be resolved with the release of data from the full survey for 2003-04 in late 2004.

Table 1. Postgraduation plans and intended country of residence—Combined data (University of Toronto and Université de Montréal)

Postgraduation plans[1]	%
Postdoctoral fellowship	30
Postdoctoral research associateship	8
Traineeship	x
Other training or study	4
Employment	55
Other	x
Intended country of residence after graduation, for those with definite plans[2]	
Canada	72
United States	17
Other country	11

Notes :
Totals may not add up to 100% because of rounding.
x Suppressed to meet the confidentiality requirements of the Statistics Act.
1. Records with 'Not stated' values have been excluded from the table.
2. "Definite plans" refers to the doctoral recipient having definite commitments for employment or postdoctoral study or research.
Source: Statistics Canada, Survey of Earned Doctorates, 2002-2003 (University of Toronto and Université de Montréal).

References

Statistics Canada, 1999, *South of the border: graduates from the Class of '95 who moved to the United States*, Catalogue No. 81-587-XIE.

Preliminary data from the demonstration project were first released in the Statistics Canada Daily on October 24, 2003. More detailed data are available upon request from Culture, Tourism and the Centre for Education Statistics, Statistics Canada (613-951-9040, educationstats@statcan.ca). Data from the full survey are expected in late 2004.

Does new technology mean the end of old technology?

Not necessarily, it seems. Some predicted that home videos and home theatres would give a fatal blow to cinemas. Yet the 125.7 million movie tickets sold in 2002/2003 was a record high. Others have predicted that music downloading and Internet radio spelled the imminent death of conventional radio. It seems that they were also wrong. Radio is alive and kicking.

A banner year for radio in 2003

Air time sales by private radio broadcasters jumped 8.4% to $1.2 billion, the second largest year-over-year increase in the last 15 years. The granddad of electronic media has also generated the best profits on record in 2003, thanks largely to cost containment. The operating expenses of private radio broadcasters grew 3.7%, less than half the revenue increase of 8.2%. As a result, profits before interest and taxes represented 19.1% of their revenues, up from 15.6% in 2002.

The 2003 results maintain a trend that began in the late 1990s after many difficult years in the late 1980s and most of the 1990s. The industry's profit margin has surpassed 10.0% in 1997 and has climbed ever since.

FM radio playing a happy tune

Radio listeners have gradually turned to FM radio at the expense of AM radio, in large part because of the sound quality and programming. FM radio now accounts for nearly three quarters of total listening time.

The changing habits of radio listeners have had a significant impact on the financial performance of FM stations. FM stations continued to account for most of the growth in air time sales by the industry. The 9.8% increase of air time in 2003 was the highest since 1998 and is equal to the average year-over-year increase of the 1992 to 2002 period. FM stations also accounted for most of the industry's profits in 2003. The robust 25.3% profit margin (before interest and taxes) realized in 2003 was consistent with the returns achieved in the previous 5 years.

To a large extent, 2003 is no different than previous years. The older AM stations continue to struggle. Without FM radio, the industry would have seen its revenues steadily decline through the 90s, and its profits gradually erode.

Why is radio thriving?

The reasons that radio is thriving include more favorable market conditions, improved technology and improved products. A 1998 regulatory decision that has allowed for increased ownership consolidation within local markets and the adoption of automated broadcast technologies has set the stage for efficiency gains in the industry. It generally takes fewer people to operate a radio station now than it did before. In 2003, the average number of employees per station was 16.7, down from 17.7 five years earlier. During that period, revenue per employee jumped 18.9% and the proportion of revenues devoted to salaries decreased to 42.1% from 43.1%.

But a more efficient radio station still needs listeners to generate revenues. At last count, Canadians spent an average of just 19.5 hours per week listening to radio, about 50 minutes less per day than the average of the previous five years. The industry managed the slow erosion of listeners by adapting to evolving tastes. For instance, stations on the less popular AM band are gradually migrating to the more popular FM band. There were 201 AM stations and networks in 2003 compared to 250 only five years before. During that period the number of FM stations and networks jumped from 242 to 337.

What lies ahead?

The good results of the recent past are no guarantee of a bright future. The radio industry faces important challenges.

Bringing back teens and young adults into the listening audience is at or near the top of the list. People aged 12 to 17 reduced their listening time by almost two hours a day in five years, from 11.3 hours per week in 1999 to 8.5 per week in 2003. Young adults aged 18 to 24 also reduced their listening time, though not by as much as teenagers. They represent the audience of the future.

The Internet is here to stay and radio will either have to put up a fight or find a way to exploit the new media. Many stations appear to have chosen the latter strategy. About one third of conventional commercial radio stations broadcast on the Internet. There is however no evidence that it leads to a significant or distinct revenue stream. The search for a business model that works is still on.

Satellite and digital radio are also on the horizon. These new technologies could well turn into new competition or trigger the need for significant investments to the broadcasting network by existing players.

The radio industry has shown a lot of resiliency. It survived television. As a matter of fact, radio has generated a higher profit margin than television for the last six years. It has also survived the walkman, and is currently battling MP3 players with apparent success. Stay tuned. It may well thrive for many more years.

More data available

For more information on the topics covered in this article and links to more detailed data, readers can go to:

- www.statcan.ca, Private radio broadcasting, 2003, The Daily, Monday July 5, 2004
- www.statcan.ca, Radio listening, fall 2003, The Daily, Wednesday July 28, 2004
- www.statcan.ca, Movie theatres and drive-ins, 2002/03, The Daily, Monday June 28, 2004
- www.crtc.gc.ca, Decisions, notices and orders, CRTC decision 1998-41, Commercial radio policy.

The information in this article first appeared in Statistics Canada's The Daily on July 5, 2004.

Daniel April, SIEID, Statistics Canada

Internet reaches almost 8 million households

According to the ***Household Internet Use Survey*** the number of Canadian households surfing the Internet continued to grow in 2003. Underlying this trend was Canadian households' continued quest for speed.

Internet use growing but at slower rate

In 2003, 7.9 million households (64%) of the 12.3 million Canadian households had at least one member who used the Internet regularly either from home, work, school, a public library or another location. This was a 5% increase from 2002, but well below the annual gains of 19% and 24% observed in 2000 and 2001.

Internet use continued to be highest from home but households were increasingly linked to the Internet by a high-speed connection. Of the nearly 6.7 million households that had at least one member who regularly used the Internet from home, 65% had a high-speed connection in 2003 up from 56% a year earlier.

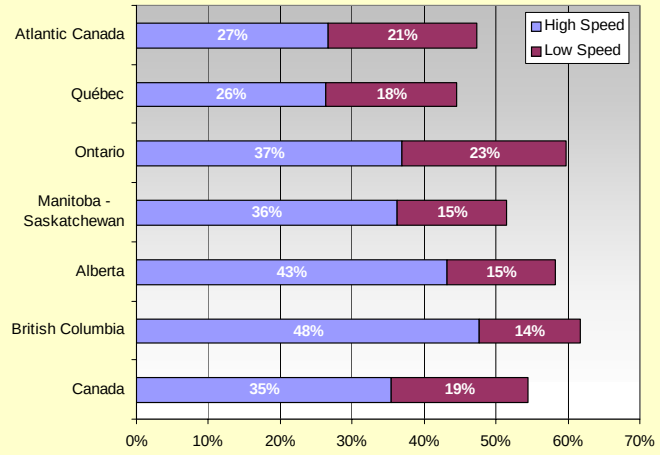
Internet use highest in British Columbia, Ontario and Alberta

Internet use from home increased in most provinces in 2003. The highest rates of use were in British Columbia, Ontario and Alberta where roughly 6 out of every 10 households were connected to the Internet at home. All other provinces had rates of Internet use from home that was below the national average of 55% (see Chart 1 which also provides high and low speed Internet data).

Income and education related factors

The survey divided households into four equal groups based on income, each representing 25% of the income spectrum from highest to lowest. Nearly 45% (1.3 million) of the households with income between $24,001 and $43,999 had someone who used the Internet from home in 2003, up 13% from 2002. This group of households had the highest growth in connections from home and work, as well as the combination of various locations.

Chart 1. High speed and low speed Internet use by province



In contrast, the proportion of households regularly using the Internet from home remained relatively unchanged for the lowest income quartile.

The higher the level of education in the household, the more likely it is to have an Internet connection from home. Nearly 77% of households with someone with a university degree were connected from home. In contrast, only about 12% of households in which the highest level of attainment was less than high school were connected from home

This article is based on information originally released in The Daily on July 8, 2004.

Jonathan Ellison, SIEID, Statistics Canada

Examining Intranet technology

By 2003, 16% of private Canadian businesses, both large and small, were using Intranets within their organization. However, growth remains slow as there remains uncertainty among some organizations and staffs as to what purpose an Intranet serves and what benefits an organization may derive from using one. This article examines the possible functions of an Intranet and the types of Canadian firms that are utilizing them.

What is an Intranet?

An Intranet is a private network of computers accessed by authorized users of the network. An Intranet can be used by an organization for distribution of information, as a communication network and to share resources. The major goal of many Intranets is to decrease individual workstation costs and increase knowledge sharing throughout the organization. These networks can consist of a few computers in a single room or may link thousands of computers in different locations.

*An Intranet, as defined by the **Survey of Electronic Commerce and Technology** (SECT), is an internal communications network using the same protocol as the Internet that allows communication within an organization. These are typically closed systems that are set up behind a firewall to control access to the corporate systems.*

Reaping the benefit of an Intranet

Some common uses for an Intranet include distributing information to employees, running an internal email system, sharing applications and files, or for deployment of software updates. Distribution of information over an Intranet can be very effective since the information can be posted in a central spot for all employees to access. In this scenario, the distribution of information through mass emails or other techniques can be reduced. The ability to share files and applications over a network can also decrease the need for e-mail attachments and separate copies of each piece of software for each user.

Slow adoption among private firms

As displayed in Table 1, in 2003, over 16% of private firms had an Intranet in use. This is a minimal increase from 2001 when almost 15% of private firms were using an Intranet. There has been larger growth in public sector firms. In 2001, 68% of public sector firms used an Intranet. By 2003, 81% of firms in the public sector were using Intranets. Clearly, the public sector has shown a propensity to adopt advanced ICTs quickly and made efforts to implement them into their practices.

In the private sector, the use of an Intranet is most prevalent among large firms (Table 2). By 2003, 61% of large firms used an Intranet. This trend is no different than with any other advanced Internet Communication Technology (ICT), as larger firms tend to adopt advances more quickly. Although the benefits of an Intranet can be reaped by firms of all sizes, large firms are more likely to have the necessary knowledge and capital to implement an Intranet.

Firms among first to recognize benefits

In 2003, 40% of firms in the Information and Cultural Industries (51) sector used an Intranet. Although similar to 2001, this sector is still one of the leaders of Intranet use in Canada. The lack of growth from 2001 to 2003 is likely a result of firms in this sector having the knowledge required to implement such a system at the beginning of its growth curve.

Data from the Survey of Electronic Commerce and Technology (SECT) reveals that firms in the Finance and Insurance (52) sector were also quick to pick up this technology and remain among the leaders in the use of Intranets today. The Educational Services (61) sector's rate of Intranet use grew the fastest between 2002 and 2003. While only 18% of firms in this sector used an Intranet in 2002, almost 32% of firms were using one in 2003.

The data in this article first appeared in Statistics Canada's The Daily on April 16, 2004.

Mark Uhrbach, SIEID, Statistics Canada.

Table 1. Firms using an Intranet (2001-2003)

Year	Private	Public
	%	%
2001	13.75	68.54
2002	14.84	76.83
2003	16.39	80.56

Table 2. Private sector firms with an Intranet in 2003

Firm Size	%
Small	12.5
Medium	39.4
Large	60.7
Overall	**16.4**

Health information and Internet use

Between 1998 and 2002, the number of households in Canada accessing web-based health and medical information increased by a staggering 262%. This rate far outstrips the 53% increase in households that use the Internet recorded for the same time period. Canadians obviously like to use the Internet to research health related or medical information. Almost two-thirds of households that regularly used the Internet from home researched health issues in 2002.

Canadians are bombarded with news stories, editorials and advertising about the state of national and provincial health care, hospitals' emergency rooms, potential medical breakthroughs, fund-raising lotteries and telethons. Health information is now seemingly much more accessible to everyone through government telehealth initiatives, official and unofficial web-sites as well as radio and television programming.

Health—the most popular topic for specific subject Internet researching

Health and medical information is the third most popular household Internet use, behind e-mail and general browsing. This makes health information the most popular specific topic of household Internet use. There is a universal appeal for health related or medical information by Canadian households. Almost two-thirds of households that regularly used the Internet from home researched health issues in 2002. There was a dramatic increase in the number of households seeking health information from 1.1 million in 1998 to almost 4 million by 2002.

Connected households researching health information

It is well documented (Dickinson and Ellison 2000; Sciadas 2003, Statistics Canada 2003) that connected households are characterized by higher levels of education, employment, incomes and more household members. Not surprisingly, seekers of Internet health information share these attributes. Whether or not there are children or seniors present in the home, households use the Internet as a source of medical information.

Households that searched on-line for medical information tended to be intensive Internet users with 69% of these households spending at least twenty hours per week connected, up from 52% in 1999 (see Table 1). Almost eight out of ten of these households went on-line daily. The households using the Internet for health related information were more likely to have a high-speed or broadband connection (58%) than households using the Internet not looking for Internet health information (52%).

Overall, households seeking on-line medical information are proportionally more likely to use the Internet more extensively for information on a variety of subjects as well as for leisure pursuits such as games, than connected households not seeking on-line medical information. This could be a result of the higher amount of time spent on-line generally by households using the Internet as a source of health information than those not looking for health information.

Table 1. Selected Internet use characteristics of regular Internet use from home households, regular search for medical or health related information households and households that did not regularly use the Internet for medical or health related information, 1999 and 2002

	1999			2002		
Internet use characteristics	Regular use from home	Regular search for medical or health related information	No regular medical or health related information Internet use	Regular use from home	Regular search for medical or health related information	No regular medical or health related information Internet use
Type of Internet connection*	100%	100%	100%	100%	100%	100%
Telephone	86%	86%	86%	64%	63%	66%
Cable	12%	13%	11%	35%	37%	33%
Speed of Internet connection*	100%	100%	100%	100%	100%	100%
High-speed or broadband	N/A	N/A	N/A	56%	58%	52%
Frequency of Internet use*	100%	100%	100%	100%	100%	100%
Daily	65%	70%	60%	75%	78%	69%
Weekly	30%	28%	33%	21%	19%	24%
Monthly and rarely	2%	2%	4%	2%	2%	3%
Weekly hours spent on the Internet*	100%	100%	100%	100%	100%	100%
Less than 20 hours	51%	47%	54%	32%	29%	37%
20 hours or more	47%	52%	42%	65%	69%	57%

Source: Statistics Canada, ***Household Internet Use Surveys***, 1999 and 2002

Notes: May not add to 100% due to rounding and / or respondent not be able to identify type or speed of connection, or the frequency or duration of Internet use. N/A means not available.

Growth evenly distributed

There have been some shifts in the proportional representation of households using the Internet from home and the subset of these households seeking on-line health information. This is likely the result of the higher Internet adoption rate of Canadian households from home in 2002 of one-half of all households as compared to one-thirtieth in 1999. Again, households seeking on-line medical information in 1999 closely resembled households connected from home and differed only slightly from those connected households from home not seeking medical information on-line. It appears that the rapid growth in interest in medical information has been fairly evenly distributed across the household types that connect to the Internet from home. Therefore, it seems that the increasing use of on-line health information closely follows the household Internet adoption rates from home.

*This article is based on information from the **Household Internet Use Survey**, 1999 and 2002*

Louise Earl, SIEID, Statistics Canada.

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Sciadas, G. 2003. Editor. *Monitoring the digital divide and beyond*. Montréal, Claude-Yves Charron, Orbicom.

Statistics Canada. 2003. *Canada's journey to an information society*. Catalogue No. 56-508-XIE. Ottawa.

Modest beginning for digital channels

There was a time, not so long ago, when television was simple. There were a few channels and they were free. Then cable gradually found its way into a majority of Canadian homes. There were more channels and television was no longer free. Today, the increasing penetration of direct-to-home satellite, wireless and digital cable opens the door to hundreds of channels, many of them of the digital variety.

Carving a niche

In 2002, 48 Canadian digital channels became available, providing the 3.2 million homes with digital television a wider choice of video programming. The launch of these new channels added to the crowded pay and specialty television space already occupied by 62 analogue channels. Some wondered if the broadcasting industry could support so many programming services. Would advertisers be interested in the new media? Would Canadians show interest and pay for the new content?

Two years later the free trials are largely over and the viability of the new channels is being put to the test. As expected, the early years are proving difficult but the fortunes of these new services are improving. As a group, digital channels have incurred a loss before interest and taxes of $85.2 million in 2003, significantly less than the $140.5 million loss incurred in 2002. Their customer base has expanded to an average of just over 500 thousands subscribers per channel, with the most popular services attracting close to one million customers at the end of August 2003. The revenues of digital channels reached $100.1 million in 2003, more than twice the revenues generated in 2002. In excess of 80% of those revenues came out of the subscriber's pockets.

Analogue specialty television thriving in the fragmented television universe

News, sports, music video, weather channels and the like are no longer the new kids on the block. Some have been around for more than 15 years and have become familiar brands of Canadian broadcasting. The average number of subscribers to Canadian analogue specialty channels reached 4.4 million in 2003, with the most popular ones having more than 9.0 million subscribers.

These subscribers are also spending a growing proportion of their viewing time watching analogue Canadian specialty channels. These changing viewing habits have a positive impact on advertising revenues. These revenues reached $597.8 million in 2003, up 19.1% from the previous year. The specialty television share of the television advertising market grew to more than 21% in 2003, continuing a steady ascent that began with the creation of this segment of the industry. Subscription fees are still the most important source of revenues for this segment of the industry. They grew 2.4% in 2003 to $811.1 million.

The profit margin for analogue specialty channels remained high in 2003 at 19.4%, essentially unchanged from the previous year.

Pay television proving to be a good business

Pay television (mostly pay-per-view and movie channels) accounts for less than 7% of the television industry's revenues, but it is the most profitable segment by a wide margin. This segment improved its profit margin (before interest and taxes) in 2003 to 26.4% from 24.2% the previous year. The industry average for private television broadcasters was 14.7% in 2003 and 10.4% in 2002.

Conventional television holding its own

Specialty television, pay television, digital television and video-on-demand are all trying to pry away viewers and business from conventional television. While it has lost ground over the years, Canadian conventional television still accounts for slightly more than half of television viewing time, close to 64% of the industry's revenues and 79% of its air time sales.

Private conventional broadcasters saw their revenues jump 10.6% to $2.1 billion in 2003 following a decline of 0.5% in 2002. This was the first double-digit increase since 1988 and can be largely attributed to an 8.7% increase in advertising revenues, after 3 years of sluggish growth. For the public and non-commercial segment, growth in revenues was a more modest 3.4% where the 8.0% increase in grants offset the 12.3% drop in air time sales.

More data available

For more information on the topics covered in this article and links to more detailed data, readers can go to:

- www.statcan.ca, Television broadcasting, 2003, *The Daily*, June 16, 2004.
- www.statcan.ca, Television viewing, fall 2002, *The Daily*, November 21, 2003
- www.statcan.ca, Cable and satellite television, 2002, *The Daily*, October 24, 2003.
- www.crtc.gc.ca, Pay and specialty, statistical and financial summaries, 1999-2003

The information in this article first appeared in Statistics Canada's The Daily on June 16, 2004.

Daniel April, SIEID, Statistics Canada

Characteristics of firms that grow from small to medium size

A series of working papers on ***Characteristics of firms that grow from small to medium size*** is being derived from a joint project of Statistics Canada and the National Research Council's Industrial Research Assistance Program (NRC-IRAP). The project developed out of a need to better understand how and why certain businesses grow.

Existing studies on business growth have largely been done on specific industries or with a limited set of factors. While building on this, the project took advantage of the specific data strengths of Statistics Canada's Science, Innovation and Electronic Information Division to provide a unique assessment of a broad range of growth factors as they relate to Canadian firms.

The foundation of this study was the analysis of firms that have made the transition from small to medium in our surveys: the Survey of Innovation 1999, the Research and Development in Canadian Industry (RDCI) survey, the Biotechnology Use and Development Survey, the Survey of Advanced Technology in Canadian Manufacturing (1998) as well as the Longitudinal Employment Analysis Program—Small Area File (LEAP-SAF). In addition to the statistical analysis, we also conducted interviews of firms that have made the transition. Each of the five working papers in the series provides one perspective on the transition from small to medium size.

In this issue, six articles are based on these working papers:

- ***Growth Strategies and Innovation*** outlines the critical growth factors resulting from interviews with senior business managers;
- ***Results of interviews of directors of high-growth biotechnology firms*** provides additional analysis from the perspective of biotechnology companies;
- ***Innovation and growth in small manufacturing firms, 1997-1999*** gives additional insight on small high-growth firms from the analysis of the *Survey of Innovation, 1999*;
- ***Industrial and geographic distribution of small high-growth firms*** provides another piece in the puzzle—which industries and communities have the highest proportions of quickly growing small firms?
- ***Adoption of advanced manufacturing technologies and growth in small to medium enterprise manufacturing firms, 1995-1998*** looks at manufacturing firms with 20 to 49 and 50 to 99 employees in 1998;
- ***R&D and growth in small to medium size enterprises*** examines average R&D spending per firm and revenue growth.

Frances Anderson and Michael Bordt, SIEID, Statistics Canada.

Characteristics of firms that grow from small to medium size:
Growth strategies and innovation

Theories of business growth lead us to believe that, to grow, a company needs to be innovative, conduct R&D, have access to multiple sources of funding, protect its intellectual property (IP), engage in alliances ***and*** establish itself in a market niche. Interviews with 25 Canadian technology-based companies show that some companies manage to grow despite breaking these rules.

For every company interviewed that had made the transition from small to medium by adhering to the "traditional" growth factors, there was another that managed to do it by breaking the rules. In general, the respondents were aware that to grow they needed to engage in alliances, conduct R&D, develop a competence in obtaining funding, manage their IP and find a market niche (Niosi, 2000). However, these factors were not important for all companies at all times. Many pointed out other growth factors that, for them, were more important.

The traditional factors

Research and development: Most of the companies interviewed did conduct R&D to develop new products. In a few cases, the R&D was very informal, such as "inventive" founders testing new materials, the software department developing new control programs or *ad hoc* applications of existing goods or services.

Business alliances: Only a few of the firms that made the transition had engaged in broad-based alliances with other businesses. Some of the alliances were specialized and limited. For example, they might engage in an R&D alliance for one specific project, for licensing their technology or for marketing. Many were determined to "go it alone"—in order to protect their IP or to maintain distance from the competition.

Competence in funding: Venture capital funding was often cited as less desirable than private sources since it required relinquishing some degree of control of the company. Similarly, "going public" was often seen as a double-edged sword. Several small firms managed to make the transition to medium-sized through private funding (including savings of the owners, "love money", angel funding, personal loans), sales of one product to support the development of another, or selling the rights from one of their early technologies. One biotechnology company referred to the latter approach as "selling your first-born".

IP protection: Almost all the companies interviewed held patents. Some had augmented patents with confidentiality agreements. Four firms, two software developers and two small manufacturers, relied entirely on confidentiality rather than patents or copyrights. Rather than simply protecting their IP, many companies were also actively managing it: generating one-time sales or an on-going revenue stream while also maintaining exclusivity.

Market niche: Respondents were assessed as to the degree of competitiveness of their markets. If they were specialized and were in a less competitive market, they were considered to be in a market niche. It has been proposed that firms with a specific market niche would have a greater chance of growing. While most of the firms interviewed that were in a niche did make the transition from small to medium, many of those in moderately or highly competitive markets also made the transition.

Other factors

Business advice: The one factor that emerged consistently was the importance of business advice. Firms that thrived during an otherwise turbulent period largely attributed their success to previous business experience or timely business advice from outside the firm.

Business advice was brought into the firms in many different ways. A few businesses were founded by individuals with business skills (whether learned formally or on-the-job) and had little need for outside advice. Others obtained business advice from people outside the firm: members of the board of directors, advisory committees, business coaches and consultants. In several instances, the respondents remarked that they should have sought business advice sooner.

Formal organization and planning: One of the qualitative differences between small and medium-sized firms is the degree of formalization of their organization and planning. A medium-sized firm is more likely to adopt management specialization (development, marketing, human resources, administration, etc.) as well as more formal business planning. Although a majority of the firms interviewed had formalized their organization and planning, there were several firms that managed to make the transition with varying degrees of informality.

The less formally-managed firms tended to cite their flexibility as a positive outcome. If all business decisions are made at the weekly meeting of partners (and there is no Board of Directors to satisfy), then the company may be in a better position to take

advantage of short-term opportunities. Larger, formally-organized firms also mentioned that they needed to maintain some level of flexibility, for example, in terms of a short-term strategic plan that was distinct from the annual business plan.

Most of the medium-sized companies interviewed, during their transition from small, experienced not only an increase in formality of their organization but also a parallel formalization and specialization of job functions. One company, during their transition had already allocated the primary roles (Technology, Finance, Marketing, etc.) to their founders and the first senior manager hired was Director of Everything else. This illustrates the chicken-and-egg situation of many growing companies: do we design the organization and fill the slots with people or do we hire the people and design the organization around them? One common theme among the companies interviewed was that soon after establishing a formal board of directors, organization and planning became more formalized and job functions became more specialized.

Innovation: Almost all the firms were innovative to varying degrees. The firms conducting R&D were clearly doing do so to develop technologies that were "new to the world". A few advised caution that it was better to remain on the "leading edge" as the "bleeding edge" was too risky. That is, incremental changes were, for some, a better strategy than breaching the frontiers to develop a technology with an unknown future. This may be interpreted as strategic R&D: developing products "on spec" for waiting clients.

Adaptability: Several respondents, in relating their growth stories, mentioned instances in which the future existence of the company was at risk. In one case, a major supplier withdrew the license; in another a major competitor marketed the technology first. A company's adaptability was often cited in terms of either (a) the diversity of its product line or (b) the flexibility of the company to "retool" or reinvent itself on demand. In contrast, many of the firms that had made the transition had done so with a single product and a single approach.

Conclusions

While the generally-accepted growth factors did play an important role in many of the firms that made the transition from small to medium, for many firms, other factors were as important or more important to their transition.

From the list of "other" factors, innovation is the only one that is well understood: Statistics Canada has been conducting innovation surveys since 1993 (Statistics Canada, 2003). Statistical information on the remaining factors (business advice, formal organization and planning and adaptability) is not currently available. Statistics Canada is currently testing strategy-related questions for possible future surveys.

This article based on the working paper ***The transition from small to medium size: Growth factors—interviews and measurability*** *by Michael Bordt, Louise Earl, Charlene Lonmo and Rad Joseph (forthcoming).*

Michael Bordt, SIEID, Statistics Canada.

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Characteristics of firms that grow from small to medium size:
Results of interviews with leaders of high-growth biotechnology firms

This article is based on a recent series of interviews with leaders of high growth biotechnology firms. The facts presented are specific to biotechnology firms and represent a sub population of the enterprise group presented in the previous article. This article highlights the importance of financing, management strategies and qualified personnel in achieving high growth. Note that the following article is a summary of the responses of the interview respondents.

Financing

Virtually all firms identified financing as the main growth factor. However, financing methods can vary from firm to firm.

Investor "angels" are often used, mainly as an initial means of financing.

There is a degree of mistrust toward venture capital firms that tend to take over total control of the financed company. The firms interviewed question the overly close relations among venture capital firms that may be detrimental to biotechnology firms.

Going public is not an automatic step in the growth of companies but rather is a management choice. It also appears that many companies are not interested in expanding so that they can continue to direct their maximum efforts toward R&D.

Alliances are the preferred means of financing when the capital market has been saturated.

The times that scientists at federal institutions or agencies are available are sometimes not compatible with those of employees in the private sector, thereby reducing common research time, which is detrimental to continuity and the speed of innovation.

Management strategy

Although there is little mention of this factor in the literature, business plans are crucial to firms and their growth. They must be precise, clear, focused on the long term and updated in the short term and as often as possible in response to internal and external change. They must be based on respect for time and innovation. Some biotechnology firms advise that the business plan must be accompanied by a strategic plan covering values, orientations and the vision that the leaders want the firm to have.

Personnel

According to the firms interviewed, hiring personnel is easier than one might think. It is made easier by the tools of persuasion available to them (high salaries, shares in the firm, excellent and spacious work environment, notoriety, etc.). The scientific (experience in the sciences or scientific education), human or management (MBA in management, for example) skills required by the leader were also raised. The leader also sets the company's values and culture.

Scientists must be highly qualified and specialized in their fields (bacteriology, immunology, etc.). Biologists are apparently easy to hire, unlike industrial chemists with experience in pharmacology. A number of firms are looking to develop an overseas sales force, considered to be more effective, notably in the United States.

Patents

Patents are growth factors but there are three major reasons that may limit their use (in order of ascending importance): loss of time, cost and concern about revealing innovations.

Infrastructures

Facilities must be large, spacious, and have biology and/or chemistry laboratories.

Exports

They are crucial to a firm's growth. The bearer markets are the United States, Europe (mainly France, the UK and Switzerland) and Asia. In some cases, the United States may account for up to 95% of a firm's total exports.

Technology clusters

They contribute to growth and the firms involved in them appreciate the benefits that they provide (financing agents, proximity to suppliers, etc.) and the quality facilities.

All of these elements are growth factors identified by leaders of the firms interviewed. Although alliance networks and public acceptance are often considered growth factors (de la Mothe and Link, 2002), they were seldom mentioned, if at all, by leaders. Innovation and the quality of that innovation are obviously also growth factors (Niosi, 2002), because without them it would no longer be "an innovative biotechnology firm".

This article presents the qualitative results of interviews conducted with leaders of innovative biotechnology firms that experienced high growth.

Of the 104 common units selected in the 1999 and 2001 Biotechnology Use and Development Surveys, 62 firms were identified as small companies (fewer than 50 employees), of which 35 were considered high growth firms (firm with over 20 employees doubling the number of employees or revenue over a five year period). Among the 25 firms that participated in the interviews as part of this project, 12 were biotechnology firms.

Cécile Pérez, SIEID, Statistics Canada.

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Characteristics of firms that grow from small to medium size:
Innovation and growth in small manufacturing firms, 1997-1999

Analysis of ***The Survey of Innovation 1999*** gives some insights into how small firms that have made the transition from small to medium differentiate themselves from the rest of the pack. This study reveals differences in innovativeness, use of patents, confidentiality agreements, R&D tax credits and collaboration.

The study focuses on firms that started with 20-49 employees in 1997 and experienced high growth, that is, they increased in number of employees by 32% or more by 1999. The small firms were shown to be distinct in many characteristics from the other growth classes: "growers" (grew by 7.7% to 32%), "stable firms" (within 7.6% of starting size) and "declining" (declined by more than 7.6%).

The greatest distinction was in terms of world-first innovations (Table 1). High-growth firms were more than twice as likely to have world-first innovations as growth and stable firms. Since the high-growth firms are not significantly different from declining firms in this respect hints that firms in both classes are more likely to take risks.

The second-most striking difference is in the likelihood to apply for patents. In this characteristic, the small high-growth firms were at least 41% higher than all others.

A comparison of the other factors shows that small high-growth firms were also:

- 30% more likely to use R&D tax credits,
- 27% more likely to engage in confidentiality agreements, and
- 26% more likely to engage in collaboration.

Both small high growth firms and small growing firms were more likely to conduct R&D and use government innovation programs than stable and declining firms.

Conclusions

The analysis gives insights into the relative strength of the characteristics that differentiate small high-growth firms from others. The strongest factors are having world first innovations and having applied for patents. The second group of moderately important factors consists of: using R&D tax credits, confidenti-

Table 1. Innovation indicators for small (20-49 employees in 1997) manufacturing firms by growth class, 1997 to 1999

	Growth class			
Indicator	High growth	Growth	Stable	Declining
	%			
World first innovators	13	6	6	8
Applied for patents	17	12	11	10
Used R&D tax credits	35	27	26	22
Used confidentiality agreements	42	33	34	30
Involved in innovation collaboration	29	23	22	22
Used at least one government program	57	52	43	39
Innovators (country first or firm first)	81	76	76	68
Involved in R&D	64	62	56	52

Note: Percentages that are significantly different from the high-growth group are shaded. An hypotheses test was completed to determine if the difference between the estimate and the other types of firms was significant.

ality agreements and collaboration. The remaining factors, government programs, innovation and R&D, while contributing to growth appear less influential on high growth.

This article is a summary of an SIEID working paper of the same title, soon to be released. Details on methodology for the Survey of Innovation 1999 are available from the working paper and on Statistics Canada's Internet site at www.statcan.ca/english/sdds/4218.htm.

The survey considers three levels of innovativeness: a world first, a first in Canada and a first to the firm. The statistical unit on the survey is the provincial enterprise. The term "firm" is used as an equivalent to the statistical unit of the analysis which is provincial enterprise.

Frances Anderson, Susan Schaan, Guy Sabourin and Adele St. Pierre, SIEID, Statistics Canada.

Characteristics of firms that grow from small to medium size:
Industrial and geographic distribution of small high-growth firms

Between 1995 and 2000, 1.4% of all Canadian small businesses increased their employment by 100% or more. High-growth firms represented 3.7% of the 1995 employment in small businesses or about 260,000 jobs. The proportion of small high-growth firms varied greatly by industry and by city. The two sectors with the greatest proportion of transitions from small to medium were "Plastic products" at 6.9% and "Electrical and electronic products" at 5.9%. In seven of Canada's larger cities (CMAs) the proportion of quickly growing small firms exceeded 2%: Kitchener, Calgary, Halifax, Oshawa, Sherbrooke, Ottawa-Hull and Toronto.

Recent economic and business literature contends that location is important—that cities differ in their attractiveness to businesses and highly-skilled workers, and that the proximity to related industries and other support services such as venture capital create a cluster effect that is more conducive to growth in some industries than others. Confounding this already complex picture is the notion that communities can achieve employment growth through various pathways (high technology or low technology; specialization or generalization).

This component of the project provides another piece in the puzzle—which industries and communities have the highest proportions of quickly growing small firms? By providing an estimate of the number of small companies that have grown to medium size—and the number that haven't—this puts the other components of the project into perspective. For example, the propensity for small R&D performers to grow to medium size is much higher than the general population of businesses. Finally, this analysis may also be used to establish a "target" for future business development—where are the firms that have not yet grown to medium size and how could they be supported in their growth strategy?

Results

Of all regional enterprises in existence in 1995 (1.1 million), about half did not survive until 2000. This rate of extinction is not unusual as shown by Baldwin et al. (1996) where firms had only a 36% probability of surviving past their 5th year. Almost all of the deaths were very small firms. There were also a great number of births (607 thousand) so that over the period, the total number of firms actually increased by about 55 thousand.

Between 1995 and 2000, 1.4% of all Canadian small businesses increased their employment by 100% or more. Of all the size classes, firms with 1-99 employees were less likely to double in size than larger businesses. In contrast, 3.9% of businesses with 100-499 employees managed to double their employment over the period.

High growth firms represented 3.7% of 1995 employment in small firms. Although half the regional enterprises existing in 1995 no longer existed in 2000, the loss represented only 21.9% of the employment. This should not be construed as painting a bleak picture of the economy of that period—as many or more new regional enterprises and jobs were created. The focus of this analysis is the firms that remained in existence from 1995 through 2000, not the overall business and employment dynamics of the era.

Table 1. Industries with highest proportion of high growth small firms, 1995-2000

Industry class (SIC80 custom grouping)	% high growth
Plastic products industry	6.9
Electrical electronic products	5.9
Primary metal industries	5.3
Transportation equipment industries	5.2
Furniture fixture industries	5.1
Wood industries	5.0
Paper allied products industries	5.0
Machinery industry	4.5
Fabricated metal products	4.2
Primary textile industry	4.0
All industries	**1.4**

Source: Statistics Canada, LEAP-SAF.

This proportion of high growth small firms varied greatly by industry and by city. The two sectors with the greatest proportion of transitions from small to medium were "Plastic products" at 6.9% and "Electrical and electronic products" at 5.9%. Industries generally fell into three groups in terms of the proportion of small high-growth firms. The industries with the highest proportions, above 4%, were all in manufacturing. The highest non-manufacturing sector was "Mines" with 3.7%. At the low end of the scale, with between 0.0% and 1.1%, were most of the primary industries together with "Accommodation, food and beverage service industries". Construction, utilities, trade and services constituted a middle group with between 1.3% and 1.5% of their small businesses growing doubling or better over the period.

In seven of Canada's larger cities (CMAs) the proportion of quickly growing small firms exceeded 2%: Kitchener, Calgary, Halifax, Oshawa, Sherbrooke, Ottawa-Hull and Toronto. Eleven smaller cities exceeded the 2% level: Yellowknife (NW), Wood Buffalo (AB), Saint Georges (QC), Chatham (ON), Grande Prairie (AB), Leamington (ON), Guelph (ON) and Fort St. John (BC), Alma (QC), Cornwall (ON) and Brantford (ON) stood above the rest.

Table 2. Proportion of high-growth small firms for selected cities, 1995-2000

CMA /CA	NAME	High growth small firms(%)
Newfoundland and Labrador		
001	St. John's	1.7
Prince Edward Island		
105	Charlottetown	1.1
Nova Scotia		
205	Halifax	2.1
New Brunswick		
305	Moncton	1.7
Quebec		
408	Chicoutimi-Jonquière	1.9
410	Alma	2.0
421	Québec	1.9
428	Saint-Georges	2.9
433	Sherbrooke	2.1
459	Saint-Jean-sur-Richelieu	1.8
462	Montréal	1.9
465	Salaberry-de-Valleyfield	1.8
468	Lachute	1.9
Ontario		
501	Cornwall	2.0
505	Ottawa-Hull	2.0
532	Oshawa	2.1
535	Toronto	2.0
541	Kitchener	2.4
543	Brantford	2.0
550	Guelph	2.3
556	Chatham	2.6
557	Leamington	2.4
Manitoba		
602	Winnipeg	1.6
Saskatchewan		
725	Saskatoon	1.7
745	Prince Albert	1.7
Alberta		
825	Calgary	2.2
850	Grande Prairie	2.6
860	Wood Buffalo	3.0
British Columbia		
933	Vancouver	1.3
977	Fort St. John	2.2
Yukon Territory		
990	Whitehorse	0.9
Northwest Territories		
995	Yellowknife	3.5
All CMA/CAs		**1.7**

Conclusions

Although the reference period for this work was one of exceptional growth in some sectors, it is not only these industries (that is, the information and communications technologies) that show high proportions of small high-growth firms. Similarly, over this period, certain cities will have experienced overall high rates of growth for firms of all sizes—not only small ones. As with most indicators, this one—the proportion of high growth small firms in an industry or a city—needs to be considered in the context of other data that help to understand the dynamics of our businesses and communities.

Complete findings, more detailed tables and references will appear in the working paper ***The characteristics of firms that grow from small to medium size: Industrial and geographic distribution of small high-growth firms*** *by Michael Bordt, SIEID Working Paper Series (forthcoming), Statistics Canada.*

Michael Bordt, SIEID, Statistics Canada.

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Characteristics of firms that grow from small to medium size:
Adoption of advanced manufacturing technologies and growth in small to medium manufacturing firms, 1995-1998

Larger-sized high-growth SMEs are more likely to adopt advanced manufacturing technologies than either non-high-growth firms or smaller high-growth firms. The ***Advanced Technologies in Canadian Manufacturing Survey (1998)*** asked manufacturing firms about their adoption of a wide variety of advanced manufacturing technologies. This study examined the difference in adoption rates between firms that reported high employment growth and firms that did not.

This study looks at manufacturing firms with 20 to 49 and 50 to 99 employees in 1998. These firms were then classified as "high growth" or not, where high growth was defined as doubling of employment over five years, pro-rated to a three-year span.

There are two noticeable trends in the data (Table 1). The first is that as firms increase in size their rates of adoption of advanced manufacturing technologies increase. In a wide variety of technologies from each group, the rates of adoption more than double between firms with 20 to 49 employees and those with 50 to 99 employees. This applies to all firms, not just high growth firms.

The second finding applies to firms with between 50 and 99 employees in the base year. Amongst these firms, those firms reporting high growth consistently report higher levels of adoption of advanced manufacturing technologies than other firms. In

Table 1. Rates of adoption of advanced manufacturing technologies by high growth firms by size, 1998

Advanced manufacturing technologies	Firm size	
	20-49	50-99
	%	
Design and Engineering		
Computer Aided Design/Engineering (CAD/CAE)	*36.2*	**74.8**
Computer Aided Design/Manufacturing (CAD/CAM)	32.5	**63.7**
Modelling or simulation technologies	**9.0**	**24.7**
Electronic exchange of CAD files	**31.2**	**50.3**
Processing, Fabrication and Assembling		
Flexible Manufacturing Cells or Systems	**22.3**	**27.0**
Programmable Logic Control (PLC) machine(s) or process(es)	*28.4*	**63.8**
Lasers used in materials processing (including surface modification)	*3.8*	**16.1**
Robot(s) with sensing capabilities	**12.2**	7.7
Robot(s) without sensing capabilities	**7.2**	**8.9**
Rapid Prototyping Systems (RPS)	7.9	5.0
High speed machining	**25.9**	**33.8**
Near net shape technologies	*5.1*	**13.8**
Automated Material Handling		
Part identification for manufacturing automation	*10.1*	**42.3**
Automated Storage and Retrieval System (AS/RS)	1.4	5.0
Inspection		
Automated vision-based systems used for inspection/testing of inputs and/or final products	*8.8*	**23.6**
Other automated sensor-based systems used for inspection/testing of inputs and/or final products	*3.7*	**21.5**
Network Communications		
Local Area Network (LAN) for engineering and/or production	*17.7*	**65.6**
Company-wide computer networks (including Intranet and WAN)	**20.7**	**75.1**
Inter-company computer networks (including Extranet and EDI)	*4.9*	**63.6**
Integration and Control		
Manufacturing Resource Planning (MRP II)/Enterprise Resource Planning (ERP)	*2.9*	36.6
Computer(s) used for control on the factory floor	*18.9*	**55.5**
Computer Integrated Manufacturing (CIM)	20.3	**43.8**
Supervisory Control and Data Acquisition (SCADA)	*10.8*	**29.4**
Use of inspection data in manufacturing control	13.9	**44.1**
Digital, remote controlled process plant control	*0.2*	**2.0**
Knowledge-based software	*11.3*	17.6

Note:
Bold-High growth firms are statistically significantly **more likely** to use the technology than other firms
Regular-High growth firms are **as likely** to use the technology as other firms
Italic-High growth firms are statistically significantly **less likely** to use the technology
Source: Survey of Advanced Manufacturing Technologies, Statistics Canada, 1998

20 out of 25 advanced manufacturing technologies, the high growth firms were more likely to report adoption than non-high growth firms (see bold numbers in table). There was no technology they were less likely to report.

Conclusion

Small and medium size manufacturing firms tend to increase their use of advanced technology as they increase in size. Amongst larger SMEs with 50 to 99 employees, high-growth firms were consistently more likely to report adoption of advanced manufacturing technologies than non-high-growth firms.

*This article provides highlights from the **Survey of Advanced manufacturing technologies, 1998**. The survey was sent to a representative sample of all manufacturing industries, except food processing. The statistical unit was the enterprise. These data were then linked to the Annual Survey of Manufacturing 1995 and 1998 to establish rates of growth.*

Frances Anderson, Charlene Lonmo, Susan Schaan, Guy Sabourin and Adele St. Pierre, SIEID, Statistics Canada.

Characteristics of firms that grow from small to medium size:
R&D and growth in small to medium size enterprises

Analysis of the survey of ***Research and Development in Canadian Industry*** (RDCI) revealed differences in R&D spending and revenue growth between high-growth and non-high-growth. This article examines average R&D spending per firm and revenue growth.

High-growth R&D performers spent more on R&D per firm on average than other firms, regardless of firm size. Growing firms spent the next largest sums per firm (Table 1).

When R&D was measured per employee, R&D spending drops as firm size increased. The high-growth firms continued to report higher R&D spending with growing firms reporting the second-highest R&D spending levels (Table 2).

R&D-performing firms that reported high growth in employment also reported the highest level of growth in revenues (Table 3). High-growth R&D-performing firms with fewer than 50 employees more than doubled their revenues between 1995 and 2000. High growth firms with between 20 and 49 employees in 1995 reported revenue growth of almost 200%, the highest level reported by any firm type or size.

Concluding highlights

High-growth R&D-performing firms reported the highest levels of R&D performance whether measured per firm or per employee. Their high employment growth was paralleled by high growth in revenues, which indicates that their growth appears balanced and sustainable.

Description of the firms studied

The RDCI database contains records for all firms which reported R&D spending and who applied for a tax credit from the federal government. Records from 1995 were matched to those from 2000. As a result, 3,255 records of small and medium-sized firms

Table 1. Average R&D spending per firm, by firm type and firm size

	Size (number of employees in 1995) ($,000s)		
Firm Type	**<20**	**20-49**	**50-99**
High-growth	204	497	999
Growing	167	394	807
Stable	120	237	436
Declining	136	327	650

Source: Research and Development in Canadian Industry (RDCI), Statistics Canada.

Table 2. Average R&D spending per employee, by firm type and firm size

	Size (number of employees in 1995) ($,000s)		
Firm Type	**<20**	**20-49**	**50-99**
High-growth	24	17	16
Growing	18	13	12
Stable	16	8	6
Declining	17	11	10

Source: Research and Development in Canadian Industry (RDCI), Statistics Canada.

Table 3. Percentage change in revenues*, by firm type and firm size

	Size (number of employees in 1995) (%)		
Firm Type	**<20**	**20-49**	**50-99**
High-growth	117	197	75
Growing	48	43	36
Stable	37	7	18
Declining	-2	17	-3

Source: Research and Development in Canadian Industry (RDCI), Statistics Canada

* Revenues were measured in constant value 1997 dollars.

(with less than 100 employees as of 1995) that existed in the 1995 database also existed in the 2000 database. These firms were then classified by their rate of growth of employment. High growth firms were those that, at minimum, doubled their employment between 1995 and 2000. Growing firms reported less than 100% but more than 20% growth; whereas stable firms reported net changes in employment less than 20% and declining firms reported declines in employment of 20% or more.

This article provides data from an SIEID working paper on growth by R&D performing firms summarizing various characteristics of these firms and proposing a variety of indicators for growth, soon to be released. Details on the RDCI methodology are available from the working paper. The survey is an annual census of all enterprises that report R&D spending in Canada.

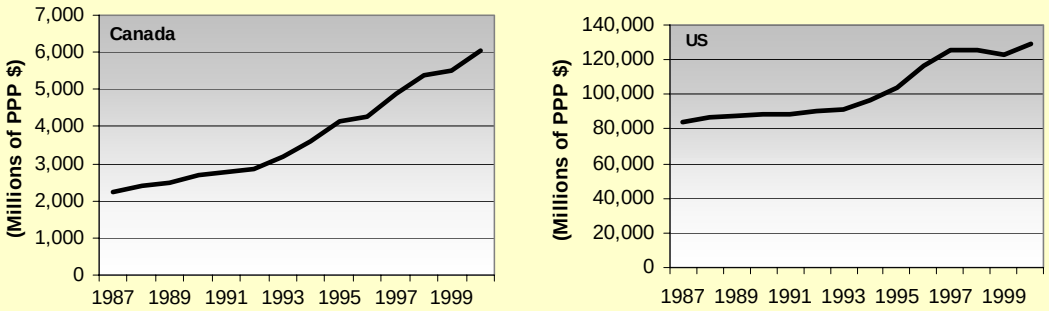
Charlene Lonmo, SIEID, Statistics Canada.

Comparing Canadian and U.S. manufacturing R&D

How do expenditures for R&D by Canadian manufacturers compare with those in the United States? Whether measured as a percentage of GDP, as a per capita amount or as a percentage of value-added, Canada's industrial R&D is less than that of the United States. This article provides an overview of R&D expenditures by the two countries' manufacturing sectors and then examines the data by industry to measure the relative R&D intensity of Canada's manufacturing industries compared with those of the United States.

The manufacturing sector accounts for the majority of R&D spending in most OECD countries and for about two-thirds of industrial R&D in Canada and the United States. While the U.S. manufacturing sector is about 11 times larger than the Canadian manufacturing sector, American manufactures reported R&D expenditures[1] about twenty times those of their Canadian counterparts (Figure 1) in 2000.

Figure 1. A comparison of Canadian and U.S. R&D expenditures by manufacturers



Source: STAN database, OECD (Canada); ANBERD database, OECD, 2004 (US).

R&D expenditures by the manufacturing sector increased during the 1990s in both countries. In Canada this was the result of steady, year-after-year increases while in the United States manufacturing R&D held steady for the first half the decade and then increase sharply from 1994 through 1998.

R&D per capita

R&D spending per capita provides a measure which takes into account the relative size of the two countries. By this measure the United States reported considerably higher levels of manufacturing R&D (Figure 2). The amount of manufacturing R&D performed in both countries increased over the 1990s.

R&D intensity

Another way of comparing data from the two countries is to look at R&D intensities, which will be measured as R&D spending as a percentage of value-added (Figure 3). The R&D intensity of U.S. manufacturing dropped during the late 1980s and early 1990s but rebounded in the late 1990s. Manufacturing R&D intensity in Canada, by contrast, increased slowly through the 1990s.

R&D intensity by industry

R&D data can be broken out by manufacturing industry with some degree of detail. It is therefore possible to compare specific industries to see if there are any industries in which Canada re-

1. Data are based on purchasing power parity dollars. This measure has been adopted by the OECD for the purposes of comparing economic data of member states. The measure is based on the purchasing power of the local currency in the local economy relative to the U.S. dollar in the U.S. economy. It is preferred to the alternative which is conversion at an annual exchange rate.

Table 1. R&D intensity by industry, Canada and the United States, 2000

Industry	ISIC R3	R&D Intensity R&D / Value-added %		Relative R&D intensity Canada / U.S.
		Canada	US	
Food products, beverages and tobacco	15-16	0.5	1.0	0.5
Textiles, textile products, leather and footwear	17-19	1.3	0.5	2.6
Wood products	20	0.3	0.4	0.8
Pulp, paper, paper products, printing and publishing	21-22	0.5	1.9	0.3
Coke, refined petroleum products and nuclear fuel	23	3.8	3.2	1.2
Chemicals excluding pharmaceuticals	24 excl. 2423	1.4	6.6	0.2
Pharmaceuticals	2423	24.0	19.9	1.2
Rubber and plastics products	25	0.6	2.8	0.2
Other non-metallic mineral products	26	0.3	2.0	0.1
Iron and steel	271+2731	0.2	1.3	0.1
Non-ferrous metals	272+2732	2.7	1.1	2.4
Fabricated metal products, except machinery and equipment	28	1.1	1.8	0.6
Machinery and equipment, n.e.c.	29	2.4	5.0	0.5
Office, accounting and computing machinery	30	14.8	25.8	0.6
Electrical machinery and apparatus, n.e.c.	31	3.3	9.0	0.4
Radio, television and communication equipment	32	23.9	19.6	1.2
Medical, precision and optical instruments	33	9.2	29.9	0.3
Motor vehicles, trailers and semi-trailers	34	1.1	15.5	0.1
Aircraft and spacecraft	353	22.3	21.0	1.1
Railroad equipment, ships and transport equipment n.e.c.	35-353	0.4	9.5	0.0
Manufacturing n.e.c.; recycling	36-37	0.9	1.4	0.6
Total manufacturing	15-37	4.2	8.3	0.5

Sources: ANBERD database, OECD, 2004, STAN database, OECD, 2004, and Statistics Canada.

Figure 2. R&D per capita

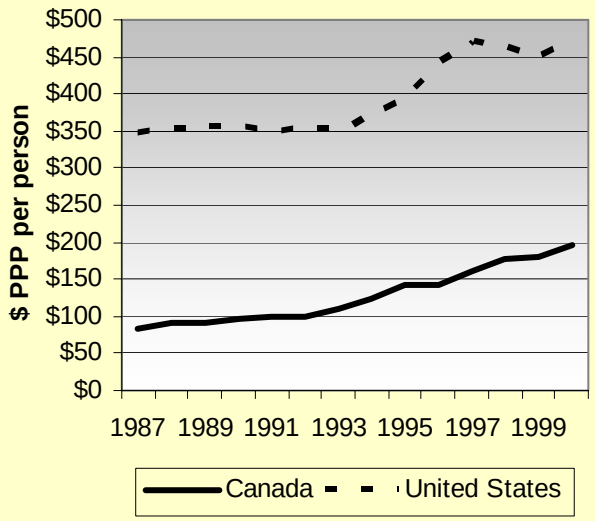
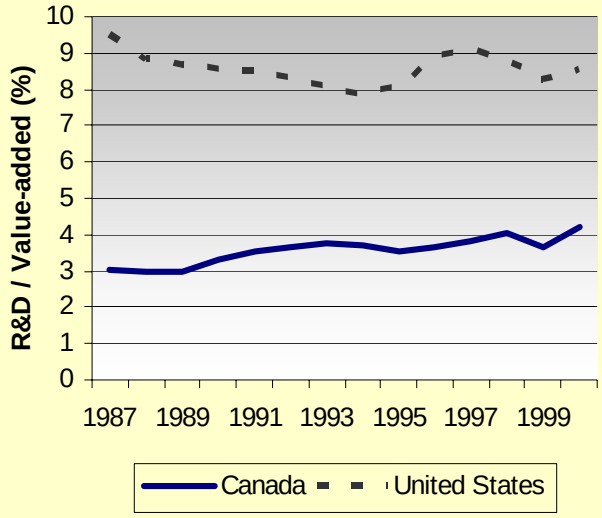


Figure 3. R&D intensity



ports R&D intensities which are similar to, or higher than, those in the United States.

In 2000, the overall level of manufacturing R&D intensity in Canada was about half that reported in the United States (Table 1). Of the 21 manufacturing industries[2], Canada reported lower R&D intensities in 15 industries and higher in six. Canada reported higher R&D intensities in textiles, leather and footwear, non-ferrous metals, communications equipment, pharmaceuticals, and coke, petroleum and other refined fuel products. In aerospace the R&D intensity reported by Canadian manufacturers was just slightly higher. For the remaining industries, Canada reported lower R&D intensities.

Comparing manufacturers in selected industries

In the United States there were 10 industries which reported R&D intensities higher than 5%, which represents a significant

2. These industries represent the most detailed breakout available for the entire manufacturing sector. These industries are classified according to the International Standard for Industry Classification, Revision 3 (ISIC R3), which is the industry classification system used by the OECD.

commitment to R&D. How did Canadian manufacturers in these selected industries compare with their U.S. counterparts?

Canada reported higher R&D intensities in three of these high R&D industries: communications equipment, pharmaceuticals and aerospace. Their relative R&D intensity ranged from 1.2 to 1.1, in other words higher, but not a lot higher (relative R&D intensity is equal to the Canadian R&D intensity divided by the U.S. R&D intensity). In the case of another three industries, 1) machinery and equipment, 2) office, accounting and computing machinery and 3) electrical machinery and apparatus, Canadian R&D intensities were about one-half of those in the United States. In the case of the remaining four high R&D industries, the R&D intensities of the Canadian industries were much lower than those reported in the United States. These industries were instruments, chemicals other than pharmaceuticals, motor vehicles and railroad, ships and other transportation equipment.

Development of new and improved instruments has been, and continues to be, a primary focus of U.S. science policy[3]. Accordingly, the United States has a very well developed instruments industry which accounts for over 4% of value-added in the manufacturing sector (vs. 0.9% for Canada)[4]. In Canada the R&D intensity of 9.2% was over twice the average for the entire manufacturing sector, but was less than a third of the comparable value in the United States.

Chemicals other than pharmaceuticals accounted for a significant share of manufacturing value-added in both Canada and the United States, at 6% and 8% respectively. The respective R&D intensities were quite different with Canadian manufacturers reporting a relative R&D intensity of 0.2.

R&D by motor vehicle manufacturers accounted for 14% of all manufacturing R&D in the United States but only 3% in Canada. The R&D intensities reported by motor vehicle manufacturers in the two countries were similarly divergent, with a figure of 15.5% in the United States and 1.1% in Canada

There are differences

Generally, R&D expenditures are higher and less concentrated in the United States than in Canada. The top three manufacturing industries in Canada account for 70% of all manufacturing R&D, but 49% in the United States.

While there are some manufacturing industries in which Canadian R&D intensity is higher than U.S. R&D intensity, there are many more industries in which it is lower, sometime significantly lower.

Data for this article were obtained from the ANBERD database (U.S.), OECD, 2004 and the STAN database (Canadian), OECD 2004. There are differences on how R&D statistics are collected. The major difference being the American based data is collected through a sample survey whereas the Canadian data is collected as part of an administrative census survey.

Charlene Lonmo, SIEID, Statistics Canada.

3. See address of John Marburger III, Science Advisor to the President, Director of the Office of Science and Technology Policy, to the American Association for the Advancement of Science at www.ostp.gov/htm/01_/012.html., testimony before the Congressional Committee on Commerce, Science and Transportation.
4. In fact, the United States accounted for over 60% of all R&D in instruments by all OECD members.

New economy indicators

We have compiled some of the most important statistics on the new economy. The indicators will be updated, as required, in subsequent issues. For further information on concepts and definitions, please contact the editor.

	Units	1998	1999	2000	2001	2002	2003
General economy and population[1]							
GDP	$ millions	914,973	982,441	1,076,577	1,108,200	1,157,968	1,218,772
GDP implicit price index	1997=100	99.6	101.3	105.5	106.7	107.8	111.2
Population	thousands	30,157	30,404	30,689	31,021	31,362	31,630
Gross domestic expenditures on R&D (GERD)[2]	$ millions	16,077	17,631	20,359	22,116	21,704	22,450
"Real" GERD	$ millions 1997	16,142	17,405	19,298	20,727	20,134	20,189
GERD/GDP ratio	ratio	1.76	1.79	1.89	2.00	1.87	1.84
"Real" GERD/capita	$ 1997	535.27	572.45	628.82	668.16	641.99	638.29
GERD funding by sector							
Federal government	% of GERD	17.6	18.2	17.5	18.1	19.5	19.5
Provincial governments	% of GERD	4.0	4.4	4.3	4.9	5.4	5.6
Business enterprise	% of GERD	45.7	44.9	44.1	48.3	45.3	44.3
Higher education	% of GERD	14.5	15.0	14.2	13.5	15.1	16.0
Private non-profit	% of GERD	2.3	2.2	2.2	2.4	2.7	2.9
Foreign	% of GERD	15.9	15.3	17.7	12.9	12.0	11.7
GERD performance by sector							
Federal government	% of GERD	10.8	10.5	10.2	9.5	10.2	9.7
Provincial governments	% of GERD	1.3	1.3	1.3	1.4	1.5	1.5
Business enterprise	% of GERD	60.2	59.0	59.8	59.6	55.2	53.7
Higher education	% of GERD	27.2	28.8	28.4	29.3	32.8	34.9
Private non-profit	% of GERD	0.5	0.4	0.3	0.2	0.2	0.2
Federal performance as a % of federal funding	% of federal	61.6	57.8	58.4	52.6	52.5	49.8
"Real" federal performance of R&D	$ millions 1997	1,750	1,835	1,972	1,971	2,063	1,955
Information and communications technologies (ICT)							
ICT sector contribution to GDP - basic prices[3]							
ICT, manufacturing	$ millions	9,720	13,168	18,062	12,788	10,608	..
% of total ICT	% of total ICT	25.8	27.7	31.2	22.3	18.1	..
ICT, services	$ millions	28,020	34,340	39,870	44,457	48,063	..
% of total ICT	% of total ICT	74.3	72.3	68.9	77.7	81.9	..
Total ICT	$ millions	37,734	47,464	57,858	57,222	58,670	..
Total economy[4]	$ millions	848,414	892,870	933,713	947,039	977,322	..
ICT % of total economy	%	4.4	5.3	6.2	6.0	6.0	..
Total business sector	$ millions	710,188	752,197	791,306	801,870	828,842	..
ICT % of business sector	%	5.3	6.3	7.3	7.1	7.1	..
ICT adoption rates (private sector)							
Personal Computer	% of enterprises	..	81.9	81.4	83.9	85.5	87.4
E-Mail	% of enterprises	..	52.6	60.4	66.0	71.2	73.8
Internet	% of enterprises	..	52.8	63.4	70.8	75.7	78.2
Have a website	% of enterprises	..	21.7	25.7	28.6	31.5	34.0
Use the Internet to purchase goods or services	% of enterprises	..	13.8	18.2	22.4	31.7	37.2
Use the Internet to sell goods or services	% of enterprises	..	10.1	6.4	6.7	7.5	7.1
Value of sales over the Internet	$ millions	..	4,180	7,246	10,389	13,339	18,598

1. Source: Statistics Canada, 2003, *Canadian Economic Observer*, Cat. No. 11-010-XIB, June 2004, Ottawa, Canada.
2. Source: Statistics Canada, 2003, *Science Statistics*, Cat. No. 88-001-XIB, various issues, Ottawa, Canada.
3. Source: Statistics Canada, 2002, *Beyond the information highway: Networked Canada (Information and communications technologies (ICT))*, Cat. No. 56-504-XIE, Ottawa, Canada.
4. The "total economy" is in chained-Fisher methods of deflation and therefore does not match GDP.

	Units	1998	1999	2000	2001	2002	2003
Information and communications technologies (ICT) continued							
ICT adoption rates (public sector)							
Personal Computer	% of enterprises	..	100.0	100.0	100.0	99.9	..
e-mail	% of enterprises	..	96.6	99.0	99.7	99.6	..
Internet	% of enterprises	..	95.4	99.2	99.7	99.6	..
Have a Web site	% of enterprises	..	69.2	72.6	86.2	87.9	..
Use the Internet to purchase goods or services	% of enterprises	..	44.2	49.1	54.5	65.2	..
Use the Internet to sell goods or services	% of enterprises	..	14.5	8.6	12.8	14.2	..
Value of sales over the Internet	$ millions current	..	244.6	11.5	354.8	327.2	
Teledensity indicators							
Wired access (Voice Grade Equivalent - VGE)	per 100 inhabitants	63.8	64.3	66.1	66.9	65.1	62.9
Wireless access (VGE)	per 100 inhabitants	18.5	23.7	29.4	34.8	37.6	41.7
Total public switched telephone network (PSTN) (VGE)	per 100 inhabitants	82.3	86.9	94.4	101.1	102.9	104.6
Homes with access to cable	thousands	10,564.6	10,725.2	10,896.1	11,107.4	..	..
Homes with access to Internet by cable	thousands	..	..	7,609.7	9,391.4	..	..
Access indicators							
Total wired access lines (VGE)	thousands	19,293.7	19,623.6	20,347.0	20,805.1	20,456.3	19,950.9
Residential access lines (VGE)	thousands	12,601.5	12,743.9	12,871.7	12,854.2	12,752.1	12,650.4
Business access lines (VGE)	thousands	6,692.2	7,062.4	7,475.3	7,950.9	7,702.2	7,300.5
Analogue mobile subscribers	thousands	3,939.0	4,305.2	4,282.6	3,138.9	2,691.2	2,085.9
Digital mobile subscribers	thousands	1,406.4	2,592.7	4,444.0	7,509.9	9,180,8	11,135.9
Digital cable television subscribers	thousands	..	..	390.4	811.7	..	..
Satellite and MDS subscribers	thousands	..	..	967.5	1,609.4	..	..
High speed Internet by cable subscribers	thousands	..	..	786.3	1,387.8	..	
Network investment indicators[5]—Capital expenditures							
Wireline public telecommunication networks	$ millions	4,629.1	4,258.7	4,989.9	5,451.7	4,328.6	..
Wireless public telecommunication networks	$ millions	1,462.6	1,374.1	2,005.7	1,896.0	1,934.6	..
Cable networks	$ millions	773.2	1,110.8	1,523.9	2,124.6	..	..
Satellite and MDS networks	$ millions	30.6	194.1	158.1	521.2	..	..
Characteristics of biotechnology innovative firms[6]							
Number of firms	number	..	358	..	375	..	..
Total biotechnology employees	number	..	7,748	..	11,897	..	..
Total biotechnology revenues	$ millions	..	1,948	..	3,569	..	..
Expenditures on biotechnology R&D	$ millions	..	827	..	1,337	..	..
Export biotechnology revenues	$ millions	..	718	..	763	..	..
Import biotechnology expenses	$ millions	..	234	..	433	..	..
Amount of capital raised	$ millions	..	2,147	..	980	..	..
Number of firms that were successful in raising capital	number	..	138	..	134	..	..
Number of existing patents	number	..	3,705	..	4,661	..	..
Number of pending patents	number	..	4,259	..	5,921	..	..
Number of products on the market	number	..	6,597	..	9,661	..	..
Number of products/processes in pre-market stages	number	..	10,989	..	8,359	..	..
Intellectual property commercialization[7]							
Federal government							
New patents received	number	130	89	..	109[r]	133[p]	142[r]
Royalties on licenses	$ thousands	6,950	11,994	..	16,467	16 284[r]	15 508[r]
Universities							
New patents received	number	143	325	..	339	..	..
Royalties on licenses	$ thousands	15,600	18,900	..	44,397	..	..

5. Figures for 2001 and 2002 are based on Q4 data from the service bulletin *Quarterly Telecommunications Statistics*, Cat. No. 56-001-XIE.
6. Source: Statistics Canada, 2003, *Features of Canadian biotech innovative firms: Results from the Biotechnology Use and Development Survey – 2001*, Science, Innovation and Electronic Information Division Working Paper Series, Cat. No. 88F0006XIE2003005, Ottawa, Canada.
7. Sources: Statistics Canada, Federal Science Expenditures and Personnel Survey, and Survey of Intellectual Property Commercialization in the Higher Education Sector (various years).

What's new?

Recent and upcoming events in connectedness and innovation analysis.

Connectedness

The report, *Study: Connectivity and Learning in Canada's School, Academic year, 2003/04* was released on September 24th. This report provides key indicators of connectedness for Canada's elementary and secondary schools and is based on the Information and Communications Technologies in Schools Survey (CTSS) and includes national, provincial and territorial measures of ICT infrastructure and reach.

Telecommunications

Annual survey of telecommunications service providers

No updates to report.

Quarterly survey of telecommunications service providers

Telecommunications statistics, first quarter, 2004, Catalogue No. 56-002-XIE, was released in *The Daily* on September 7th.

Telecommunications statistics, Second Quarter, 2004 will be released in the early fall.

Broadcasting

The service bulletin *Broadcasting and Telecommunications, Private Radio Broadcasting 2003*, Catalogue No. 56-001 XIE, Vol. 34, No. 3 was released on July 5th.

The service bulletin, *Cable, satellite and multipoint distribution systems 2003*, Catalogue No. 56-001 XIE, Vol. 34, no.4 was released on September 14th.

Household Internet use

The document, *Household Internet Use Survey—Microdata User's Guide* Catalogue No. 56M0002GIE was released on September 28th.

Data from the ***Household Internet Use Survey 2003*** were released in *The Daily* on July 8th.

The article *E-commerce: Household Shopping on the Internet, 2003* was released in *The Daily* on September 23rd

Business e-commerce

The report, *Broadband: Removing the Speed Limit for Canadian Firms* Catalogue No. 11-621-MIE2004016 was released in *The Daily* on September 27th.

Survey of electronic commerce and technology

The questionnaire for the 2004 ***Survey of Electronic Commerce and Technology*** will be mailed out in November

Science and innovation

S&T activities

Research and development in Canada

The working paper, *Estimates of total expenditures on research and development in the health field in Canada, 1988 to 2003*, Catalogue No. 88F0006XIE, No. 014, was released on July 19th.

The service bulletin *Biotechnology scientific activities in selected federal government departments and agencies, 2002-2003*, Catalogue No. 88-001-XIE Vol. 28, No. 7 was released on July 19th.

Industrial research and development

The service bulletin, *Industrial Research & Development, 2000 to 2004*, Catalogue No. 88-001-XIE Vol. 28, No. 9 was released on August 5th 2004.

Federal science expenditures

The working paper *Federal Government Payments to Industry, 1997/98 to 2001/02*, Catalogue No. 88F0006XIE2004012, was released on July 15th.

Higher Education Sector R&D

No updates to report.

Provincial research organizations

The working paper *Scientific and technological activities of provincial governments, 1994/95 to 2002/2003* Catalogue No. 88F0006XIE2004011 was released on Jun 30th.

The service bulletin *Scientific and technological (S&T) activities of provincial governments, 1994-95 to 2002-03* Catalogue No. 88-001-XIE Vol. 28, No. 6 was released on June 30th.

Human resources and intellectual property

Federal intellectual property management

Federal science expenditures and personnel, intellectual property management annex

No updates to report.

The higher education sector

Intellectual property commercialization in the higher education sector

The 2003 survey is now in the field. Preliminary results are expected to be available in January 2005.

Innovation

Innovation in manufacturing

No updates to report

Innovation in services

A first facilitated access research project to analyze data from the ***Survey of Innovation*** 2003 has been approved. Pierre Therrien, Marketplace Innovation Division, Industry Canada will be conducting research on *Advantage on commercialization: drawing lessons by technology-content innovations*.

Community innovation

The working paper, *Community Innovation: Industrial Specialization in Canadian Cities, 2003*, Catalogue no. 88F0006XIE2004013, was released July 16th.

The working paper, *Community Innovation: Innovation Performance of Manufacturing Firms in Canadian Communities, 1999*, Catalogue no. 88F0006XIE2004015 was released September 9th.

Biotechnology

The ***Biotechnology use and development survey 2003*** is in the field. Preliminary results are expected in late fall of 2004.

A new survey, ***Bioproducts Development Survey***, is in the field.

The working paper, *Trends in Canadian biotechnology activity 1997 to 2001* Catalogue no. 88F006XIE2004017 was released on October 22nd.

Technological change

Public sector technology transfer in Canada, 2003 by Michael Bordt and Louise Earl is based on analysis of Section "D" of SECT 2003 and will be released on November 2. The survey asked respondents if they licensed technologies from Canadian universities, hospitals or federal labs and if the technologies transferred from these institutions played a major role in their inception or growth. Respondents were also asked if they were spun-off from universities.

Other

A series of working papers on *Characteristics of firms that grow from small to medium size* is being derived from a joint project of Statistics Canada and National Research Council's Industrial Research Assistance Program (NRC-IRAP). The project developed out of a need to better understand how and why certain businesses grown.

Characteristics of firms that grow from small to medium size: Industrial and geographic distribution of small high-growth firms by Michael Bordt, SIEID, Statistics Canada is forthcoming.

Characteristics of firms that grow from small to medium size: Innovation and growth in small manufacturing firms, 1997-1999. by Frances Anderson, Susan Schaan, Guy Sabourin and Adele St. Pierre, SIEID, Statistics Canada is also forthcoming.

SIEID research workshops and their outcomes

The Science, Innovation and Electronic Information Division (SIEID) promotes research workshops on technological and related organizational change. Five research workshops were held between 1997 and 2002 and each gave rise to a set of papers that were published by Kluwer Academic Publishers in Boston. As these papers appear only in these books, they are listed here by volume, and by author, as an aid to research into technological and related organizational change.

The five workshops, and published volumes, all deal with innovation from different perspectives: regional effects; networks, alliances and partnerships; information, communication technologies (ICTs); biotechnologies; and, knowledge management practices. The contents of the books provide a basis for reflection on what has been learned about the process of innovation, and its determinants, over the last decade.

The Program of Research on Innovation Management and the Economy (PRIME), of the University of Ottawa, was a partner in each of the workshops and staff from PRIME and SIEID managed the production of the camera-ready text. The PRIME involvement was led by Dr. John de la Mothe, with the assistance of Tyler Chamberlin, and the work at Statistics Canada was coordinated by Louise Earl for four volumes, the first having been managed by Frances Anderson.

Volume 14 - LOCAL AND REGIONAL SYSTEMS OF INNOVATION (Edited by: John de la Mothe and Gilles Paquet; Published: September 1998)

Acs, Zoltan J., Felix R. FitzRoy and Ian Smith (1998), "Contrasting U.S. Metropolitan Systems of Innovation", pg. 111-124.

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