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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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- 11 publications for sale
- 12 free publications
- 12 research papers
- 105 working papers, and
- 35 questionnaires.

Symbols

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

Comparing the gross domestic expenditure on research and development (GERD) and gross domestic product (GDP) ratios

Canada has targeted 2010 to be one of the top five countries in the world performing research and development (R&D). What's going on with the gross domestic expenditure on research and development (GERD) and the gross domestic product (GDP) ratios?

Key science and technology indicator

One of the most carefully watched indicators in science and technology these days is the gross domestic expenditure on research and development (GERD) to gross domestic product (GDP) ratios. This ratio took on a new life when Paul Martin, then Minister of Finance, announced in 2001 that Canada's target for 2010 was to be one of the top five countries in the world performing research and development (R&D). The Organisation for Economic Co-operation and Development (OECD) regularly publishes the ranking for member countries. Canada in the past 5 years has ranked between 13th and 15th.

Understanding the difference in matching

Any analysts attempting to rank Canada based on GERD/GDP published by Statistics Canada will have noticed that this ratio does not quite match the ratio provided by the OECD, as highlighted in Tables 1 and 2. The source of the difference is not in how R&D data are recorded but in how the Canadian GDP are adjusted and calculated in comparison to other OECD countries. The Canadian GDP data provided to the OECD are adjusted by excluding "Financial Intermediation Services Indirectly Measured" or FISIM. This adjustment done prior to being sent to the OECD, effectively lowers Canada's GDP and is done to ensure comparability of Canadian to European countries' information.

Explaining financial intermediation services indirectly measured (FISIM)

"Banks and other financial institutions provide a variety of services. Those that are specifically charged for include currency exchange, handling of cheques etc; and the corresponding revenues form part of the institution's output. An additional, and very significant part of their income comes from charging higher interest rates to borrowers and paying lower rates to depositors than they would need to if they charged explicitly for all their services. This "hidden" charge (known as imputed banking service in the 1968 United Nations System of National Accounts) is called FISIM in the 1993 System of National Accounts." according to Lal (1998).

Use adjusted data for comparability

Thus, when comparing GERD to GDP, it is important that analysts use the adjusted data for comparability purposes when ranking Canada against other OECD countries (Table 2). The differences in the calculation, although subtle, can change the tone of the comparison. For instance, using the Canadian GERD/GDP ratio, Canada's ratio equalled that of the European Union's countries in 2000. However, using the OECD GERD/GDP ratio for the same time period, Canada's ratio was higher than that of the European Union's countries.

The European Union member countries have been testing methods of calculating and allocating FISIM in their national GDPs.

TABLE 1. Gross domestic expenditures on R&D (GERD) in current dollars, and as a percentage of the gross domestic product, 1990 to 2003

Year	GERD	GDP[1]	GERD/GDP published by STC	GERD/GDP published by OECD
	in millions of dollars		%	
1990	10,260	679,921	1.51	1.53
1991	10,770	685,367	1.57	1.60
1992	11,338	700,480	1.62	1.64
1993	12,184	727,184	1.68	1.70
1994	13,342	770,873	1.73	1.76
1995	13,754	810,426	1.70	1.72
1996[r]	13,816	836,864	1.65	1.68
1997[r]	14,636	882,733	1.66	1.68
1998[r]	16,077	914,973	1.76	1.79
1999[r]	17,631	982,441	1.79	1.82[r]
2000[r]	20,359	1,076,577[r]	1.89	1.92[r]
2001	22,116	1,108,200[r]	2.00	2.03[r]
2002[p]	21,704	1,157,968[r]	1.87	1.91[r]
2003[p]	22,450	1 218 772[r]	1.84	..

Sources: Statistics Canada. GDP: CANSIM II, Table 380-017; GERD: *Science Statistics*, Volume 28, No 2, Catalogue 88-001; and OECD. 2003. *Main Science and Technology Indicators, No. 2,* DSTI. Paris.

TABLE 2. Gross domestic expenditures on R&D (GERD) as a percentage of gross domestic product for selected OECD countries

Country	1997	1998	1999	2000	2001	2002
Austria	1.71	1.78	1.86	1.86	1.92	1.93
Canada	1.68	1.79	1.82	1.92	2.03	1.91
France	2.22	2.17	2.18	2.18	2.23[p]	2.20
Germany	2.29	2.31[e]	2.44	2.49	2.51	2.51
Italy	1.05	1.07	1.04	1.07	..	..
Japan	2.83	2.94	2.95	2.98	3.06	..
Sweden[1]	3.54	..	3.65	..	4.27	..
U.K.	1.81	1.80	1.88	1.85	1.89	..
U.S.A.[2]	2.58	2.60	2.65	2.72	2.74	2.67
European Union	1.80	1.81	1.86	1.89	1.93	..

1 Underestimated or based on underestimated data.
2 Excludes most or all capital expenditures.
Source: OECD. 2003. *Main Science and Technology Indicators, No. 2,* DSTI, Paris.

It is hoped that starting in 2005 all member countries of the European Union will allocate FISIM in their national totals. When this adjustment is made to the published GDP of each country then Canada's GERD to GDP ratio produced for the OECD will match the published figures of Statistics Canada.

For more information on FISIM please see: www.statcan.ca/english/concepts/nateco/remain.pdf and www.oecd.org/dataoecd/3/5/15065902.doc.

Janet Thompson, SIEID, Statistics Canada

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Changes in the number of biotechnology innovative firms and revenues

Biotechnology activity in Canada is flourishing. The total number of biotechnology firms has been continually increasing in recent years, from 282 in 1997 to 375 in 2001. This expansion can also be observed from the changes in revenues generated by biotechnology, which more than quadrupled between 1997 and 2001. Research and development efforts are starting to bear fruit and this is reflected in the revenue ratio on R&D, which increased from $1.65 to $2.67 between 1997 and 2001. However, a number of firms are still experiencing difficulties in raising the capital needed to finance their research projects. This is notably the case for small firms, which constitute over 70% of biotechnology firms.

This article deals with changes in the number of biotechnology innovative firms and in the revenues generated by biotechnology activities. The data come from the 1997, 1999 and 2001 Biotechnology Use and Development Surveys.

Distribution of biotechnology firms

In 2001, Canada had 375 biotechnology innovative firms, compared with 358 in 1999 and 282 in 1997[1]. However, between 1999 and 2001 this number started to stabilize, with a 5% increase in the total number of such firms.

In 2001, small firms[2] continued to dominate in terms of numbers, making up over 70% of the total number of biotechnology firms in Canada. While 56 small firms were added between 1997 and 1999, the 1999-2001 period saw a decrease in the number of small firms but an increase in the number of medium-sized firms. Three factors may explain the decrease in the number of small firms between 1999 and 2001: (i) the fact that a number of small firms became medium-sized firms, (ii) the disappearance of a number of small firms, and (iii) mergers and acquisitions between firms.

Between 1997 and 1999, the number of biotechnology firms increased for all activity sectors, especially in the agriculture and food processing sector, which witnessed an increase of 45 firms during that period. Such firms “are beginning to emerge around

[1] The actual impact of the changes in survey methodology between 1997 and 1999 on the variation in a particular indicator of biotechnology activities is 9%. For further details on the impact of these changes, see Traoré (2004).

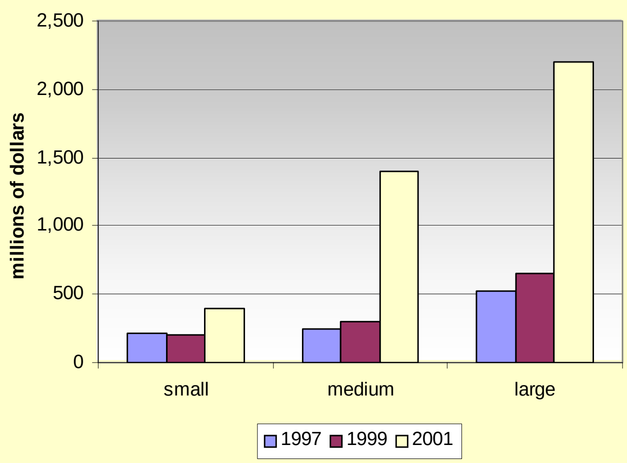
[2] Size is defined in terms of the number of employees in a firm: a small firm is comprised of fewer than 50 employees, a medium-sized firm has between 50 and 149 employees and a large firm at least 150 employees.

Table 1. Distribution of Canadian biotechnology innovative firms, 1997 to 2001.

	Number of firms			Change in number	
	1997	**1999**	**2001**	**1999-1997**	**2001-1999**
A) Size					
Small (fewer than 50 employees)	214	270	267	56	-3
Medium (50 to 149 employees)	37	51	62	14	11
Large (150 employees and over)	31	37	46	6	9
Canada	**282**	**358**	**375**	**76**	**17**
B) Sector					
Human health	136	150	197	14	47
Agriculture and food processing	74	119	113	45	-6
Environment	31	35	33	4	-2
Other	41	54	32	13	-22
Canada	**282**	**358**	**375**	**76**	**17**

Source: Statistics Canada.

Figure 1. Biotechnology revenues by firm size, 1997 to 2001



Source: Statistics Canada

new technologies coming off the laboratory benches.” (Traoré et al, 2003). However, between 1999 and 2001, the number of firms decreased in all sectors other than human health. That sector continues to dominate in terms of numbers and in 2001 accounted for close to 72% of Canadian biotechnology firms. For other sectors, the decrease in the number of firms can be attributed to the fact that firms ceased operating, transferred to another sector of activity, or were no longer part of the group of biotechnology innovative firms (McNiven et al, 2003).

Changes in biotechnology revenues

Despite the economic uncertainty and instability that characterized the 1999-2001 period, the key indicators for Canadian biotechnology firms remain rather strong. Biotechnology revenues increased by 83% during this two-year period, from $1,948 to $3,569 million. The rate of growth for biotechnology revenues was higher than that for biotechnology R&D expenses (62%), indicating that the research is beginning to pay off. The number of products and procedures on the Canadian biotechnology market rose from 6,597 to 9,661 between 1999 and 2001, an increase of 3,064.

Changes in revenues by size

Between 1997 and 2001, the revenues generated by biotechnology activities increased for all size categories. Medium-sized biotechnology firms made the largest gains in revenues: while their revenues were close to those of small firms in 1997 and 1999, their revenues for 2001 were twice as high. Although more small firms reported biotechnology revenues in 2001, it was large firms that reported the largest amount of biotechnology revenues in 2001. A smaller number of large firms reported biotechnology revenues because they may have had a tendency to diversify their activities, while small firms were more likely to focus their efforts on biotechnology activities (McNiven et al., 2003). While the percentage of revenues generated by biotechnology activities in relation to total revenues (all sources) was 9% for large firms in 2001, the proportion for small and medium-sized firms respectively was 45% and 56%.

Changes in revenues by sector: predominance of human health

In 2001, the human health sector continued to dominate in terms of revenues generated, accounting for 69% of biotechnology revenues for that year. Biotechnology firms in that sector saw their revenues increase by 138% between 1999 and 2001.

In relation to other sectors, firms in the human health sector continued to have more activities geared to biotechnology; in 2001, 49% of total revenues came from the sale of biotechnology products. That sector also continued to have the highest number of firms reporting biotechnology revenues, at 115 out of 252 in 2001, as compared with 88 in the agriculture and food processing sector, 27 in the environment sector, and 23 in the “other” (bioinformatics, aquaculture, mining/energy/petroleum/chemicals and forest products) sector. Firms in the human health sector were more likely to be successful in terms of revenue growth.

This success is partly a result of the ability of firms in the human health sector to market their biotechnology products. The data from the 2001 Biotechnology Use and Development Survey indicate that close to 69% of the biotechnology products marketed in Canada come from that sector. To bring a product to market and start generating revenues, a biotechnology firm needs considerable financial resources at each step of the product's development. In 2001, human health firms accounted for close to 88% of the total amount of capital raised for biotechnology in Canada. Moreover, firms in that sector receive increasing amounts of government financial assistance to encourage basic biomedical research (Traoré et al., 2003).

This article is a summary of a document entitled "Changes in Biotechnology in Canada between 1997 and 2001", which is soon to be released. The complete document gives a detailed analysis of changes in Canadian biotechnology activity by size, sector and province. The analysis covers the distribution of biotechnology firms, biotechnology revenues, exports, R&D expenses and financing.

Lara Raoub, SIEID, Statistics Canada.

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Commercialization in Canadian federal science-based departments and agencies, 2002-03

The new focus on commercialization has peaked interest in the government's own IP management activities. Many federal departments and agencies conduct R&D, patent inventions and license their technologies. Statistics Canada's Federal Science Expenditures and Personnel (FSEP) survey has been tracking their IP management activities since 1998. Based on preliminary data from the most recent survey, the number of patent applications and patents issued appear to be steadily increasing but the patent portfolio is decreasing. Furthermore, the total number of licenses and royalties from licensing could be dropping off.

Results

This article is based on preliminary data that will be revised when more complete data are available.

The importance of demonstrating results from the government's R&D is shown in the steady increase in the number of patent applications and patents issued. In 2002-03, an estimated 384 patents were applied for and 146 were issued. Both figures show an increase over the previous year.

The total number of patents in the federal government's collective patent portfolio took a major drop between 1998-99 and 2000-01, largely due to a rationalization of existing patents. Some departments explained that it costs money to maintain a

Table 1. Federal government intellectual property management indicators, 1997-98 to 2002-03[1]

	1997-98	1998-99	2000-01	2001-02	2002-03
Patents					
Patent applications	233	222	363	342^{p}	384^{p}
Patents issued	130	89	109	133^{p}	146^{p}
Patents in force	1,950	1,946	1,466^{r}	1,475^{p}	1,309^{p}
Licenses					
New licenses	398	191	207^{r}	175^{p}	161^{p}
Total licenses	1,112	1,130	1,533	1,358^{p}	1,382^{p}
Royalties ($ millions)	6.9	12.0	16.5^{r}	16.3^{p}	15.3^{p}
Spin-offs (total historical)	14^{r}	44^{r}	62^{r}	86^{p}	95^{p}

Notes:

There was no survey in 1999-00.

1. All figures for 2001-02 and 2002-03 are preliminary. Data for 2001-02 and 2002-03 are partially based on estimated data. As an indicator, about 3% of the figure for royalties for 2001-02 are based on 2002-03 data. Similarly, about 27% of the figure for royalties in 2002-03 is based on 2001-02 data.

Sources:

Statistics Canada, 2003, Federal science expenditures and personnel 2004/2005, Intellectual property management fiscal year 2002-03. Science, Innovation and Electronic Information Division.

patent and there is little incentive to maintain patents that have little hope of generating revenues.

The number of spin-off companies has also been increasing steadily. By 2002-03 technology developed by the federal departments and agencies were responsible for creating at least 95 new companies over the past 10 years.

Given the preliminary nature of the data, the drop in royalties and licenses over the past two years may or may not be substantiated when the data are updated.

Data quality

The IP management annex to the FSEP was developed to obtain detailed information on the commercialization activities of selected departments. It has been conducted for five of the past six years and has a potential respondent base of 12 departments and agencies. Since not all of these departments and agencies are able to respond to the survey each year, these preliminary data include estimates for certain years.

In part, the pattern of spin-offs shown in the table is a figment of reporting. The spin-offs are shown in the year they were first reported, not the year of incorporation. In 1998-99 several companies created before 1997 were newly reported. Work is planned to determine the actual year of incorporation for all spin-offs and future reports will be on the basis of year of incorporation.

Statistics Canada is working with the Federal Partners in Technology Transfer (FPTT) and other stakeholders to produce a more extensive working paper before the end of the calendar year. We are also cooperating on the revision of the IP questionnaire and process.

This is new analysis of data originally released in the May 10, 2004 issue of the Statistics Canada Daily.

Michael Bordt, SIEID

Community Innovation

Since early 2003, Statistics Canada's Science Innovation and Electronic Information Division (SIEID) have been working in conjunction with Industry Canada's Marketplace Innovation Division to bring together existing indicators of community innovation and to develop new ones. The following two papers are the first of a series of working papers on **Community Innovation**. While there are other initiatives to develop more detailed community-level data in Canada, the focus of this work is on innovation, technology-based industries, R&D and highly-qualified personnel.

In some cases, we have been able to generate community-level estimates from surveys that were not originally intended to provide them. In other cases, we have exploited and refined administrative datasets to extract reliable community-level data. Relevant innovation indicators have also been developed from existing sub-provincial datasets such as Statistics Canada's Census of Population Community Profiles data. The intent of these papers is to propose indicators and to stimulate discussion.

Further papers in the series are in progress and will be released as they become available. The topics include (1) patents, (2) high-growth firms and (3) the importance of tolerance, talent and technology for innovation.

Michael Bordt and Frances Anderson, SIEID, Statistics Canada.

Community innovation: Innovation performance of manufacturing firms in Canadian communities

More information on community innovation is required by policy developers. Data from the 1999 Survey of Innovation reveals that the national estimate of innovative manufacturing establishments is 81%. On analysis of 88 communities, almost half have a percentage of innovative manufacturing establishments not significantly different from the national estimate, while approximately 20% are significantly below the national estimate and one-third are significantly above the national estimate.

This analysis considers 140 communities in Canada with an urban core population of at least 10,000. Of these communities, 26 have an urban population core of at least 100,000 and are called Census Metropolitan Areas (CMAs), while the remaining 114 have urban core populations of at least 10,000 and not more than 99,999 and are called Census Agglomerations (CAs).

Data are available from the 1999 Survey of Innovation on manufacturing firms[1] for all 26 CMAs and for approximately 50% of the CAs. Data are not available for the other 50% of the CAs because there were too few establishments sampled in these CAs. Table 1 reveals an analysis of 88 communities, almost half have a percentage of innovative manufacturing establishments not significantly different from the national estimate, while approximately 20% are significantly below the national estimate and one-third are significantly above the national estimate.

Table 1. Community innovation as measured by percentage of innovative manufacturing establishments relative to the national estimate for selected communities, 1999

	Number of Communities	Percentage of Communities
Significantly above national estimate (+)	29	33
Not significantly different from national estimate (=)	43	49
Significantly below the national estimate (-)	16	18
Total	**88**	**100**

Source: Statistics Canada, Survey of Innovation 1999.

The size of the communities alone cannot explain the differences in the percentage of innovators in a community. Table 2 results show that there are several CMAs with percentages that are significantly below the national estimates (7 out of 26 CMAs) while several CAs have a significantly higher percentage of innovative establishments (22 out of 114 CAs). This result was also found in a study by Therrien (2003) where he finds that there is more variation in the percentage of innovative manufacturing establishments by industrial sector than by city size[2].

Central Canada (Quebec and Ontario) and Eastern Canada (Atlantic Provinces) are more likely than the West to have communities with a percentage of manufacturing innovators that is significantly higher than the national estimates. Only 3 out of the 29 communities with a significantly higher percentage of innovators than the national average come from the West (one in Alberta and two in BC). However, one must note that factors not taken into account in this analysis, such as industrial composition and firm size, could explain these differences.

This article is based on a working paper that will shortly be released as part of the SIEID Working Paper series.

Pierre Therrien, Industry Canada and Frances Anderson, Statistics Canada.

Table 2. Community innovation as measured by percentage of innovative manufacturing firms relative to the national estimate, for all census metropolitan areas and census areas, 1997-1999

	CMAs		CAs	
	number	%	Number	%
Significantly above national estimate (+)	7	27	22	19
Not significantly different from national estimate (=)	12	46	31	27
Significantly below the national estimate (-)	7	27	9	8
Confidential (X)	0	0	52	46
Total	**26**[1]	**100**	**114**[2]	**100**

Source: Statistics Canada, Survey of Innovation 1999.
1. Ottawa-Hull appears in counts twice for both parts in Ontario and Quebec.
2. CAs that cross provincial boundaries were counted in each province and CAs for which there were insufficient sample unites to produce an estimate were excluded.

[1] The term firm is used as an equivalent to the statistical unit of the analysis which is the establishment. See note at the end of the paper for details.

[2] See http://www.druid.dk/conferences/summer2003/Papers/THERRIEN.pdf or contact: therrien.pierre@ic.gc.ca

Community innovation: Industrial specialization in Canadian cities

Economic specialization indices enable communities to identify local economic strengths and weaknesses and to assist in making the best use of their knowledge resources. A new working paper provides an index of specialization for Canada's 50 largest communities including analysis comparing changes in specialization in selected "high technology" industries with changes in employment in these communities.

Background

"*A paradox of the global, knowledge based economy is that sources of competitive advantage tend to be localized. Communities and regions across Canada use their knowledge resources to create economic value, and it is in communities that the elements of the national innovation system come together*." - Government of Canada (2002)

Economic specialization indices allow communities to identify local economic strengths and weaknesses and to help them make the most efficient use of their knowledge resources. They also enable communities to see potential cluster development opportunities. According to Michael Porter (1998), business clusters are: "geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. They include, for example, suppliers of specialized inputs such as components, machinery, and services, and providers of specialized infrastructure."

The creation of an index of specialization allow for the initial analysis comparing changes in specialization in selected "high technology" industries with changes in employment in these communities. The indicators provide interesting and useful insight into community innovation.

Key Concepts

Key concepts required to understand the results include an LQ which is a *measure of specialization*—the higher the LQ, the more specialized the community is in that industry compared with the national level. The Tech-Pole (see Gertler et al., 2002) industries are selected sectors that represent some *high technology* sectors. The LQ Tech-Pole shows how specialized a community is in these selected industries. The HHI (Herfindahl-Hirschmann Index) is a general *measure of concentration* (or market share). If a community's economy is evenly distributed among all the sectors, the concentration is low. If one sector dominates, the concentration increases towards 1.00.

Summary of results

Many smaller communities tend to exhibit high specializations for the industries in which they specialize but, for the year 2000, none of these included high technology industries. The larger communities, wherein the specializations are less extreme, do generally exhibit the expected specializations. This may be, at least in part, to the economic inertia observed by Shearmur and Polese (2001). According to their analysis of Canadian regional specialization between 1971 and 1996: "*…areas will tend to grow and decline as the sectors which are located there grow and decline: only in rare circumstances…will an area grow because it has been able to significantly modify its economic base.*"

Table 1. Location quotients in selected cities, 2000

Community (2001 population)	LQ	Industry	SIC[1]
Newfoundland			
St. John's (172,918)	4.12	Petroleum and coal products	36x
	3.37	Other communication	482
	3.03	Other education	85x
Prince Edward Island			
Charlottetown (58,358)	5.71	Fishing and trapping	03
	3.94	Petroleum products wholesale	511
	3.15	Pharmaceuticals and medicine	374
Nova Scotia			
Halifax (359,183)	5.21	Utility	49
	2.27	Investment companies	72
	2.19	Other business services	779
New Brunswick			
Saint John (122,678)	27.09	Air transport	451
	3.64	Other business services	779
	3.56	Construction services	44
Quebec			
Montreal (3,426,350)	3.46	Apparel and dry goods wholesale	53
	3.19	Clothing	24
	3.00	Pharmaceuticals and medicine	374
Ontario			
Toronto (4,682,897)	2.55	Advertising services	774
	2.51	Other financial	74
	2.32	Insurance	73
Manitoba			
Winnipeg (671,274)	5.07	Farm products wholesale	501
	3.69	Aircraft and aircraft parts	321
	3.07	Foods wholesale	521
Saskatchewan			
Saskatoon (225,927)	3.88	Mines	06
	3.22	Other education	85x
	2.84	Post-secondary non-university education	852
Alberta			
Calgary (951,395)	6.14	Oil, gas. mineral extraction services	07x
	3.79	Pipeline transport, storage and warehousing	46x
	3.21	Architectural engineering and other scientific services	775
British Columbia			
Vancouver (1,986,965)	3.53	Agricultural services	02
	1.98	Other communication	482x
	1.89	Accounting and bookkeeping services	773

1. The industry classification is a custom aggregation of the SIC80(E). See the working paper for details.

Between 1989 and 2000, some communities increased their specialization in high tech industries while others decreased theirs. There was no obvious relationship between these changes and the change in employment in the later years of that period. All of the cities in Figure 1 experienced an increase in employment between 1996 and 2001 but almost half of them did so by becoming less specialized in the high tech industries.

While there were similar changes in concentration over the same period, there were also no obvious relationships with employment change (Figure 2).

Statistics for the 50 largest cities are provided in the SIEID working paper: "Community Innovation: Industrial specialization in Canadian cities", forthcoming.

Sharonne Katz, Marketplace Innovation, Industry Canada and Michael Bordt, SIEID, Statistics Canada.

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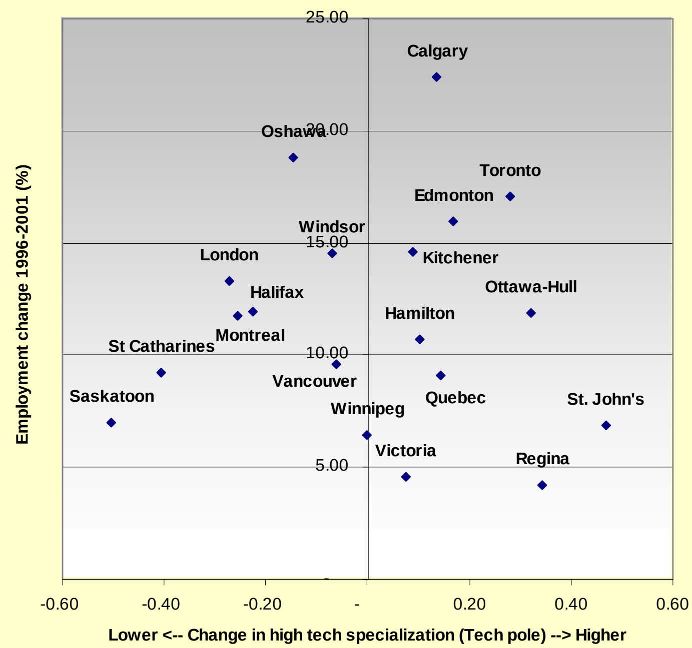
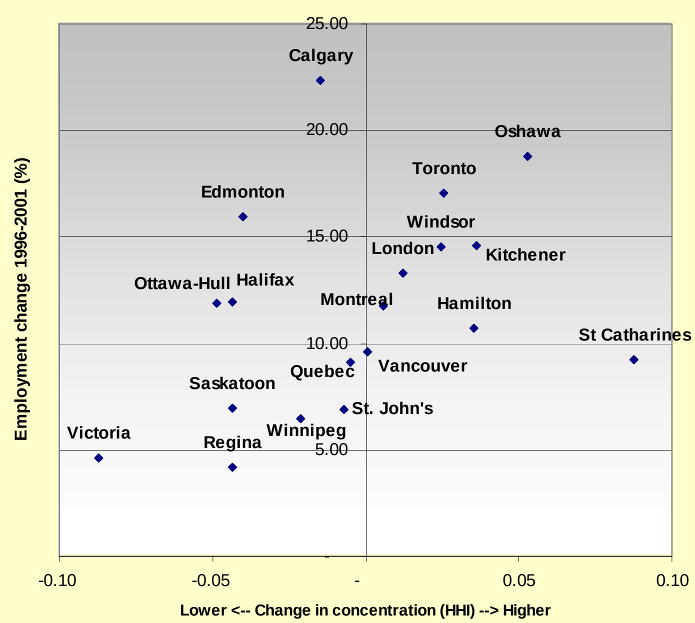
Figure 1. LQ Tech Pole change and employment change (selected cities)



Source: Statistics Canada, LEAP-SAF and Census of Population.

Note: For simplicity, only the largest 19 cities are represented.

Figure 2. Concentration (HHI) change and employment change (selected cities)



Source: Statistics Canada, LEAP-SAF and Census of Population.

Note: For simplicity, only the largest 19 cities are represented.

Importance of research and development in the business services sector

Research and development (R&D) activities are often closely associated with the manufacturing sector. However, in recent years, R&D has assumed an increasingly important place in Canada's services sector. In the services sector, the business services are the ones performing the majority of the R&D. This paper highlights the importance of the effort dedicated to R&D in this sector. In 2000, the business services sector represented 17% of all industrial R&D expenditures and 28% of all industrial R&D jobs.

Research and development in the services sector[1] , an often underestimated activity

R&D activity in the services sector is currently the subject of renewed attention by researchers. The following are some authors and organizations whose recent publications cover the issue of R&D in the services sector: Hanel (2004); Rosa (2004); Rosa and Gault (2004); Djellal and al. (2003); *Conseil de la science et de la technologie* (2003); Gallouj (2002); Akerblom (2002); Preissl (2000); Gault (1998). These various works seek to show that, not only is R&D a significant factor in the services sector, but that it may assume different forms from what is generally observed in the manufacturing sector.

The very nature of the activities in the services sector makes it a sector with specific characteristics, which may make the measurement and interpretation of the definition of R&D more difficult. The services are often intangible in nature, to the extent that they represent an activity, an action or an effort (Djellal et al., 2003). Services are particularly diversified in that the majority of these services are personal. Services are likewise more difficult to store, since the majority of them are consumed instantaneously. All these specific characteristics force researchers to question the validity of using conventional statistical indicators for measuring R&D in the services sector.

R&D in the services sector is not always technological in nature, as it may have a social character (economic research, research on behaviour and preferences, social research, financial risk analysis etc.). Activities in Research and development partly focus on conquering the areas of uncertainty, particularly on the social issues, we have just mentioned. The industrial classification of the services sector is constantly changing to take into account the evolution of the industrial structure of our economy. These changes sometimes make our understanding of the nature and typology of this sector complicated.

The overall message conveyed by the majority of the studies that we have just referenced suggest a possible underestimation of the R&D activities in the services sector, since we do not take into consideration all the items specific to this measurement.

[1] The SIC-E codes for business services are: Computer and Related Services (7721, 7722); Architects, engineers and other Scientific and Technical Services (7751, 7752, 7759); Management Consulting Services (7771); Other Service Industries (7711, 7712, 7731, 7739, 7741, 7742 ,7743, 7749, 7761, 7791, 7792, 7793, 7794, 7795, 7796, 7799). This last category includes: (Employment agencies and personnel suppliers: Accounting and bookkeeping services, Advertising services, Offices of lawyers and notaries, Other business services).

Industrial and regional structure of the business services sector

The Research and development activities in the business services sector represented in 2000 more than 2 billion dollars of expenditures and more than 28,000 employees allocated to R&D, namely 17% of all industrial R&D expenditures and 28% of all industrial R&D jobs in Canada, (see Table 1).

Between 1994 and 2000, the share of R&D expenditures in the business services sector as against the total of R&D expenditures in industry remained stable, shifting from 18% in 1994 to 17% in 2000. However, the share of jobs allocated to R&D in this sector as against the total of industries rose from 24% in 1994 to 28% in 2000. There has consequently been an overall decline in the share of R&D expenditures per employee. Two possible explanations exist for this phenomenon. The first is that the structural composition of jobs and expenditures in the business services sector has changed dramatically over the past decade; the article demonstrates that expenditures on business services such as management consulting have in fact decreased within the business services sector, whereas those on the Computer and Related Services and Architects, Engineers, Scientific and Technical Services industries have increased. A second possible explanation, an extension of the first, is that salaries in R&D have increased at a slower rate in the business services sector than in the rest of the economy. Variation in the efforts dedicated to R&D (measured as R&D expenditures per employee) has decreased in this sector overall in Canada over the last decade, a direct consequence of the change in industrial composition of this sector.

The figures in Table 1 show that over the period, 1994 to 2000, the jobs allocated to R&D in the business services sector made more rapid progress than those same jobs for all businesses, namely 51% for business services, as compared to 28% for all businesses. On the other hand, the growth rate of total R&D expenditures in the business services sector was 50%, compared to 61% for all businesses. This strong growth in the business services sector is partly attributable to the rise of the Information and Communication Technologies (ICT) industry, according to Rosa and Gault (2004) and a report from the *Conseil de la science et de la technologie* (2003).

Research and development activity in the business services sector is very concentrated. It largely involves Quebec and Ontario, with respectively 39% and 41% of total R&D expenditures in this sector in 2000. The concentration is also industrial, since the Computer and Related Services industry and the Architects, En-

Table 1. Number of employees engaged in R&D, intramural expenditures (in thousands of dollars), in business services by industry

Industry		1994	2000	Change (%)
Computer and Related Services	Employees engaged in R&D	7,912	15,896	100.9
	Total R&D expenditures	503,077	965,521	91.9
Architects, engineers and other Scientific and Technical Services	Employees engaged in R&D	8,562	10,540	23.1
	Total R&D expenditures	710,051	963,022	35.6
Management Consulting Services	Employees engaged in R&D	1,074	493	-54.1
	Total R&D expenditures	71,121	28,895	-59.4
Other Business Services	Employees engaged in R&D	1,106	1,194	7.9
	Total R&D expenditures	63,116	70,120	11.1
Total for the Business Services Sector	Employees engaged in R&D	18,654	28,123	50.8
	Total R&D expenditures	1,347,365	2,027,558	50.5
All industries in Canada	Employees engaged in R&D	78,883	100,892	27.9
	Total R&D expenditures	7,567,176	12,174,504	60.9

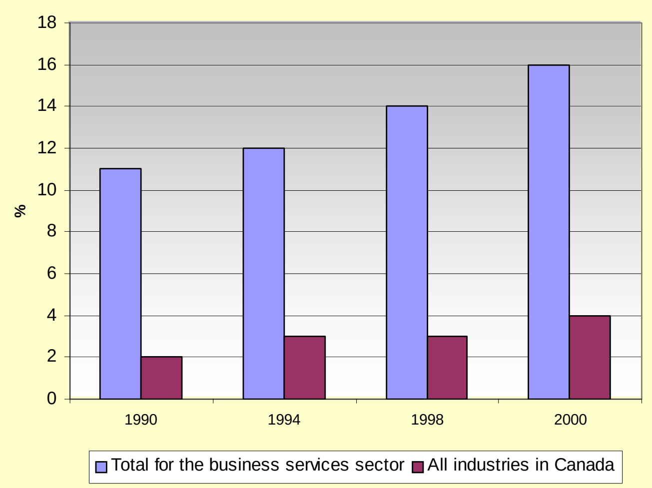
Source: Statistics Canada. Survey of Research and Development in Canadian Industry.

Tableau 2. Number of employees engaged in R&D, intramural expenditure (in thousands of dollars), in business services by region

Region		1994	2000	Change (%)
Atlantic Provinces	Employees engaged in R&D	469	695	48.2
	Total R&D expenditures	28,943	34,724	19.9
Quebec	Employees engaged in R&D	5,513	10,678	93.7
	Total R&D expenditures	384,877	785,955	104.2
Ontario	Employees engaged in R&D	6,910	11,225	62.4
	Total R&D expenditures	510,880	841,278	64.7
Saskatchewan and Manitoba	Employees engaged in R&D	580	458	-21.0
	Total R&D expenditures	39,539	28,357	-28.3
Alberta	Employees engaged in R&D	1,767	1,578	-10.7
	Total R&D expenditures	114,844	92,821	-19.2
British Columbia	Employees engaged in R&D	3,415	3,489	2.2
	Total R&D expenditures	268,282	244,423	-8.9
Total for the Business Services Sector	Employees engaged in R&D	18,654	28,123	50.8
	Total R&D expenditures	1,347,365	2,027,558	50.5

Source: Statistics Canada. Survey of Research and Development in Canadian Industry

Chart 1. Share of employees with postsecondary education engaged in R&D as compared to total jobs in the business services sector.



Source: Statistics Canada. Survey of Research and Development in Canadian Industry.

Engineers, Scientific and Technical Services industry represent together 95% of R&D expenditures in this sector. This industrial concentration has intensified over the past 10 years, also resulting in a certain reallocation of areas of specialization on both a sectoral and regional basis.

Between 1994 and 2000, the Prairie Provinces were the only regions to experience a significant decline in R&D expenditures and jobs.

Human resources engaged in R&D in the business services sector

The business services sector not only increased its numbers of staff engaged in R&D, but also the general level of personnel with postsecondary education engaged in R&D. In 2000, the proportion of employees with postsecondary education (at the Bachelor's, Master's or doctoral levels) engaged in R&D for businesses declaring R&D exceeded 16% in the business services sector, while this same proportion was only 4% for all industries. Furthermore, the proportion of staff with high levels of skills has never stopped growing in the business services sector since 1994. Great emphasis in relation to the application of new technologies is placed on knowledge; for example, a very high percentage of new hires in the services sector in biotechnology and the environment have an advanced level of educational attainment. Strong growth in these areas in recent years has contributed to the hiring within the sector of employees with advanced academic qualifications.

The full paper "Regional disparities of Research and Development on the business services sector" appears in publication 88F0006XIF, No. 9 in the working paper series (April) 2004.

Julio Miguel Rosa, SIEID, Statistics Canada

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Measuring "high-growth" firms that perform R&D

Quickly growing firms, whether measured in terms of employment, revenues or profits, are a matter of interest to government policy analysts and economists, as well as investors. Recent studies have examined high-growth firms, often referred to as "gazelles", that have doubled their employment or revenues in five years. This article highlights the impact of using different statistical indicators of "high growth".

Defining "high growth"

High-growth firms are a topic of interest to many[1], but who is interested and why depends on how the concept is defined. Growth can be related to employment or revenues or profits or some combination of these measures. This paper will compare four different indicators of high growth based on available measures:

- doubling of employment,
- doubling of revenues[2],
- doubling of employment or revenues and
- doubling of employment and revenues,

each over the five year period from 1995 to 2000. Using data from the Research and Development in Canadian Industry (RDCI) database, records from 1995 were matched to records from 2000. This matching process produced 3,926 matches or 37% of all firms which reported performing R&D in 1995[3] (Table 1A).

R&D and high-growth firms

Statistics Canada, as part of a joint project with National Research Council–Industrial Research Assistance Program (NRC/IRAP), undertook a study of high-growth firms[4]. During the preliminary analysis a variety of indicators of growth were considered. During this process, it was noted that for R&D performing firms, the profile of high-growth firms changed noticeably depending on how the concept of high growth was defined. This paper will provide an overview of those differences.

Measuring growth by employment or revenues

Measuring growth in employment is reasonably straightforward given that the RDCI survey has collected the same information for years[5]. Measuring growth by revenues by contrast is somewhat more complex given changes in the purchasing power of a dollar over time. To overcome part of this problem, revenues were measured in constant value dollars[6].

[1] For example, National Commission on Entrepreneurship. 2001. *High-Growth Companies: Mapping America's Entrepreneurial Landscape*, Available on the Internet at http://www.ncoe.org.

[2] Note all revenue figures are in constant dollars.

[3] RDCI, 2003, Note: larger firms were somewhat more likely to be matched than smaller firms. Thirty-two percent of firms with fewer than 20 employees were matched while over 40% of firms with 20 or more employees were matched. The highest match rate was 45% for firms with 500 or more employees.

[4] Related working papers will be available through the Statistics Canada website, SIEID Working Papers.

[5] Data for the RDCI survey come from paper questionnaires for firms with $1 million or more in R&D spending and administrative data files for those firms with less R&D. Both of these sources include data on total numbers of employees.

[6] In this case growth was calculated to take into account changes in the value of the dollar between 1995 and 2000, based on price indices from CANSIM Table 380-0056.

Table 1A. Types of high-growth firms by size category (number of firms)

	Firm size by employees						
High-growth measure	1-9	10-19	20-49	50-99	100-499	500+	All firms
Employment or revenues	719	299	265	115	112	44	1,554
Employment only	576	212	199	81	69	14	1,151
Revenues only	461	182	177	75	85	35	1,015
Employment and revenues	318	95	111	41	42	5	612
All matched firms	1,321	706	793	435	449	222	3,926

Source: Statistics Canada, Survey of Research and Development in Canadian Industry

Table 1B. Types of high-growth firms as a percentage of all matched firms by size category

	Firm size by employees						
High-growth measure	1-9	10-19	20-49	50-99	100-499	500+	All firms
Employment or revenues	54	43	33	26	25	20	40
Employment only	**44**	**30**	**25**	**19**	15	6	29
Revenues only	35	26	22	17	**19**	**16**	26
Employment and revenues	24	13	14	9	9	2	16
All matched firms	100	100	100	100	100	100	100

Source: Statistics Canada. Survey of Research and Development in Canadian Industry.

Depending on which measure is selected, the proportion of high-growth R&D performing firms ranged from 16% to 40% of all matched firms (Table 1b). The most inclusive measure, based on a doubling of either employment or revenues resulted in 1,588 firms qualifying as high-growth. By contrast, the most exclusive definition required both measures to double and resulted in only 612 firms qualifying as high-growth. While the number of firms that are high-growth based on employment is similar to the number that doubled based on revenue, the overlap between the two groups was only 53 or 60%, depending on which group was used as the reference point.

Firm size has an impact on measurement

The smallest firms were most likely to be high-growth firms. It is also clear that smaller firms, in this case those under 100 employees, were more likely to report doubling their employment levels than their revenues (Table 1b). By contrast, the larger firms with 100 or more employees were more likely to report doubling of revenue than employment. The largest firms, those with 500 or more employees, were much more likely to report doubling of revenues than employment. This may indicate that larger firms are better able to generate efficiencies, which enables them to increase revenues without a correspondingly large increase in employment, thereby increasing their overall productivity.

Results vary for some industries

Regardless of which indicator is selected, the industry with the highest number of high-growth R&D performing firms is computer systems design services (Table 2), followed by machinery manufacturing, which in turn is followed by architectural and engineering services. When high growth is measured in terms of the proportion of R&D performing firms reporting high growth, computer systems design, semiconductor manufacturing and information and cultural services industries report consistently high levels regardless of the growth indicator selected.[7]

Three industries reported much higher proportions of revenue-only high-growth firms[8]. Almost a quarter of all the manufacturers of pharmaceuticals and semiconductors, along with firms in health care and social services, reported doubling of revenue without a corresponding doubling in employment. Communications equipment, instrument manufacturers and management consulting firms were the only other industries to report a higher proportion of high growth firms using revenue-based indicators than employment-based measures.

The highest proportions of employment-only growth were reported by non-metallic minerals, computers and peripheral equipment manufacturers and aerospace industries, in which just under 20% of firms reported high growth in employment only.

Generally, industries with high R&D spending and high R&D intensities[9] were more likely to report a higher proportion of high-growth firms. Overall 40% of R&D performing firms were high-growth firms based on the broadest measure, revenue or employment growth. Industries that reported higher proportions of high-growth firms (45% or more of firms reporting high growth) included pharmaceuticals, communications equipment, semiconductors, instruments, aerospace, information and cultural services, architectural and engineering services, scientific research and development services and health care and social services. Amongst those industries with higher proportions of high-growth firms, with the exceptions of aerospace and health care and social services, firms in manufacturing were more likely to report high growth in revenues while firms in services were more likely to report high growth in employment.

[7] If, instead of the overall GDP deflator, industry-specific price indices for manufacturing industries are applied (CANSIM Table 329-0038), then the "high tech" industries of computers, peripherals and other electronics, communications equipment and semiconductors would report even greater proportions of high-growth firms. Machinery and motor vehicles manufacturing industries by contrast, would report fewer high growth firms.

[8] To calculate the number and percentage of "revenue-only" high-growth firms, subtract the number or percentage of revenue and employment high growth firms from the number of revenue based high-growth firms in Table 2.

[9] See Statistics Canada. 2004. *Research and Development in Canadian Industry, 2003 Intentions*, Cat. no. 88-202-XIE Table 3 for total spending by industry and Table 12 for current R&D spending as a percentage of revenues.

Table 2. High-growth firms by industry and type of growth indicator

Industry	Revenue ***and*** employment indicator		Revenue indicator[1]		Employment indicator		Revenue ***or*** employment indicator	
	#	%	#	%	#	%	#	%
Agriculture, forestry, fishing etc.	7	12	13	22	16	**27**	22	**37**
Oil, gas and mining	4	11	8	21	8	21	12	**32**
Utilities	1	9	2	18	2	18	3	**27**
Construction	7	12	13	22	15	**26**	22	**38**
Food, beverages and tobacco	7	6	16	13	22	18	32	**27**
Textile	4	8	4	8	10	20	12	24
Wood, paper and printing	10	10	19	18	24	23	33	**31**
Pharmaceutical and medicine	9	20	20	**44**	14	**31**	25	**56**
Petroleum and other chemical products	16	8	30	15	38	19	**53**	**26**
Plastic products	13	12	19	17	27	24	34	**31**
Non-metallic mineral products	3	9	3	9	8	**25**	9	**28**
Primary metals	5	13	8	20	12	**30**	16	**40**
Fabricated metal products	7	13	9	17	11	20	14	**26**
Machinery	23	13	38	21	46	**25**	**63**	**34**
Computers, peripherals and other electronics	**54**	14	**82**	21	**101**	**26**	**139**	**35**
Communications equipment	13	16	18	23	28	**35**	35	**44**
Semiconductor and other electronic components	17	19	33	**37**	24	**27**	42	**47**
Navigational, measuring, medical and control instruments	21	**25**	41	**49**	33	**39**	**53**	**63**
Electrical equipment, appliance and components	42	24	**62**	**36**	**55**	**32**	**78**	**45**
Motor vehicle and parts	14	14	25	**26**	24	24	36	**37**
Aerospace products and parts	6	16	9	24	13	**35**	18	**49**
All other transportation equipment	3	15	5	**25**	6	30	8	**40**
Furniture and other manufacturing industries	18	12	34	23	43	**29**	**60**	**40**
Wholesale trade	30	11	**53**	20	**66**	24	**93**	**34**
Information and cultural industries	43	**25**	**61**	**36**	**67**	**40**	**88**	**52**
Architectural, engineering and related services	44	16	**76**	**27**	**87**	**31**	**125**	**45**
Computer system design and related services	**122**	**28**	**167**	**38**	**188**	**43**	**238**	**54**
Management, scientific and technical consulting services	12	17	18	**25**	17	24	23	**32**
Scientific research and development services	30	24	39	**31**	47	**38**	**58**	**46**
Health care and social assistance	5	16	13	**42**	10	**32**	18	**58**
All other services	31	14	**58**	**25**	**70**	**31**	**98**	**43**
Total	631	16	1,015	**26**	1,151	**29**	1,588	**40**

Source: Statistics Canada. Survey of Research and Development in Canadian Industry.

1. Note that this figure measure all firms which reported a doubling of revenues regardless of how employment changed, not just those who reported only a doubling of revenue. Similarly, the employment figures show all firms which doubled based on employment, not just those who reported only a doubling of employment.

Instances where an industry has 50 or more firms reporting high growth are highlighted in bold, as are instances where the proportion of firms that are high-growth is 25% or greater.

Final observation

When measuring "high-growth" firms it is important to consider the purpose of the study in order to select the more appropriate indicator. Firms which report significant increases in employment without corresponding increases in revenue run the risk of becoming an unsustainable business and/or require large injections of capital to continue their operations. Firms which report only growth in revenues contribute to increased productivity but not to overall employment. It is also important to keep in mind basic economic trends, particularly when looking at which industries reported high proportions of high-growth firms based on revenues. Those industries which reported high proportions of high-growth firms amongst R&D performers also reported high growth in terms of value-added and/or employment by all firms in the industry. [10,11]

Charlene Lonmo, SIEID, Statistics Canada.

[10] Not all firms are R&D performers. To compare figures for R&D performers to the overall economy, see Table 281-0025 CANSIM II for employment figures by industry and Table 379-0017 for GDP growth by industry between 1995 and 2000. Note that the data are not always available in precisely the same industry groupings as RDCI data.

[11] This raises the question of the propensity to perform R&D by industry.

ICT industries and technological change 2000-2002

According to the Survey of Electronic Commerce and Technology (SECT), between 2000 and 2002, 65% of information and communication technology (ICT) firms acquired new technologies as compared to 41% for non-ICT firms.

ICT industrial composition

ICT firms represent a very small proportion, only 3.2%, of all firms in the private sector. As Table 2 shows, there are manufacturing or goods producing firms in the ICT special aggregation however, there are almost twice as many ICT industries in the services producing sector. Examination of the three sectors in which the majority of the ICT industries fall provides an indication why their technological change rate is higher than that of the non-ICT firms. About one-half of manufacturers and wholesalers and two-thirds of information and cultural firms adopted new technologies between 2000 and 2002.

ICT sector employment

The ICT firms also display a slight variation in their employment size structures to the non-ICT firms. ICT firms are less likely to be composed of self-employed persons, firms only providing part-time employment or firms that contract out the employment of their workers to other firms. Due to the lower proportion of this type of firms, firms with no full-time employees comprise just 4% of all ICT firms versus 13% in non-ICT firms.

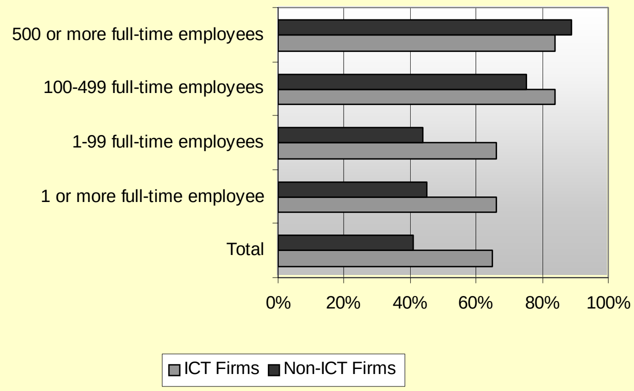
The majority of firms in both the ICT and non-ICT groups have between 1-99 employees (93% and 85% respectively). For both groups this means that there are about 3% of firms with at least 100 employees. When the technological change rates are compared (defined as acquisition of new or significantly improved technologies for ICT firms and non-ICT firms with at least one full-time employees), the rate for non-ICT firms rises from 41% to 45% but ICT firms still recorded a much higher rate of 66%, unchanged from the rate for all ICT firms.

An interesting observation is the higher technological change rate for the small (1-99 full-time employees) ICT firms (66%) is driving the difference in the rates between the two groups (44% for small non-ICT firms). On balance, there was no significant difference between the technological change rates recorded for mid-sized (100-499 full-time employees) and large (500 or more full-time employees) ICT firms and their non-ICT counterparts. However, the rates for these groups were higher, particularly for the non-ICT firms than those recorded in the small firms.

Training to accompany technological change

Over half the firms in both the ICT (63%) and non-ICT (55%) sectors trained to accompany their technological acquisitions. Almost every large (98%) ICT firm trained when new technology was introduced. As it is well-known that smaller firms have lower training rates (Earl 2004a, 2004b) and that the vast majority of ICT and non-ICT firms were small firms, these lower training rates are not out of the ordinary (Earl 2002a, 2002b, 2004a, 2004b).

Chart 1. Technological change rates for ICT and non-ICT firms by size, 2000-02



Source: Statistics Canada, *2002 Survey of Electronic Commerce and Technology*.
Firms are classified as ICT according to their North American Industry Classification code (see Table 2) as based on their industrial activity. Non-ICT firms are the remainder of the private sector firms.

Six methods used to acquire new technologies

The 2002 SECT provided respondents with six methods to acquire new or significantly improved technologies. These methods were: purchasing off-the-shelf technologies; licensing new technologies; customising or significantly modifying existing technologies; leasing new technologies; developing new technologies (either alone or with others); and putting in place an improved production facility. This last method could involve all of the other technological acquisition methods.

In a hierarchy of risk, the simple and quick purchase of readily available off-the-shelf technologies would have the lowest risk and would not necessarily impact too greatly on employees' time. This method was equally popular with ICT and non-ICT firms of all sizes. Where ICT and non-ICT diverged was in their ranking of the other technological acquisition methods. Not surprisingly, given the industries involved, developing new technologies (50%); customising existing technologies (48%); and licensing new technologies (41%) were the next most popular methods with ICT firms overall. Non-ICT firms ranked customising existing technologies (35%) second, but at significantly lower rate. For non-ICT firms, the remaining methods of acquiring new

Table 1. Methods of acquiring new technologies, ICT and non-ICT firms, 2000-2002

Methods used to acquire new technologies	ICT firms	Non-ICT firms
Purchasing off-the-shelf technologies	87% B	80% A
Licensing new technologies	41% B	17% A
Customising or significantly modifying existing technologies	48% B	35% A
Leasing new technologies	16% B	16% A
Developing new technologies	50% B	14% A
Putting in place and improved production facility	12% A	14% A

The alpha data quality indicator should be interpreted as A - Excellent and B - Very Good.

For more information, please see Earl 2004a and 2004b or search www.statcan.ca with key words *Survey of Electronic Commerce and Technology*.

Source; Statistics Canada. *2002 Survey of Electronic Commerce and Technology*.

technologies were rated equally lowly—all with under one-fifth of employing these methods.

ICT more willing to invest

It appears that ICT firms were more willing to invest in new technologies than non-ICT firms. In addition, ICT firms showed a tendency towards using more high risk methods of obtaining new technologies with half of these firms developing their own technologies or customising existing technologies. This suggests that ICT firms were better able to dedicate the time and resources to these technology acquisition methods. Finally, ICT firms also showed a higher inclination towards licensing new technology, suggesting a heightened awareness and interest in technological advances that affected their industries.

For more information, see the Statistics Canada Daily, *January 19, 2004.*

Louise Earl, SIEID, Statistics Canada

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Table 2. Information and Communication Technology (ICT). Special aggregation based on the North American Industry Classification System (NAICS) 2002

NAICS Code	Title
333310	Commercial and service industry machinery manufacturing
333410	Computer and peripheral equipment manufacturing
334210	Telephone apparatus manufacturing
334220	Radio and television broadcasting and wireless communications equipment manufacturing
334310	Audio and video equipment manufacturing
334410	Semiconductor and other electronic component manufacturing
334511	Navigational and guidance instruments manufacturing
334512	Measuring, medical and controlling devices manufacturing
335920	Communication and energy wire and cable manufacturing
417310	Computer, computer peripheral and pre-packaged software wholesaler- distributors
417320	Electronic components, navigational and communications equipment and supplies wholesaler-distributors
417910	Office and store machinery and equipment wholesaler-distributors
511210	Software publishers
517110	Wired telecommunications carriers
517210	Wireless telecommunications carriers (except satellite)
517310	Telecommunications resellers
517410	Satellite telecommunications
517510	Cable and other program distribution
517910	Other telecommunications
518111	Internet service providers
518112	Web search portals
518210	Data processing, hosting and related services
532420	Office machinery and equipment rental and leasing
541510	Computer systems design and related services
811210	Electronic and precision equipment repair and maintenance

Note: The Survey of Electronic Commerce and Technology 2002 sampled all of these information communication technology industries; however, information cannot be disseminated for the individual 6-digits NAICS codes.

Innovation in selected service industries 2001-03

As revealed in data from the 2003 Survey of Innovation, more than three-quarters of establishments in information and communications technology (ICT) service industries were innovative between 2001 and 2003, the highest proportion of all industries surveyed.

Survey includes

The 2003 Survey of Innovation covers establishments with at least 15 employees and $250,000 in revenues. Industries surveyed include ICT service industries; selected professional, scientific and technical services industries; selected natural resource support service industries; and selected transportation industries. Detailed working papers for each of the groups of industries will be released in the Fall of 2004.

Table 1. Percentage of innovative establishments in information and communication technology service industries, 2001 to 2003

	%
Total information and communication technology (ICT) service industries	78.2
Satellite telecommunications	100.0
Software publishers	94.3
Computer systems design and related services	87.2
Wired telecommunications carriers	75.4
Internet service providers	75.4
Telecommunications resellers	74.5
Data processing, hosting, and related services	72.4
Cable and other program distribution	66.5
Computer and communications equipment and supplier wholesaler-distributors	65.1
Other machinery, equipment and supplies wholesaler-distributors	61.8
Wireless telecommunications carriers (except satellite)	60.0
Electronic and precision equipment repair and maintenance	53.3
Office machinery and equipment rental and leasing	52.6
Other telecommunications	x
Web search portals	x

x - Suppressed to meet the confidentiality requirements of the Statistics Act.

Among other things, the data collected includes general information on the business unit's operations; business unit success factors; new or significantly improved products and processes; unfinished or abandoned innovation activities; innovation activities; sources of information for innovation; co-operative and collaborative arrangements for innovation; obstacles to innovation; impact of innovation; and protection of intellectual property.

ICT leads the way

Innovation refers to a new or significantly improved product offered to clients or a new or significantly improved process. This would include new or significantly improved ways of supplying services and delivering products which were new to the establishment. More than 75% of establishments in information and communications technology service industries were innovative between 2001 and 2003. Those ICT service industries with more than 75% of innovative establishments included satellite telecommunications (100%), software publishers (94.3%), computer systems design and related services (87.2%), wired telecommunications carriers (75.4%), and Internet service providers (75.4%).

More data available

The survey provides information on innovation and related activities with the ultimate aim of assisting other government departments in developing policies and programs. It developed as a result of collaboration between Statistics Canada, Industry Canada, Natural Resources Canada and Transport Canada.

Data on a limited number of variables from the survey are now available from Science, Innovation and Electronic Information Division. Working papers for each of the industry sectors will be released in the fall of 2004.

The information in this article first appeared in Statistics Canada's The Daily *on March 31, 2004.*

Susan Schaan, SIEID, Statistics Canada

Electronic commerce and technology, 2003

E-commerce posted a big gain in 2003 for the fourth year in a row, but online sales still accounted for less than 1% of total operating revenues for private businesses.

Combined private and public sector online sales in Canada soared almost 40% to $19.1 billion, following a 27% jump in 2002. The gains were driven by an increase in domestic sales of over $5.7 billion.

Private firms accounted for the vast majority of sales, $18.6 billion. Online sales by public sector enterprises rebounded from a decline in 2002, jumping 56.3% to $511.4 million.

About 7% of private sector firms sold goods or services online last year, virtually unchanged from the year before. These firms accounted for 29% of gross business income in Canada.

Table 1. Firms using high-speed Internet access

	Private sector	Public sector
2001	%	%
Low-speed	46.8	9.9
High-speed	48.4	86.5
2002		
Low-speed	36.6	4.4
High-speed	58.4	93.2
2003		
Low-speed	27.5	2.4
High-speed	66.3	95.3

Internet sales, however, are only one key element of the e-commerce picture. There are many other important aspects to consider when examining technology access and use by Canadian firms. Websites, high-speed Internet access, purchasing, intranets and extranets are also key measures of business connectivity.

Broadband catches on quickly

A major factor in rising e-commerce, particularly in the private sector, is the adoption of high-speed access to the Internet. In 2003, two-thirds (66%) of all private companies used broadband to connect to the Internet, up from 58% the year before, and only 48% in 2001.

The use of high-speed Internet access enables many other technologies to be utilized more effectively. The effectiveness of a firm hosting a website, selling online or having an intranet or extranet all depend on broadband Internet.

Both broadband access and online sales are concentrated in large private companies, those with more than 500 employees. Of these large firms using the Internet, 95% had high-speed access, and accounted for 45% of online sales in 2003. One out of every four large firms sold goods or services online.

Note to readers

Data in this release are from the 2003 Survey of Electronic Commerce and Technology (SECT), which included the entire economy, except for local governments. The survey covered about 21,000 enterprises.

Electronic commerce (e-commerce) is defined as sales over the Internet, with or without online payment. Included is the value of orders received over the Internet. Sales using electronic data interchange over proprietary networks and transactions conducted on automatic teller machines are excluded.

The value of financial instruments transacted on the Internet such as loans and stocks are not considered e-commerce sales, but the service charges received for conducting these transactions over the Internet are included.

Domestic online sales up, foreign markets off

Domestic sales increased 55.2% last year to $16.6 billion, accounting for all of the growth in online sales. Sales for export fell slightly from $2.9 billion in 2002 to $2.4 billion in 2003.

As a result, the domestic market accounted for 87% of total sales, up from 78% in 2002. The share headed to foreign markets fell from 22% to 13% in 2003, continuing a trend from previous years.

Manufacturers accounted for the highest value of exports, shipping $753 million of online sales outside the country, about 30% of their total online sales.

The dollar value of business-to-consumer sales rose 51% to $5.5 billion in 2003. Business-to-business sales reached $13.1 billion, up 35.2%. About 30% of the value of online sales last year was to consumers, up from 27% in 2002, and 22% in 2001.

Firms in retail trade sold $1.7 billion in goods and services online to consumers, the largest volume. This represented 82% of their total online sales. Although the arts, entertainment and recreation sector sold only just over $160 million online to consumers, this accounted for 92% of their total online sales, the highest proportion of any sector.

The data in this article first appeared in the Statistics Canada Daily*, April 16, 2004.*

Bryan van Tol, SIEID, Statistics Canada.

New economy indicators

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

	Units	1998	1999	2000	2001	2002	2003
General economy and population[1]							
GDP	$ millions	914,973	982,441	1,076,577	1,108,200	1,157,968	1.218.772
GDP implicit price index	1997=100	99.6	101.3	105.5	106.7	107.8	111.2
Population	thousands	30,157	30,404	30,689	31,021	31,362	31,630
Gross domestic expenditures on R&D (GERD)[2]	$ millions	16,077	17,631	20,359	22,116	21,704	22,450
"Real" GERD	$ millions 1997	16,142	17,405	19,298	20,727	20,134	20,189
GERD/GDP ratio	ratio	1.76	1.79	1.89	2.00	1.87	1.84
"Real" GERD/capita	$ 1997	535.27	572.45	628.82	668.16	641.99	638.29
GERD funding by sector							
Federal government	% of GERD	17.6	18.2	17.5	18.1	19.5	19.5
Provincial governments	% of GERD	4.0	4.4	4.3	4.9	5.4	5.6
Business enterprise	% of GERD	45.7	44.9	44.1	48.3	45.3	44.3
Higher education	% of GERD	14.5	15.0	14.2	13.5	15.1	16.0
Private non-profit	% of GERD	2.3	2.2	2.2	2.4	2.7	2.9
Foreign	% of GERD	15.9	15.3	17.7	12.9	12.0	11.7
GERD performance by sector							
Federal government	% of GERD	10.8	10.5	10.2	9.5	10.2	9.7
Provincial governments	% of GERD	1.3	1.3	1.3	1.4	1.5	1.5
Business enterprise	% of GERD	60.2	59.0	59.8	59.6	55.2	53.7
Higher education	% of GERD	27.2	28.8	28.4	29.3	32.8	34.9
Private non-profit	% of GERD	0.5	0.4	0.3	0.2	0.2	0.2
Federal performance as a % of federal funding	% of federal	61.6	57.8	58.4	52.6	52.5	49.8
"Real" federal performance of R&D	$ millions 1997	1,750	1,835	1,972	1,971	2,063	1,955
Information and communications technologies (ICT)							
ICT sector contribution to GDP - basic prices[3]							
ICT, manufacturing	$ millions	9,720	13,168	18,062	12,788	10,608	..
% of total ICT	% of total ICT	25.8	27.7	31.2	22.3	18.1	..
ICT, services	$ millions	28,020	34,340	39,870	44,457	48,063	..
% of total ICT	% of total ICT	74.3	72.3	68.9	77.7	81.9	..
Total ICT	$ millions	37,734	47,464	57,858	57,222	58,670	..
Total economy[4]	$ millions	848,414	892,870	933,713	947,039	977,322	..
ICT % of total economy	%	4.4	5.3	6.2	6.0	6.0	..
Total business sector	$ millions	710,188	752,197	791,306	801,870	828,842	..
ICT % of business sector	%	5.3	6.3	7.3	7.1	7.1	..
ICT adoption rates (private sector)							
Personal Computer	% of enterprises	..	81.9	81.4	83.9	85.5	..
E-Mail	% of enterprises	..	52.6	60.4	66.0	71.2	..
Internet	% of enterprises	..	52.8	63.4	70.8	75.7	..
Have a website	% of enterprises	..	21.7	25.7	28.6	31.5	..
Use the Internet to purchase goods or services	% of enterprises	..	13.8	18.2	22.4	31.7	..
Use the Internet to sell goods or services	% of enterprises	..	10.1	6.4	6.7	7.5	..
Value of sales over the Internet	$ millions	..	4,180	7,246	10,389	13,339	..

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

	Units	1998	1999	2000	2001	2002	2003
Information and communications technologies (ICT) continued							
ICT adoption rates (public sector)							
Personal Computer	% of enterprises	..	100.0	100.0	100.0	99.9	..
e-mail	% of enterprises	..	96.6	99.0	99.7	99.6	..
Internet	% of enterprises	..	95.4	99.2	99.7	99.6	..
Have a Web site	% of enterprises	..	69.2	72.6	86.2	87.9	..
Use the Internet to purchase goods or services	% of enterprises	..	44.2	49.1	54.5	65.2	..
Use the Internet to sell goods or services	% of enterprises	..	14.5	8.6	12.8	14.2	..
Value of sales over the Internet	$ millions current	..	244.6	11.5	354.8	327.2	
Teledensity indicators							
Wired access (Voice Grade Equivalent - VGE)	per 100 inhabitants	63.8	64.3	66.1	66.9	65.1	62.9
Wireless access (VGE)	per 100 inhabitants	18.5	23.7	29.4	34.8	37.6	41.7
Total public switched telephone network (PSTN) (VGE)	per 100 inhabitants	82.3	86.9	94.4	101.1	102.9	104.6
Homes with access to cable	thousands	10,564.6	10,725.2	10,896.1	11,107.4	..	..
Homes with access to Internet by cable	thousands	..	..	7,609.7	9,391.4	..	..
Access indicators							
Total wired access lines (VGE)	thousands	19,293.7	19,623.6	20,347.0	20,805.1	20,456.3	19,950.9
Residential access lines (VGE)	thousands	12,601.5	12,743.9	12,871.7	12,854.2	12,752.1	12,650.4
Business access lines (VGE)	thousands	6,692.2	7,062.4	7,475.3	7,950.9	7,702.2	7,300.5
Analogue mobile subscribers	thousands	3,939.0	4,305.2	4,282.6	3,138.9	2,691.2	2,085.9
Digital mobile subscribers	thousands	1,406.4	2,592.7	4,444.0	7,509.9	9,180,8	11,135.9
Digital cable television subscribers	thousands	..	..	390.4	811.7	..	..
Satellite and MDS subscribers	thousands	..	..	967.5	1,609.4	..	..
High speed Internet by cable subscribers	thousands	..	..	786.3	1,387.8	..	
Network investment indicators[5]—Capital expenditures							
Wireline public telecommunication networks	$ millions	4,629.1	4,258.7	4,989.9	5,451.7	4,328.6	..
Wireless public telecommunication networks	$ millions	1,462.6	1,374.1	2,005.7	1,896.0	1,934.6	..
Cable networks	$ millions	773.2	1,110.8	1,523.9	2,124.6	..	..
Satellite and MDS networks	$ millions	30.6	194.1	158.1	521.2	..	..
Characteristics of biotechnology innovative firms[6]							
Number of firms	number	..	358	..	375	..	..
Total biotechnology employees	number	..	7,748	..	11,897	..	..
Total biotechnology revenues	$ millions	..	1,948	..	3,569	..	..
Expenditures on biotechnology R&D	$ millions	..	827	..	1,337	..	..
Export biotechnology revenues	$ millions	..	718	..	763	..	..
Import biotechnology expenses	$ millions	..	234	..	433	..	..
Amount of capital raised	$ millions	..	2,147	..	980	..	..
Number of firms that were successful in raising capital	number	..	138	..	134	..	..
Number of existing patents	number	..	3,705	..	4,661	..	..
Number of pending patents	number	..	4,259	..	5,921	..	..
Number of products on the market	number	..	6,597	..	9,661	..	..
Number of products/processes in pre-market stages	number	..	10,989	..	8,359	..	..
Intellectual property commercialization[7]							
Federal government							
New patents received	number	130	89	..	109[r]	133[p]	146[p]
Royalties on licenses	$ thousands	6,950	11,994	..	16,467	16 270[p]	15 253[p]
Universities							
New patents received	number	143	325	..	339	..	..
Royalties on licenses	$ thousands	15,600	18,900	..	44,397	..	..

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5 Figures for 2001 and 2002 are based on Q4 data from the service bulletin *Quarterly Telecommunications Statistics*, Cat. No. 56-001-XIE.

6 Source: Statistics Canada, 2003, *Features of Canadian biotech innovative firms: Results from the Biotechnology Use and Development Survey – 2001*, Science, Innovation and Electronic Information Division Working Paper Series, Cat. No. 88F0006XIE2003005, Ottawa, Canada.

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

What's new?

Recent and upcoming events in connectedness and innovation analysis.

Connectedness

A number of analytical studies are underway for the *Connectedness Series*, including a study of information and communications technology (ICT) in schools, ICT literacy and skills development, as well as an examination of the effects of ICT usage on people's time and behaviour.

The *Connectedness Series* (http://www.statcan.ca/cgi-bin/downpub/listpub.cgi?catno=56F0004MIE) is available free of charge on Statistics Canada's website. To download any of the ten issues in the series or other analytical products, visit www.statcan.ca and click on *Our products and services.* Under *Browse our Internet publications* choose *Free*, then *Communications.*

Telecommunications

Annual survey of telecommunications service providers

The service bulletin, *Broadcasting and telecommunications – Telecommunications industries - 2002*, Cat. No. 56-001-XIE, Vol. 34, no. 1, was released in June 2004.

Quarterly survey of telecommunications service providers

The 2003 fourth quarter edition of service bulletin *Quarterly Telecommunications Statistics*, Cat. No. 56-002-XIE, Vol. 27, no. 4 was released in April 2004.

Broadcasting

The service bulletin *Broadcasting and telecommunications, Television broadcasting 2003*, Cat. No. 56-001-XIE, Vol. 34, no. 2. was released in June 2004

Household Internet use

No updates to report.

Business e-commerce

Survey of electronic commerce and technology

Data from the survey, Electronic Commerce and Technology 2003 were released in April 2004.

Science and innovation

S&T activities

Industrial research and development 1999 to 2003

A working paper *Regional disparities of research and development in the business services sectors* by Julio Rosa was released in April 2004.

Federal science expenditures

No updates to report.

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 Expenditures and Personnel were released in May 2004.

The higher education sector

Intellectual property commercialization in the higher education sector

The 2003 survey will be mailed out in June 2004. Preliminary results are expected to be available in January 2005.

Innovation

The working paper *Innovative Firms: A Look at Small Firms*, 88FOOO6XIE2004010, was made available free online in May 2004.

Innovation in manufacturing

Analysis of the micro-data from the Survey of Innovation 1999 by internal and external researchers is on-going.

Innovation in services

Data from the *2003 Survey of Innovation* in Selected Service Sector Industries was released in the Daily on March 31, 2004. The survey covered establishments with at least 15 employees and $250,000 in revenues from 36 service industries including ICT service industries; selected professional, scientific and technical service industries; selected natural resource support service industries; and selected transportation industries.

Biotechnology

The *Biotechnology Use and Development Survey 2003* is in the field. Preliminary results are expected in the fall of 2004.

Forthcoming this summer, *Access to financing capital: Where Canadian biotech firms are getting funds to finance their activities?*

Technological change

The working paper *Technological change in the public sector, 2000-2002*, Cat. No. 88F0006XIE2004008 was released in March 2004.

The working paper *An historical comparison of technological change, 1998-2000 and 2000-2002, in the private and public sectors* Cat. No. 88F0006XIE2004007 was released in March 2004.

The working paper *Starting the new century: technological change in the Canadian private sector, 2000-2002* Cat. No. 88F0006XIE2004001 was released in January 2004.

Daood Hamdani retires

Daood Hamdani has retired after 30 years of dedicated service to the Government of Canada. Daood spent 17 years with the Department of Finance as Chief of Professional Services.

The latter half of his career was devoted to the understanding of innovation. As Chief of Innovation and Jobs in SIEID, his main interests were the study of information and knowledge as the strategic agents of change. He has published countless articles and written chapters in books on the relationship between organizational knowledge and innovative solutions.

As a personal research hobby, Daood became one of the pioneers of the study of Islam in Canada and author of numerous articles on the evolution of the Muslim community. His work has been translated into several languages including French, Spanish and Arabic. He is among the most cited writers on the emerging demographic trends in Canada's changing religious spectrum.

Recognized as one the world's foremost experts on innovation measurement, Daood Hamdani has received several recognitions, including an honorary citizenship of the State of Tennessee.

A quiet and gentle person, Daood was always willing to share his wisdom with colleagues. We are indebted to Daood for his friendship, conceptual guidance and insight.

NESTI notes

NESTI is the OECD’s Working Party of National Experts on Science and Technology Indicators. In the October 2003 issue of the Innovation Analysis Bulletin (Vol. 5 No. 3), we described NESTI’s overall mandate and its early experience in revising the Oslo Manual on the collection of innovation statistics. Since that time, two further workshops have been held to coordinate the revision.

The main concern for the revision had been the definition of innovation. The current Oslo Manual focuses on “technological innovation”, which does not explicitly include changes in marketing, packaging, organizational structures and management practices. The focus group in charge of concepts and definitions (led by France and Japan) conducted extensive research on how these concepts are perceived by experts and by business. They concluded that “innovation” could be considered a nested definition. If innovation surveys asked separate questions on product, process, marketing and organizational innovation, the user could combine these according to their own needs. For example, a “product or process innovator” would be historically compatible with the definition of “innovator”.

The implications of this change in definition were considered by the focus groups working on other aspects of the manual and were discussed at a two-day workshop in Oslo on April 22-23. The recommendations will be finalized and presented to the full NESTI meeting in June. Once the recommendations have been approved, a team will begin drafting the revised manual. A final draft is expected to be presented to the NESTI meeting in June 2005.