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Innovation Analysis Bulletin

A report from Statistics Canada with statistical and analytical updates on:

- **Government science and technology activities**
- **Industrial research and development**
- **Intellectual property commercialization**
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Investment in research and development (R&D) is important to the economy of a country, and its measurement is an essential component of the Canadian statistical system. The publication, *Gross Domestic Expenditures on Research and Development in Canada and the Provinces (GERD), 1997 to 2008* (Statistics Canada 2008a) provides a statistical picture of the Canadian system of research and development. These data inform public policy, help benchmark Canadian performance against other countries (OECD 2007, 2008) and provide essential input to the study of the impact of science and technology on the life of Canadians.

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The Organisation for Economic Co-operation and Development (OECD) collects and reports on statistics from its member countries for various subject matter fields. In order to properly compare these statistics, the OECD develops common concepts and measurement standards. For the field of research and development (R&D) statistics, the OECD's proposed standard practice for R&D surveys is detailed in the *Frascati Manual* (OECD 2002). However, not all OECD countries' national practices align with the *Frascati Manual* standards. The OECD receives Canadian R&D data from surveys conducted by Statistics Canada. While the general concepts of the *Frascati Manual* are integrated with Statistics Canada's survey framework, national variations in reporting with the OECD still exist. One of these national differences in data presentation can be found in the allocation of public general university funds.

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Besides the articles to which we refer in this bulletin, Statistics Canada's Web site provides a wealth of statistics, facts and research papers on a variety of related topics. As well, the questionnaires we have used to collect the information are available for research purposes.

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

Differences in the characteristics of innovative and non-innovative manufacturing plants

This article explores differences in characteristics of innovative and non-innovative manufacturing plants in Canada using results from the Survey of Innovation (SOI) 2005. It finds that innovative plants are more likely than non-innovators to be large, to have employees with higher education credentials, to engage in research and development (R&D) and marketing activities and to have full-time R&D employees. Innovative plants are also more likely to receive external funding, to export and import, to use both formal and informal methods of intellectual property protection, and to have differences in how they rate the importance of success factors.

Plant size and the innovation/non-innovation divide

Innovation is a key factor in firm growth because it can contribute to aggregate productivity growth which can translate into long run improvements in living standards (Baldwin 1995, 1999). Results from the 2005 SOI show that almost two-thirds (65.0%) of Canadian manufacturing plants were innovators.

Evidence from the 2005 SOI indicates that innovators are more likely to be large plants, as defined by number of employees and by revenue. Table 1 shows that manufacturing plants with 50 or more employees were more likely to be innovators than non-innovators. More than half of innovative plants (58.2%) had 50 or more employees, compared to 43.6% of non-innovative plants.

Table 1
Size comparison of innovative and non-innovative manufacturing plants, 2002 to 2004

	Innovators	Non-innovators
Characteristic	%	
Plants with at least 50 employees	58.2	43.6 *
Plants with revenues of at least $5 million	65.3	50.7 *
Percentage of plants that are part of a larger firm	37.6	29.1 *

* Difference is statistically significant ($p < 0.05$).
Source: Statistics Canada, Survey of Innovation, 2005.

The size of a plant can also be gauged by its revenue. Empirical evidence shows that when compared to non-innovators, innovators were more likely to be higher revenue earners. Almost two-thirds (65.3%) of innovators had revenues greater than $5 million, compared to one-half (50.7%) of non-innovators.

These findings may buttress the thesis that larger plants have certain advantages which make them more innovative than smaller ones. Some of these advantages include stronger cash flows to fund innovation activities, higher value assets that they can use as collateral for loans geared toward innovation, and lastly, wider access to human capital for innovation (Rogers 2000).

Further, innovators have a greater likelihood of being part of a larger firm. Almost four-in-ten innovators (37.6%) were part of a larger firm compared to three-in-ten (29.1%) non-innovators.

About this article

An innovation is defined as the introduction of new or significantly improved goods or services to the market, or the introduction of new or significantly improved processes, including new or significantly improved ways of delivering goods or services (OECD/Eurostat 1997). Only innovations occurring between 2002 and 2004—the survey reference period—were included in this analysis.

Although the *Oslo Manual* has since undergone revision (OECD/Eurostat 2005) to include both organizational and marketing innovations, the third edition had not yet been published when the 2005 SOI was undertaken. Thus, the 2005 SOI did not measure the prevalence of marketing and organizational innovations.

Innovative plants are those that indicated in the 2005 SOI that they introduced a new or significantly improved product or process during the reference period.

Non-innovative plants are those that did not introduce a new or significantly improved product or process during the reference period.

The sample unit for the SOI 2005 was the statistical establishment, for which the questionnaire substituted the more familiar word “plant”. The latter term is also used in this article.

More information about the SOI 2005 is available at http://www.statcan.ca/english/sdds/4218.htm.

Note to readers

The following tables have been changed:

Tables 2, 3, 4 and 6.

July 10, 2009

Is there a skills gap between innovative and non-innovative plants?

It is now well-established that the probability of a firm being an innovator is highly correlated with the skill structure of its employees (Gellatly 1999). Innovative capabilities depend on the knowledge capital of employees, which is partly embodied in the formal level of qualification. Hall (1998) concluded that innovative firms are more likely than non-innovators to implement policies that favour hiring qualified workers in order to foster the most adequate environment for the materialization of new ideas.

The results of the SOI 2005 suggest that the employment of university and college or technical institute graduates differs significantly between innovative and non-innovative plants, with the former being more likely than the latter to have full-time employees with higher education. Innovative plants are more likely to employ university graduates than non-innovative plants (Table 2). They are also more likely to have a higher proportion of employees with college or technical institute diplomas.

Table 2
Employee education credentials of innovative and non-innovative manufacturing plants, 2004

	Innovators	Non-innovators
Characteristic	%	
Plants with some full-time employees with a university degree	86.9	67.4 *
Plants with some full-time employees with a college/technical institute diploma	95.3	82.9 *

* Difference is statistically significant ($p < 0.05$).
Source: Statistics Canada, Survey of Innovation, 2005.

Propensity of innovative and non-innovative plants to engage in research and development and marketing activities

Research and development (R&D) is one of the key drivers of productivity growth (Baldwin 1999). International evidence suggests that high levels of R&D support strong and stable firm growth (Basile 2001). Although R&D performance by itself does not guarantee success in innovation, it has been found to be a key component in the innovative process (Baldwin 1997, Napolinato 1991). Results of the SOI 2005 show that innovators were more likely than non-innovators to have full-time employees engaged in R&D (Table 3).

Table 3
Research and development (R&D) and marketing in innovative and non-innovative manufacturing plants, 2002 to 2004

	Innovators	Non-innovators
Characteristic	%	
Plants with some full-time employees involved in R&D, 2004	80.6	36.4 *
Plants with some full-time employees involved in marketing, 2004	95.0	85.2 *
Plants that use R&D tax credits, 2002 to 2004	51.6	12.9 *

* Difference is statistically significant ($p < 0.05$).
Source: Statistics Canada, Survey of Innovation, 2005.

Good marketing strategies complement innovation. Innovators place greater emphasis on marketing activities, they have a broader range of products and spend more on marketing than non-innovators (Baldwin and Johnson 1995). The results of the SOI 2005 show that innovators are more likely to have full-time employees engaged in marketing than non-innovators.

Many governments have introduced R&D tax credits as a further incentive for firms to increase their R&D investment. Evidence (Mohnen and Bérubé 2007, Dalby 2005, Dagenais, Mohnen and Therrien 1997) suggests that tax incentives stimulate R&D activity between $0.98 and $1.38 per dollar of foregone tax expenditure (excluding possible provincial tax incentives) and that R&D tax credits impact positively on the firm's decision to conduct R&D and to increase innovation output (Czarnitzki, Hanel and Rosa 2005).

According to the results of the SOI 2005, innovative plants were more likely to use R&D tax credits than non-innovative plants (see again Table 3). Also, innovators were more likely to use both federal and provincial R&D tax credits than non-innovators.

Use of intellectual property protection methods among innovators and non-innovators

According to the results of the SOI 2005, about 7 out of every 10 innovative plants (69.6%) used formal intellectual property protection methods, while only about 4 out of every 10 non-innovative plants (42.1%) used similar methods (Table 4). In addition, three-quarters of innovative plants (74.7%) also used informal methods of intellectual property protection, compared to less than one-half of non-innovators (41.0%).

Table 4
Use of intellectual property protection in innovative and non-innovative manufacturing plants, 2002 to 2004

	Innovators	Non-innovators
Characteristic	%	
Plants using formal methods of intellectual property protection, 2002 to 2004	69.6	42.1 *
Plants using informal methods of intellectual property protection, 2002 to 2004	74.7	41.0 *
Plants with revenues protected by patents, 2004	25.5	9.6 *

* Difference is statistically significant ($p < 0.05$).
Source: Statistics Canada, Survey of Innovation, 2005.

Another indicator of the level of use of intellectual protection methods is the percentage of plants with revenues protected by patents. Innovators were more likely to have their revenues protected by patents (25.5% versus 9.6%).

Are innovators more likely than non-innovators to receive external funding?

Overall, innovative plants are more likely than non-innovative plants to receive funding from external sources. However, this was dependent on the type of funding in question. For example, innovators were more likely to receive Canadian-based venture capital, American-based venture capital and other external sources (Table 5). On the other hand, innovators were just as likely as non-innovators to receive venture capital from other countries, angel investors/ family capital, private placement, initial and secondary public offerings, and collaborative arrangements and alliances.

Table 5
External funding characteristics of innovative and non-innovative manufacturing plants, 2002 to 2004

Characteristic	Innovators	Non-innovators
	%	
Plants that received external funding	44.5	31.6 *
Plants that used conventional sources	90.4	93.5
Plants that used Canadian-based venture capital	9.7	3.8 *
Plants that used American-based venture capital	2.4	0.5 *
Plants that used venture capital from other countries	0.6	0.2
Plants that used angel investors/family capital	13.3	10.7
Plants that used private placement	9.5	5.1
Plants that used initial public offering	1.0	0.6
Plants that used secondary public offering	0.7	0.3
Plants that used collaborative arrangement and alliances	4.5	4.7
Plants that used other external funding sources	11.4	4.9 *

* Difference is statistically significant ($p < 0.05$).
Source: Statistics Canada, Survey of Innovation, 2005.

Innovators more likely than non-innovators to export and import

Studies have shown that R&D and innovation are very important drivers of firms' decisions to export (Basile 2001, Bernard and Jensen 1999, Cassiman and Martinez-Ros 2007). Results of the SOI 2005 support these findings. As discussed earlier, innovative plants were more likely than non-innovators to have full-time employees engaged in R&D. In addition, compared to their non-innovative counterparts, innovative plants were found to be more likely to have markets outside Canada. Table 6 shows that in addition to being more likely to have revenues from the rest of Canada (outside their province of operation) innovative plants are more likely than non-innovative firms to have revenues from the United States, Europe, Mexico, the Asia-Pacific region and other countries. This suggests that encouraging and raising innovation levels could also lead to increased export levels.

Compared to non-innovators, innovators are also more likely to import raw materials from outside Canada. Table 6 shows that for all the geographical areas listed, innovative plants were more likely than their non-innovative counterparts to import raw materials. For example, almost 8 out of every 10 innovators (78.5%) imported raw materials from the United States, compared to about 6 out of every 10 non-innovators.

Table 6
Location of revenue sources, raw material expenditures, and machinery and equipment purchases, innovative and non-innovative manufacturing plants, 2004

Characteristic	Innovators	Non-innovators
	%	
Revenues		
Plants with some of their revenues from the rest of Canada (outside their province of operation)	76.8	59.1 *
Plants with some of their revenues from the United States	77.0	58.2 *
Plants with some of their revenues from Mexico	11.7	5.2 *
Plants with some of their revenues from Europe	20.2	8.5 *
Plants with some of their revenues from the Asia-Pacific region	16.2	7.3 *
Plants with some of their revenues from other countries	17.0	9.4 *
Raw material expenditures		
Plants with expenditure on raw materials from the United States	78.5	59.9 *
Plants with expenditure on raw materials from Mexico	5.0	2.4 *
Plants with expenditure on raw materials from Europe	22.1	10.8 *
Plants with expenditure on raw materials from the Asia-Pacific region	21.8	12.4 *
Plants with expenditure on raw materials from other countries	11.4	6.2 *
Machinery and equipment purchases		
Plants that bought new machinery or equipment	74.2	46.7 *
Plants that bought new machinery or equipment from Canadian-based firms	36.8	24.9 *
Plants that bought new machinery or equipment from the United States	56.1	38.5 *

* Difference is statistically significant ($p < 0.05$).
Source: Statistics Canada, Survey of Innovation, 2005.

Also, in 2004, innovators were more likely than non-innovators to buy new machinery or equipment. This was true of machinery and equipment purchased from both Canada and the United States.

Innovators and non-innovators have different perceptions of success factors important to their plant

Important differences were found between innovative and non-innovative plants with respect to the factors they considered highly important for their plants' success. As Table 7 shows, innovative firms are more likely to report that developing niche markets, new markets and export markets are success factors of high importance to them. On the other hand, both of these groups are equally likely to indicate that satisfying existing clients and complying with environmental regulations are success factors of high importance. These two factors can be considered more general factors important to plants regardless of innovation status.

Table 7
Success factors of high importance for innovative and non-innovative manufacturing plants, 2002 to 2004

	Innovators	Non-innovators
Success factors	%	
Developing export markets	24.2	14.4 *
Developing custom-designed products	45.1	25.8 *
Developing niche markets	37.2	23.6 *
Developing new markets	40.0	24.2 *
Complying with environmental standards	36.3	32.3
Satisfy existing clients	88.2	89.3

* Difference is statistically significant ($p < 0.05$).

Source: Statistics Canada, Survey of Innovation, 2005.

Developing new markets, niche and export markets, and developing custom-designed products are all factors that would be expected to require some level of innovation, thus it is not surprising that these factors are highly emphasized by innovative plants.

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Internet use: An international and inter-provincial comparison

The adoption and use of information and communications technologies (ICTs) by individuals and businesses in part determines a country's ability to participate successfully in the global information economy. As the Internet is an essential component of ICT infrastructure, its use has become a key hallmark of this participation. In order to situate Internet use both geographically and over time, this study compares 2005 and 2007 Canadian use rates with those of other selected countries, as well as among Canadian provinces.

Measuring Internet use

The measurement of Internet use in Canada has evolved with shifting policy interests. Since the commercial launch of the Internet in 1993, policy objectives have included connecting Canadians, promoting broadband, understanding individual online use and the impacts on Canadian society and the economy. The Canadian Internet Use Survey (CIUS) was designed to focus on individual Internet use and more closely conform to international standards; in particular the Organisation for Economic Co-operation and Development's (OECD) model survey. This focus has spawned new research on impacts of the Internet such as distance learning, health information, and social participation.[1] At the same time, this new design allows for Canadian estimates to be more internationally comparable (see About this article).

Factors that influence Internet use

Internet use prevalence in a given country is influenced by a combination of economic, cultural, demographic and geographic factors as well as public policy. For example, income levels combined with price and availability of service play an important part. Culturally, a large portion of Web content has traditionally been dominated by a few languages. Demographically, younger individuals adopt ICTs, including the Internet, more quickly than older members of society. And studies also continue to identify other factors such as education, gender and employment characteristics as significant influences.[2]

Geographically, Internet use diffused from early adopters, primarily in the academic and scientific communities. Initially, these communities tended to cluster around universities located predominantly in large population centres. In Canada, research has found that residents of small towns and rural areas, irrespective of distance from urban areas, continue to have lower odds of Internet use, controlling for other factors such as age, income and education.[3] While geographic factors may play a larger role in countries such as Canada or Australia, this finding also implies that regions with larger rural populations will have lower rates of Internet use.

An international comparison

To compare Canada with other countries, Chart 1 presents rates of individual Internet use from any location during 2005 and 2007. Among those listed in the chart, Scandinavian countries continue to lead, while Canada's Internet use rates in 2005 (72%) and in 2007 (77%) are similar to that of the United Kingdom and Germany, with Australia closely following.[4] Overall, Internet use rates increased in most countries during this period.

About this article

The 2005 Canadian Internet Use Survey (CIUS) asked more than 30,000 Canadians aged 18 years and over about their personal Internet use over a 12-month period. The 2007 CIUS asked approximately 26,500 Canadians aged 16 and over about their Internet use. The inclusion of those aged 16 and 17 in the 2007 survey accounted for almost one percentage point of the overall five percentage point increase in Internet use reported in Canada between 2005 and 2007. For more information on the CIUS, see:
http://dissemination.statcan.ca/english/sdds/4432.htm

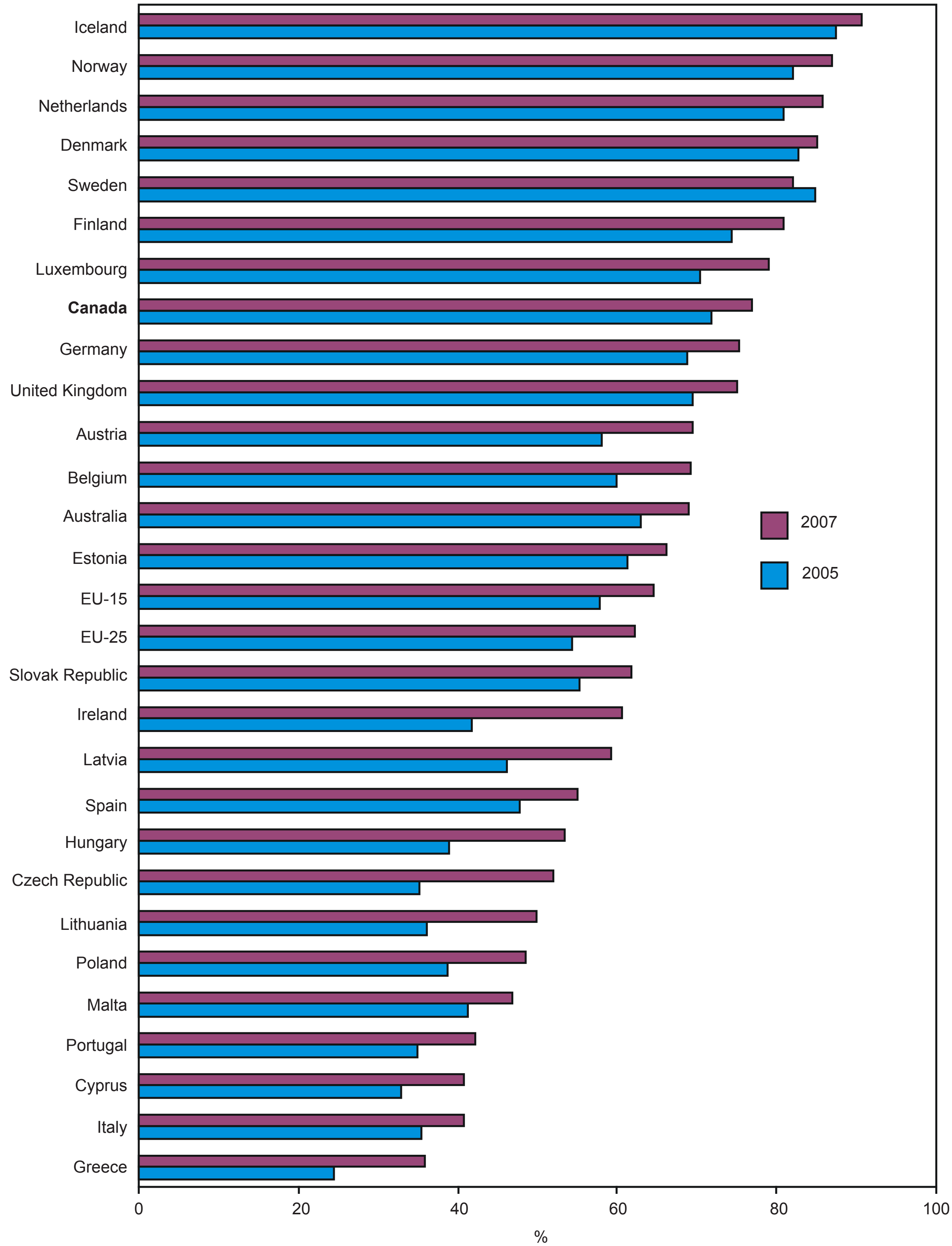
For other countries in this article, data published by Eurostat—the statistical agency of the European Union—are used. Eurostat surveys all member countries using the same questionnaire based on the OECD model. The Eurostat survey covers Internet use for personal or professional purposes. Some members are excluded due to a lack of comparability and/or availability for the years studied. For more information on the Eurostat surveys, see:
http://epp.eurostat.ec.europa.eu/portal/page/portal/information_society/introduction.

To compare with Eurostat estimates, figures for Canada refer to individuals aged 18 to 74 in 2005 and 16 to 74 in 2007. Consequently, these estimates will differ from those published elsewhere by Statistics Canada. For example, in 2007 the rate for the total population aged 16 and over was 73% (Statistics Canada 2008), compared with 77% for those aged 16 to 74. Data for Australia come from the Australian Bureau of Statistics. These data were not available with the 74 years of age cap.

As with most international country comparisons, extending the analysis to more detail beyond a broad level poses challenges due to differences in methodology, collection and data availability. Even at this level, estimates for certain countries could not be furnished. For example, comparable American data are not available and measures from Japan and Korea report individual use rates for those aged 6 years and older. In spite of these limitations, this article provides an overview of how Canadian Internet use rates compare with a number of other countries.

While most countries experienced little change in their relative position, some reported high rates of growth. For example, the Internet use rate in Greece reached 36% of individuals by 2007. While still comparatively low in 2007, the proportion of Greek users was one-and-a-half times higher than in 2005. Ireland also

Chart 1
Internet use by individuals in the last 12 months from any location, by country, 2005 and 2007



Notes: Data refer to individuals aged 16 to 74. For Canada, 2005 refers to individuals aged 18 to 74 and 2007 refers to age 16 to 74. For Australia, 2005 refers to individuals aged 18 or older for the reference period 2004 to 2005 and 2007 refers to age 15 or older for the period 2006 to 2007.

The EU-15 and EU-25 values refer to European Union 15-country and 25-country aggregate averages, respectively.

Sources: Eurostat, Community Survey on ICT Usage in Households and by Individuals, 2005 and 2007, Statistics Canada, Canadian Internet Use Survey, 2005 and 2007 and Australian Bureau of Statistics, Multi-Purpose Household Survey, 2004 to 2005 and 2006 to 2007.

experienced a high rate of growth, from a 42% use rate in 2005 to 61% in 2007. In countries with higher Internet use rates, there was less room for large growth as usage approaches saturation. The average percentage point increase in Internet use among countries with rates below 60% in 2005 was more than twice that of countries with rates over 60% in 2005.

Some studies have compared broadband connectivity among countries.[5] However, as differences are becoming more a matter of degree with the proliferation of bandwidth, Internet use remains a good indicator of digital participation.[6] Other studies develop indices of digital participation using several indicators. The framework upon which these studies are based allows for analyses within and across countries over time, as well as the monitoring of penetration of specific ICTs, including the Internet and broadband.[7] Finally, comparing specific online behaviours (for example, breadth of activities and intensity of use) across countries is very challenging and often limited to case studies or a small number of countries.[8]

The provincial dimension

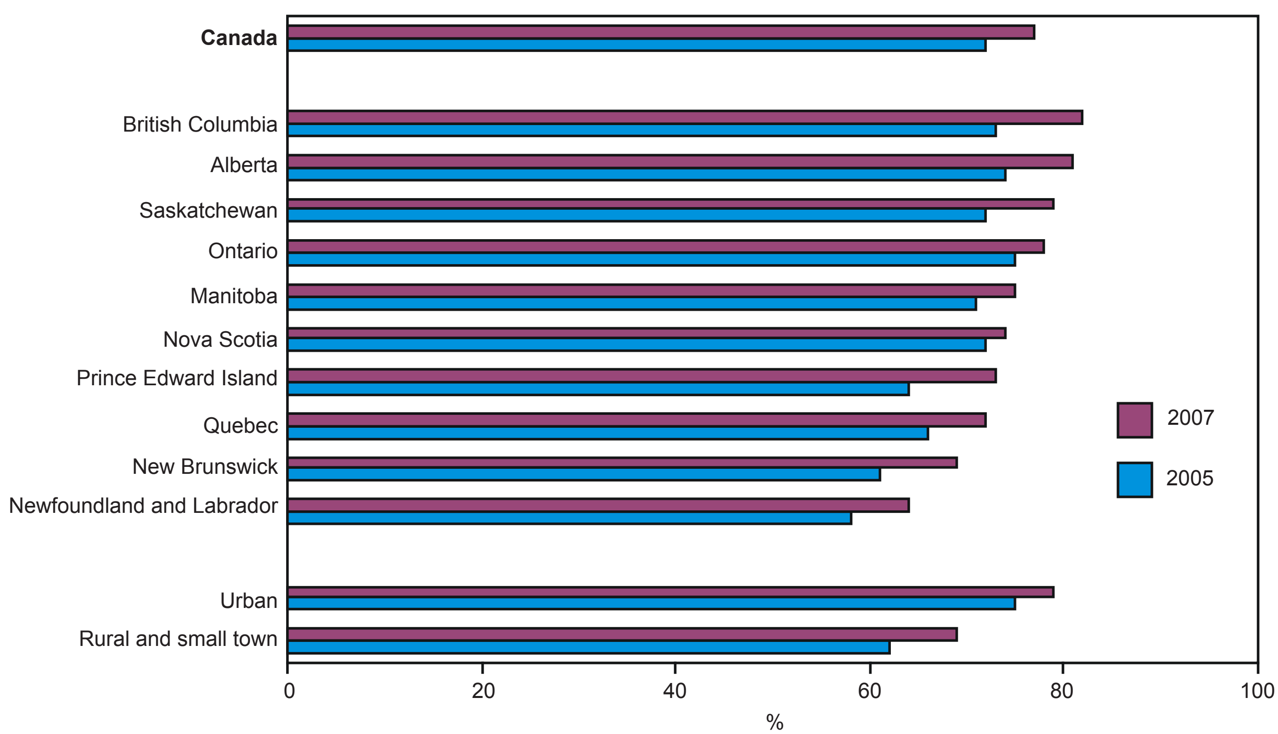
To compare and situate Internet use within Canada, Chart 2 presents provincial rates for 2005 and 2007. It is important to note the effect of location—urban versus rural and small town—on the prevalence of use. For example, while the 2005 Internet use rate in Nova Scotia equaled the national average (72%), it masked the difference between Halifax (79%) and the rest of the province (66%). Halifax is a provincial capital with a concentration of universities and health sciences facilities. With a younger population and relatively more residents having university education and higher incomes than elsewhere in the province, Halifax is an attractive market for Internet service providers.

By 2007, three western provinces—Saskatchewan, Alberta and British Columbia—had Internet use rates similar to leading European countries (Charts 1 and 2). The level of Internet use in these provinces was driven by high rates in urban areas, including Saskatoon (86%), Calgary (86%) and Victoria (89%). As with growth among countries, certain provinces with the lowest Internet use rates in 2005, such as Prince Edward Island and New Brunswick, experienced the highest growth rates.

Considerations

The Internet is one of the fastest diffusing ICTs to date.[9] The countries observed in Chart 1 had, on average, an 8 percentage point increase in Internet use over the two-year period, testimony to the rapidity by which this technology is diffusing. Countries with the highest rates of individual use in 2005 also reported the highest rates in 2007. Over a longer period of time, differences in Internet use rates should diminish as those countries with very high use rates approach saturation while others continue to experience growth.

Chart 2
Internet use by individuals in the last 12 months from any location, by province, 2005 and 2007



Notes: 2005 data include individuals aged 18 to 74 and 2007 data include individuals aged 16 to 74. The inclusion of individuals aged 16 and 17 accounted for almost one percentage point of the overall five percentage point increase in Canada over the 2005 to 2007 period.

Urban is defined as Statistics Canada's census metropolitan areas (CMA) and census agglomerations (CA). Rural and small town is defined as Canadians living outside CMAs and CAs.

Sources: Statistics Canada, Canadian Internet Use Survey, 2005 and 2007.

Canada reported similar Internet use rates to the United Kingdom and Germany for 2005 and 2007. And like Australia, Canada has a vast landscape with a dispersed population concentrated in urban areas.

In summary, differences in the collection and availability of Internet use data among countries present challenges for making precise comparisons. Future work could extend the comparison to uses of the Internet for specific activities and to the intensity of usage. Such exercises could help provide measures of successful participation in the global information economy.[10]

Notes

1. See McKeown and Underhill (2007); Underhill and McKeown (2008); and Veenhof, Wellman, Quell and Hogan (2008).

2. See OECD (2004); Huyer, Hafkin, Ertl and Dryburgh (2005); and McKeown, Veenhof and Corman (2008).

3. See McKeown, Noce and Czerny (2007). Another recent international comparison found that 'urbanicity'—the urban population percentage multiplied by the average density of urban areas—is the second most important factor in influencing broadband penetration. (Atkinson, Correa and Hedlund 2008).

4. The Australian rate would be much closer to Canada's if it was also capped at age 74 since the inclusion of elderly persons accounts in part for the lower figures reported for Australia.

5. Atkinson, Correa and Hedlund (2008) compared American household broadband use with thirty other countries. South Korea and Japan ranked the highest for broadband use on a composite score based on penetration, speed and price. On this same composite, Canada ranked 11th, just ahead of Australia and the United Kingdom, while the United States ranked 15th.

The OECD publishes a variety of broadband statistics (including broadband subscriptions per 100 inhabitants) at the OECD broadband portal, available at: http://www.oecd.org/sti/ict/broadband.

6. To illustrate, a Spearman's rank order correlation coefficient was calculated for the 22 countries common to the comparisons of Internet use (see Chart 1) and broadband penetration (Atkinson, Correa and Hedlund 2008). The 0.87 value implies a very strong, positive correlation between individual Internet use and household broadband penetration.

7. See Orbicom (2003, 2005, 2007); ITU (2007, 2009).

8. Montagnier and Vickery (2007) compile and analyze data from several sources to make comparisons of online activities and scope of individual Internet use among selected countries.

9. Sciadas (2002) analyzes the diffusion of various ICTs over time in Canada, and found that the diffusion of television occurred even faster than that of the Internet.

10. Atkinson, Castro and Ezell (2009) assert that investments in digital infrastructure lead to higher productivity, increased competitiveness, and improved quality of life in the longer term.

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Larry McKeown and Ben Veenhof, SIEID, Statistics Canada

The ongoing importance of gross domestic expenditures on research and development (GERD)

Investment in research and development (R&D) is important to the economy of a country, and its measurement is an essential component of the Canadian statistical system. The publication, *Gross Domestic Expenditures on Research and Development in Canada and the Provinces (GERD), 1997 to 2008* (Statistics Canada 2008a) provides a statistical picture of the Canadian system of research and development. These data inform public policy, help benchmark Canadian performance against other countries (OECD 2007, 2008) and provide essential input to the study of the impact of science and technology on the life of Canadians.

Canadian system of research and development

Business, government, higher education sector and non-profit organizations all play a part in the system of research and development. Their research may be driven by different motivations, but they all contribute to the advancement of knowledge and well-being of Canadians. While their activities overlap, their roles are distinct. University research is inspired by the spirit of inquiry; business integrates research findings into applications to create new products and processes; and government and private non-profit organizations perform and support research for the public good.

The players are linked through various formal and informal arrangements to take advantage of each other's core competencies. The relationship can take the form of a contract, a collaborative arrangement, a partnership or a donation. Table 1 provides a measure of this association. For example, the higher education sector spent $9.8 billion on R&D in 2008. Of this amount, 46% was contributed by universities and colleges themselves while government provided 36% and business and private non-profit organizations gave about 8% each.

International collaboration also plays an important role, as countries try to share the high costs, risks and expertise involved in the development of complex technologies. Common objectives and, in some cases, the global scope of the projects (for example, global warming) also drive co-operation. In 2008, foreign organizations supported R&D in Canada in the amount of $2.6 billion. All but a small amount went to businesses, including subsidiaries of foreign multinational corporations and to the headquarters of Canadian multinational corporations.

Trends in research and development performance

Business is the main R&D performing sector of the economy. Its research is usually targeted at proprietary product development. While most of business research is performed by the sector itself, it also enters into collaborative arrangements with other sectors. Partnership with universities and colleges is particularly beneficial because the latter specialize in knowledge creation, offer economies of scale and can quickly bring together multidisciplinary research teams. These arrangements enable industry to license technologies which incorporate not only the work sponsored by it but also the accumulated knowledge of researchers partly acquired from projects funded by government grants.

While business is the leading R&D performer, institutions of higher education are becoming increasingly important. University research is the fastest growing component (Chart 1). Research activity is widely dispersed among many institutions but a small number account for much of the activity.

Table 1
Gross domestic expenditures on research and development (R&D), Canada, 2008^{p}

	Performing sector				
	Government	Business	Higher education	Private non-profit organizations	Total R&D
Funding sector	millions of dollars				
Government	2,702	376	3,558	52	6,686
Business	84	13,461	826	15	14,386
Higher education	0	0	4,532	0	4,532
Private non-profit organizations	0	0	793	58	850
Foreign	0	2,479	128	7	2,616
Total R&D	**2,786**	**16,316**	**9,837**	**132**	**29,071**

Source: Statistics Canada, Gross Domestic Expenditures on Research and Development in Canada (GERD) and the Provinces, 1997 to 2008, Catalogue no. 88-221-X.

The educational function of universities and colleges gives them a particular advantage in research. While universities' primary role in the system of research is to advance knowledge and generate highly qualified people, they do create intellectual property and commercialize it, by licensing it out to businesses or setting up spin-off companies, although their involvement in commercialization is small (Statistics Canada 2008b). The primary benefit of their research to society stems from the open nature of their work. Free dissemination of new findings increases the stock of knowledge and can guide applied research into more promising areas. The quantitative impact of scholarly publications can be studied by applying bibliometric analysis, which evaluates the number of times an article is cited in other publications and patent applications and their quality. For a bibliometric study of Canada, see Godin, Gingras and Davignon (1998); Narin, Hamilton and Olivastro (1997) offer an analysis of the new public knowledge (produced by academics and government researchers) embodied in commercial patent applications in the United States.

Government is one of the smaller performers in the system, in large part because of the nature of its role. While the government itself does perform research through its agencies and laboratories to meet its needs and those of its citizens, it mainly supports work in other sectors to correct what is known as market failure, or to fill the gap between private investment in basic research and the level that would maximize benefits to society. In 2008, government R&D performance amounted to $2.8 billion, compared with $4.0 billion spent in support of private sector research (Table 1).

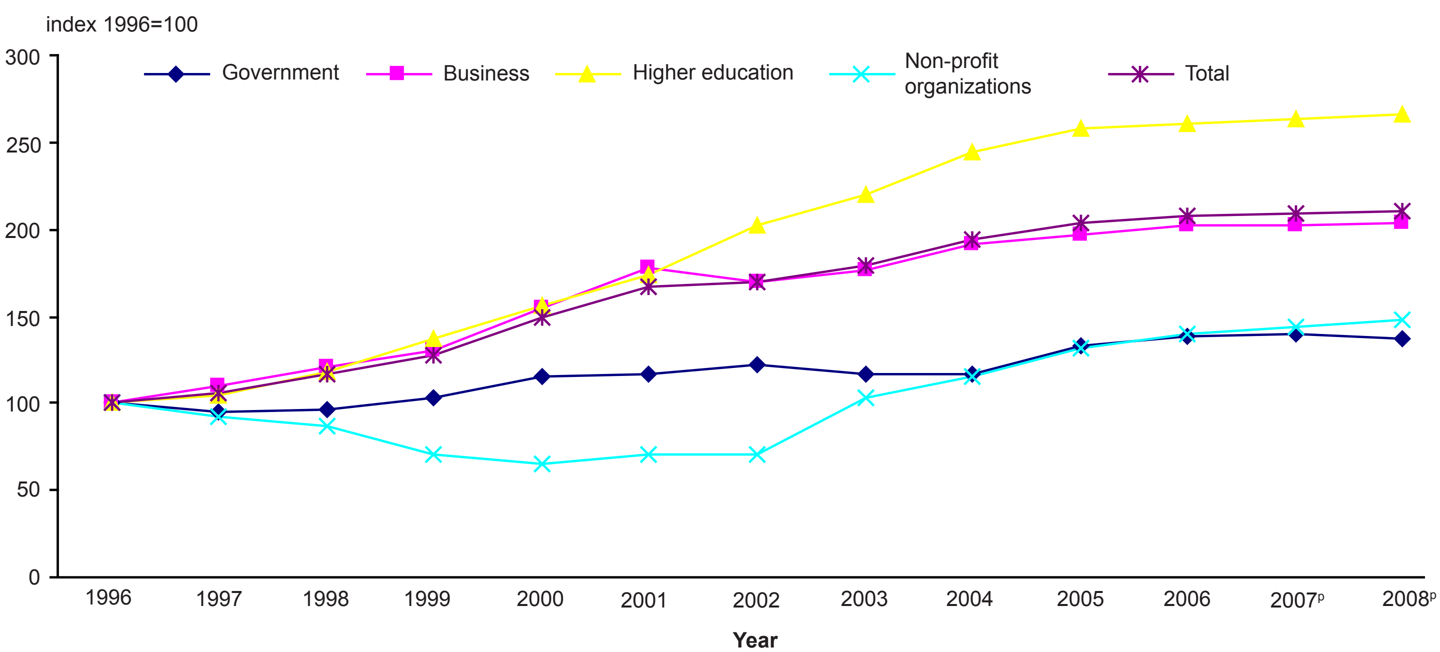
R&D by the non-profit sector follows a pattern very similar to that observed for government. It performs a very small amount of R&D, but supports research at institutions of higher education through philanthropic activities. For more information on the R&D activities of Canadian private non-profit organizations, see ten Den (2008).

Benefits

R&D is a major factor in advancing knowledge, producing new technologies and improving the quality of life in the long run, although its benefits may not be immediately obvious. Outcomes of applied research become evident in the short term, but breakthrough contributions are usually the culmination of a series of studies and experiments done over time, in different countries and often in several fields of study.

Quantitative indicators of the impact of R&D, such as private and social rates of return, have been developed but they are restrictive, generally confined to economic benefits. Beyond raising incomes, R&D contributes to improvements in the quality of life, through innovations in all fields, from space research to health to entertainment, and for all age groups. The Canadarm (Shuttle Remote Manipulation System or SRMS), which made its space debut in 1981, and BlackBerry are examples of Canadian research and technology.[1] Substantial improvements in cancer survival rates owe much to advances in cancer prevention, detection and treatment achieved through research. In the area of communication and entertainment, new products based on information and communications technologies (ICTs) are facilitating and enhancing options, including such popular utilities as social networking sites and text messaging.

Chart 1
Trends in R&D performance, by sector, Canada, 1996 to 2008



Source: Statistics Canada, Gross Domestic Expenditures on Research and Development in Canada (GERD) and the Provinces, 1997 to 2008, Catalogue no. 88-221-X.

Selected data sources for international comparisons of science and technology activities

OECD

Organisation for Economic Co-operation and Development, *Main Science and Technology Indicators*, Paris.

This publication contains various indicators of the level and trends in the gross domestic expenditures on research and development (GERD) for member states of the OECD and selected non-member states. The pattern of financing and of performance of GERD is also presented.

Organisation for Economic Co-operation and Development, *OECD Science, Technology and Industry Scoreboard*, Paris.

The Scoreboard presents data to explore the interaction between knowledge and globalization. It offers measures for international comparisons in key areas of policy interest. A wide range of indicators, including GERD, is presented to map the complexity of innovation activities instead of producing an overall ranking of countries derived from a unique, synthetic value.

United States

National Science Foundation, *Science and Engineering Indicators*, Volumes 1 and 2.

This publication is in two volumes. Volume 1 contains discussion and analysis. Volume 2 provides a broad base of quantitative information about United States science, engineering and technology, including science and engineering education, workforce, and R&D.

Canada

Statistics Canada, *Science Statistics*, Catalogue no. 88-001-X.

This series, which consists of eight issues a year, presents a variety of science and technology statistics. Each issue concerns a different topic.

Statistics Canada, *Gross Domestic Expenditures on Research and Development in Canada (GERD) and the Provinces*, Catalogue no. 88-221-X.

This release presents levels and trends in GERD. Data are provided for total sciences, natural sciences and engineering and social sciences and humanities. It also offers matrices showing the flow of funds from the funding to performing sectors at the national and provincial levels as well as by science type.

Annual data on GERD by science type and by funding and performing sector are also available in CANSIM table 358-0001, available at http://www.statcan.gc.ca/.

Note

1. For a list of other Canadian inventions, see: www.cbc.ca/inventions/.

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Daood Hamdani, SIEID, Statistics Canada

How general university funds (GUF) fit in research and development statistics

The Organisation for Economic Co-operation and Development (OECD) collects and reports on statistics from its member countries for various subject matter fields. In order to properly compare these statistics, the OECD develops common concepts and measurement standards. For the field of research and development (R&D) statistics, the OECD's proposed standard practice for R&D surveys is detailed in the *Frascati Manual* (OECD 2002). However, not all OECD countries' national practices align with the *Frascati Manual* standards. The OECD receives Canadian R&D data from surveys conducted by Statistics Canada. While the general concepts of the *Frascati Manual* are integrated with Statistics Canada's survey framework, national variations in reporting with the OECD still exist. One of these national differences in data presentation can be found in the allocation of public general university funds.

Many higher education institutions house R&D labs. Universities are recognized internationally as institutions that cultivate learning and development, with R&D forming an essential part of these activities. While many universities in Canada are publicly funded, they are not managed by a government body. Based on this concept of management, Statistics Canada uses the higher education sector to capture government funding earmarked for universities. However, since funding instruments such as general grants are obtained by universities at a government level, the OECD prefers to allocate these expenditures to the government sector in its own measures (see About this article).

About this article

The *Frascati Manual* describes three types of funds which public universities typically draw upon to finance their R&D activities:

→ R&D contracts and earmarked grants received from government and other outside sources (such as businesses).

→ The university's "own funds" from sources such as endowments, shareholdings and property, plus surplus from the sale of non-R&D services such as fees from individual students, journal subscriptions, etc.

→ General grants received from the Ministry of Education or from the corresponding provincial or local authorities in support of their overall research or teaching activities. For the purposes of international comparisons, the R&D content of these public general university funds is credited to the government as a source of funds.

Canadian data presented in this article are from Statistics Canada (2008), *Gross Domestic Expenditures on Research and Development (GERD) in Canada and the Provinces, 1997 to 2008*, Catalogue no. 88-221-X, available at: http://www.statcan.gc.ca/pub/88-221-x/88-221-x2008002-eng.pdf.

Data from the OECD are available at the *OECD.Stat Extracts* membership service at the following address: http://stats.oecd.org/WBOS/.

There are two ways to view expenditures in R&D: by performing sector; and by funding sector. Canadian data illustrate how much each sector performs (performing sector) by source of funds (funding sector). The sectors that perform in Canada are: federal government, provincial governments, provincial research organizations, business enterprises, higher education and private non-profit organizations. The sectors providing R&D funding are the same as those performing, with the addition of the foreign funding sector. The differing allocation in measuring GUF between Canada and the OECD influences the comparability of funding sector data for the higher education performing sector. Canadian statistics do not report GUF as a separate funding line item; instead the GUF value is combined with the higher education funding sector. Conversely, the OECD does report GUF as a separate line item. Table 1 demonstrates that the difference among funding sectors between Canada and OECD is attributable to GUF.

Table 1
Higher education performing sector, 2002

	Canada	OECD
Funding sectors	millions of dollars	
Government	2,645	2,645
GUF	.	2,031
Higher education	3,462	1,431
Total	**6,107**	**6,107**

Notes: The government sector comprises federal and provincial levels of government in addition to provincial research offices.

The business enterprise, private non-profit and foreign funding sectors are not shown in this table.

Sources: OECD OLIS (2009), Gross Domestic Expenditure on R-D by Sector of Performance and Source of Funds, February, and Statistics Canada (2008), Gross Domestic Expenditures on Research and Development (GERD) in Canada and the Provinces, 1997 to 2008. Catalogue no. 88-221-X.

On the other hand, the OECD's aggregate statistics combine GUF with the government funding sector to obtain total government funding. When aggregate Canadian and OECD statistics are compared within the higher education performing sector (Table 2), the OECD will always display a higher value for government funding and a lower value for higher education funding (with the inverse holding for Canada). These funding sector differences in the aggregate statistics can be confounding without having an understanding of how GUF is allocated in measures used by Statistics Canada and the OECD.

Table 2
Aggregate statistics on higher education performing sector, 2002

	Canada	GUF	OECD
Funding sectors		millions of dollars	
Government	2,645		4,676
GUF	.	2,031	.
Higher education	3,462		1,431
Total	**6,107**		**6,107**

Notes: The government sector comprises federal and provincial levels of government in addition to provincial research offices.

GUF data is provided above for information purposes; it would not be present in the actual aggregate statistical tables.

The business enterprise, private non-profit and foreign funding sectors are not shown in this table.

Sources: OECD OLIS (2009), Gross Domestic Expenditure on R-D by Sector of Performance and Source of Funds, February, and Statistics Canada (2008), Gross Domestic Expenditures on Research and Development (GERD) in Canada and the Provinces, 1997 to 2008. Catalogue no. 88-221-X.

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Cindy Carter, SIEID, Statistics Canada

What's new?

Read about recent releases, updates and new activities in the areas of information and communications technology, and science and technology.

Information and communications technology

Information society

The study, 'How Canadians' Use of the Internet Affects Social Life and Civic Participation' (*Connectedness Series*, Catalogue no. 56F0004M, no. 16), was released on December 4, 2008.

The Public Use Microdata File (PUMF) for the 2007 Canadian Internet Use Survey (CIUS) was released on December 23, 2008.

Two sessions were organized for the 2009 Statistics Canada Socio-economic conference, held May 4 and 5 in Gatineau. The analytical work uses data from the Canadian Internet Use Survey (CIUS) and the Survey of Electronic Commerce (SECT), as well as other related data sources:

Hallmarks of a Knowledge Economy: Internet Use and Impacts—Session 1

Broadband-ICT-Use-Productivity Project
Hans-Olof Hagén, Statistics Sweden, Stockholm, Sweden;

Internet Shopping in Canada: Trends and Patterns
Larry McKeown, Science, Innovation and Electronic Information Division, Statistics Canada and Josie Brocca, Industry Canada;

La mise en oeuvre des processus d'affaires électroniques au Canada
Sylvain Ouellet, Science, Innovation and Electronic Information Division, Statistics Canada and Trever Bova, Transportation Division, Statistics Canada.

Hallmarks of a Knowledge Economy: Internet Use and Impacts—Session 2

Intensity of Internet Use in Canada: Understanding Different Types of Users
Catherine Middleton, Ted Rogers School of Information Technology Management, Ryerson University; Jordan Leith, Communication and Culture Graduate Program, Ryerson University and York University; and Ben Veenhof, Science, Innovation and Electronic Information Division, Statistics Canada;

Matters of Internet Privacy and Security
Cathy Underhill, Income Statistics Division, Statistics Canada and Cathy Ladds, Treasury Board of Canada;

Online Activities of Canadian Seniors of Today and Tomorrow
Ben Veenhof and Peter Timusk, Science, Innovation and Electronic Information Division, Statistics Canada.

The 2009 Canadian Internet Use Survey will be in the field in the fall of 2009.

Telecommunications

Annual Survey of Telecommunications Service Providers

The 2008 cycle of the Annual Survey of Telecommunications conducted jointly with the Canadian Radio-Television and Telecommunications Commission (CRTC) is ongoing. Selected results will be released by the CRTC in their *Communications Monitoring Report 2009* (www.crtc.gc.ca) in late July. Summary results will be published by Statistics Canada at a later date.

Quarterly Survey of Telecommunications Service Providers

The processing and analysis of the 2007, 2008 and 2009 data from the redesigned survey are ongoing. The first release is planned for 2009.

Broadcasting

Annual surveys of the radio, television and cable industries

The 2007 statistics for the program distribution industry were released on December 8, 2008 in *The Daily* and in *Cable and Satellite Television Industry*, 2007 (56-209-XWE, free).

The collection and processing of 2008 data for the radio, television and program distribution industries are ongoing. Statistics for these industries will be released between July and November 2009.

Science and Technology activities

Research and development in Canada

Gross Domestic Expenditures on Research and Development, in Canada and the Provinces (otherwise known as the GERD matrix) is available through the electronic publication Catalogue no. 88-221-X released on December 10, 2008.

Research and development (R&D) data for the GERD matrix are available through CANSIM nationally and by province for each of the following science types: for natural sciences and engineering (NSE), social sciences and humanities (SSH), and the total for NSE and SSH. See CANSIM Table 358-0001.

Industrial research and development

The publication *Industrial Research and Development: Intentions*, Catalogue no. 88-202, is the final component of the GERD matrix to migrate to an HTML format. It will be available under Catalogue no. 88-202-X.

Also of note, the Canada Revenue Agency application form for Scientific Research and Experimental Development (SR&ED) tax credits has undergone significant changes. This revision may impact the scope of the data available for industrial R&D and may lead to corresponding revisions to the paper questionnaire. In turn, this may lead to changes in future data availability. For more information on the new SR&ED tax form, please visit www.cra-arc.gc.ca.

The service bulletin *'Industrial Research and Development, 2004 to 2008'* (Catalogue no. 88-001-X, Vol. 32, no. 5) was released on September 5, 2008.

Federal science expenditures

The service bulletin *'Federal Government Expenditures on Scientific Activities, 2008/2009 (Intentions)'* (Catalogue no. 88-001-X, Vol. 32, no. 7) was released on November 20, 2008.

The service bulletin *'Biotechnology Scientific Activities in Federal Government Departments and Agencies, 2007/2008'* (Catalogue no. 88-001-X, Vol. 33, no. 1) was released on March 4, 2009.

Provincial governments and provincial research organizations

Coverage for this component of the GERD matrix has been expanded through the participation of Newfoundland and Labrador (2006), Prince Edward Island (2007), New Brunswick (2007) and Saskatchewan (2007) in the Provincial Government Scientific Activites in the Natural Sciences and Engineering and Social Sciences and Humanities Survey.

The service bulletin *'Scientific and Technological Activities of Provincial Governments and Provincial Research Organizations, 2002/2003 to 2006/2007'* (Catalogue no. 88-001-X, Vol. 32, no. 6) was released on October 17, 2008.

Higher education sector research and development

The service bulletin *'Estimates of Research and Development Expenditures in the Higher Education Sector, 2006/2007'* (Catalogue no. 88-001-X, Vol. 32, no. 4) was released on August 14, 2008.

Research and development in the health field

The service bulletin *'Estimates of Total Spending on Research and Development in the Health Field in Canada, 1997 to 2008'* (Catalogue no. 88-001-X, Vol. 33, no. 2) was released on March 25, 2009.

Small research and development performers

The 2008 Survey on Small Research and Development Performers is now complete. Preliminary results were released on April 3, 2009.

Human resources and intellectual property

Human resources

No updates to report.

Federal science expenditures and personnel, intellectual property management annex

No updates to report.

Intellectual property commercialization in the higher education sector

The publication *Survey of Intellectual Property Commercialization in the Higher Education Sector, 2006 and 2005, 2008*, Catalogue no. 88-222-X, was released on October 24, 2008.

Innovation

Innovation in manufacturing

Analysis of Survey of Innovation 2005 microdata by external facilitated access researchers continues. The OECD sponsored project to study the relationship between innovation and productivity in selected OECD countries has been completed, using results of the Survey of Innovation 2005 linked to the 2002 and 2004 Annual Survey of Manufactures and Logging. Results will be published through the OECD.

A working paper containing descriptive statistics of innovation in manufacturing will be published in the summer.

Innovation in advanced technologies in manufacturing and logging

Statistical tables from the Survey of Advanced Technology 2007 are now available. This survey of advanced technology use sent to almost 9,500 manufacturing plants and about 370 logging operations shows that almost all (92%) manufacturing plants and more than half of logging operations (58%) currently use at least one advanced technology. More than two-thirds (69%) of manufacturing plants and about one in five logging operations (18%) currently use at least five advanced technologies. A paper on the characteristics of manufacturing firms that undertake design activities was presented at Statistics Canada's Socio-economic Conference on May 5, 2009.

Results of the follow-up to the Survey of Advanced Technology 2007 were released on October 27, 2008. This survey achieved a 73% response rate (1,219 completed questionnaires) and examined plants that modify or create technologies. Findings were presented at Statistics Canada's Socio-economic Conference on May 5, 2009.

General Business Panel Survey Project

Creation of a satellite of the federal Research Data Centre was completed and is providing facilitated access to external researchers who are investigating topics such as the impact of innovative activities on firm performance.

Business incubators

Collection for the Survey of Business Incubation 2007 was completed, achieving a 70% response rate. An announcement of the availability of final estimates was published in *The Daily* on August 27, 2008.

Commercialization

No updates to report.

Emerging Technologies

Functional Foods and Natural Health Products

The 2007 Functional Foods and Natural Health Products Survey has been completed. Preliminary results were released on January 15, 2009.

Knowledge management practices

No updates to report.

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 e-mail sieidinfo@statcan.gc.ca.

Table 1a
General economy and population

	2001	2002	2003	2004	2005	2006	2007	2008
Gross Domestic Product (GDP) ($ millions)	1,108,048	1,152,905	1,213,175	1,290,906	1,373,845	1,449,215	1,532,944	1,600,081
GDP implicit price index (2002=100)	98.9	100.0	103.3	106.6	110.1	112.9	116.5	121.1
Population (thousands)	31,019	31,354	31,640	31,941	32,245	32,576	32,927	33,311

Source: Statistics Canada, 2009, CANSIM Tables 380-0017, 380-0056, 051-0001.

Table 1b
Gross domestic expenditures on research and development (GERD)

	2001	2002	2003	2004	2005	2006	2007	2008
GERD ($ millions)	23,132	23,531	24,719	26,833	28,142	28,715	28,881	29,071
"Real" GERD ($ millions 2002)	23,390	23,531	23,930	25,172	25,537	25,434	24,812	..
GERD/GDP ratio	2.09	2.04	2.04	2.08	2.05	1.98	1.88	..
"Real" GERD per capita ($ 2002)	754.05	750.50	756.33	788.09	791.96	780.76	753.54	..
"Real" federal performance of research and development ($ millions 2002)	2,126	2,190	2,016	1,955	2,190	2,211	2,178	..
GERD funding by sector				**% of GERD**				
Federal government	17.7	18.1	18.3	17.3	18.6	18.2	18.3	18.1
Provincial governments	4.4	4.9	5.5	5.1	4.8	4.9	4.9	4.9
Business enterprise	50.3	51.4	50.3	50.0	48.9	49.6	49.4	49.5
Higher education	12.7	14.7	14.6	15.5	15.4	15.4	15.5	15.6
Private non-profit	2.3	2.7	2.6	2.7	2.8	2.9	2.9	2.9
Foreign	12.6	8.2	8.7	9.4	9.5	9.0	9.0	9.0
GERD performance by sector								
Federal government	9.1	9.3	8.4	7.8	8.6	8.7	8.8	8.5
Provincial governments	1.2	1.2	1.1	1.1	1.1	1.2	1.1	1.1
Business enterprise	61.7	57.5	57.1	57.0	56.1	56.2	56.0	56.1
Higher education	27.8	31.7	32.9	33.7	33.8	33.5	33.7	33.8
Private non-profit	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5
Federal performance as a % of federal funding	51.4	51.5	46.0	44.8	46.0	47.8	47.9	46.8

Source: Statistics Canada, CANSIM Table 358-0001 "Gross domestic expenditures on research and development, by science type and by funder and performer sector, annual".

Table 1c
Information and communications technology (ICT) sector

	2003	2004	2005	2006	2007	2008
ICT sector contribution to GDP[1]			millions of chained (2002) dollars			
ICT, manufacturing	6,908	7,435	7,665	7,930	8,402	8,508
ICT, services	40,448	43,023	44,778	47,020	48,741	50,153
Total ICT sector	47,400	50,508	52,493	54,999	57,199	58,714
Total economy GDP	1,091,378	1,124,998	1,155,681	1,189,661	1,219,327	1,225,858
Total business sector GDP	913,871	944,295	971,685	1,000,642	1,025,436	1,026,645

1. Gross Domestic Product at basic prices.

Source: Statistics Canada, Gross Domestic Product by Industry, Catalogue no. 15-001-X.

Table 1d
Information and communications technology (ICT) access and use

	2001	2002	2003	2004	2005	2006	2007
ICT adoption rates (private sector)				% of enterprises			
Personal computer	83.9	85.5	87.4	88.6	..	..	..
E-mail	66.0	71.2	73.8	76.6	76.2	77.5	81.1
Internet	70.8	75.7	78.2	81.6	81.6	82.8	86.7
Have a website	28.6	31.5	34.0	36.8	38.3	39.7	41.4
Use the Internet to purchase goods or services	22.4	31.7	37.2	42.5	43.4	44.8	48.5
Use the Internet to sell goods or services	6.7	7.5	7.1	7.4	7.3	8.0	8.2
Value of sales over the Internet ($ millions)	10,389	13,339	18,598	26,438	36,268	46,492	58,235
ICT adoption rates (public sector)							
Personal computer	100.0	99.9	100.0	100.0	..	..	..
E-mail	99.7	99.6	99.8	99.9	99.6	99.9	100.0
Internet	99.7	99.6	100.0	99.9	99.6	99.9	99.9
Have a website	86.2	87.9	92.7	92.4	94.9	94.4	93.2
Use the Internet to purchase goods or services	54.5	65.2	68.2	77.4	82.5	79.5	82.1
Use the Internet to sell goods or services	12.8	14.2	15.9	14.0	15.2	15.9	15.9
Value of sales over the Internet ($ millions current)	354.8	327.2	511.4	1,881.5	2,924.7	3,424.3	4,450.0
ICT adoption rates (individuals aged 18 years and over)[1]				% of individuals			
Personal (non-business) Internet use from any location	..	..	..	..	67.9	..	73.2
Personal (non-business) Internet use from home	..	..	..	..	60.9	..	68.6
Use the Internet to order or purchase goods or services (% of Internet users)	..	..	..	..	41.1	..	43.7
Total value of e-commerce orders or purchases ($ billions)	..	..	..	..	7.9	..	12.8
Average value of e-commerce orders or purchases (dollars per consumer)	..	..	..	..	1,150	..	1,520

1. Target population has changed from individuals 18 years of age and older in 2005 to individuals 16 years of age and older in 2007.

Sources: Statistics Canada, Canadian Internet Use Survey; Survey of Electronic Commerce and Technology.

Table 1e
Telecommunications services indicators

	2001	2002	2003	2004	2005	2006	2007	2008
Teledensity indicators				**per 100 inhabitants**				
Wired access – Voice Grade Equivalent (VGE)	67.9	65.6	65.0	64.2	64.2	64.2	63.2	...
Wireless access (VGE)	34.7	38.2	41.9	46.9	52.6	57.4	61.4	...
Total public switched telephone network (PSTN)(VGE)	102.6	103.7	106.8	111.1	116.8	121.6	124.5	...
				thousands				
Homes with access to cable	11,068.6	11,379.2	11,695.8	11,908.9	12,119.7	12,411.1	12,572.9	...
Homes with access to Internet by cable	9,339.3	10,046.0	10,692.4	11,119.2	11,517.9	11,916.6	12,195.1	...
Access indicators								
Total wired access lines (VGE)	21,126.0	20,622.0	20,612.0	20,563.0	20,780.0	21,000.0	20,876.0	...
Residential access lines (VGE)	12,920.0	12,913.0	12,886.0	12,891.0	12,900.0	12,950.0	12,906.0	...
Business access lines (VGE)	8,206.0	7,709.0	7,726.0	7,672.0	7,880.0	8,050.0	7,970.0	...
Total mobile subscribers	10,800.0	11,997.0	13,291.0	15,020.0	17,016.6	18,749.1	20,277.4	...
Digital cable television subscribers	808.4	1,146.3	1,403.7	1,810.0	2,283.0	2,776.5	3,336.7	...
Satellite and multipoint distribution system subscribers	1,609.2	2,018.6	2,205.2	2,324.6	2,491.5	2,628.6	2,664.4	...
Total residential Internet subscribers	...	6,547.0	7,013.0	7,442.0	7,997.0	8,700.0	9,290.0	...
Total dial-up Internet subscribers	...	3,020.0	2,500.0	2,025.0	1,568.0	1,239.0	934.0	...
Total residential high-speed subscribers	...	3,527.0	4,513.0	5,416.0	6,429.0	7,461.0	8,356.0	...
High speed Internet by cable subscribers	1,624.0	2,055.0	2,532.0	2,933.0	3,467.0	4,041.0	4,573.0	...
High speed Internet - Other	...	1,472.0	1,981.0	2,483.0	2,962.0	3,420.0	3,783.0	...
Investment indicators								
Investments by the telecommunications services industries (NAICS 517) ($ millions current)	10,652.9	9,080.5	6,912.3	8,355.9	8,170.8	7,947.3	8,974.9	10,049.2
Investments by the telecommunications services industries (NAICS 517) ($ millions constant)	10,621.4	9,080.5	7,403.7	9,441.1	9,660.5	10,163.2	11,436.0	13,674.2

Sources: Statistics Canada, Telecommunications statistics (various years), CRTC Telecommunications Monitoring report, July 2007, CRTC Communications Monitoring report 2008.

Table 1f
Characteristics of biotechnology innovative firms

	2001	2002	2003	2004	2005
			number		
Firms	375	..	496	..	532
Total biotechnology employees	11,897	..	11,931	..	13,433
Firms that were successful in raising capital	134	..	178	..	173
Existing patents	4,661	..	5,199	..	3,849
Pending patents	5,921	..	8,670	..	7,038
Products on the market	9,661	..	11,046^E	..	2,438
Products/processes in pre-market stages	8,359	..	6,021	..	F
			$ millions		
Total biotechnology revenues	3,569	..	3,820	..	4,191
Expenditures on biotechnology research and development	1,337	..	1,487	..	1,703
Export biotechnology revenues	763	..	882	..	792^E
Import biotechnology expenses	433	..	422^E	..	689^E
Amount of capital raised	980	..	1,695	..	1,350

Source: Statistics Canada, Biotechnology Use and Development Survey (various years).

Table 1g
Intellectual property (IP) commercialization

	2001	2002	2003	2004	2005	2006
Federal government						
Number of new patents issued	133	142	178	169	108	..
Royalties on licenses ($ millions)	16.3	15.5	14.9	15.2	17.2	..
Universities and hospitals						
Number of new patents issued	381	..	347	397	376	339
Income from intellectual property ($ millions)	52.5	..	55.5	51.2	55.2	59.7

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