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Innovation Analysis Bulletin

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

- **Government science and technology activities**
- **Industrial research and development**
- **Intellectual property commercialization**
- **Advanced technology and innovation**
- **Biotechnology**
- **Connectedness**
- **Telecommunications and broadcasting**
- **Electronic commerce**

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Please address all enquiries to the Editor, Innovation Analysis Bulletin

E-mail: sieidinfo@statcan.ca
Telephone: (613) 951-8585
Fax: (613) 951-9920
Post: SIEID
Statistics Canada
7th Floor R.H. Coats Building
100 Tunney's Pasture Driveway
Ottawa, Ontario, Canada K1A 0T6

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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	use with caution
F	too unreliable to be published

Insights on science, innovation and the information society

We are often asked what we have learned from working with clients, exchanging ideas with counterparts in other countries, in talking to our respondents and conducting surveys. We report in detail in our publications and, on occasion, we provide IAB readers with a detailed summary (see Vol. 4, No. 1 and Vol. 8, No. 1). This is the first of what we hope is an annual article highlighting in more detail some of the insights we have gained from our work.

Research and development

Federal science expenditures intended to directly benefit developing countries

In February 2004, Prime Minister Paul Martin stated that: 'our long-term goal as a country should be to devote no less than 5% of our research and development investment to a knowledge-based approach to develop assistance for less fortunate countries.' Preliminary data for 2004-2005 from the **Survey on Federal Science Expenditures Intended to Directly Benefit Developing Countries** indicate that the federal government spent $495 million on science and technology to benefit developing countries, or 5.7% of Canada's total expenditures on science and technology ($8.7 billion) in 2005. The majority of science and technology expenditures were in the areas of public health, agricultural production and agricultural technologies, representing 74% of expenditures on developing countries (*The Daily*, March 23, 2006).

Industrial R&D

Although the industrial makeup of the G7 countries (Canada, France, Germany, Italy, Japan, United Kingdom and the United States) is similar, the R&D intensity of their economies and of specific sectors vary greatly. Canada reports high levels of R&D in "utilities" and "services" with lower levels in "construction" and "total manufacturing". The "motor vehicle manufacturing" industry represents a significant industry in Canada in terms of GDP, but is very under represented in terms of industrial R&D. Canada and the US are the only two countries to report a higher than average proportion of R&D performed in "business services". In 2000, Canada allocated a smaller proportion of its GDP to R&D of all G7 countries other than Italy. Canada accounted for 4.1% of the value added of the G7 but only 2.5% of the industrial R&D (*Innovation Analysis Bulletin*, Vol. 7, no. 3).

Innovation and commercialization

The speed of innovation varies with the product lifecycle

In some industries, new and significantly improved products need to be released more frequently than in others. For ICT service industries as a whole 78.2% of the establishments were innovative between 2001 and 2003. In some sub-sectors, almost all establishments introduced new or significantly improved products, for example "satellite communications" (100%), "software publishers" (94.3%), "computer systems design and related services" (87.2%) (*The Daily*, October 25, 2005).

Business incubators

Two-in three new businesses do not survive to their fifth year. Business incubators provide space, advice and other support designed to assist new and growing businesses to become established and profitable. Incubators tend to be small businesses, but also include several government offices and universities. Preliminary data from the **Survey of Business Incubators 2005** indicate that there are at least 83 active business incubators in Canada. On average, they provide space to 9 companies each. In total, they receive about $40 million in operating funds, 25% of which comes from grants from the federal government. Rent from clients covers only about 18% of the cost of operation. The most common services provided include "help with business basics" (71%), "marketing assistance" (56%) and "help with accounting or financial management" (54%) (*The Daily*, March 27, 2006).

Intellectual property commercialization

The framework agreement between the Government of Canada and the universities (signed in November 2002 by the Minister of Industry and the Association of Universities and Colleges of Canada) sets a target to triple the 1999 gross income from intellectual property commercialization to $70.2 million by 2010. Income in universities and affiliated hospitals actually decreased by 8% from 2003 to $51 million in 2004. However, the number of inventions entering the commercialization pipeline increased. The number of invention disclosures was up 19%, while the number of patents held increased by 23% (*The Daily*, Jan. 27, 2006).

Life sciences

Canadian firms involved in bioproducts development numbers 232

A bioproduct is a commercial or industrial product other than food, feed or medicine made with biological or renewable agricultural (plant or animal), marine or forestry materials. Based on data from the **Bioproducts Development Survey** for the year 2003, 232 Canadian firms were involved in the development or the production of bioproducts. The most common products were bio-chemicals and bio-fuels (*Innovation Analysis Bulletin*, Vol. 8, no. 1).

Biotechnology firms with patents have higher success rates in obtaining funding than those with no patents

Protection of intellectual property is not seen as a priority in all industries but for biotechnology a patent gives investors evidence of the credibility of the company and feasibility of the product. Biotechnology firms that had patents—especially those with many patents—had a higher success rate in obtaining funding than do those with no patents. More than two-thirds of biotechnology firms—315 firms out of 490—had biotechnology-related patents in 2003. Only 14% are Canadian patents. The others come from the U.S. Patent and Trademark Office (36%), the European Patent Office (15%) or other patent-issuing countries (36%) (*Innovation Analysis Bulletin*, Vol. 7, no. 3).

Information society

The ICT sector resumes growth but contribution to R&D is declining

Following a modest dip in 2001, GDP for the ICT sector has been growing steadily over the last few years. This is largely due to the ICT services sector, which accounted for 80% of total ICT sector GDP in 2005. The ICT sector contributed $61.2 billion (1997 chained dollars) to Canada's GDP in 2005, accounting for 6.7% of business sector GDP, and 5.7% of total economy GDP (CANSIM Tables 379-0017 and 379-0020).

The ICT sector makes up a substantive – albeit declining – share of total private sector research and development (R&D). The ICT sector accounted for 38% of total private sector R&D in 2005, down from nearly 50% in 2000 (CANSIM Table 358-0024).

Business-to-business (B2B) sales account for 75% of online sales

Business-to-business (B2B) sales have accounted for the majority of the growth in e-commerce over the past few years. In 2004, B2B sales accounted for 75% of total online sales in Canada. Firms in manufacturing and wholesale trade were most likely to engage in business-to-business sales. In 2005, private Canadian firms sold $36.3 billion over the Internet, an increase of 37% over 2004 (*The Daily*, April 20, 2006).

Literacy skills and the use of information and communications are connected

A study based on the **Adult Literacy and Life Skills Survey (ALLS)** confirms the association between literacy skills and the use of information and communications technology (ICT). As literacy skill levels increased among Canadian adults, so too did their perceived usefulness and attitude toward computers, their use of the Internet, and their use of computers for task-oriented purposes (*The Daily*, December 5, 2005).

Internet varies widely based on age, education, income and family type

Internet adoption within Canadian households has been increasing steadily over the past five years (between 1999 and 2003). Further analysis of these data, however, show the Internet adoption patterns in quite a different light. Adoption of the Internet varies widely based on age, education, income and family type.

Households headed by lower-income, less educated, or older Canadians have Internet adoption rates well below the Canadian average. For example, although on average, fewer than 30% of Canadian households were not using the Internet in 2003, more than 70% of households headed by someone over the age 65 were not Internet users (*The Daily*, December 5, 2005).

Telecommunications and broadcasting

The transformation of the telecommunications services sector is accelerating

New technology, competition and changing consumer habits are contributing to the gradual transformation of telecommunication services markets.

There were 12.2 million traditional residential telephone lines at the end of the third quarter of 2005, down 3.0% from the same period in 2004. This was the largest year-over-year drop since the end of 2001 when the erosion of this market began. The entry of a few large cable television companies into the local telephony market largely explains the acceleration of the downward movement in 2005.

During this time, wireless telecommunications continued to gain steadily in popularity. That industry attracted more than 500,000 new customers between June and September of last year, bringing up the total number of wireless subscribers to more than 16 million at the end of the quarter, up 12.4% from the third quarter of 2004.

The means of receiving entertainment in the home is also transforming. In August 2004, 42% of the 11.2 million subscribers to multi-channel video services chose digital services in preference to analogue. This critical mass of consumers having a digital set-top box opens a path to fundamental changes in the distribution and consumption of audiovisual content. (*The Daily*, March 6, 2006).

Staff, SIEID, Statistics Canada.

Measuring the impact of non-profit innovation enablers

Innovative firms cite industry associations as important sources of ideas more frequently than they cite federal government research laboratories or universities according to data from Statistics Canada's 2003 Innovation Survey. We need a better understanding of the contributions and impact of non-profit innovation enablers such as industry associations. To achieve that, we need to overcome obstacles to identifying them and their contributions in the data. Without this understanding, policy makers may overlook an important class of actual and potential innovation enablers.

Margaret Dalziel is Assistant Professor, School of Management, University of Ottawa.

This is an advance summary of "The Impact of Industry Associations", Innovation: Management, Policy & Practice (forthcoming), published with the permission of eContent Management.

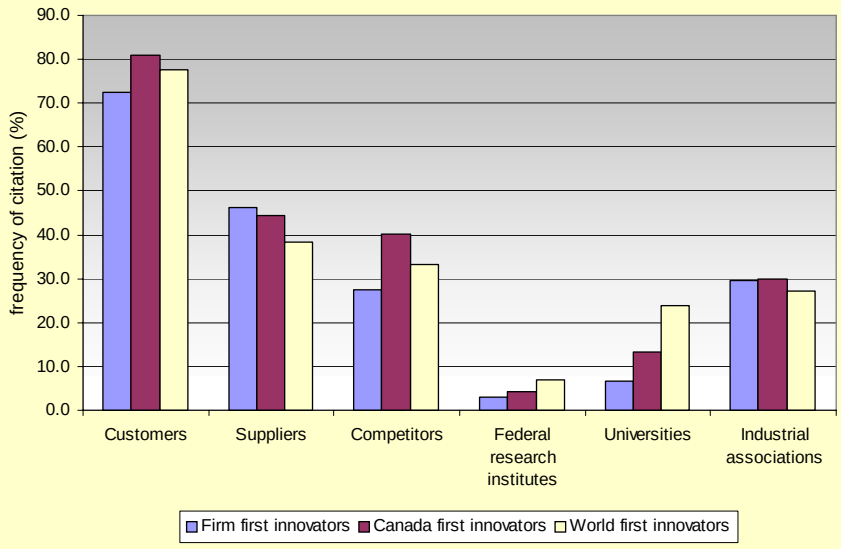
The Data

Canadian innovative firms turn to industry associations for ideas up to 9.5 times more frequently than they turn to federal government research institutes and up to 4.4 times more frequently than they turn to universities.

One explanation for these surprising numbers is that since something like 99% of Canadian firms don't conduct research they can hardly be expected to turn to universities and federal government research institutes for ideas. But it turns out that the pattern is the same, even for firms that do conduct research. Firms with R&D personnel cite industry associations as important sources of ideas an average of 6.0 times more frequently than they cite federal government research institutes, and an average of 2.4 times more frequently than they cite universities.

An alternative explanation is that industry associations are a frequent source of important ideas because industry associations bring firms together with their peers to address *their* problems in *their* timeframes. That is, industry associations are able to contribute unique value to Canadian firms by virtue of their being designed by and for them. Despite their intentions to be industrially relevant, universities and federal government research institutes may be preoccupied by balancing other priorities.

Figure 1 Important sources of ideas for innovative firms



Source: Statistics Canada. Survey of Innovation 2003.

Note: The responses are segregated according to the extent to which the responding firm's 'new' products, processes, and services have not appeared earlier. The innovations of 'world first' innovators are new to the world, those of 'Canada first' innovators are new only within Canada, and those of 'firm first' innovators are new only to the firm.

The Obstacles to More Data

The following five obstacles identify the existence and contributions of non-profit innovation enablers.

1. Non-profits not included as information sources. The Oslo Manual offers guidance on possible sources for transfer of knowledge and technology (OECD, 2005: 81). The list of sources includes those that are internal to the firm, external, market and commercial sources, public sector sources, and general information sources. Industry associations and research consortia do not appear on the list.

2. List of innovation sources combines actors and roles. To be clear about the impact of organizational actors and organizational roles it is necessary to distinguish between them. There are four major types of organizational actors in an economy: firms, governments, universities, and non-profit organizations. Common transactional roles are customer, supplier, competitor, and complementor. The Oslo Manual's list of possible sources for transfer of knowledge and technology combines actors, roles, artifacts, and events, making it impossible to measure the contributions of specific types of actors such as non-profits. For example, when customers are identified as sources of ideas it is not clear whether the customer is a for-profit Canadian firm or a foreign government organization.

3. A focus on economic transactions rather than social relations. Unlike social relations, economic exchanges leave clear paper trails that make them relatively easy to measure. But people engage with one another and learn through both economic and social relations, and it can be argued that social relations are at least as important to innovation and the exchange of knowledge as their economic counterparts. With their focus on producing reliable data, statistical agencies focus on economic relations but the contributions of non-profits are more likely to be social.

4. Only a subset of non-profits are classified as non-profits. The Frascati Manual, and the Oslo Manual by reference to it, identifies four sectors of the economy: the business enterprise sector, the government sector, the private non-profit sector, and the higher education sector (OECD, 2002). Innovation-related non-profit organizations are not necessarily classified in the non-profit sector as might be expected because non-profits are excluded from the non-profit sector if: they mainly render services to enterprises; they primarily serve government, or if they are entirely or mainly financed and controlled by government; or if they offer higher education services or are controlled by institutes of higher education. As a consequence, the number of non-profit organizations that are classified as non-profits is a subset of the total population of non-profit organizations.

5. The OECD definition of a national system of innovation does not mention non-profits. The OECD defines a national system of innovation in such a way as to exclude non-profit organizations from consideration:

> "A system of interacting private and public firms (either large or small), universities and government agencies aiming at the production of science and technology within national borders. Interaction among these units may be technical, commercial, legal, social and financial, inasmuch as the goal of the interaction is the development, protection, financing or regulation of new science and technology" (OECD, 1994: 3).

Conclusion

It is understandable that statisticians looking at innovation measures have not yet focused on non-profits and social exchanges but the time has come to take their measure. The data presented in the figure above exist because: a) in addition to the prescripts of the Oslo Manual, the Canadian survey included industry associations in the list of possible sources of ideas, and b) respondents were asked about a social phenomenon, being a source of ideas. We can build on these findings by:

1. Consistently distinguishing between organizational actors and roles and by including non-profits among the organizational actors considered.

2. Considering a fuller range of the social mechanisms that enable innovation. Social mechanisms that enable innovation include connecting firms to resources, and facilitating networking and joint action.

Policy makers in Europe and elsewhere have recognized the potential of non-profit organizations to contribute to innovation[1]. Policy makers in Canada need data that reflect the existence and contributions of all organizational actors, and especially those that may be important sources of ideas for innovative firms.

References

OECD. 1994. *National systems of innovation: general conceptual framework*. OECD, Paris, France. DSTI/STP/TIP (94)4. p. 3.

OECD. 2002. *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development*. Paris, France.

OECD/Eurostat. 2005. *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*. Paris, France.

1. See for example, European Commission. 2005. *Giving more for research in Europe: The role of foundations and the non-profit sector in boosting R&D investment*, Available at http://europa.eu.int/invest-in-research/pdf/REC%205%207800%20Giving%204%20051018_BAT.pdf (Accessed March 7th, 2006).

Pockets of Canadian organizations look to open-source solutions

For the first time in 2005, the **Survey of Electronic Commerce and Technology (SECT)** collected information on the use and development of open-source software. The use of open-source software is a movement that has attracted significant momentum in recent years as public organizations, private firms and governments alike have explored possible benefits.

Until recently, open-source was not considered a legitimate software option for firms. There were concerns about its reliability and robustness as it had not yet reached a critical mass. These concerns have been alleviated more recently as many large technology companies have recognized the benefits that open-source software may offer. In turn, these companies have provided monetary and technical support for the development of new and improved open-source initiatives.

What is open-source software?

Open source software is that for which the underlying source code is readily available for modification by any interested person or firm. In contrast, the source code for most commercial software is a closely held secret and not available for modification.

Benefits of open-source can be many

The basic principle and benefit of open-source is very simple. Placing source code in the public domain allows programmers from around the world to read, redistribute, modify and improve it. This allows software the potential to evolve at a breakneck speed compared to conventional software development.

Although open-source software is often adopted by a firm as a cost-saving measure, the process can be transformative as firms can freely adapt software to meet changing needs or priorities. One of the greatest advantages of open-source software is the flexibility it offers as firms with the proper expertise can modify source code to their own specifications.

The use of open-source software by Canadian organizations is varied. There are many organizations that may use commercial open-source software to replace their current word processing or spreadsheet software in order to avoid large licensing fees. Other firms may use an open-source option to run their servers or to address a specific need in their business. Since the source code can be changed easily, firms can tweak the software to address an explicit task.

It would not be surprising to find that the proportion of organizations in Canada reporting the use of open-source software is underrepresented. This is because open-source software is often being used in back-end systems such as servers and networks. SECT respondents may not be aware of or be in a position to identify it in these applications.

Large firms and public sector are primary users

In 2005, 10.4% (Table 1) of private firms in Canada responded that they were using open-source software. This proportion is much lower than the percentage of private firms that purchased online (43%) or even had a website (37%) in 2005. The percentage of public sector firms that used open-source software was considerably higher than their private counterparts. Over 50% of public sector firms used open-source. The public sector tends to be on the leading edge of Information and Communication Technology (ICT) adoption and this is no exception.

The percentage of firms that was reportedly using open-source software in 2005 also varied greatly by size of firm. While only 9% of small firms used open-source more than 37% of large firms did so (Table 2). These findings fit a trend that has been identified previously. Results from SECT in previous years (*Information and Communication Technology Use: Are Small Firms Catching Up?* available at: http://www.statcan.ca/Daily/English/040223/d040223b.htm) have demonstrated that large firms are more likely to use advanced technologies and be early adopters of new technology.

Table 1 Use of Open Source Software, by firm type

Sector	% of firms using open-source software in 2005
Private sector	10.4
Public sector	52.7

Table 2 Use of Open Source Software, by firm size

Size of Private Firm	% of firms using open-source software in 2005
Small	9.0
Medium	16.5
Large	37.3

Small cluster of industries adopt use

Another determining factor of open-source software adoption is the industrial sector of the firm. Firms in the information and cultural industries were most likely to use open-source with 37% in 2005. This was followed by firms in utilities and educational services at 22%, and professional, scientific and technical services at 20%.

These four industries are also high-intensity users of other ICTs. Thus, it appears that firms who have familiarity with other technologies are more inclined to explore the advantages that open-source software may offer.

Open-source software development limited

The proportion of firms in Canada reporting that they develop their own open-source software is very low. Just over 2% of private firms reported open-source development. The development of open-source software is a skill that relies on programming talent that many firms may not possess or may choose to utilize elsewhere.

Although open-source development is not widespread across the economy, there are pockets of innovation that are recognizable. About 13% of firms in information and cultural industries were responsible for open-source development as well as 9% of large firms across the economy. Just over 15% of public sector organizations participated in the development of open-source software.

While the number of firms that recognized their use of open-source software is limited, we would expect to see this proportion rise as organizations identify their use of open-source and the advantages it may offer.

The data in this article is taken from the 2005 Survey of Electronic Commerce and Technology. Further estimates available on CANSIM: Table 358-0121.

Mark Uhrbach, SIEID, Statistics Canada.

Acquisition strategy of research and development services

Not every firm is in a position to overcome constraints to R&D, such as costs. Those that perform R&D must choose between forming a partnership with other firms, governmental organisations, universities or doing it themselves internally. During the period 1997 to 2002 around 62% of R&D spending was of internal origin. Another 24% was performed on behalf of another organization (contracted in). The remaining 14% was conducted by another R&D performer (contracted out).

Research and development (R&D) is a crucial activity in the innovation process. Firms that do not engage in this activity, seriously jeopardize their competitiveness and their creativity in relation to competitors.

However, not every firm is in a position to overcome constraints to R&D, such as costs. Those that perform R&D must choose between forming a partnership with other firms, governmental organisations, universities or doing it themselves internally.

If a firm opts to enter into partnership, it could choose between selling or buying research and development services. A firm could also combine these acquisitions strategies of research and development services.

Motivation

This study expands our thinking on the choice of R&D performance modes. Drawing on data from the R&D survey conducted by Statistics Canada we have shown that the R&D performer can do R&D for its own purposes or have it done by other organizations, or it may do it for other organizations.

Knowing the acquisition strategy of research and development services for a firm increases our understanding of the organizational system of research in industry.

The Statistics Canada survey (RDCI) allows the identification of the source and the destination of payments for R&D services for all R&D performers in Canada. It is based on this information that we draw the following performers' strategies, that is: do R&D for its own purposes, sell or buy R&D services. This study covers the period 1997 to 2002 and dealt with more than 60,000 observations.

R&D is particularly done by oneself

The study showed that during the period 1997 to 2002 the majority of R&D spending, around 62%, was of internal origin (Table 1), that is, it was conducted by the performer. The remain-

Table 1 Breakdown of the total amount spent by type of strategy for R&D purpose according to characteristics of the firm, for the period 1997 to 2002

Characteristics	Perform own R&D	Sell R&D services	Buy R&D services	Total
	millions of dollars			
Canadian controlled firms	33,673	12,239	7,029	52,941
Foreign controlled firms	14,945	6,525	3,999	25,469
Fewer than 50 employees	7,278	1,548	1,410	10,237
Between 50 and 499 employees	13,230	3,197	2,185	18,612
More than 500 employees	28,110	14,019	7,431	49,560
Total expenditures by strategy	48,618	18,764	11,027	78,409
in % of total transactions	(62%)	(24%)	(14%)	

Source: Statistics Canada, RDCI Survey.

Table 2 Total firm-years by type of strategy and country of control, for the period 1997 to 2002

Strategies	Canadian controlled firms		Foreign controlled firms		Total firm-years	
Perform own R&D	56,540	(97.6%)	2,479	92.9%)	59,019	(97.4%)
Sell R&D services	5,089	(8.8%)	596	(22.3%)	5,685	(9.4%)
Buy R&D services	31,299	(54.0%)	1,532	(57.4%)	32,831	(54.2%)
Total firm-years	57,909		2,668		60,577	

Brackets indicates the number (in percentage) of total firm-years by column.

Source: Statistics Canada, RDCI Survey.

ing 38% was comprised of two groups: one group representing 24% performed R&D on behalf of another organization (selling contracts), that is, they contracted in. The remaining 14% was conducted by another R&D performer, that is, they contracted out (buying contracts).

It is interesting to note that the "Buy R&D services" strategy is chosen by 54% of performers, but it represent only 14% of total transactions spending for R&D services for the period 1997 to 2002.

Firms under foreign control resort more easily to selling R&D services strategy

Table 2 shows that 22% of all firms under foreign control have conducted their R&D for outside organizations, more than twice the proportion of only 9% of domestic performers.

Table 1 shows us that firms with fewer than 50 employees performed less external R&D (Buy or sell contracts). The portion of external contracts increases with firm's size. This statement seems to indicate that to acquire R&D via external contracts or partnerships the firm should previously perform R&D for oneself and possess an acceptable absorption capability.

Whatever the origin of firm control, the R&D performers made first conducts R&D for itself, second to buy and eventually to sell.

The complete document provides additional information related to acquisition strategies of R&D services notably about partnerships between different organizations such affiliated firms, government and others firms. The study always shows the link that exists between the research intensity and the level of partnerships links by industry.

This article is partially extracted from the working paper: **Buying and selling research and development services**, *by Julio Rosa, Antoine Rose and Pierre Mohnen (Cat. no. 88F0006XIE2006002) released in the Statistics Canada Daily May 2nd, 2006.*

Julio Rosa, SIEID, Statistics Canada.

Business incubation in Canada: preliminary indicators

In Canada, two-in three new businesses do not survive to their fifth year. Business incubators provide space, advice and other support designed to assist new and growing businesses to become established and profitable. There are at least 83 operating business incubators in Canada and their funding totals almost $40 million.

Incubators tend to be small businesses, but also include several government offices and universities. Preliminary results from the **Survey of Business Incubators 2005** indicate that there are at least 83 active business incubators in Canada. On average, they provide space to nine companies each. In total, they receive about $40 million in operating funds, 25% of which comes from grants from the federal government. Rent from clients covers only about 18% of the cost of operation. The most common services provided include "help with business basics" (71% of respondents), "marketing assistance" (56%) and "help with accounting or financial management" (54%).

What is a business incubator?

A *business incubator* is a business unit that specializes in providing space, services, advice and support designed to assist new and growing businesses to become established and profitable. For a private company, a business unit generally corresponds to an establishment. For a large organization such as a university, college or government department, a business unit may be any distinguishable office or program.

Characteristics of incubators

These initial statistics are for all incubators. A forthcoming working paper will differentiate between different types and sizes of incubators. The survey includes both business incubators and technology incubators.

Employment

Incubators often draw on the expertise of a host institution, the employees of which may or may not be paid specifically to work with the incubator. The average number of full-time employees (paid or unpaid) employed to operate the incubator is 3.2. The number of professional staff (managers, scientists, senior technical advisors, mentors) that are employed (paid or unpaid) by the incubator, on average is 2.2.

Source of Funds

Most incubators depend heavily on federal government funding. In Canada funding for incubators totalled $39.9 million. The federal government was the largest provider of funding accounting for $10 million (25%). Loans equalled $8.8 million (22%); and rent from clients was $7.1 million (18%).

Clients

The respondents included some "virtual" incubators, that is, those that provided some incubation services but no office or laboratory space. However, most incubators did provide space to their clients. The average number of companies occupying space in an incubator is 9. On average, the number of companies receiving services or advice during the year was 68 per incubator.

Of significance, the average number of people employed by client firms was 65 indicating the impact incubators have on creating employment.

Average floor space

The average space occupied by an incubator in Canada is 11,784 square feet. The amount of space available to clients averaged 9,347 square feet. Overall, incubators used on average 71% of their available capacity, that being 6,667 square feet.

Most important goals of the program

Creating jobs in the local community is the most important goal for 64% of the incubator units. The second most important goal was building or accelerating growth of local industry (40%) followed by commercializing technologies (37%).

Services offered to clients

Incubators offer a variety of services to clients, and some specialize in specific areas. The most common services included:

- **Management/business support.** Help with business basics (developing business plan, refining business concepts, etc.) were cited as the leading common service offered (71%). Marketing assistance (advertising, promotion, market research, market strategy) followed at 56% and help with accounting or financial management at 54%
- **Equipment and technical support.** Among the array of equipment and technical support incubators can offer, high-speed Internet access (64%) was the service most offered, followed closely by provision of office space (59%) and access to a library (53%).
- **Network and training.** Provision of networking activities to clients was an important activity (56%). Linkages to strategic partners (49%) and business training (49%) were of equal significance.
- **Financing.** A major issue for incubator clients is financing and help accessing commercial bank loans was offered by 45% of the incubator respondents. In addition, assistance accessing specialized non-commercial loan funds or loan guarantee programs was available by 37% of the programs and linkages to angel or venture capital investors followed closely behind at 35%.
- **Legal support and regulatory compliance.** Growing and developing businesses need assistance with applying for government grants and tax credits, a service offered by 36% of Canadian incubator units. In addition, intellectual property management and help with regulatory compliance was available (12%).
- **Commercialization.** Regarding the critical aspect of commercialization, technology transfer (e.g., links to potential customers for your clients) was cited by 29% of the respondents. This was followed closely by business management process, customer assessment service, inventory management at 27% and assistance with e-commerce (22%).
- **Additional activities to provide support to incubator clients.** These additional activities were not considered core business incubation services that were offered to clients. Rather, they may be activities undertaken by the incubator to better integrate with the business community. The most prevalent additional activities utilized by incubator clients included networking with local companies, 79% of which respondents rated first. Participating in community business groups was second (72%) and hosting local networking events was responded to as third most notable activity by 67% of respondents.

Barriers

A majority of clients responded that finding appropriate candidate clients (65%), having candidate clients with no start-up financing (65%), and obtaining funding for incubator operation (63%) were significant barriers to their success.

Concluding remarks

The number of incubators is relatively small, but their population has been increasing steadily since the 1980s. The demand for incubation services apparently exceeds supply. While applicants may be rejected for several reasons, including the lack of a convincing business case, demonstration of need for incubation and lack of space, only one in three proposals submitted in 2005 were accepted.

A working paper on business incubators in Canada is forthcoming.

Rad Joseph and Daood Hamdani, SIEID, Statistics Canada.

Federal S&T commercializes

New licenses and patents issued reached all-time highs in federal departments and agencies in 2003/2004 and 2004/2005. Invention disclosures and patent applications showed moderate declines from previous years.

Much of the technology developed at federal government labs is viable commercially. Therefore, departments and agencies make concerted efforts to transfer that technology to the private sector. Statistics Canada's **Federal Science Expenditures and Personnel** survey (FSEP) tracks the federal government's science and technology activities and an annex to that survey (the Intellectual Property Management Annex) monitors the management and commercialization of intellectual property (IP) in departments that hold patents (Table 1).

We generally think of the IP process as a pipeline: inventions are reported, patented and licensed. But the pipeline is not always linear or smooth. Innovators and inventors in federal labs first disclose an invention that they believe should receive intellectual property protection. The rate of disclosures varies not only with research effort but also the nature of the research and the current priority given to protecting IP.

Applications are made to patent inventions that are considered feasible while the remaining inventions may be sent "back to the lab" for refinement or retained for future consideration. The number of patent disclosures declined from a peak of 347 in 2000/2001 to 193 in 2004/2005. The number of patent applications has not fallen off as severely, dropping from 352 to 308 over the same period. This may be due to multiple patents (for example, in Canada, the US and Europe) for the same invention but also because the technologies that were "on the shelf" from previous years are now considered viable.

Given the time lags inherent in the patent process, applications in one year will result in patents one or two years after. The number of patents issued in 2003/2004 reached an all-time high of 178 — double that of 1998/1999.

Every year hundreds of patents are "lapsed" or not renewed because either they have reached the end of their lifespan (20 years in most jurisdictions) or because paying the renewal fee is not justified by the potential economic benefit. The total patent portfolio of the federal government has remained relatively stable over the past 5 years indicating that the new patents are barely replacing the ones being lapsed each year.

Table 1 Federal natural science-based departments and agencies covered in 2003/2004 and 2004/2005 surveys

Agriculture and Agri-food Canada
Canadian Food Inspection Agency
Canadian Space Agency
Communications Research Centre (Industry Canada)
Department of Fisheries and Oceans
Department of National Defence
Environment Canada
Health Canada
National Research Council
Natural Resources Canada
Royal Canadian Mounted Police
Transport Canada

The number of licenses and the royalties derived from these licenses have also remained stable. This is in contrast to the situation in the higher education sector which has experienced a decline in income from IP of about 8% between 2003 and 2004 (See *The Daily*, January 27, 2006).

Michael Bordt, SIEID, Statistics Canada.

Table 2 Federal government intellectual property management indicators, 1998/1999 to 2004/2005[1]

	1997/1998	1998/1999	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005
Invention disclosures	131	113	347	216	243	194	193
Patents							
Patent applications	232	222	352[r]	356[r]	410[r]	341[p]	308[p]
Patents issued	130	89	110[r]	133[r]	142[r]	178[p]	169[p]
Patents in force	1,950	1,946	1,466[r]	1,466[r]	1,471[r]	1,438[p]	1,589[p]
Licenses							
New licenses	398	207	247[r]	181[r]	181[r]	185[p]	231[p]
Total licenses	1,112	1,305	1,532[r]	1,440[r]	1,403[r]	1,390[p]	1,492[p]
Royalties ($ millions)	6.9	12.0	15.7[r]	16.3[r]	15.5[r]	15.1[p]	15.2[p]

Notes:
There was no survey in 1999/2000.
1. All figures for 2003/2004 and 2004/2005 are preliminary.
Sources: Statistics Canada, 2005, Federal science expenditures and personnel 2006/2007, Intellectual property management fiscal year 2004/2005. Science, Innovation and Electronic Information Division.

Are cell phones replacing traditional home phones?

Since the launch of cellular services in the mid-1980s, mobile phones have largely been a complement to the traditional phone line – but that is beginning to change. Recent statistics show that more and more of those making plans for the evening have not only chosen to stay connected wherever they happen to be, they have also chosen to make their cell phone their only means of communication. Today it seems that everyone has a cell phone, from the teenager discussing after-school plans, to the businessperson checking into the office or with clients. Case in point: by the end of 2005 there were 16.6 million subscribers to mobile communications services.

A recent study based on the **Residential Telephone Services Survey (RTSS)** shows that the proportion of Canadians who only have a cellular phone is less than 5%, double the level observed two years earlier (Table 1). Other surveys at Statistics Canada also provide supporting evidence that cell phones are replacing traditional home phones.

The **Survey of Household Spending (SHS)** looks at how households budget their money and the **Annual and Quarterly Survey of Telecommunications (AST and QST)** looks at, among other things, the customer base of telecommunications companies – or put another way – at customer usage of telecommunications services[1]. Some of the findings are provided below.

Canadians are spending a larger percentage of their budgets on cellular phones and Internet access.

From 1997 to 2004, households increased their total expenditure by 27.5%. Over the same period, expenditures on household operations also increased by 27.7%. However, when examining communications, we note that expenditures on traditional telephone service fell by 8.4% while expenditures on wireless increased by 253%, and Internet access by 600%.

In addition to this dramatic growth in expenditures on wireless and Internet access, the share of total expenditures has increased from 0.2% to 0.5% for wireless and from 0.1% to 0.3% for Internet access. The share of expenditures on wireline service fell from 1.5% in 1997 to 1.0% in 2004 (Table 2).

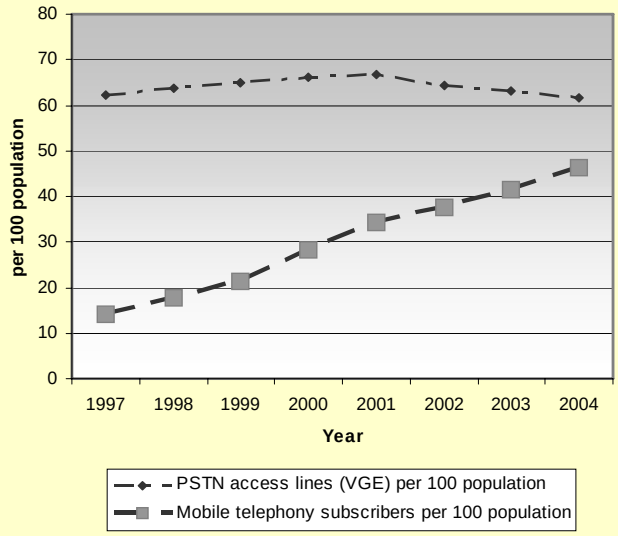
Even though we are only looking at average expenditures for all households, the increasing share of cellular and Internet expenditures and declining share of wireline expenditures suggests that Canadians are increasing the relative importance of cellular phones and Internet access in their household budgets.

Table 1 Proportion of households with only a cell phone

	May- 2003	May- 2004	Dec- 2004	Dec- 2005
	%			
Canada	1.9	2.4	2.7	4.8

Source: *The Daily*, Residential Telephone Service Survey, April 5, 2006.

Figure 1 Mobile and PSTN teledensity



Wireline access to PSTN[2] falling while households and population continue to grow

For the four years between 2000 and 2004, the number of households grew on average by 1.5% per year. However, for the final three years (2001 to 2004), the number of PSTN access lines fell on average by 1.7%. While this alone would suggest that households are connecting to the PSTN through other means, we have to remember that for a number of years the growth in PSTN lines exceeded the growth in households as households took second lines for Internet access and other communications needs. Therefore, some of the difference in growth rates can be explained by the replacement of second lines for dial-up access in favour of high-speed access (Table 3).

Figure 1 shows that between 1998 and 2000, wireless subscribers and PSTN access lines per 100 inhabitants were on the increase. However, starting in 2001, the ratio of PSTN access lines started to decline while the wireless ratio continued to increase.

The difference between the growth rates suggest that a number of different events are taking place in the telecommunications market at the same time. First, the positive difference between population and wireless subscriber growth shows that more Canadians are becoming cellular customers each year. However, the flattening of the growth rate suggests that this is becoming a mature technology.

1. Although the focus of each survey is different, the SHS focuses on households, while the AST/QST focus on telecommunications companies. It is reasonable to assume that combining their data gives an accurate picture of the typical Canadian consumer of telecommunications services.

2. PSTN – Public Switched Telephone Network.

Table 2 Share of expenditures on wireline service of total household expenditures

Selected household expenditures	1997	1998	2003	2004
	% of total household expenditure			
Total expenditure	100.0%	100.0%	100.0%	100.0%
Total household operation	4.6%	4.6%	4.7%	4.6%
Telephone services (including LD, installation and repairs)	1.5%	1.4%	1.2%	1.0%
Cell phone, pager and handheld text messaging services	0.2%	0.2%	0.5%	0.5%
Internet access services	0.1%	0.1%	0.3%	0.3%
	% change in expenditure since 1997			
Total expenditure		2.1%	23.4%	27.5%
Total household operation		2.7%	26.0%	27.7%
Telephone services (including LD, installation and repairs)		-1.0%	-1.2%	-8.4%
Cell phone, pager and handheld text messaging services		16.8%	198.9%	252.6%
Internet access services		60.0%	466.7%	600.0%

Source: Statistics Canada. Survey of Household Spending.

On the other hand, since the number of PSTN access lines is declining even though the population and number of households continues to increase suggests that Canadians are replacing their traditional landlines with some other form of telecommunications.

Table 3 Change over previous year for selected variables

Indicator	1998	1999	2000	2001	2002	2003	2004
	% change over previous year						
PSTN lines (VGE)	3.4	2.7	2.7	2.3	-2.4	-1.1	-1.5
Mobile subscribers	27.4	22.7	33.0	22.0	11.5	11.4	12.6
Population	0.8	0.9	1.0	1.1	1.1	0.9	1.0
Households	1.3	1.4	1.5	1.6	1.5	1.5	1.5

Source: Annual Survey of Telecommunications, Special Tabulations, 2006.

Conclusion

Consumers are spending a higher percentage of their total expenditure on wireless communications than ever before. This combined with the decreasing importance of spending on wireline, suggests that Canadians are placing a higher priority on wireless access to the PSTN than traditional wireline access. In addition, the increase in wireless subscribers, population and households, along with the decrease in the number of wireline connections to the PSTN, supports the idea that cell phones are replacing home phones.

Cimeron McDonald, SIEID, Statistics Canada.

Research and development services in physical, engineering and life sciences (PELS) – Why do so many establishments say that satisfying existing clients is not relevant to their success?

While firms engaged in R&D services are part of the population of firms covered by the **Research and Development in Canadian Industry (RDCI)** survey and the **Biotechnology Use and Development Survey (BUDS)**, this industry group is not covered by a typical industry survey. This means that there are no industry-specific figures for contribution to GDP or other measures of industrial activities and finances. However, data for the industry group are available from the **Survey of Innovation 2003**, along with other selected professional services. Data from that survey indicate that the establishments in R&D services in physical, engineering and life sciences may be part of a select and highly atypical group of firms.

The North American Industry Classification System (NAICS), which was implemented as part of the North American Free Trade Agreement (NAFTA), included more detailed categories for services industries. One of the new categories was "Research and development services" (R&D services: 5417). This industry group is composed of two industries: R&D services in physical, engineering and life sciences (NAICS: 54171) and R&D services in social sciences and humanities (NAICS: 54172).

A highly atypical group of firms

Data from the **Survey of Innovation 2003** indicate that the establishments in NAICS 5417, particularly those in R&D services in physical, engineering and life sciences, may be part of a select and highly atypical group of firms. As part of the survey, firms were asked to rate a series of factors in terms of their importance to the success of the firm. One of these factors was "satisfying existing clients". In all but two of the selected service industries covered by the survey, over 90% of establishments indicated this was important[1]. Amongst firms in R&D services in physical, engineering and life sciences however, only 69% of firms thought it was important, while 21% thought it was "irrelevant". This raises a question: *What kind of firm thinks that satisfying*

1. Importance was indicated on a scale of 1 to 5, and 0, where "1" was "low importance", 5 was "high importance" and "0" indicated "not relevant".

Table 1 Percent of establishments using patents to protect intellectual property, selected professional services industries, 2003

Industry	Innovators		Non-innovators	
	%	Standard error	%	Standard error
Engineering services	13	4.1	1	1.1
Industrial design services	41	7.1	0	-
Computer systems design services	17	4.3	1	0.7
Management consulting	16	5.4	0	-
Environmental consulting	19	3.8	0	-
Other scientific consulting	5	2.2	9	4.1
R&D PELS	**67**	**5.4**	**65**	**7.1**
R&D SSH	27	5.9	4	2.4

Source: Survey of Innovation 2003.

existing customers is not relevant to its success? Other data from the survey provide a possible explanation.

When examined more closely, it turns out that establishments reporting that satisfying existing customers is irrelevant to firm success are mostly located within one sub-group of firms: non-innovators in physical, engineering and life sciences. A possible explanation may lie in an interaction of NAICS classification and the internationally-accepted statistical definition of innovation, found in the Oslo Manual (OECD/Eurostat, 1997).

NAICS classifications are based on value-added activities. Firms with very similar activities are classified to the same industry. Firms that are engaged primarily in laboratory R&D are classified to R&D services in physical, engineering and life sciences. This industry encompasses a wide variety of types of firms, including:

- large, multi-national companies that do not have any manufacturing activities in Canada and whose R&D activities are more significant than any of their other activities;
- firms that are contract service providers of R&D services to their clients; and
- firms that are in an early stage of development, which do not yet have a significant market presence.

The impact of inventive vs. innovative

It is this last group of firms that may account for the unusual findings. According to the 1997 Oslo Manual[2], a firm is "innovative" if it has introduced a new or significantly improved product to the market or a new or significantly improved process to production, within a specified window of three years. This definition combines three key elements: novelty or invention + commercialization + time. All three elements must be present for a firm to be innovative. Thus, if a firm is actively engaged in R&D but does not yet have a product ready for the market, nor a production process in place, it might well be "inventive" but it is not "innovative". Such a firm would not have significant sales that would sustain the continued operation of the firm, and so, would not view satisfying existing clients as important to the success of the firm. If they have nothing to sell, they have no "clients" as traditionally understood. Therefore, satisfying clients would not be relevant to their success. Their success would involve keeping their sources of funding satisfied and they would most likely accomplish this by meeting the discovery and cost targets in their research and development plan. These firms could therefore be labelled "venture firms".

Innovators vs. non-innovators

Further evidence that venture firms may be a significant part of this population lies in the lack of differences between innovators and non-innovators in this industry (see Table 1). Typically, innovators are more likely to report activities and practices related to discovery and commercialization. One such measure is the use of patents to protect new ideas. In R&D PELS, there are no differences between innovators and non-innovators with respect to patent use, while there are significant differences for almost all other selected professional services industries. It is also interesting to note that the proportion of innovative establishments using patents in R&D PELS is significantly different from innovators in all the other selected professional services industries.

Data from the **Survey of Innovation 2005** therefore suggest that R&D services in physical, engineering and life sciences (industry 54171) may include an important proportion of young venture firms which have not yet brought a product to market. Once these firms are established with products they may be reclassified to a new industry. The net effect would be to have two distinct types of firms in 54171 – firms that are traditional service providers engaged in R&D services for other firms or other units in a larger entity of which they are a part and smaller, younger venture firms that have not yet brought their product to market.

Charlene Lonmo, SIEID, Statistics Canada.

References

OECD/Eurostat. 1997. *The Oslo manual: Proposed guidelines for collecting and interpreting technological innovation data*, 2nd edition. Paris, France.

OECD/Eurostat. 2005. *The Oslo manual: Proposed guidelines for collecting and interpreting technological innovation data*, 3rd edition. Paris, France.

2. This version was the one in place at the time of the survey (2003). The manual was subsequently revised in 2005 to include organizational and marketing innovation.

Returns to education: median employment income comparisons of 35 to 44 years old science and engineering doctorates and non-NSE doctorates working full-year and full-time in 2000

There is a growing supply of scientists and engineers with doctorates in the natural and applied sciences occupation but, on the other hand, there is a potential for future shortages of university professors, concludes a forthcoming Statistics Canada study entitled ***Where are the Scientists and Engineers?*** One reason for the lower replacement numbers for university professors is that PhDs may be turning away from educational services towards higher paying industries for employment.

In Canada, only a small proportion of students going into the elementary school system ultimately pursue a career in science and technology. Indeed, according to Michael Bordt, et. al. (2001), "interest in mathematics and science declines between Grade 4 and Grade 8 and continues to drop during high school." Despite the fact that Canada is now regarded as a world leader in educational attainment with the highest proportion among OECD countries with its adult population (age 25-64) having combined college and university education, Canada's percentage of graduates with doctorates in natural sciences and engineering (NSE) is much lower than many other OECD countries including the United States. The principal source of the NSE gap at the doctorate level, according to Boothby and Rainville (2004), "is low levels of overall doctoral output in Canada, since a high percentage (around 40%) of Canadian doctoral output is in science and engineering fields."

The study Where are the Scientists and Engineers? uses data from the 2001 Census of Population to examine many characteristics, such as geographic concentration, age, sex and income, of Canada's stock of PhDs.

In 2001, 57% of the 100,000 employed doctorate degree holders were in science and engineering fields and the employed NSE doctorate degree holders perform quite well in the labour market with both higher average and higher median employment income in comparison to non-NSE doctorate degree holders.

Four out of every five of Canada's scientists and engineers with doctorate degrees can be found in five key industrial sectors, namely, educational services; professional, scientific and technical services; health care and social assistance; public administration and manufacturing.

Most doctorate degree holders enter the labour force in their early to mid-thirties and thus the comparative age bracket should be the 35 to 44 age group in terms of the examination of the labour force entrants of doctorate degree holders. Indeed, for the 35-44 years old doctorate holders working full year full time (FY-FT) the median employment income was $60,134; The NSE doctorates' median of $62,169 was over $3 thousand higher than the $58,957 for the non-NSE PhDs working full year full time in 2000 (See Table 1).

Educational services, which is the leading industry of employment with 44% of Canada's total employed PhDs, had the lowest median employment income among 35-44 year old PhDs from all major fields of study working FY-FT in 2000 and were at or near the bottom when comparisons are made between NSE and non-NSE PhDs' median FY-FT employment income among the five key industrial sectors.

The number of PhDs in Canada grew by 93% between the 1986 and 2001 Census while the number of university professors had only increased by 22%. Furthermore, almost a third of the university professors were in the older (55 to 64) age group. Doctorates in the manufacturing sector were younger and there were almost four younger replacements for each one nearing retirement compared to only one younger replacement in educational services where the majority of university professors are found. Indeed, the FY-FT median employment income for the 35 to 44 year old individuals with non-natural science and engineering doctorates in educational services ($59,364) was also last among the top five industry of employment for individuals with non-NSE PhDs (Table 1). Non-NSE PhDs were half (54%) of the employed doctorates in the educational services sector in 2001.

Canada's lower proportion of doctoral graduates in NSE has meant that Canada is increasingly reliant on the rest of the world's supply of doctoral graduates. Thirty five percent or 23,000 of the 65 thousand immigrant PhDs in Canada arrived during the 10-year period before the 2001 Census. In fact, there were two employed immigrant doctorates in NSE for every one employed immigrant PhD in non-NSE.

The balance between immigrant and non-immigrant PhDs has remained around 50% when 1986 and 2001 Census data are compared. The domestic supply of Canadian born PhDs in non-science and engineering fields is therefore being balanced with the supply of immigrant doctorates in science and engineering. The FY-FT median employment income of the 35-44 years old immigrant PhDs with NSE doctorates, however, is over $8 thousand lower than their Canadian born NSE counterpart and over $5 thousand less for total major field of studies (Table 2).

There is virtually no difference between immigrants and Canadian-born doctorate holders' FY-FT median employment income in 2000 for total major field of studies when total ages are compared and thus the gap for immigrants does close as age and experience in the labour force advances. The $8 thousand gap for the NSE younger doctorates is cut in half to about $4 thousand when total ages FY-FT median employment income is compared (Table 2). Part of the reason for the existence of the gap is the

Table 1 Median employment income for 35-44 year old PhDs working FY-FT in 2000 –Top 5 industry of employment

Major field of study Industry of employment	Median employment income
Total major field of study	
All industries	**$60,134**
Manufacturing	$69,708
Professional, scientific and technical services	$64,817
Health care and social assistance	$60,155
Public administration	$60,149
Educational services	$59,974
Natural sciences and engineering	
All industries	**$62,169**
Manufacturing	$69,849
Professional, scientific and technical services	$64,907
Public administration	$60,136
Educational services	$60,113
Health care and social assistance	$59,308
Non-NSE	
All industries	**$58,957**
Health care and social assistance	$65,015
Public administration	$61,988
Professional, scientific and technical services	$61,973
Manufacturing	$59,960
Educational services	$59,364

lower median employment income of NSE women doctorates working FY-FT in 2000. On average, women with NSE doctorates working FY-FT earned 78% of what men NSE doctorates earned working FY-FT in 2000.

Examination of the 35 to 44 year old doctorates' FY-FT median employment income has shown that there are indeed higher returns to education at the doctorate degree level, especially for doctorate holders in science and engineering. By comparison, the median FY-FT employment income in 2000 for all of Canada's workers age 35 to 44 was $39,346.

The FY-FT median employment income in an industry is an important labour market signal. In the private sector, especially for manufacturing along with professional, scientific and technical services incomes were higher than public sector industries such as educational services. For all doctorates, professional, scientific and technical services were in fact the second largest industry of employment behind educational services.

Educational services will continue to be a leading employer for doctorate degree holders and the labour market conditions in 2000 and 2001 may have improved substantially over the years. In fact, Gluszynski and Peters (2005) have found that the majority (57%) of the graduates in their survey of earned doctorates with firm employment plans were planning to work in the educational services industry.

Table 2 Median employment income for PhDs 35-44 and all ages working FY-FT in 2000 – Immigration status

	Median employment Income (age 35-44)	Median employment income (all ages)
Total Major field of study		
All industries	**$60,134**	**$69,647**
Non-immigrants	$64,129	$69,940
Immigrants	$58,949	$69,638
Natural sciences and engineering		
All industries	**$62,169**	**$70,035**
Non-immigrants	$68,048	$74,209
Immigrants	$59,916	$69,772
Non-NSE		
All industries	**$58,957**	**$67,015**
Non-immigrants	$59,971	$67,009
Immigrants	$54,953	$67,683

Where are the Scientists and Engineers? concludes that there was an increasing supply of scientists and engineers in the natural and applied sciences occupation since there were three replacement 35 to 44 year old doctorates for every one older doctorate (age 55 to 64) nearing retirement. Indeed, the conclusion is also supported by Boothby and Rainville (2004) who also found that the labour market position of scientists and engineers is somewhat better than that of university graduates as a whole and that this would not seem to indicate a persistent and growing shortage of scientists and engineers

Michael McKenzie, SIEID, Statistics Canada.

References

Boothby, Daniel and Bruno Rainville. 2004. *Adjustments in Labour Markets for Skilled Workers in Canada*. Industry Canada, Skills Research Initiative, Working Paper 2004, C 01.

Bordt, Michael, Patrice de Broucker, Cathy Read, Shelly Harris and Yanhong Zhang. 2001. *Determinants of science and technology skills: Overview of the study* in ***Education Quarterly Review***, Vol. 8, No. 1. Statistics Canada: Catalogue No. 81-003.

Gluszynski, Tomasz and Valerie Peters. 2005. *Survey of Earned Doctorates: A Profile of Doctoral Degree Recipients.* Statistics Canada, Catalogue No. 81-595-MIE-No. 32.

Update on Canadian activity in development of nanotechnology statistics

This article summarizes the Canadian experience in collecting and accessing information on government expenditure (both federal and provincial) on nanotechnology R&D in Canada. The steps taken to measure nanotechnology activities in the private sector on illustrate the many challenges facing measurement of nanotechnology.

Like biotechnology, nanotechnology is not a single industry but a collection of products and processes, based in both realized and potential technologies that cut across all sectors of the economy. This creates challenges in its measurement, that have been addressed in biotechnology statistical programs both in Statistics Canada and the OECD and its member countries.

Establishing a systematic and consistent process for investments in nanotechnology research will provide key stakeholders, policy analysts and decision makers with a reliable, validated and comparable information base to help inform strategy and policy decision making on the scientific economic, health, environmental and social impacts of nanotechnology. In 2003, Statistics Canada took its first concrete action towards the systematic measurement of nanotechnology activities and has since continued to build on this foundation.

Defining nanotechnology

A critical first step in the collection of statistics on expenditures and outcomes on nanotechnology R&D is for stakeholders to agree on a definition of nanotechnology. This allows for government, universities and industry researchers and managers to consistently report and analyze data using the same language. It should be recognized there is no internationally accepted formal definition (ISO or OECD) of nanotechnology, due to the newness of this field of research, the multidisciplinary aspects of the technology, and its rapidly evolving nature. However, a review of definitions reveals that all definitions of nanotechnology contain two essential statements: the length scale of 1 to 100 nanometers and the use or development of unique phenomena at that scale.

At the inaugural meeting of the International Organization for Standardization (ISO) Technical Committee 229, Nanotechnologies, held in November, 2005, it was decided that ISO/TC 229 will approach the development of International Standards for nanotechnology with three working groups: terminology and nomenclature; metrology and characterization; and health, safety and the environment, convened by Canada, Japan, and the United States, respectively. To inform and develop the Canadian input to the ISO/TC 229 Working Group on terminology and nomenclature, a Federal Workshop was held in March 2006.

Classifications reflect differences amongst government departments, for example, the Canadian Institutes of Health Research (CIHR) has the following categories:

- molecular imaging and technology development
- clinical imaging/tools
- biomaterials
- drug delivery

In comparison NSERC has the following categories:

- nanomaterial development
- nano-electronics/photonics
- tools development
- life sciences

The process of coming to an international definition of nanotechnology is progressing; however, the definition of commonly-accepted categories or fields of nanotechnology is by necessity lagging behind. It will be important to collect this information in a consistent manner as nanotechnology is a very broad area of research and it will greatly assist identification of trends within nanotechnology R&D, its uptake by industry and its impacts on society.

Data collection by analysis of funding databases

The Office of the National Science Advisor (ONSA) collected data from various Canadian funding agencies. Each funding agency required a unique approach demonstrating the complexity of the nanotechnology sector and highlights the need for a rigorous yet flexible approach to data collection and subsequent analysis. Definitions used by an agency can be affected by the agency's mandate. Keyword searches, with key words and techniques customized to each funding agency were performed and then assessed to ensure the project related to nanotechnology. This evaluation was based on the grant title, as well as additional information known about the principal investigator either through scientific publications, web site information, or other sources.

For example the search for CIHR nanomedicine-funded grants in the CIHR database were identified through a validated keyword search. Keywords were searched for under grant title, grant keyword, grant abstract (where available), and researcher expertise. Keywords are shown in Table 1. Results were then validated for their adherence to the nanomedicine definition, resulting in 115 of the nearly 400 grant hits deemed relevant as "nanomedicine".

Beyond the main research granting councils and foundations, other federal programs and organizations fund research primarily in industry that will increasingly be focused on nanotechnology.

Table 1 Keywords

Aptamer	AFM	atomic force microscop*
Biochip	biomedical imag*	cellular imag*
Dendrimer	femtosecond	lab-on-a-chip
liposom*	medical imag*	MEMS
microfluidic*	molecular beam epitaxy	molecular comput*
molecular manufactur*	molecular elec*	molecular imag*
molecular switch	nano*	NEMS
optical imag*	optical tweezer	photonic*
Quantum	scanning prob*	scanning tunnel*
self assem*	self-assem*	single electron*
sub-micro*	submicro*	STM
Ultrafast	ultrafine	

However, it is possible that the keyword search for nanotechnology in academia may be less applicable for more applications-driven R&D in the private sector. A small number of universities were asked to "self identify" their nanotechnology research, and demonstrated a large variance in how these universities self identified nanotechnology research.

Activities at Statistics Canada

Statistics Canada has used the **Emerging Technology Surveys** for reference years 2003 and 2005 to identify and inventory firms engaged in nanotechnology activity. The survey is mailed to all firms in industry codes where nanotechnology has been observed, or where there is a possibility of nanotechnology activities. The 2003 resulted in 89 firms being identified with 2005 results pending in summer 2006.

The Biotechnology Use and Development Survey – 2005 contains a dedicated nanotechnology section that asks basic question of firms that have been identified as being active in nanotechnology. Results are expected in fall 2006. This process was successfully utilized in 2003 for Bioproducts, contributing to a full survey the following year for Bioproducts. Questions on nanotechnology are included in the **Advanced Technology in Canadian Manufacturing Survey – 2006** with results expected in 2007. These surveys are intended to provide concrete information on nanotechnologies as well as test concepts and definitions, with the intent to implement dedicated nanotechnology surveys in the future. Currently all nanotechnology activities at Statistics Canada are done on an ad hoc unfunded basis. Inclusion of nanotechnology in the Federal S&T survey and other existing surveys is being explored

The biotechnology statistics program at Statistics Canada serves as a workable model, completing the first national surveys on biotechnology and participating in the development of international definitions and model surveys on biotechnology at the OECD. All these potential steps would benefit from the early and active participation of stakeholders, creation of definitions and concepts that are rigorous enough for international comparisons, but flexible enough to capture and reflect the evolving and multi-sector nature of nanotechnology.

Summary

Measurement of nanotechnology is in its infancy, and much work and many challenges remain. Important first areas to focus on include, but not limited to the following.

Definition of nanotechnology: As evidenced by the numerous definitions mentioned in this document, steps need to be taken to establish a definition of nanotechnology that recognizes the complex and changing nature of the phenomena and facilitates international comparisons. Concurrent to defining nanotechnology, the issue of classification requires clear and rigorous attention, in order to fully measure using concise categories and then understand the emerging sector.

Data collection by funding databases: A method of collecting nanotechnology R&D expenditure data is through searching funding databases as it enables the most consistent application of the nanotechnology definition.

Data collection by surveys: Surveys can collect public and private sector data from performers of nanotechnology and this work could include introducing nanotechnology to the annual federal survey of science expenditures and personnel (FSEP); include a nanotechnology section in the provincial surveys and finally, development of a program of surveys and associated analysis on the development and adoption of nanotechnologies and related issues in Canadian industry.

NE3LS: Nanotechnology Ethical, Environmental, Economic, Legal and Social aspects: The need to undertake research into NE3LS issues has been strongly advocated to the Government of Canada by the International Science Panel that reviewed Canada's nanotechnology research.

Human Resources: Classifying and counting the specialized work force in nanotechnology will be a challenge and will require extensive work to reach international comparability.

Nanotechnology poses many challenges to those that are attempting to systematically classify and measure this emerging and evolving set of activities, but challenges that that can be managed. The first steps have been taken but much work faces the international community in the development comprehensive internationally comparable statistics.

Adapted by Chuck McNiven (Statistics Canada) and Kevin Fitzgibbons (ONSA) from the report ***Annual Process for Collecting, Validating, Storing and Accessing Data on Canadian R&D Expenditure on Nanotechnology*** *prepared for the Office of the National Science Advisor (ONSA) by Kevin A. Smith.*

What's new?

Recent and upcoming events in connectedness and innovation analysis.

Connectedness

Two new studies will be released in the *Connectedness Series* (Catalogue No. 56F0004MIE) over the summer and fall. The first, based on data from the **2005 General Social Survey on Time Use**, examines how the Internet is changing the way Canadians spend their time. A second study, entitled *Our Lives in Digital Times* (author: George Sciadas) looks further into the outcomes and impacts associated with information and communications technology (ICT).

Telecommunications

Annual survey of telecommunications service providers

The release of 2004 statistics is expected for June 2006.

Quarterly survey of telecommunications service providers

Selected statistics on telecommunications services industries for the third and fourth quarter of 2005 (56-002-XIE) were released on March 6 and May 9, 2006 in *The Daily*.

The third and fourth quarter 2005 issue of *Quarterly telecommunications statistics (Cat. No. 56-002-XIE, volume 29, no.3 and no. 4)* are available.

The release of statistics for the first quarter of 2006 is expected for August 2006.

Broadcasting

The processing of 2005 data is ongoing. The release of 2005 statistics for the television, radio and cable television industries is planned for the summer and fall of 2006.

Canadian Internet use survey

No updates to report.

Business e-commerce

Survey of electronic commerce and technology

The results from the **2005 Survey of Electronic Commerce and Technology (SECT)** were released in *The Daily* on April 20, 2006.

Science and innovation

S&T activities

Research and development in Canada

The service bulletin *Science Statistics: Estimates of total spending on research and development in the health field in Canada, 1998 to 2005* (Vol. 30, no. 3, 88-001-XIE) was released in *The Daily* on May 12, 2006.

Industrial research and development

No updates to report.

Federal science expenditures

The service bulletin *Science Statistics: Distribution of federal expenditures on science and technology by province and territories, 2003/2004*, (Vol. 30, No. 1, 88-001-XIE) was released in *The Daily* on February 10, 2006.

A working paper *Provincial distribution of federal expenditures and personnel on science and technology, 1997/1998 to 2003/2004* (Cat. No. 88F0006-XIE, No. 001) was released in *The Daily* on April 13, 2006.

The service bulletin *Science Statistics: Biotechnology scientific activities in federal government departments and agencies, 2004/2005* (Vol. 30, No. 2, 88-001-XIE) was released in *The Daily* on March 9, 2006.

Higher education sector R&D

No updates to report.

Provincial research organizations

No updates to report.

Human resources and intellectual property

Federal intellectual property management

Federal science expenditures and personnel, intellectual property management annex

Preliminary results from the Intellectual Property Management annex to the **Survey on Federal Science Expenditure and Personnel** were released in *The Daily* on March 27, 2006.

The higher education sector

Intellectual property commercialization in the higher education sector

A working paper on the 2003 survey will be released shortly.

The 2005 survey is now in the field.

Innovation

Innovation in manufacturing

Preliminary results from the **Survey of Innovation 2005** were released in *The Daily* on June 2, 2006. Coincident with this release was the availability of detailed statistical tables on CANSIM (Table 358-0062) for selected variables. More tables will follow. In addition, CANSIM tables presenting results from the **Survey of Innovation 2003** were also made available (Tables 358-0027 to 358-0061).

Innovation in advanced technologies

Questionnaire design continues on the **Survey of Advanced Technology**. The questionnaire will be field tested in June.

One paper presenting findings based on the **Survey of Advanced Manufacturing Technologies 1998** was presented at the Statistics Canada Socioeconomic Conference on May 16, 2006: *Technology Adoption, Skills and Productivity Performance: Firm-Level Evidence for Canadian Manufacturing* by Daniel Boothby, Anik Dufour and Jianmin Tang.

Innovation in services

Three papers presenting findings from the **Survey of Innovation 2003** were presented at the Statistics Canada Socioeconomic Conference on May 16, 2006: *Globalization, Innovation and Intellectual Property in Selected Service Industries* by Frances Anderson and Ingrid Schenk; *Innovation and Exports among Selected Knowledge-Intensive Business Services* by Radu Chiru; *Innovators, Non-innovators and Venture Firms: What is the Nature of Firms in Scientific R&D Services Industries* by Charlene Lonmo.

Commercialization

Preliminary results from the **Survey of Business Incubators 2005** were released in *The Daily* on March 27, 2006. Two working papers will be released over the summer months.

Biotechnology

No updates to report.

Other

The study, *Buying and selling research and development services* (88F0006XIE2006002) was released in *The Daily* on May 2, 2006.

A working paper *Characteristics of Growth Firms, 2004/2005* (No. 3, Cat. no. 88F0006XIE2006003) by Michael Bordt, Frances Anderson, Louise Earl, Charlene Lonmo of SIEID and Denise Guillemette of NRC-IRAP was released in *The Daily* on May 11, 2006.

The Blue Sky II 2006 Forum will be held in Ottawa, September 25-27, 2006. It will include examination of new areas for indicator development and set a broad agenda for future work on science, technology and innovation (STI) indicators. Emphasis will be placed on indicators of outcomes and impacts in order to support monitoring, benchmarking, foresight activity, and evaluation, applied to policies and programs, and their economic and social impacts. The Forum is expected to provide ideas and guidance for indicators work in both OECD and non OECD countries, as well as in their international organizations. Information should be available as of July 2006 at www.statcan.ca/english/conferences/sciencetech2005/index.htm

In brief

In this section, we highlight articles of interest that have recently appeared in the Statistics Canada ***Daily*** and elsewhere.

Access to Statistics Canada's electronic publications at no charge

As of April 24, 2006, all electronic publications on Statistics Canada's Web site will be available free of charge.

The Agency has been steadily increasing the volume of free content on its Web site to respond to the information needs of Canadians. This latest move makes available at no charge more than 150 electronic publications for which fees were previously charged.

Statistics Canada will continue to charge for print versions of publications and for other electronic products and services, such as CD-ROMs, specialized data tables and customized retrievals from CANSIM and the Canadian International Merchandise Trade database.

Study: The year in review: The revenge of the old economy, 2005

Economic developments in Canada last year were again largely shaped by the global economy. This reflects the historic changes taking place as a result of globalization, notably the integration of Asia into the world economy.

Canada's economy is undergoing rapid and profound changes, and not just between booming resources and construction and declines in some manufacturing industries. The energy sector is developing new sources, while manufacturing itself was being buoyed by the strength in resources and investment demand. And all sectors have to deal with a shift in trade flows to Asia.

Some trends remained unchanged. Inflation stayed low, keeping interest rates near their historic lows. And old habits were hard to break: Canadians continued to buy trucks and sport utility vehicles in increasing numbers, and energy consumption grew despite high prices.

The growth of the resource sector has revived fears that the current boom will quickly revert to the bust of previous cycles (notably for energy). However, solid arguments can be made that prices will stay "stronger for longer."

The participation rate shrank last year, the first time it has contracted outside of a recession, despite low unemployment and rising wages. The decline was led by youths aged 15 to 24 years and adult women. For adult women, this is a notable break from decades of sustained increases.

The study *The year in review: The revenge of the old economy* is now available for free. The study is also included in the April 2006 Internet edition of *Canadian Economic Observer*, Vol. 19, no. 4 (11-010-XIB, $19/$182), which is also available. The monthly paper version of *Canadian Economic Observer*, Vol. 19, no. 4 (11-010-XPB, $25/$243) became available on April 20. This issue also presents another feature article entitled *Recent trends in corporate finance*." This announcement appeared in *The Daily* on April 13, 2006.

Philip Cross, Current Economic Analysis Group, Statistics Canada.

Business Dynamics in Canada – 1991 to 2003

The publication *Business Dynamics in Canada*, 2003 (61-534-XIE), was created using data from the Longitudinal Employment Analysis Program (LEAP) file and was announced in *The Daily* on March 10, 2006.

It contains summary tables with information on various aspects of business. These include business creation (births or entry); business destruction (deaths or exits); distribution of firm and employment by size knowledge-based industry and geography; survival rates of firms by knowledge-based industry; and average size of business by knowledge-based industry and by size of firm.

Lyne Lafrance, Analytical Studies Branch, Statistics Canada.

Federal science expenditures intended to directly benefit developing countries – 2004/2005 (preliminary)

Preliminary data for 2004/2005 from the **Survey on Federal Science Expenditures Intended to Directly Benefit Developing Countries** indicate that the federal government spent $495 million on science and technology to benefit developing countries, or 5.7% of Canada's total expenditures on science and technology ($8.7 billion) in 2005.

The Canadian International Development Agency and the International Development Research Centre accounted for 97% of federal expenditures on developing countries.

The majority of science and technology expenditures were in the areas of public health, agricultural production and agricultural technologies, representing 74% of expenditures on developing countries.

This article was announced on March 23, 2005 in *The Daily*.

Julio Rosa, SIEID, Statistics Canada.

Management, scientific and technical consulting services

The management, scientific and technical consulting services industry consists of firms that provide expert advice and assistance to other organizations on management, environmental, scientific and technical issues. Growth in these consulting services mirrored that of many other service activities in 2004, with a strong increase in business and technical consulting stemming from resource development, particularly in Alberta.

The consulting services industry generated $8.8 billion in operating revenues in 2004, up slightly from 2003. While operating expenses remained relatively stable at $7.0 billion, the industry's operating profit margin rose to 20% in 2004, up from just over 17% in 2003. As the primary input to consulting services is human capital, salaries and wages accounted for 43 cents of every dollar of operating expenditure during 2004.

Businesses providing consulting services in Alberta showed the strongest growth rate in 2004, increasing 11% over 2003, while those businesses operating in Ontario were up 5%. Approximately half (49%) of the industry's operating revenues were generated by firms located in Ontario, followed by Quebec and Alberta at 17%, and British Columbia at 12%.

Data for 2004 and revised data for 2002 and 2003 are now available and were announced in *The Daily* on March 24, 2006. The data for 2002 and 2003 have been revised to reflect more accurate coverage of the target population for this industry.

Luc Provençal, Service Industries Division, Statistics Canada.

Study: Science and engineering employment in Canada and the United States – 2000 and 2001

Although Canada may lag behind the United States in terms of domestic expenditures on research and development, proportionally, scientists and engineers are just as prevalent here as they are south of the border, according to a new report. In 2000 and 2001, scientists and engineers together accounted for 4.5% of paid employment in both countries.

This proportion nearly doubled in both nations during the previous two decades. In 1980 and 1981, scientists and engineers represented 2.3% of paid workers in Canada, and 2.6% in the United States.

Canada's system of innovation is sometimes characterized as "disadvantaged" because Canadian businesses devote proportionately fewer resources to research and development than do businesses elsewhere, particularly in the United States.

However, the intensity of research and development is only one measure of an economy's innovative capacity. Scientists and engineers have long been regarded as important to innovation and technological progress.

This study focuses on a set of occupations that are classified as science or engineering-based by the National Science Foundation. These occupations include computer and

mathematical scientists, life scientists, physical scientists, social scientists and engineers.

The research paper *The Canadian Economy in Transition: Innovation Capabilities: Science and Engineering Employment in Canada and the United States* (11-622-MIE2006011) was announced in *The Daily* on May 4, 2006.

Guy Gellatly and Desmond Beckstead, the Micro-economic Analysis Division, Statistics Canada.

Study: Science and engineering employment in Canadian and US metropolitan centres – 1981 to 2001

Based on the strength of their science and engineering (S&E) work forces, Canadian cities have the same innovative capacity as US cities, with Ottawa, Calgary and Toronto leading the way.

Increasingly, analysts point to cities as hot beds of innovation, with Silicon Valley regarded as the quintessential innovative region. A study released today compares the innovative capacity of Canadian and US metropolitan areas using their shares of employment in S&E occupations.

In 2001, scientists and engineers represented 5.6% of all paid employment in Canada's metropolitan areas. This compares favourably to the proportion of 5.1% in the United States.

Two decades earlier, the proportions were almost the same — 2.9% in Canada and 3.0% south of the border. Employment in science and engineering in Canadian cities increased at a faster pace than in US metropolitan areas during this 20-year period.

The research paper The Canadian Economy in Transition: Innovation Capabilities: Comparing Science and Engineering Employment in Canadian and US Cities (11-622-MIE2006012) was announced in *The Daily* on May 11, 2006.

Desmond Beckstead and Mark Brown, Micro-economic Analysis Division, Statistics Canada.

Research and development in the health field

Research and development (R&D) in the health field is gaining importance in Canada, accounting for nearly one-quarter of total spending on R&D in 2005, according to preliminary figures.

Gross spending on health R&D amounted to an estimated $6.0 billion last year, 6.8%, or $379 million higher than the level in 2004.

R&D on health accounted for 23% of gross domestic spending on R&D in 2005. A decade earlier, it represented only 16%.

The higher education sector accounted by far for the lion's share of R&D spending on health, about 62%.

This sector, which includes universities and teaching hospitals, performed an estimated $3.7 billion of R&D on health, up 10.0% from 2004 and more than double the level from 1995. The business enterprise sector performed more than $2.0 billion, up 2.6%.

The largest funders of R&D spending on health were the business enterprise sector and the higher education sector, which contributed about $1.6 billion each in 2005. They were followed by the federal government sector, which contributed $1.2 billion.

The service bulletin *Science Statistics: Estimates of Total Spending on Research and Development in the Health Field in Canada, 1988 to 2005*, Vol. 30, No. 3 (88-001-XIE) was announced in *The Daily* on May 12, 2006.

Janet Thompson, SIEID, Statistics Canada.

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	2000	2001	2002	2003	2004	2005
General economy and population[1]							
GDP	$ millions	1,076,577	1,108,048	1,154,204	1,216,191	1,290,185	1,368,726
GDP implicit price index	1997=100	105.5	106.7	107.8	111.3	114.7	118.3
Population	thousands	30,689	31,021	31,373	31,669	31,974	32,271
Gross domestic expenditures on R&D (GERD)[2]	$ millions	20,635	23,206	23,382	23,992	25,259	26,268
"Real" GERD	$ millions 1997	19,559	21,749	21,690	21,556	22,022	22,205
GERD/GDP ratio	ratio	1.92	2.09	2.03	1.97	1.96	1.92
"Real" GERD/capita	$ 1997	637.34	701.10	691.36	680.67	688.74	688.07
GERD funding by sector							
Federal government	% of GERD	17.3	17.7	18.0	18.7	19.4	19.1
Provincial governments	% of GERD	4.3	4.5	5.1	5.8	6.1	6.3
Business enterprise	% of GERD	44.9	50.3	51.3	49.3	47.9	47.1
Higher education	% of GERD	14.0	12.6	14.8	14.9	15.6	16.5
Private non-profit	% of GERD	2.2	2.3	2.7	2.6	2.7	2.9
Foreign	% of GERD	17.5	12.7	8.2	8.6	8.3	8.2
GERD performance by sector							
Federal government	% of GERD	10.1	9.1	9.4	8.7	8.9	8.1
Provincial governments	% of GERD	1.2	1.3	1.3	1.3	1.4	1.4
Business enterprise	% of GERD	60.3	61.7	57.2	55.8	54.0	52.7
Higher education	% of GERD	28.1	27.7	31.9	33.9	35.4	37.5
Private non-profit	% of GERD	0.3	0.2	0.2	0.3	0.3	0.3
Federal performance as a % of federal funding	% of federal	58.4	51.3	52.0	46.3	46.1	42.6
"Real" federal performance of R&D	$ millions 1997	1,972	1,971	2,032	1,872	1,968	..
Information and communications technologies (ICT)							
ICT sector contribution to GDP - basic prices[3]							
ICT, manufacturing	$ millions	17,070	11,069	8,889	8,871	9,949	11,428
% of total ICT	% of total ICT	30.9	20.6	16.3	15.9	17.1	8.6
ICT, services	$ millions	38,316	42,349	45,016	46,093	47,465	49,221
% of total ICT	% of total ICT	69.4	78.6	82.4	82.8	81.7	80.3
Total ICT	$ millions	55,176	53,857	54,608	55,698	58,112	61,294
Total economy[4]	$ millions	943,738	957,257	986,070	1,008,945	1,040,779	1,072,446
ICT % of total economy	%	5.8	5.6	5.5	5.5	5.6	5.7
Total business sector	$ millions	798,412	808,811	834,533	854,425	884,924	913,593
ICT % of business sector	%	6.9	6.7	6.5	6.5	6.6	6.7
ICT adoption rates (private sector)							
Personal Computer	% of enterprises	81.4	83.9	85.5	87.4	88.6	n/a
E-Mail	% of enterprises	60.4	66.0	71.2	73.8	76.6	76.2
Internet	% of enterprises	63.4	70.8	75.7	78.2	81.6	81.6
Have a website	% of enterprises	25.7	28.6	31.5	34.0	36.8	38.3
Use the Internet to purchase goods or services	% of enterprises	18.2	22.4	31.7	37.2	42.5	43.4
Use the Internet to sell goods or services	% of enterprises	6.4	6.7	7.5	7.1	7.4	7.3
Value of sales over the Internet	$ millions	7,246	10,389	13,339	18,598	26,438	36,268

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, 2006, CANSIM Tables 379-0017 "Gross Domestic Product (GDP) at basic prices, by North American Industry Classification System (NAICS), annual" and 379-0020 "Gross Domestic Product (GDP) at basic prices, special industry aggregations based on North American Industry Classification System (NAICS), annual". www.statcan.ca, Ottawa, Canada.
4. The "total economy" is in chained-Fisher methods of deflation and therefore does not match GDP.

	Units	2000	2001	2002	2003	2004	2005
Information and communications technologies (ICT) continued							
ICT adoption rates (public sector)							
Personal Computer	% of enterprises	100.0	100.0	99.9	100.0	100.0	n/a
e-mail	% of enterprises	99.0	99.7	99.6	99.8	99.9	99.6
Internet	% of enterprises	99.2	99.7	99.6	100.0	99.9	99.6
Have a Web site	% of enterprises	72.6	86.2	87.9	92.7	92.4	94.9
Use the Internet to purchase goods or services	% of enterprises	49.1	54.5	65.2	68.2	77.4	82.5
Use the Internet to sell goods or services	% of enterprises	8.6	12.8	14.2	15.9	14.0	15.2
Value of sales over the Internet	$ millions current	111.5	354.8	327.2	511.4	1,881.5	2,924.7
Teledensity indicators							
Wired access (Voice Grade Equivalent - VGE)	per 100 inhabitants	28.3	67.1	64.7	63.4	60.7	58.6
Wireless access (VGE)	per 100 inhabitants	28.4	34.3	37.9	41.8	46.5	51.5
Total public switched telephone network (PSTN) (VGE)	per 100 inhabitants	94.7	101.4	102.6	105.2	107.2	110.1
Homes with access to cable	thousands	10,900.5	11,078.7	11,396.2	11,718.5	11,937.1	..
Homes with access to Internet by cable	thousands	7,609.7	9,341.8	10,058.8	10,705.6	11,156.4	..
Access indicators							
Total wired access lines (VGE)	thousands	20,347.0	20,805.1	20,300.8	20,067.6	19,470.5	18,976.1
Residential access lines (VGE)	thousands	12,871.7	12,854.2	12,752.1	12,648.2	12,488.1	11,947.9
Business access lines (VGE)	thousands	7,475.3	7,950.9	7,548.7	7,419.3	6,982.4	7,028.1
Total mobile subscribers	thousands	8,726.6	10,648.8	11,872.0	13,227.9	14,912.5	16,663.8
Digital cable television subscribers	thousands	387.2	808.4	1,150.1	1,382.4	1,843.5	..
Satellite and MDS subscribers	thousands	967.1	1,609.2	2,018.6	2,205.2	2,324.6	..
High speed Internet by cable subscribers	thousands	786.3	1,384.8	1,874.8	2,363.3	2,837.8	..
Investment indicators							
Investments by the telecommunications services industries (NAICS 517)	$ millions (current)	9,517.8	10,720.5	7,310.4	6,181.0	6,984.3	7,365.9
Investments by the telecommunications services industries (NAICS 517)	$ millions (constant)	9,866.2	11,146.5	7,586.8	6,977.5	8,074.8	8,782.1
Characteristics of biotechnology innovative firms[5]							
Number of firms	number	..	375	..	496	..	..
Total biotechnology employees	number	..	11,897	..	11,931	..	..
Total biotechnology revenues	$ millions	..	3,569	..	3,820	..	..
Expenditures on biotechnology R&D	$ millions	..	1,337	..	1,487	..	..
Export biotechnology revenues	$ millions	..	763	..	882	..	..
Import biotechnology expenses	$ millions	..	433	..	422[E]	..	..
Amount of capital raised	$ millions	..	980	..	1,695	..	..
Number of firms that were successful in raising capital	number	..	134	..	178	..	..
Number of existing patents	number	..	4,661	..	5,199	..	..
Number of pending patents	number	..	5,921	..	8,670	..	..
Number of products on the market	number	..	9,661	..	11,046[E]	..	..
Number of products/processes in pre-market stages	number	..	8,359	..	6,021	..	..
Intellectual property commercialization[6]							
Federal government							
New patents received	number	..	110[r]	133[r]	142[r]	178[p]	169[p]
Royalties on licenses	$ thousands	..	15,669[r]	16,284[r]	15,508[r]	15,063[p]	15.154[p]
Universities and hospitals							
New patents received	number	..	381	..	347	396	..
Income from intellectual property	$ thousands	..	52,510	..	55,525	51,235	..

5. 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.
6. Sources: Statistics Canada, Federal Science Expenditures and Personnel Survey, and Survey of Intellectual Property Commercialization in the Higher Education Sector (various years).