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Symbols

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

The multinational enterprise project

In the current environment, economic activities undertaken by enterprises extend beyond national borders. As a result, national and international statistical offices are faced with new challenges for the accurate measurement of these activities. These challenges call for increased statistical standardization together with greater international co-operation. The Multinational Enterprise Project (MNE) arose from a presentation made by Statistics Canada during the session on globalization at the June 2003 Conference of European Statisticians in Geneva. This article highlights results and recommendations of the first phase of the project.

A working team was created to carry out the first phase. It includes representatives from five participating countries: Canada, France, Italy, The Netherlands and the United Kingdom. An extended project team was formed to provide overall coordination, to help with the provision of resources and support within their respective organizations, and to ensure liaison with other key stakeholders of the project (UNECE, EUROSTAT, OECD and UNCTAD). The bureau of the Conference of European Statisticians (CES) acted as the steering committee.

The relationship between the Multinational Enterprise Project and innovation was placed into context by Michael Bordt, Head of Canada's Delegation to the OECD's Working Party of National Experts on S&T Indicators (NESTI). Bordt commented, "The international treatment of MNEs is of interest to those measuring innovation since the role of a local firm in its parent's system of innovation may vary. It could be the R&D department and yet not market new products in the host country. Alternatively, it may market innovative products and yet not have its own capacity to innovate. Understanding the role of the local firm in the MNE parent is discussed conceptually in the new Oslo Manual (OECD/Eurostat, 2005) but its successful implementation will depend on statistical agencies adopting common definitions of statistical units and a common treatment of MNEs."

Daood Hamdani introduced some of the conceptual implications for innovation and MNEs in Vol. 5 no. 3 of the *Innovation Analysis Bulletin* (October 2003).

Project objectives and structure

The main objective of the project was to identify areas where the measurement of the activities of multinational enterprises could be improved. In this respect, the feasibility of having MNEs report in an integrated fashion to several national statistical offices (NSOs), taking into account the confidentiality legislation governing the respective NSOs, was to be evaluated.

The hypotheses underlying the study were that the areas where improvements might be identified were the description of the structure of the MNE in the registers and other files of the NSOs, the measurement of important economic and financial variables relevant to national accounting and the coordination of measurement activities between NSOs. In this respect, gauging the reactions of MNEs to attempts to improve this coordination was a study objective.

The study was therefore designed to shed light on each of these issues. In general, the methodology adopted was to have participating MNEs provide information to the NSO of their home country on their operations in each of the participating country, using a common questionnaire. The home country NSO would then share the relevant national information with the NSO of the countries in which the MNE had foreign affiliates, with the MNE's consent. In this way, at the end of the process, each NSO would have the collected information for the domestic operations of their home country MNEs, collected directly from the MNE, plus the data for the domestic operations of foreign affiliates, received from the relevant NSO. The information collected in this way from the MNEs would then serve as a benchmark against which the NSO would compare the data collected in its regular statistical program. Results of this comparison would be shared among participating NSOs, and reported to the CES, without divulging information on any specific MNE.

Measuring variables and results of the comparison

All participating MNEs agreed to a waiver permitting the home country NSO to share the relevant national information with the NSO of the countries in which they had foreign affiliates. This coordinated data collection approach therefore proved feasible from an operational point of view. Overall, however, data collected in a coordinated fashion from the MNEs for this study provided results that were different from the data collected by survey or administrative instruments in the regular programs of the NSOs.

The employment variable was the most accurately measured, followed closely by the sales variable. Capitalized expenditures were less well measured than either while the operating earnings

variable was the most poorly reported and the least accurately measured.[1]

Of the 220 possible measurements of key variables (4 variables, for 11 MNEs in 5 countries), the NSO measure is within 10% of the MNE report in 61 cases (28%), is more than 10% divergent in 79 cases (36%) and cannot be compared for a variety of reasons in 80 cases (36%). In these 80 cases, the data comparison was not possible because of missing values either from the data provided by MNEs or available in NSO sources. The main reasons for the absence of data were: either issues of "Confidential" (11 cases); "No affiliates in one of the 5 countries" (12 cases); "Data requested not reported by the MNE" (25 cases) and; "Data not available from NSO sources" (32 cases).

All of the participating countries found the exercise interesting and valuable. It helped to understand some of the problems related to the data provision by MNEs to NSOs and identified potential weaknesses in our statistical systems.

Canadian perspective

Paul Johanis, Director General of Classification within Statistics Canada headed the four-member Canadian delegation. He stated, "Our participation in the 2 year project highlighted the work we need to do on our own Business Register, particularly for large complex enterprises". Johanis noted, "It is always interesting to share experiences with other NSOs dealing with similar problems and to work collaboratively to finding solutions".

Main findings

- A consistent definition of enterprise groups and the timeliness of updates to registers are key factors in improving the description of MNE structures on NSO registers.
- The legal structures of the MNEs tend to be larger in their home countries and special attention needs to be paid to accurately profiling these domestic operations.
- Consolidation and deconsolidation of financial results of enterprise groups is a key difficulty, which must be resolved to accurately measure financial variables such as sales and operating surplus.
- Specific definitions and instructions must be provided for the accurate measurement of employment as between employer-employee relationships and other means of labour supply.

Even though only a few, high-level variables were requested in the study, there were problems related to the sensitivity of the information, especially for operating profits or losses (earnings before interest and taxes). While the requested information is generally made available on a global basis, many MNEs considered it highly sensitive once broken out by country.

The determination of the allocation of the EBIT in specific countries may be influenced by cost effectiveness considerations, including national advantages from taxation or subsidies. Various means can be used to effect the allocation of EBIT such that the total consolidated result of the MNE is optimised. This could be the reason that some MNEs were very cautious in reporting the EBIT, because the formal allocation of the EBIT could be different from the business related one.

For this reason, a centrally coordinated collection approach, such as used for this study, might in fact elicit a defensive reaction by MNEs that is not encountered when each national component is approached individually.

Continuation of the study – European register of enterprise groups

Even though the project was expected to unfold in successive phases over several years, with each phase expanding on content and involving a greater number of participating countries and MNEs, the participants recommended that the study in its current configuration be terminated after the first phase. The participants believe that they have learned a great deal from the study, which learnings can be better applied in a different approach to the study of MNEs than an expansion of the current study. More specifically, it is recommended that the work be continued under the auspices of the Eurostat project on the creation of a European register of enterprise groups. The MNE project can be seen as a precursor to the Eurostat project and experiences gained from it can be usefully applied in the context of this new project. Should the work continue in this way, means would need to be found to keep non-EU members of the ECE involved in the project in some way.

More detailed information on the study can be found by accessing the document, Multinational Enterprise (MNE) Project, Final report – Phase 1, May 2005 *at* http://www.unece.org/press/pr/2005.

Paul Johanis, Director General, Classification Systems, Statistics Canada.

References

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

1. Data analysis methodology: For the Canadian MNEs, the results from two enterprise statistics programs namely: the Quarterly Survey of Financial Statements (QSFS) and the Annual Financial and Taxation Statistics (AFTS) were used for the analysis process. The QFSF is a survey of the very large enterprises in Canada while the data for the remaining portion of the corporate population are estimated through a model approach. The AFTS is a mixture of annualized reports from the QSFS and financial data coming from tax sources. So in essence, the MNE data were compared to either reported data filed on survey questionnaires or to data provided as supportive documentation when corporations are filing their tax forms to the Canada Revenue Agency. The drawback in using data from the corporate tax source is that data are reported for legal entities and the sum of the revenues is not consolidated at the enterprise level. This, however, still provided an approximation of how close the two sources are.

Establishment-based surveys such as the Survey of Employment, Payrolls and Hours as well as the Capital Expenditures Survey were used for cases where all the establishments of an enterprise were covered.

Trends in business intramural R&D expenditures in Alberta, 1994-2003

This article analyses trends in business intramural R&D expenditures in Alberta between 1994 and 2003 using data from Statistics Canada's Research and Development in Canadian Industry (RDCI) Survey. In Alberta, R&D related to oil and gas activities accounts for much of the growth in intramural R&D in the Oil and Gas Extraction, Manufacturing and Services industries. Of particular interest in the growth of R&D in the Scientific Research and Development Services industry which can be considered as an indicator of the growth of start-ups or venture capital based firms.

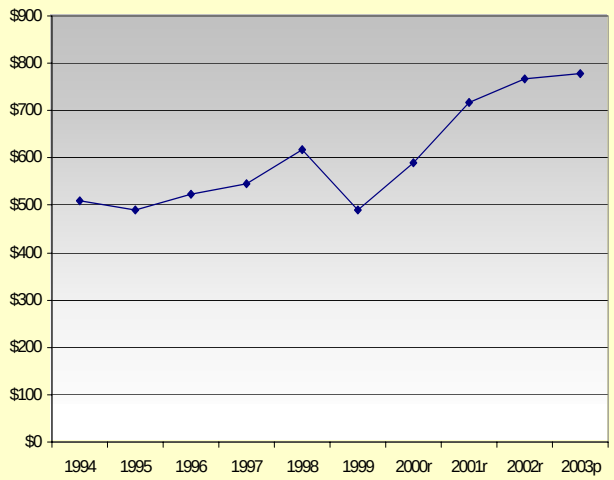
This article is a result of a collaborative project between SIEID and The Centre of Innovation Studies (THECIS), which has as its objective to build research capability in Western Canada to meet the needs of the Western Canadian innovation community by extracting and analyzing information available from Statistics Canada. Support and direction of the project was provided by National Research Council Canada-Industry Research and Assistance Program (NRC-IRAP), Alberta Innovation and Science (AIS) and Western Economic Diversification Canada (WED). Kiranpal S Sidhu, a graduate student from University of Calgary, spent two months working with SIEID analysts, being trained to analyze statistical data that were available on science, technology and innovation in Western Canada. The results of the analysis were sent back on a regular basis to the policy analysts and researchers involved in the project. A summary report presenting the results of the analysis prepared over the summer is underway and will be posted on the THECIS website (www.thecis.ca).

This article will analyse intramural R&D expenditures of firms in Alberta. These expenditures include expenditures on all R&D work performed by the reporting company, including work financed by others. Capital expenditures on R&D are not included in this analysis.

Growth of intramural R&D expenditures in Alberta (1994-2003)

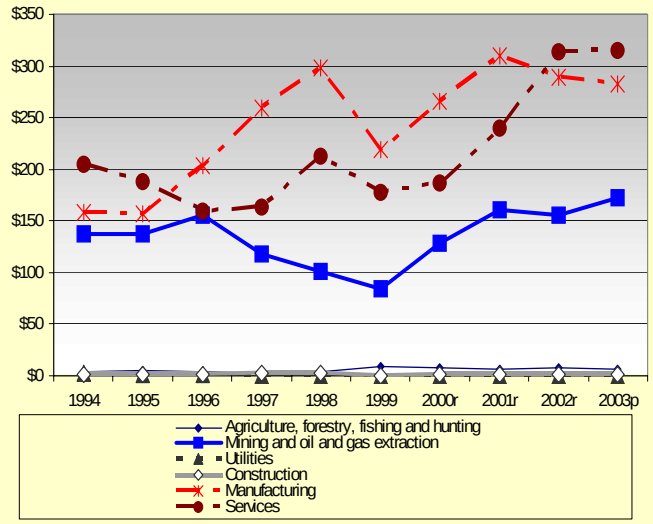
Chart 1 shows that intramural R&D expenditures in Alberta grew by 53% from a total of $508.8 million in 1994 to $778.6 million in 2003. Expenditures on intramural R&D expenditures in Alberta grew less that those in Canada as a whole, which experienced a growth of 77% over the same period. The growth in Alberta over the period was relatively steady, interrupted only by a decline in 1999.

Chart 1 Total intramural R&D expenditures in Alberta, 1994 to 2003 ($ millions)



Source: Statistics Canada, RDCI, Special Tabulations.

Chart 2 Intramural R&D expenditures, by sector in Alberta, 1994 to 2003 ($ millions)



Source: Statistics Canada, RDCI, Special Tabulations

Intramural R&D expenditures by industry sector

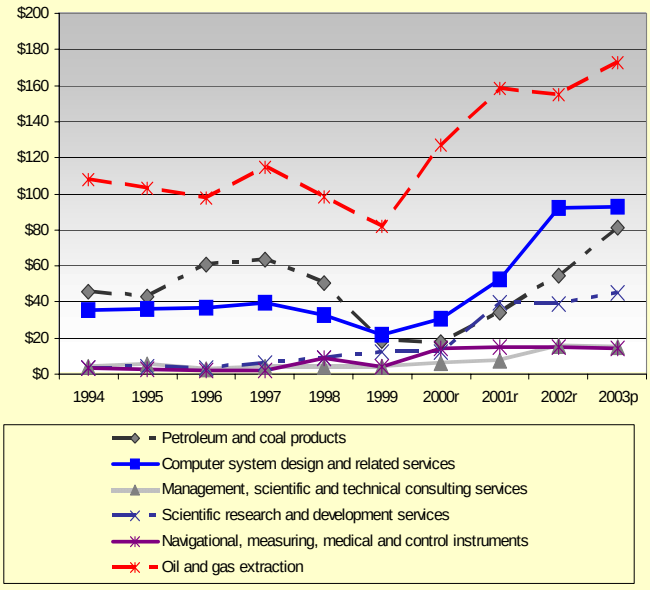
Three of six sectors contributed the most to the increase in intramural R&D expenditures, the Manufacturing and Service sectors, as well as the Mining, Oil and Gas sector, which had increases of 79%, 56% and 25% respectively over the period (Chart 2). All three sectors saw a decline in intramural R&D expenditures in 1999, with the decline in Mining, Oil and Gas sector beginning earlier in 1996. Growth in the Service sector occurred primarily after 1999. The contribution of the other sectors to the growth over the period is minimal.

Table 1 Top 10 Industries by contribution to Intramural R&D Expenditures in 2003

Industry	2003 ($000)	Change between 1994 and 2003	Percentage of total in 2003
Oil and gas extraction	$172,455	60%	22%
Computer system design and related services	$93,068	160%	12%
Petroleum and coal products	$81,001	77%	10%
Information and cultural industries	$53,951	-23%	7%
Scientific research and development services	$45,205	1,354%	6%
Architectural, engineering and related services	$31,708	-12%	4%
Wholesale trade	$29,592	-6%	4%
Pharmaceutical and medicine	$24,923	53%	3%
Management, scientific and technical consulting services	$15,266	288%	2%
Navigational, measuring, medical and control instruments	$14,520	345%	2%

Source: Statistics Canada. RDCI. Special tabulations.

Chart 3 Intramural R&D expenditures, by selected industries in Alberta, 1994 to 2003 ($ millions)



Source: Statistics Canada. RDCI. Special Tabulations.

Changes to intramural R&D expenditures in selected industries

Table 1 shows the top 10 industries for which estimates are available in terms of their contribution to intramural R&D expenditures in 2003.[1] The top 10 industries account for two thirds of all R&D expenditures and the top 4 industries account for one half of the total.

Looking in more detail at those industries that had the highest growth amongst the top 10 industries (Chart 3), the importance of the oil and gas and related activities R&D is evident. The Oil and Gas Extraction industry is important both in its proportion of total intramural R&D expenditures and its contribution to the growth over the period. The growth of intramural R&D expenditures by the Petroleum and Coal Products industry, which is involved in transforming crude petroleum and coal into intermediate and end products, indicates increases in expenditures on R&D during the period in the down-stream manufacturing sector.

The trends also suggests that two of the service industries with increased intramural R&D expenditures are also related to oil and gas activities. Computer Systems Design and Related Services and, to a more limited extent, Navigational, Measuring and Control Instruments both experience a decline in intramural R&D expenditures at the same time as there is a decline in intramural R&D expenditures in the two industries that are most likely to be their major oil and gas clients. A significant decline in oil prices occurred during the period 1997 to 1999 could explain the decrease in R&D expenditures in industries involved in oil and gas activities.

It is interesting to note that the two other services industries with high growth in intramural R&D expenditures do not appear to be impacted by the decline in the price of oil. The Scientific Research and Development Services industry includes firms that have as their principal activities are conducting R&D. These firms are often in the early stages of product development and are often dependent on venture capital funding. High growth is also evident in Management, Scientific and Technical Consulting Services over the period.

Acknowledgements: The authors thank would like to thank National Research Council Canada-Industry Research and Assistance Program (NRC-IRAP), Alberta Innovation and Science (AIS) and Western Economic Diversification Canada (WED), as well as Peter Josty and Cooper Langford of THECIS for their direction and support.

Kiranpal S. Sidhu, University of Calgary & The Centre of Innovation Studies (THECIS) and Frances Anderson, SIEID, Statistics Canada.

1. Estimates for the Communications Equipment industry were suppressed for reasons of confidentiality.

"Blue Sky II 2006" – What indicators for science, technology and innovation policies in the 21st century?

In September 2006, Canada will be hosting the Blue Sky II 2006 Forum that will examine new areas for indicator development and set a broad agenda for future work on science, technology and innovation (STI) indicators.

The Forum will emphasise indicators of outcomes and impacts that support monitoring, benchmarking, foresight activity, and evaluation, applied to policies and programs, and their economic and social impacts. Blue Sky II is expected to provide ideas and guidance for indicators work in both OECD and non-OECD countries, as well as in other international organizations. The Forum will include plenary sessions featuring invited guest speakers who are leading authorities in their fields. Break-out sessions will discuss papers on specific themes selected through a call for papers (see below).

Blue Sky is a synonym for thinking creatively, without limiting horizons, about developing new indicators to respond to changing policy and user needs in the STI area. The first Blue Sky Forum was organised by the OECD and held in Paris in 1996. It helped set the agenda for developing STI indicators over the past decade. The intent of Blue Sky II is to review progress made while looking towards development of policy-relevant STI indicators in today's global economy. Statistics Canada, the OECD, the U.S. National Science Foundation and Industry Canada have partnered to host this landmark conference.

The Forum will bring public policy researchers, economists, social scientists and statisticians, together with policy makers, government officials and other stakeholders with an interest in science, technology and innovation indicators.

The Forum covers four broad topics:

- New uses of existing science, technology and innovation indicators;
- New uses of existing non-STI indicators for the purpose of STI policy-making;
- Completely new science, technology and innovation indicators; and
- A synthesis of findings leading to an agenda for the next decade of work on STI indicators.

Call for papers

All papers are expected to develop metrics and indicators that can be useful to policy making. Proposals must be in the form of a 500-word (maximum) abstract submitted by Friday, March 31, 2006. Submissions should be accompanied by a detailed résumé as well as a brief biographical note of no more than 40 words.

http://www.statcan.ca/english/conferences/sciencetech2005/index.htm

Statistics Canada hosts a seven-day working visit by 27 Chinese S&T statisticians

In mid-October 2005, Statistics Canada hosted a seven-day working visit by 27 Chinese S&T statisticians, sponsored by the International Research and Development Centre (IRDC).

This workshop involved presentations by both Canadian and Chinese statisticians on methods and experiences in their respective science and technology (S&T) statistics programs. While the largest number of Chinese delegates came from the national Ministry of Science and Technology (MOST), others came from various provincial ministries and universities across the country engaged in research on S&T issues.

Major themes of the presentations included methodologies for each of the elements of the GERD matrix: R&D by government, higher education, industry and not-for-profit organizations; measuring innovation; surveys of advanced technologies; commercialization of intellectual property, highly qualified personnel and measuring the various aspects of the "Information Society". In addition to these subject-matter areas, discussions took place on strategies for building research capacity ensuring useful, policy-relevant information to government departments and other data users.

By the end of the seven days Canadian and Chinese presenters and participants had built a clearer understanding of the differences and similarities in methods and practices, as well as the challenges and opportunities faced by statisticians collecting policy-relevant data on science and technology issues.

The Internet experience of younger and older Canadians

Once the domain of office professionals and the "tech-savvy", Internet use is now so widespread in Canada and some parts of the world that Internet users are approaching a cross-section of the population at large. At the same time, studies of the "digital divide" remind us that important gaps in access to the Internet and other information and communications technologies (ICTs) continue to persist among groups, often delineated by a number of characteristics, including their income, age, gender, educational attainment, location and even family type. Clearly, such gaps are important as they may have social and economic consequences.

In a simplest sense, the Internet offers greater choice: more choices about how and when we communicate with others, more choices about where we go to get news, weather or government information, and access to a wider selection of products and prices, for example. While early studies of the Internet often tackled issues of access, it is also important to understand how the Internet is used, and further how the Internet is used by different people, if we are to more fully understand the Internet's impacts in today's world, and indeed, on particular sub-groups of the population.

This article uses data from the ICT module of Statistics Canada's 2003 ***Adult Literacy and Life Skills Survey*** to focus on what is traditionally recognized as one of the factors most strongly related to patterns of computer and Internet use in Canada and elsewhere, that is age. While age is often connected with the likelihood that someone will own or have access to computers and the Internet, age also bears strong relationships to behaviour and participation in online activities, much as it does with activities in life in general.

Intensity of ICT use and age

Although the intensity of ICT use is often highest among the young, there exists little difference between young and middle-aged adults in Canada in having home access to computers and the Internet. As of 2003, young Canadians aged 16 to 25 were only slightly ahead of middle-aged adults in terms of their access to computers and the Internet at home (see Table 1).

Those in their late 30s or 40s are not always intensive ICT users, but they are often in the peaks of their careers, and higher levels of income and the presence of children often encourage computer ownership and the purchase of Internet access. The story is quite different however for those in their late 50s and beyond, who may be approaching retirement and are less likely to have children living in the home. Home penetration of computers and the Internet among these older individuals was significantly lower in 2003.

Table 1 Home computer and Internet access, individuals, by age group, Canada, 2003

Age Group	Computer access	Internet access
	% of individuals	
16 to 25	85.3	78.9
26 to 35	78.5	71.0
36 to 45	79.1	70.5
46 to 55	73.1	65.6
56 to 65	55.5	48.6
Total (16 to 65)	75.6	68.1

Source: Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

Table 2 Time spent on computers at home in a typical month, by age group, Canada, 2003

Age Group	< 10 hrs	10 to < 30 hrs	30 to < 60 hrs	60 hrs or more
	% of computer users			
16 to 25	27.3	29.4	25.1	18.1
26 to 35	39.0	29.1	19.1	12.8
36 to 45	48.3	29.1	12.7	9.9
46 to 55	47.8	31.6	12.9	7.7
56 to 65	48.1	25.9	15.7	10.3
Total (16 to 65)	41.6	29.3	17.2	11.9

Source: Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

Average hours spent on computers

Nearly half (43.3%) of young Canadians aged 16 to 25 used computers at home for an average of one hour or more per day, while nearly one-fifth (18.1%) spent two hours or more on the PC (see Table 2). Given time spent on computers at school, work, or other locations (not measured here), the total time spent in a typical day is likely much higher.

Those in their late 30s and beyond were more likely to be casual users, with nearly half investing less than 10 hours per month (or less than 20 minutes per day on average) in front of the computer screen at home in 2003. Significantly fewer young Canadians aged 16 to 25 (27.3%) could be described as casual users.

Although the tendency is for computer use to decrease with age, there was a notable exception. The proportion of older computer users aged 56 to 65 who used computers at home for an average of one hour or more per day was not lower than that of the middle-aged population[1]. One possible explanation is that the oldest age group includes a greater number of retired persons, some of whom may have more time at their disposal to use computers at home compared to those who are regularly employed. Additionally, those who already use computers extensively at work may be less inclined to spend long hours on a PC at home.

1. In fact, results suggest an increase, but this increase is not statistically significant.

Table 3 Purposes of Internet use, by age group, Canada, 2003

Activity	Age 16 to 25	Age 26 to 35	Age 36 to 45	Age 46 to 55	Age 56 to 65	Ratio of youngest age group: oldest
	% of Internet users performing activity in a typical month					
General browsing	92.3	88.9	84.9	79.7	71.2	1.3
Email	89.1	88.6	84.8	86.6	85.0	1.0
Obtain or save music	73.5	38.8	28.9	19.3	13.0	5.7
Read about news and current events	66.8	75.8	69.6	67.3	64.8	1.0
Participate in chat groups or other online discussions	50.7	24.2	15.5	12.2	9.9	5.1
Search for employment opportunities	44.1	41.9	28.5	20.1	8.9	4.9
Search for weather related information	41.6	51.5	45.3	41.9	41.9	1.0
Shopping	41.2	49.4	44.7	40.9	34.2	1.2
Search for health-related information	34.9	56.2	52.8	53.4	54.8	0.6
Playing games with others	34.4	16.5	9.4	7.0	6.5	5.3
Search for government information	29.4	49.1	50.3	47.2	44.8	0.7
Banking	28.5	51.2	41.9	36.3	33.5	0.9
Formal education or training	25.7	18.1	15.2	14.6	6.6[E]	3.9

Source: Statistics Canada, Adult Literacy and Life Skills Survey, 2003.
[E] use with caution: coefficient of variation between 16.6% - 33.3%.

Reasons for Internet use

Data reveal the extent to which "surfing the Web" is a distinct experience for younger and older Canadians (see Table 3). Young users aged 16 to 25 were most different from older surfers for their penchant for downloading music (73.5% of users), playing games (34.4%), and participating in chat or online discussions (50.7%) in a typical month. Record companies have sometimes singled out teens and young adults in their campaign against unlicensed mp3 downloads. The proportion of surfers aged 16 to 25 who downloaded music in Canada in 2003 was nearly double the proportion of those in their late twenties or thirties, and almost six times the proportion of the oldest age group, but the data do not reveal the extent to which such downloads were licensed.

Instant messaging programs found on the Net are particularly popular among the young, a reflection of a generation that more and more wants to "reach" and "be reached" with immediacy. As is the case with cell phones, e-mail, chat groups and the like, as a society we seem to be communicating more, and with more people, than we ever have in the past (for a broader discussion, see Sciadas (forthcoming).

Although young Web surfers are often perceived as recreational users, they are leaders in other important types of Internet activity. Nearly half (44.1%) of the youngest users went online in a typical month to search for employment opportunities. This is due in part to the fact that unemployment rates are higher among young individuals in the labour force. Interestingly, however, nearly half (43.6%) of young Canadians who were already employed searched for additional employment opportunities online in a typical month. Not surprisingly, young adults also lead the way in using the Internet for formal education or training.

Older adults took advantage of different types of services on the Internet in 2003. Although relatively few (28.5%) of the youngest group of surfers ventured into online banking, this figure jumps to over half (51.2%) of Internet users in the 26 to 35 age group. Most importantly, older surfers stood out for their willingness to search for certain types of information on the Web. This included government and health information, two areas where governments at all levels in Canada have attempted to improve accessibility as part of a range of initiatives.

Canadian Internet users of various ages differed little in that using e-mail and reading about news and current events were both popular. These activities appear essential to a majority of Internet users.

Concluding comments

Although present data offer a snapshot of some of the more common activities on the Net, additional work is needed to more fully understand how the Internet is used and further how activities conducted online impact other activities. Research has highlighted already the relationships between Internet use and time spent in front of television, reading, sleeping, and interacting socially by other means. For example, a Canadian study (Dryburgh, 2001) found that over one-quarter of Internet users spent less time watching television once they started using the Internet. Sometimes Internet users took time away from reading (15% of Internet users), sleeping (11%), doing leisure activities at home (11%), doing household chores (10%) and shopping (8%). A smaller number spent less time visiting and talking with family (7%), but some also reported that their communications with friends (5%) and family (3%) increased as a result of their use of the Web.

While the Internet has touched the world on many fronts, further work related to its role in the sharing and management of knowledge is also warranted. In particular, work that moves beyond identifying the incidence of various activities on the Internet, to begin to establish strengths and weaknesses of the Internet as a knowledge-sharing tool, as well as the factors that might encourage, discourage or even prevent the exchange of knowledge among different groups of people, businesses, governments and educational institutions is important. What people do with this knowledge is also important in the attempt to move to a broader

understanding of the outcomes of Internet use in society today and its potential in the future.

Some of the information in this article first appeared in a paper released in Statistics Canada's Connectedness Series, December 5, 2005 (Veenhof, Clermont and Sciadas, 2005).

Ben Veenhof, SIEID, Statistics Canada.

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Bioproducts development in Canada: the state of an emerging and promising sector

Bioproducts are an emerging component of the Canadian economy and their global development offers many economic, environmental and social opportunities and benefits for Canada. To better understand this emerging and promising cross economy activity, this article summarizes the key results from the first national survey undertaken by Statistics Canada in an ongoing partnership with Agriculture and Agri-Food Canada (AAFC) on bioproducts development.

Defining bioproducts and biomass

A *bioproduct* is defined as a commercial or industrial product other than food, feed and medicine made with biological or renewable agricultural (plant or animal), marine or forestry materials. *Biomass* is defined as renewable or sustainable feedstock/materials of agriculture, animal, forestry, marine or aquaculture origins or from municipal and industrial waste.

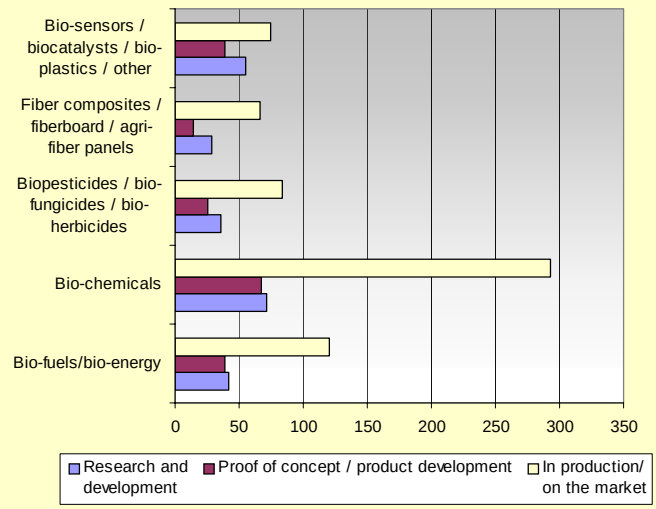
Characteristics of the 232 firms

Based on data from the ***Bioproducts Development Survey*** collected for the year 2003, there were 232 Canadian-based firms involved in the development or the production of bioproducts. The firms involved are mostly young (10 years or less of existence) and small in size (less than 50 employees) yet nearly 30% of all the firms were publicly owned. Four provinces (Québec, Ontario, British Columbia and Alberta) were home of nearly 82% of firms with Québec being the leader with 31% of all the firms.

Bioproducts development and production

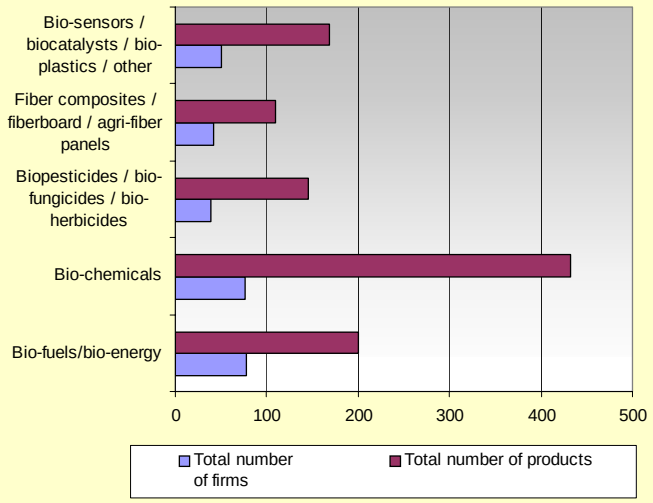
In total 1,055 bioproducts were produced or developed in Canada in 2003; 636 bioproducts were at the production/on the market stage, implying that they were bringing in some revenues or were about to enter the market. Bio-chemicals was by far the largest category of bioproducts being developed and produced, both in terms of the number of firms involved (77) and the number of products (432). Bio-fuels/bio-energy was ranked second with

Figure 1 Number of bioproducts by stage of development/production, 2003



200 products developed or made by also 77 firms (see Figure 1). Agricultural crop and forestry biomass were the top two biomass type used by Canadian firms. They were used by 93 and 77 firms, respectively, more than twice the number of firms using any other single type of biomass. Almost half of firms used by-products as biomass input and most of the remaining firms used primary products. The majority of bioproducts produced in Canada in 2003 were intended to be sold directly to consumers or distributors and to other firms to be used as input.

Figure 2 Types of bioproducts and number of firms producing them, 2003



Noteworthy findings on bioproducts development sector

One of the key findings from this survey is that bioproducts development is typically just one part of the firm's business activities in Canada and the proportion of activities related to bioproducts decreases with firm size. In fact, for bioproducts firms, approximately one third of total employees were involved in bioproduct-related activities and just over one quarter of total revenues were derived from bioproducts-related activities. Approximately 40% of total research and development expenditures were spent on bioproducts of which 11% were contracted out. In general, Canadian firms were not very involved in bioproducts-related collaborative arrangements.

More than half of Canadian bioproducts firms attempted to raise capital from various sources in 2003 and 77% were successful. Government sources were the most common, followed by angel investors/family and Canadian based venture capital. However, only 47% of all the firms used the Scientific Research and Experimental Development (SR&ED) tax program. Despite these figures, Canadian firms ranked the lack of financial capital as the most important constraint to developing and producing bioproducts, following by the high cost and timeliness of regulatory approval.

The benefits associated with bioproducts development and production, were increased sales/market share and development of new market niches/new products.

Limitations

This article summarizes results from the Sparling *et al* report, which is scheduled to be released by Agriculture and Agri-Food Canada later in 2006. As the first-ever national survey on bioproducts development, the report draws a profile of the Canadian bioproducts sector, and brings clarification to the cross-sectoral nature of bioproducts, that in most cases is only one part of firm business activities. Despite contributing to a better understanding of the bioproducts sector, and raising relevant questions and issues along with identifying potential research directions the report highlights the need for additional research and analysis to bring greater understanding of bioproducts.

This article is based on an in-depth report by David Sparling, John Cranfield, Spencer Henson and Pamela Laughland: ***The Canadian Bioproducts Development Survey – 2003: Analysis of the Summary Results*** *submitted to Agriculture and Agri-Food Canada, January 31, 2006.*

Johanne Boivin, SIEID, Statistics Canada

Loss of momentum for direct-to-home satellite television

Some technological innovations are more apparent than others; the introduction of digital satellite television and wireless cable was one of the most obvious. Satellite dishes were once huge, few and far between and found almost exclusively in rural areas. Over the last few years, small dishes on homes have become a familiar part of both rural and urban landscapes. But installers of these small dishes are not nearly as busy as they used to be.

The number of subscribers to the multi-channel video services of satellite and wireless cable operators continued to climb in 2004, but at a much slower pace than in previous years. There were 2.3 million subscribers to these services at August 31, 2004, an increase of 5.4% compared to the previous year. This followed leaps of 9.2% in 2003, 25.4% in 2002 and 66.4% in 2001.

The market share of wireless competitors, principally direct-to-home satellite television providers, increased to 23.4% in 2004 from 22.5% in 2003. This was the smallest year-over-year gain since the introduction of wireless competition late in 1997.

Towards the upper part of the S-curve

The loss of momentum observed here is not unusual. The life cycle of new technologies has often taken that route, a phenomenon described as the "S-Curve". The cycle is characterized by an initial period of accelerating growth (dynamic stage), followed by a period of decelerating growth (plateau stage), and finally by a period of stagnation (saturation stage). It appears that satellite and wireless cable television is reaching the end of the dynamic stage very early in its life cycle. There are a few possible explanations.

Unlike technologies such as the television, the personal computer or the Internet, satellite and wireless cable did not open an entirely new market. These technologies provided alternative products in a well-established multi-channel video service market. The potential market was therefore limited, to some extent, to communities not served or under-served by cable operators.

In theory, digital satellite television service is available to every home in the country. In reality its footprint is more limited. There are line of sight barriers; apartment building dwellers can attest to the fact that you need to be on the proper side of the building to become a customer. There are also intangible barriers; aesthetic concerns, contractual arrangements between building owners and service providers and customer loyalty are examples of such barriers.

Innovation breeds innovation

The arrival of satellite and wireless cable providers in the multi-channel video market gave rise to a fierce battle for customers. But that was not the only or the most lasting impact of this innovation.

Competition in this market is at the origin of a shift towards digital technology in broadcast distribution. In 2004, 42% of the 9.9 million subscribers to multi-channel video services had chosen digital over analogue services. In 2000, that proportion was barely above 15%. The continuing move to digital technology is slowly but surely changing the face of both the distribution and programming components the broadcasting system and will continue to do so.

At the outset, digital television was largely the domain of satellite and wireless cable providers. But faced with the prospect of a rapid erosion of its customer base, the cable industry upgraded its networks to enable digital distribution. In 2004, 44% of digital television subscribers were customers of cable providers.

The new distribution technologies opened the door to digital programming, an entirely new segment of the broadcasting industry. In 2002, forty-nine Canadian channels were launched and three have been added since then. In effect, the number of Canadian specialty channels doubled that year, a phenomenon unheard of in the analogue era.

The average number of subscriber per digital channel reached half a million in 2004 and subscriber revenues surpassed $100 million, more than twice the amount generated in 2002.

More recently, many subscribers to digital television gained access to video-on-demand and high definition television. Those innovations and others such as personal video recorders have the potential to transform the television viewing experience; those innovations are not possible without broadband digital distribution systems.

Daniel April, SIEID, Statistics Canada

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Innovation management toolkit

Located on the Government of Canada website, the Innovation Management ToolKit is a set of interactive, easy-to-use Internet-based tools. It introduces approaches to improving innovation used by global leaders to managers of smaller companies.

The site contains:

- An overview of the benefits of innovation and the barriers to success
- Best Practice standards achieved by leading innovators
- An optional, firm-level diagnostic
- Eight thematic diagnostics that cover a firm's key management areas from Leadership and Culture to Management of Technology

Supported by Industry Canada, the website has an objective to help companies improve their innovation performance and to improve the links between industry and other sectors of Canada's innovation system.

The Best Practices Frameworks used in the TookKit is based on current global standards. The diagnostics reflect leading management practices in innovative firms from around the world, and present best practices relevant to small and medium-sized enterprises (SMEs). The outputs from the diagnostics will include:

- A review of your firm's strengths and weaknesses
- A report to help you focus on areas that require action
- A listing of hot keys to sources of external support.

This informative site can be found at http://prodt.businesscanada.gc.ca/CFDOCS/firm_en/main.html.

Why conduct R&D?

While it may seem like a question that doesn't need asking in some circles, we don't always have all the reasons in a handy list. Furthermore, the longer-term outcomes are more difficult to attribute to any specific activity. While Statistics Canada's framework of *Science and Technology Activities and Impacts* has guided us for the past seven years, it is time to improve our understanding of the impacts and outcomes.

Statisticians generally divide S&T activities into groups according to the sector of the actor: the private sector, the public sector (excluding universities), universities and sometimes the private non-profit sector. There are also foreign organizations that fund S&T in Canada but their contributions are tracked through the Canadian performer that they fund.

Although the framework covers the broader concept of S&T, it is simpler to start with the R&D. S&T includes R&D but also related scientific activities (RSAs) such as education, data collection and testing. Since the impacts of S&T are even more diffuse than R&D, this article will focus on the impacts of R&D.

We are hoping to eventually develop a useful framework that goes beyond program evaluation or the "social returns" to R&D. An approach that uses only program evaluation focuses on partial (and generally short-term) impacts. If, for example, the mandate of a program is to stimulate R&D in SMEs, one indicator would be the number of SMEs that conduct R&D. If this indicator increases, the program is successful. To look at the general (and longer-term) economic and even social impacts, we would need to consider the impacts of the R&D that was stimulated by the program. This would require evaluating the situation many years after the R&D was conducted and looking at positive and negative externalities (e.g. crowding-out effect for larger firms, "snowball" effect in a given industry). Therefore, it would have to take into account the confounding influences of other factors besides the one-time infusion of support into a given company.

Previous work to assess the results of R&D typically draws upon innovation theories that envisaged a linear relationship between input and outputs. Their focus tends to be narrow, restricted primarily to impacts within the academic community and business sector or the indicators developed are too aggregate to shed light on specific aspects that only individual indicators can elucidate. Two of the most common measures are the private and social rates of return on investment in R&D. Private rate of return takes account of only benefits accruing to the investor. However, other firms and segments of the society also benefit through spillovers as the knowledge spreads through research papers, patents, technology licenses, mobility of the workforce, etc. Social rate of return covers all of these benefits (see Cameron, 1998 for a summary of studies). These measures emphasize the economic dimension and further their accuracy is constrained by the lack of data on knowledge flows and inadequate measures of outputs and outcomes (Cooper and Merrill, 1998).

New studies argue that innovation relationships are more complex. Far from being linear, the benefits of R&D are widely dispersed, new discoveries and technological advances have a long history of research behind them, and knowledge gained from research done in one field may result in a discovery in another field (see OECD, 1998 for a summary).

Similarly, there are important sectoral linkages in the process of research and diffusion of its outcome. Publicly-funded R&D may accelerate research activity in the economy as a whole, leading to earlier introduction of new technologies. By intensifying R&D activity and broadening its R&D portfolio, government expands technology opportunities and therefore increases the chances of a successful outcome.

Assessing the benefits of R&D, in particular that financed by public funds, requires identifying and mapping the public value of research, including its contribution to sustainable economic development and quality of life. The challenge is to identify all the relevant research outputs and outcomes, link them in a logical sequence and define them in an operational way that they are in principle measurable.

Direct and indirect outcomes and impacts

To ensure that we have taken all the important outcomes and impacts of R&D into account, it is useful to start with a framework for the *objectives* of R&D for all the major players. For example, the federal government performs R&D to (a) advance national goals (health, environment, space) improve regulations (b) manage risks (e.g., develop advance weather warning) (c) improve policies and regulations and (d) contribute to economic development. Table 1 provides a starting point for such a framework but it will be subject to revision as consultation and literature search progress.

Statistics Canada has been guided in its development of S&T indicators by ***Science and technology activities and impacts: A framework for a statistical information system*** (Statistics Canada, 1998). While the framework ensures the broad coverage of many aspects of R&D and innovation, its concept of impacts and outcomes could be considered "intermediate" rather than "ultimate". For example, outcomes of an activity are listed as "published article, patent, new product, etc." There is a demand to move up the value chain (e.g., Was the new product commercialized? Was it profitable? Did it provide benefits to its users? Did it contribute to the well-being of Canadians?) For example, Godin and Doré (2005) suggest that it would be possible to further broaden the economic scope to include social and cultural considerations (e.g., Did the activity influence individuals to modify their habits? Did the activity influence participation in scientific activities?).

Table 1 Direct and indirect outcomes/impacts of R&D

Sector	Objectives	Direct outcome/impact	Indirect outcome/impact
Private	Commercialization of new or improved products Development of new or improved processes	Sales from Innovation IP income New knowledge generation Increased productivity	Spillovers, Skills development, Economic development
Government - R&D performer - R&D facilitator (through granting councils) - technology-enabler policy maker/regulator	Advancement of national goals Risk management Improvement of regulations/ policies Economic development	New knowledge generation New technology opportunities Diffusion and adoption of technology by firms New policies/regulations New instrumentation	Economic development Commercialization Spillovers Social and cultural development
Higher education	Advancement of science High-skill training	New knowledge generation New technology opportunities Educating students	Commercialization, Skills development, Spillovers; Diffusion of know-how throughout the economy (via graduates)
Private non-profit	Any or all of the above, depending on sector served	Any or all of the above, depending on sector served	Any or all of the above, depending on sector served

Implications for measurement

Obtaining better measures of the results of S&T would require (a) a more complete commonly applied framework, (b) further research into the longer-term economic and social impacts of R&D and (c) new data collection.

In terms of new data collection, Statistics Canada has proposed several feasibility studies to improve data on one aspect of the economic impacts of R&D: commercialization. These studies were described in Vol. 7 no. 1 (February 2005) of the Innovation Analysis Bulletin (see Bordt *et al*, 2005) and some are already underway.

This will be an excellent year to make progress in understanding and measuring the results of R&D. The Blue Sky II Forum (described elsewhere in this issue) will bring together many of the world's leading S&T researchers, statisticians and policy-makers in Ottawa in September of this year. Indicators of the impacts and outcomes of S&T will be among the main topics of discussion.

Michael Bordt, Daood Hamdani, SIEID, Statistics Canada.

Pierre Therrien, Innovation Policy Branch, Industry Canada.

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Organization for Economic Co-operation and Development, 1999. *Managing National Innovation Systems.* Paris.

Statistics Canada. 1998. *Science and technology activities and impacts: A framework for a statistical information system.* Cat. no. 88-522-XPB.

Enhancing customer loyalty through innovation

Just as the cable industry was poised to realize the full extent of investments made in its networks by offering local telephony in a number of Canadian markets, it seems to have put an end to the erosion of its traditional customer base. This may be a sign that the industry is reaping the benefits of a customer loyalty strategy founded on product and technological innovation.

The number of subscribers to cable television reached 7.6 million at the end of August 2004, up 0.4% from a year earlier. This modest increase followed four consecutive years of decline during which the industry lost a total of 442,000 multi-channel video services customers to wireless competitors. In a fiercely competitive market, the cable industry had to rely on the diversification of its product portfolio to ensure its growth and retain customers. That could only be achieved by transforming its networks from a one-way broadcasting system into a 2-way broadband network capable of delivering a broader range of digital video and communication services.

High speed Internet – A staple of the cable industry

High speed Internet was the first endeavour of the cable industry into mass-market telecommunications services. Less than eight years after launching this service in a few markets, it was available to 93.5% of the 11.9 million homes passed by cable.

The appetite of Canadians for fast Internet is at the core of the cable industry's renewal. The adoption of Internet by cable has been impressive. At the end of August 2000, a little less than 4 years after the launch, there were 0.8 million subscribers. Four years later, 2 million more had embraced the technology. Fast out of the gate, the industry took a lead in this market early on and was still ahead in the residential market at the end of 2004 with a 54% market share.

Digital cable – Another weapon in the battle for customers

Digital cable is the second weapon in the cable industry's arsenal to build customer loyalty. Digital technology allows for the distribution of a greater number of channels – some of which are available only to subscribers with a digital set-top box – and opens the door to new services such as video-on-demand and high definition television. These new services are not only important to keep a competitive edge; they also provide opportunities for new sources of income.

The deployment of digital cable closely followed that of high speed Internet. In 2004 it was available to 11.1 million homes, or just over 93% of homes passed by cable.

Although not as popular as Internet by cable, digital cable was the fastest growing market segment for the industry last year. There were 1.8 million subscribers to this service on August 31, 2004, a whopping 33.4% increase from a year earlier. Just over 24% of subscribers to cable television had chosen digital cable compared to 18% in 2003.

The result – An industry much less dependent on multi-channel video services

In 2004, subscription revenue for multi-channel video services accounted for 73% of the industry's revenues of $4.8 billion. Five years earlier, it had accounted for almost 92% of the industry's revenues.

Telecommunications services, and particularly high speed Internet, account for much of the non-programming services revenue. The diversification of revenue sources will accelerate with the launch of telephony services (Voice-over-Internet or VoIP) in several markets across the country in 2005. Until early in 2005, only selected homes in parts of Atlantic Canada could subscribe to telephony services from their local cable operator. The deployment of telephony services by cable operators is the culmination of the fundamental redesign of the industry's business model that began some 8 years ago.

Daniel April, SIEID, Statistics Canada

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We're still learning!

In the January 2002 issue (Vol. 4 no. 1), we reviewed the many new findings reported in the previous four years of the *Innovation Analysis Bulletin*. This article continues that tradition. We again discuss the insights that would not have been possible without the continued efforts of Statistics Canada's Science, Innovation and Electronic Information Division with our Director, Dr. Fred Gault.

IAB: Dr. Gault, what have been some of the important accomplishments in Statistics Canada's efforts to develop and present a coherent picture of technological and related organizational change in Canadian institutions?

FG: The programme has certainly matured over the past four years. The main difference is that, with the cooperation of a number of partners, we have expanded our realm of understanding. The innovation, biotechnology and ICT surveys were developmental four years ago, now they are more routine and they improve incrementally. At the same time, we have made inroads into new, related areas such as commercialization, nanotechnology, bioproducts, business dynamics, knowledge management, S&T skills and the "digital divide".

IAB: Your staff is working with a remarkably diverse subject matter. How has the nature of your program changed?

FG: The program hasn't changed substantially but we're becoming much more efficient. We have always worked closely with stakeholders and engaged in partnerships. We not only engage the stakeholders intellectually but we depend on them for additional financial support. We can use the funds to "contract out" certain aspects of the survey process to other areas of Statistics Canada.

IAB: What do you see in terms of conceptual development and new subject areas in the future?

FG: We already have proposals for new initiatives in commercialization, R&D services, capitalizing R&D in the National Accounts. We have been doing developmental work on subprovincial R&D data and business dynamics as they relate to technology industries. Canada is hosting the OECD's Blue Sky II conference (see page 7 in this issue). This will set the stage for the next 10 years of development in indicators for S&T policies.

IAB: It's a monumental task but we'll try to summarize some of SIEID's findings over the past four years.

Science and technology

Emerging technologies

Biotechnology

In 2002, Canada's growing biotechnology sector was producing a significant number of spin-off companies. Universities or research hospitals created the vast majority of the spin-off firms. These firms are experiencing growing revenues, providing significant employment opportunities and are investing and spending more on biotechnology research and development. (Vol. 4 no. 1 p. 12)

The main barriers to using biotechnology are cost factors reported by 50% of firms, followed by lack of qualified staff by 41% of firms and then public acceptance cited by 36% of firms. (Vol. 4 no. 1 p. 19)

Canadian biotech firms raised $980 million in financing capital in 2001, a sharp drop from the $2.1 billion raised in 1999. Overall, 61% of firms that attempted to raise capital either failed or did not reach their targets. (Vol. 5 no. 2 p. 10)

There are 133 biotechnology Canadian-based firms manufacturing or developing bioproducts. Bioprocessing-based bioproducts (products developed or made using enzymes and bacteria culture) lead the way. (Vol. 6 no. 1 p. 12)

Between 1997 and 2003, the number of innovative biotechnology firms rose from 282 to 490. Biotechnology in Canada continued to expand between 2001 and 2003, generating revenues of almost $4 billion. Biotechnology companies have more than quadrupled their revenues since 1997, making biotechnology a quickly-growing activity. (Vol. 7 no. 2 p. 12) However, a number of firms are still experiencing difficulties in raising the capital needed to finance their research projects. (Vol. 6 no. 2 p. 4)

Biotechnology firms that have patents — especially those with many patents — have a higher success rate in obtaining funding than do those with no patents. (Vol. 7 no. 3 p. 14)

Nanotechnology

In 2003, an estimated 89 firms were involved in the development in R&D of nanotechnologies. Nanotechnology R&D activity was found in a total of seven different industries. The most predominant industry sector of activity is Scientific Research and Development Services with 65% of all respondents, followed by Chemical Manufacturing with 11%, while 7% are found in Pharmaceutical and Medicine Manufacturing. (Vol. 7 no. 1 p. 6)

Innovation

Statistics Canada's annual Economic Conference provides a forum for the exchange of empirical research among business, government, research and labour communities. The theme in 2002 was **Innovation in an Evolving Economy**. Twelve presentations were based on directly on the analysis of SIEID data. (Vol. 4 no. 2 p. 10)

Ajay Agrawal (Queen's University School of Business) contributed an article on the importance of knowledge spillovers and absorptive capacity to the issue of innovation and growth, offering a useful point of departure for further investigation. (Vol. 4 no. 3 p. 3)

Four-fifths of Canadian public sector organisations introduced significantly improved organisational structures or management techniques between 1998 and 2000. This rate of introduction of organisational change is twice that recorded by the private sector (38%). (Cat. no. 88F0006XIE2002001**)**

Soma Hewa (Research Program on Philanthropy and Social Development in Montreal) outlined some of Max Weber's (1864-1920) contributions to understanding the role of innovation in the organization. He concludes that the formal structure of a bureaucracy must be designed to achieve its goals. (Vol. 4 no. 3 p. 7)

Daood Hamdani investigated the four identifiable types of globally operating corporations: **global, multinational, international and transnational**. Each represents a different business model and corporate strategy to cope with uncertainties of a rapidly changing business environment and to participate in the world market. (Vol. 5 no. 3 p. 3)

A high-technology orientation is closely associated with success of food processing firms. (Vol. 5 no. 2 p. 3)

John Baldwin and Petr Hanel (Université de Sherbrooke) conclude that while industrial sector, firm size, nature of the technology and foreign ownership are important determinants of innovation, factors that are intrinsic to the firm itself such as export orientation, propensity to conduct R&D, abilities to secure financing and preferences for intellectual property regimes differ across innovators. (Vol. 5 no. 3 p. 8)

Two-thirds of non-innovators perceived that innovation is not needed or that innovation is irrelevant to their industry. (Vol. 5 no. 3 p. 20)

A workshop on *The many guises of innovation: What we have learnt and where we are heading* in October 2003 developed a common understanding between theorists, empiricists and policy developers on the activity of firm-level innovation and of the factors that affect it. There was also common ground on the outcomes of innovation, such as enhanced productivity, and on the link between firm performance and management practices. (Vol. 6 no. 1 p. 3)

Innovation in manufacturing

Pierre Mohnen (MERIT) and Pierre Therrien (Industry Canada) reported that the percentage of innovative firms is higher in Canada than in the European countries. The percentage is closer to the Canadian level in Ireland and Germany, and somewhat lower in France and Spain. (Vol. 4 no. 1 p. 16)

Jianmin Tang of Industry Canada found that competition has a positive and significant impact on both technology invention and technology adoption. Thus, the empirical evidence substantiates the belief that competition induces innovation. (Vol. 4 no. 1 p. 22) He also reported that skills influence productivity directly as well as indirectly by stimulating fundamental innovation via increased R&D spending. (Vol. 4 no. 3 p. 13)

John Baldwin found that firms with a larger share of long-term debt in their capital structure devote less of their investment expenditures to R&D. (Vol. 5 no. 1 p. 4) Another study reported by John Baldwin confirmed that innovation is a main factor contributing to labour productivity growth, gains in market share and survival in Canadian manufacturing plants. The study also found that research and development (R&D) investment, competencies and past innovation activities are the three main factors affecting innovation outcomes of Canadian manufacturing firms. (Vol. 6 no. 3 p. 3)

David Sabourin concluded that over the period 1993 to 1998, manufacturing companies that increased their use of advanced technology during the mid-1990s also experienced greater growth in labour productivity during the same period. (Vol. 6 no. 3 p. 4)

Don Wagner of the University of Prince Edward Island found very little relationship between innovation and proximity to rivals or proximity to universities. Being close to rivals or universities appears to foster innovation only at very short distances of a few hundred metres. (Vol. 7 no. 2 p. 4)

There are positive effects of R&D tax credits on the direct output of R&D activities, like the percentage of firms that introduced a new product or process that was a world or Canadian first. (Vol. 7 no. 2 p. 6)

Innovation in services

Service firms do a much smaller proportion of their work for governments and affiliated companies than they did in the past. On the other hand, they receive more contracts from other business firms because of the intellectual depth, economies of scale and a faster turn around they offer. (Vol. 4 no. 2 p. 9)

Once viewed as weak in R&D capabilities, the service sector is emerging as an increasingly attractive place for foreign controlled firms to do R&D in Canada. Multinational corporations undertake R&D abroad to acquire new insights or apply the knowledge they already have. (Vol. 5 no. 1 p. 5)

In 2000, the business services sector represented 17% of all industrial R&D expenditures and 28% of all industrial R&D jobs. (Vol. 6 no. 2 p. 11)

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. (Vol. 6 no. 2 p. 18)

The three top innovators in selected service industries are members of the ICT services group "Computer systems design and

related services", "Software publishers" and "Satellite telecommunications". (Vol. 7 no. 2 p. 7)

Knowledge management

Knowledge management practices were put into place to improve the competitive advantage of firms and to train workers to meet strategic objectives of the firm. The firms' strengths were related to internalising their knowledge. Not looking outside for sources of knowledge and expertise was found to be a general weakness. (Vol. 4 no. 2 p. 6)

Overall, the public sector by far outstripped the networked private sector in the usage of electronic networks to share information both internally and externally in 2001. (Cat. no. 88F0006XIE2003002)

Technological change

In 2002, the rate of technological adoption in the public sector (82%) stood at twice that of the private sector (42%). (88F0006XIE2004008) Between 1998 and 2002, 85% of public sector organisations that introduced technological change purchased off-the-shelf technologies (73% for the private sector). (Vol. 4 no. 2 p. 8)

Community Innovation

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. (Vol. 6 no. 2 p. 8)

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. (Vol. 6 no. 2 p. 10)

Business dynamics

Industries with high R&D spending and high R&D intensities were more likely to report a higher proportion of high-growth firms. (Vol. 6 no. 2 p. 14)

Theories of business growth lead us to believe that, to grow, a company needs to be innovative, conduct R&D, have access to multiple sources of funding, protect its intellectual property (IP), engage in alliances and establish itself in a market niche. Interviews with 25 Canadian technology-based companies show that some companies manage to grow despite breaking these rules. (Vol. 6 no. 3 p. 12)

The strongest factors that differentiate small high-growth firms from others are having world first innovations and having applied for patents. (Vol. 6 no. 3 p. 16)

Between 1995 and 2000, 1.4% of all Canadian small businesses increased their employment by 100% or more. High-growth firms represented 3.7% of the 1995 employment in small businesses or about 260,000 jobs. The proportion of small high-growth firms varied greatly by industry and by city. The two sectors with the greatest proportion of transitions from small to medium were "Plastic products" at 6.9% and "Electrical and electronic products" at 5.9%. In seven of Canada's larger cities (CMAs) the proportion of quickly growing small firms exceeded 2%: Kitchener, Calgary, Halifax, Oshawa, Sherbrooke, Ottawa-Hull and Toronto. (Vol. 6 no. 3 p. 16)

Larger-sized high-growth SMEs are more likely to adopt advanced manufacturing technologies than either non-high-growth firms or smaller high-growth firms. (Vol. 6 no. 3 p. 18)

High-growth R&D-performing firms reported the highest levels of R&D performance whether measured per firm or per employee. Their high employment growth was paralleled by high growth in revenues, which indicates that their growth appears balanced and sustainable. (Vol. 6 no. 3 p. 19)

The follow-up to ***Characteristics of firms that grow from small to medium size*** has added some new dimensions to our understanding of firm growth. Frequent messages included: "A small company **can** provide a solution for a large client.", "Large Canadian clients need to pay more attention to small Canadian companies.", "The technology is easy, it's getting noticed that's difficult!" and "Now that we're here, how do we get rid of the people who got us here?" (Vol. 7 no. 2 p. 10)

Commercialization and technology transfer

An estimated 4,400 Canadian firms directly benefited from technologies developed in Canadian universities, hospitals and federal labs. (Cat. no. 88F0006XIE2004018)

The current usage of the word "commercialization" is challenging the statistical system. Universities and federal labs sometimes commercialize their technologies and we measure their license revenues and spin-off firms. In the private sector, commercialization is called "survival". How do we provide a framework and indicators of "everything"? (Vol. 7 no. 1 p. 3)

Research and Development

When comparing GERD to GDP, it is important that analysts use the adjusted data for comparability purposes when ranking Canada against other OECD countries. The differences in the calculation, although subtle, can change the tone of the comparison. (Vol. 6 no. 2 p. 3)

Research and development in Canadian industry

Although there were over 8,000 companies in Canada reporting R&D expenditures in 2000, 30 companies accounted for over half of all business R&D spending. The highest levels of concentration of R&D spending were found in the communications equipment manufacturing sector, while computer systems design and related services showed the lowest. (Vol. 5 no. 3 p. 16)

In the 1990s, Canada's growth in GERD was driven by growth in business R&D (BERD). This is also true for all the high R&D performing countries. (Vol. 5 no. 3 p. 22)

Generally, R&D expenditures are higher and less concentrated in the United States than in Canada. The top three manufacturing

sectors in Canada account for 70% of all manufacturing R&D, but 49% in the United States. R&D intensities are generally lower in Canadian sectors than in their equivalents in the US. (Vol. 6 no. 3 p. 22)

Industries with high R&D spending tend to have high R&D intensities. (Vol. 7 no. 1 p. 9) In 2000, Canada reported lower than average industrial R&D relative to its share of G7 GDP. (Vol. 7 no. 3 p. 7)

During the period 2000 to 2002, compared with the period 1994 to 1996, there was a substantial increase in the share of R&D dedicated to energy "alternatives", in particular to renewable energy resources. (Vol. 7 no. 3 p. 8)

Federal science expenditures and personnel

The federal government's spending on S&T including research and development (R&D) remained a stable 3.6% of the total federal budget through most of the 1990's, then climbed to 4% in 1998-99 and is estimated at 4.5% for 2001-02. (Vol. 4 no. 2, p. 3)

Intellectual property

Petr Hanel (Université de Sherbrooke) reported that even though intellectual property rights (IPRs) are not perceived as being very effective, two-thirds of innovative manufacturing firms used at least one instrument between 1997 and 1999. (Vol. 4 no. 1 p. 10)

Royalties from licensing technology of Canadian universities increased from $18.9 million in 1999 to $44.4 million in 2001. The increase is due to a few "big successes" in recent years. (Vol. 5 no. 3 p. 14)

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 to federal departments and agencies. In 2002-03, an estimated 384 patents were applied for and 146 were issued. (Vol. 6 no. 2 p. 6)

The National Research Council (NRC) is the major contributor to most of the federal government's IP activity in 2002-03. The NRC was responsible for 55% of the federal government's patent applications, 55% of patents issued and 41% of all patents held. (Vol. 7 no. 1 p. 6)

To commercialize their technologies, Canadian universities and hospitals created 64 spin-off companies in 2002 and 2003, for a total of 876 created to date. Between 2001 and 2003, the number of inventions reported or disclosed by researchers to universities and hospitals increased from 1,105 to 1,133 (3%). The number of patent applications filed by these institutions also increased from 932 to 1,252 (34%) and the total number of patents held rose from 2,133 to 3,047 (43%). (Vol. 7 no. 3 p. 11)

Human resources in science and technology

Skills

Many Canadian students lose interest in science and math between Grades 4 and 8. This lack of interest is even more pronounced in the last year of high school. Only 42% of these students were enrolled in both science and math courses in 1995. Regardless of this drop in interest and participation, Canadian students continue to perform very well in international mathematics and science performance assessments. (Vol. 4 no. 1 p. 5)

Other than the large numbers of science graduates taking advanced degrees in business, once a graduate has received a bachelors degree in sciences, it is likely that advanced studies will also be in the sciences. (Vol. 4 no. 1 p. 5)

Careers of doctorate holders

One out of every five individuals (21%) who graduated with a doctorate from a Canadian institution between July 2003 and June 2004 intended to leave Canada in the year following graduation. (Vol. 7 no. 3 p. 10)

Connectedness

Telecommunications and broadcasting

Radio, the oldest electronic medium steadily continues to generate profits. The radio industry achieved relatively good financial results in 2002 despite a slowdown in the growth of its revenues. Revenues reached just over $1.1 billion. (Vol. 5 no. 3 p. 20)

Airtime sales by private radio broadcasters jumped 8.4% to $1.2 billion in 2003, the second largest year-over-year increase in the last 15 years. (Vol. 6 no. 3 p. 6)

In 2001, specialty television reported revenues of $1.2 billion, up 13.9% from 2000. This level represented 26.6% of total television industry revenues of $4.5 billion, compared with only 19.0% in 1998. (Vol. 4 no. 3 p. 17)

Despite the strong growth in the adoption of digital television by Canadians, the transition to digital television lags behind that observed in the United States. (Vol. 5 no. 1 p. 7)

The arrival of new suppliers and increased programming choices has led a growing number of Canadians to subscribe to multichannel video programming services. The number of subscribers grew by 5.9% in 2001 to reach 9.5 million. (Vol. 5 no. 3 p. 11)

Television broadcasters spent a greater proportion of their revenues on programming and production in 2002 than in the previous three years. That proportion reached 61.3% in 2002 compared to 59% in 2001. (Vol. 5 no. 3 p. 21)

At the end of August 2002, more than one third of multi-channel video services customers subscribed to digital wireless or digital cable services. Of these 3.2 million subscribers to digital services, 2.0 million were customers of wireless operators and 1.2 million customers of cable operators. (Vol. 6 no. 1 p. 17)

Digital television channels incurred a loss before interest and taxes of $85.2 million in 2003, significantly less than the $140.5 million loss incurred in 2002. Their customer base has expanded to an average of just over 500 thousands subscribers per channel,

with the most popular services attracting close to one million customers at the end of August 2003. (Vol. 6 no. 3. p. 10)

At 41.8 cellular subscribers per 100 inhabitants (end of 2003), the penetration of mobile communications in Canada is well below that achieved in the United States (54.3), in Europe (55.4) and in OECD countries (63.2). (Vol. 7 no. 2 p. 9)

The number of network telephony connections (the sum of all connections) stood at 158.3 per 100 persons at the end of 2003 compared to 127.1 at the end of 1999. (Vol. 7 no. 2 p. 13)

Telecommuncations services markets were found to be less concentrated in mobile services, followed by long distance wireline, private line and data services, and lastly, local wireline services. (Vol. 4 no. 3 p. 15)

Despite stagnating revenues, the telecommunication services industry improved its profits during the first half of 2003 by controlling operating costs and reducing capital spending. (Vol. 6 no. 1 p. 16)

Internet use

Access to high-speed Internet by cable increased substantially in 2001, but smaller communities in Canada were still far behind their larger counterparts. (Vol. 4 no. 3 p. 13)

Business and government

The percentage of private firms that use e-mail has grown from 53% in 1999 to 71% in 2002. Private firms' Internet use has increased from 53% in 1999 to 75% in 2002. (Vol. 6 no. 1 p. 14)

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. (Vol. 6 no. 2 p. 16)

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. (Vol. 6 no. 2 p. 19)

By 2003, 16% of private Canadian businesses, both large and small, were using Intranets within their organization. However, growth was slow. (Vol. 6 no. 3 p. 8)

Once the size is taken into account, the ICT use of large businesses and large public organizations are very similar. (Vol. 5 no. 2 p. 10)

The percentage of firms using an extranet in Canada remains low with just over 6% of private firms using an extranet in 2003. (Vol. 7 no. 1 p. 8)

Household and individual

Almost one-quarter (23.7%) of all households in Canada connected to the Internet by broadband in 2001. This rate of adoption places Canada among the world leaders in broadband use, second only to Korea among OECD countries in broadband use on a per capita basis. (Vol. 5 no. 3 p. 8)

In 2003, 7.9 million households (64%) of the 12.3 million Canadian households had at least one member who used the Internet regularly either from home, work, school, a public library or another location. This was a 5% increase from 2002, but well below the annual gains of 19% and 24% observed in 2000 and 2001. (Vol. 6 no. 3 p. 7)

Almost two-thirds of households that regularly used the Internet from home researched health issues in 2002. (Vol. 6 no. 3 p. 9)

On-line household spending jumped 25% from a year earlier to just over $3.0 billion in 2003, as Canadians bought everything from airplane tickets to books online. (Vol. 7 no. 1 p. 7)

Information and communications technologies

The digital divide (the gap between ICT "haves" and "have-nots") is sizeable. It is closing as a result of the progress made by middle-income groups when compared to the highest income group. The lowest income groups continue to lose ground vis-à-vis the very high-income groups. Clearly, despite changes, there is a long way to go before the divide between these groups is eliminated. (Vol. 4 no. 3 p. 11)

As evident by its contribution of $58.3 billion to Canada's GDP in 2002 and accounting for more than 7% of business sector GDP, the ICT sector is playing an increasingly greater role in the Canadian economy. The computer and telecommunications sector represents a significant subset of the ICT sector and accounts for 3.9% of total economy employment. (Vol. 5 no. 2 p. 7)

The chances of earning high income are even greater for those with both average or higher literacy skills and intensive computer use. In fact, individuals in this group had over five times the odds of being high income earners compared to those with below average literacy and less intense computer use. (Vol. 7 no. 3 p. 3)

IAB: Thank you very much, Dr. Gault. We're sure our readers will appreciate such a succinct summary of this vast amount of new knowledge that your Division and its collaborators have created.

These findings were published in previous issues of the ***Innovation Analysis Bulletin*** and SIEID working papers.

Michael Bordt, SIEID, Statistics Canada

What's new?

Recent and upcoming events in connectedness and innovation analysis.

Connectedness

A study entitled *Literacy and Digital Technologies: Linkages and Outcomes* (B. Veenhof, Y. Clermont and G. Sciadas) was released on December 5, 2005 in the Connectedness Series (Cat. No. 56F0004MIE). This followed the November 30, 2005 release of a national report, *Building on Our Competencies: Canadian Results of the International Adult Literacy and Skills Survey* (Cat. No. 89-617-XIE).

Further work on the outcomes and impacts of information and communications technology (ICT) will be released in the Connectedness Series over the spring and summer.

Telecommunications

Annual survey of telecommunications service providers

The data processing for 2004 is ongoing. The data release is expected for March 2006.

Quarterly survey of telecommunications service providers

Selected statistics on telecommunications services industries for the second quarter of 2005 were released on November 8, 2005 in ***The Daily.*** The second quarter 2005 issue of *Quarterly telecommunications statistics* (Cat. no. 56-002-XIE, volume 29, no. 2) was released on November 18, 2005.

The release of third quarter statistics is expected in February 2006.

Broadcasting

Statistics for 2004 for the cable and other program distribution industry were made available on October 20, 2005 in *Broadcasting and Telecommunications, Cable, satellite and multipoint distribution systems, 2004* (Cat. no. 56-001-XIE, Vol. 35, No. 4).

This completed the release of 2004 statistics for broadcasting industries. The collection and processing of data for 2005 are ongoing.

Canadian Internet use survey

No updates to report.

Business e-commerce

Survey of electronic commerce and technology

The 2005 ***Survey of Electronic Commerce and Technology*** (SECT) was mailed out in November 2005. Results are expected in April 2006.

Science and innovation

S&T activities

Research and development in Canada

The service bulletin *Total spending on research and development in Canada, 1990 to 2005[p], and provinces, 1990 to 2003*, (Cat. no. 88-001-XIE Vol. 29, no. 8) was released on December 9, 2005. Table number 358-0001 on CANSIM and associated tables on the Canadian Statistics Web site under the **Science and Technology** heading were also updated the same day. In addition, a working paper titled *Estimates of Canadian research and development expenditures (GERD), Canada, 1994 to 2005, and by province 1994 to 2003*, (Cat. no. 88F0006-XIE no. 020) was also released.

The pilot survey ***Research and development in Canadian Industry Intended to Directly Benefit Developing Countries, 2004*** is in the field.

Industrial research and development

A working paper titled *Industrial R&D statistics by region, 1994 to 2003*, (Cat. no. 88F0006-XIE no. 017) was released on November 22, 2005.

The annual publication 88-202-XIE *Industrial research and development, 2005 intentions* (with 2004 preliminary estimates and 2003 actual expenditures) was released on January 11, 2006.

Federal science expenditures

The service bulletin *Federal government expenditures on scientific activities, 2005-2006,* (Cat. no. 88-001 Vol. 29, No. 7) was released on December 8, 2005.

The pilot survey ***Federal Science Expenditures Intended to Directly Benefit Developing Countries, 2004-2005*** is in the field.

Higher education sector R&D

The service bulletin *Estimation of research and development expenditures in the higher education sector, 2003-2004*, (Cat. no. 88-001 Vol. 29, No. 6) was released on December 7, 2005. In addition, a working paper with the same title (Cat. no. 88F0006XIE no. 019) was released the same day.

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

The 2003-04 and 2004-05 surveys are in the field. A working paper summarizing the results from 1997-98 to 2002-03 is in progress.

The higher education sector

Intellectual property commercialization in the higher education sector

Preliminary data from the 2004 survey were released in ***The Daily*** on January 27, 2006. A working paper is in progress.

Innovation

Innovation in manufacturing

Collection for the 2005 ***Survey of Innovation*** has been extended. Preliminary data for Canada will be released later this spring. The survey is collecting information on core issues surrounding innovation such as business success factors, innovation activities, sources of information for innovation, innovation cooperation, impact of innovation, problems and obstacles for innovators, intellectual property and technology acquisition, market and supply chain, and business funding and support.

Innovation in advanced technologies

A survey of advanced technology use in Canadian manufacturing and logging industries will be conducted during the fall of 2006. The questionnaire is being designed in consultation with industry experts, policy analysts and researchers including those from various government departments.

Innovation in services

A series of four working papers have been released based on the results of the Survey of Innovation 2003. *Innovation in Selected Industries Serving the Mining and Forestry Sectors: Results from the Survey of Innovation 2003* was published on Friday November 4, 2005.

Innovation in Selected Transportation Industries: Results from the Survey of Innovation 2003 was released on Wednesday, November 2, 2005.

I*nnovation in Selected Professional, Scientific and Technical Services: Results from the Survey of Innovation 2003* was released on October 31, 2005:

Innovation in Information and Communication Technology (ICT) sector service industries: Results from the Survey of Innovation 2003 was released on October 25, 2005.

Commercialization

Preliminary results from the ***Survey of Business Incubators 2005*** will be released in March.

Biotechnology

No updates to report.

In brief

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

Antoine Rose accepts one year assignment as Senior Policy Advisor with the Canadian Biotechnology Secretariat

In his role as Special Advisor, Life Sciences within SIEID, Antoine Rose was instrumental in developing Statistics Canada's biotechnology statistics program. He played a central role at the OECD in the creation of international definitions and pilot survey of biotechnology.

In addition to his work in biotechnology, Antoine was also responsible for the Science and Technology Surveys Section whose major surveys are the Federal science and technologies survey and the Research and Development in Canadian Industry survey.

Antoine's contributions in the Science Innovation & Electronic Information Division have been significant and Michael Bordt and Chuck McNiven will hold the fort until he returns. No doubt, Antoine will continue to make a contribution to Canada's biotechnology community at the CBS.

Course 0430 – Introduction to Exploratory Data Analysis and 0432 Intermediate Exploratory Data Analysis

Through Statistics Canada, SIEID offers a five day and follow-up three day course with the purpose of familiarizing data analysts with the principles, techniques, and tools of Exploratory Data Analysis and Intermediate Exploratory Data Analysis in order to better understand, edit, and analyze their datasets. These courses will benefit analysts who are involved in collecting, processing, editing, and/or analysing survey and administrative micro-data.

Case studies with "hands-on" approach

Analysts will learn new techniques and methods of exploring and analyzing social and business data sources and discover new and potentially valuable and actionable insights into datasets consisting of up to hundreds of variables and many thousands of records. Case studies using real business and social examples are used to illustrate the relevance of the approach. Course participants will learn how to visually identify outliers, inliers and various micro-data anomalies, as well as to uncover previously hidden interesting analytical stories from their datasets. Each student in a session has their own PC and gets to participate in a "hands-on" mode, which greatly enhances learning and retention.

Recently developed analytical tools

Analyst are introduced to two recently developed new non-programming point-and-click visually oriented analytical tools: SAS/Insight - a special set of point-and-click tools imbedded within PC/SAS that lets an analyst view and interact with several inter-connected windows simultaneously in order to visually identify possible data anomalies and better understand potential inter-relationships among variables; and, SAS/Enterprise Guide - a separate piece of software that facilitates SAS use through Wizards. It is useful for pre-grooming data to be used within SAS/Insight and in data analysis generally. Like SAS/Insight, it is menu-driven, requiring no programming expertise.

Exploratory Data Analysis with SAS/INSIGHT allows quick and easy interactive identification of observations in any combination of linked scatter plots, histograms, box plots, line plots, contour plots, and three-dimensional plots. All graphs and analyses are linked. Brush one or more observations in one window and they are highlighted in all windows. Assign a colour or a special symbol to a point or set of points in one graph and they receive the same treatment in all displays. Exclude observations from calculations, and all analyses recalculate automatically. The dataset is easily sorted, searched, edited, extracted/subsetted with this new tool. Dynamically linked graphs, interactive juxtaposition of several graphs in one window, re-expressing data etc. make it easy to find patterns in the data.

Classical data analysis with SAS\INSIGHT allows calculation of descriptive statistics and correlations to confirm statistically the pattern/ relationships that are visually interesting. Analyze, evaluate and test hypothesis for potential relationships in data: add and remove model effects quickly as they are evaluated. Examine univariate distributions and fit models using regression, analysis of variance, and the generalized linear model. This introductory course deals with data visualization and data mining techniques rather than the above; more formal statistical modelling of identified potential relationships is explored further in our intermediate EDA course.

The courses are available in either French or English. Course information can be found at

Beginner course

http://www.statcan.ca/english/training/statistical.htm#0430

http://www.statcan.ca/francais/training/statistical_f.htm#0430

Intermediate course

http://www.statcan.ca/english/training/statistical.htm#0432

http://www.statcan.ca/francais/training/statistical_f.htm#0432

Estimates of Canadian Research and Development Expenditures (GERD), Canada, 1994 to 2005, and by Province 1994 to 2003

This publication presents the National GERD from 1994 to 2005[p] as well as the Provincial GERD from 1994 to 2003. Up until 1985, GERD included R&D expenditures in the Natural Sciences and Engineering (NSE) only. Beginning in 1985, Social Sciences and Humanities (SSH) activities are also included in GERD. An additional series of tables showing R&D expenditures at the national level in either science from 1963 to 1993, or at the provincial level from 1979 to 1993, may be obtained from the Science and Innovation Surveys Section, Science, Innovation and Electronic Information Division.

The publication, *Estimates of Canadian Research and Development Expenditures (GERD). Canada, 1994 to 2005, and by Province 1994 to 2003* (Cat. no. 88F0006XIE2005020, free) is available online and was announced in ***The Daily*** on December 9, 2005.

Janet Thompson, SIEID, Statistics Canada

Federal government spending on S&T, 2005/06 (intentions)

The federal government's spending on S&T is expected to surpass $9 billion in the fiscal year 2005/06, with the majority headed for research and development. A survey of S&T activities of federal departments and agencies shows total spending intentions will reach $9.1 billion. This would represent 4.9% of total government spending, compared with 3.6% in 1994/95.

Of the total, 63 cents out of every dollar spent on S&T will go to research and development, the second highest share during the past 10 years.

The $5.8 billion anticipated for research and development will include intramural performance, which are activities carried out primarily by the federal government, and extramural funding, which are activities managed and performed by non-federal organizations.

Just over one-half (52%) of total S&T expenditures are expected to be spent on activities performed by the federal government itself. Of total planned research and development spending, the federal government will perform $2.1 billion, or 37%.

Federal government research and development funding to the higher education sector is expected to exceed $2.5 billion.

The service bulletin ***Science Statistics, Vol. 29, no. 7*** (Cat. no. 88-001-XIE, free) is now available online and was announced in ***The Daily*** on December 8, 2005.

Janet Thompson, SIEID, Statistics Canada.

Spending on research and development in the higher education sector

Spending on research and development in the higher education sector reached $8.1 billion in 2003/04. This increase is explained by augmented funding from two sources: the grants and contract part of funding provided to the higher education sector by provincial governments and increase funding from the federal government.

There were 43 universities in Ontario and Quebec that performed sponsored research as did 16 universities in Atlantic Canada and 15 in the Western provinces.

Of the $8.1 billion, about 80% or $6.5 billion was spent in the natural sciences and engineering. The remaining $1.5 billion (20%) was allocated to the social sciences and humanities.

The service bulletin *Science Statistics*, Vol. 29, no. 6 (88-001-XIE, free) and the working paper *Estimation of Research and Development Expenditures in the Higher Education Sector 2003/04* (Cat. no. 88F0006XIE2005019, free) are available online and was announced in ***The Daily*** on December 7, 2005.

Janet Thompson, SIEID, Statistics Canada.

Global links: Multinationals, foreign ownership and productivity growth in Canadian manufacturing

This paper examines two potential benefits of foreign-controlled plants in the Canadian manufacturing sector: the superior performance of foreign-controlled plants and their productivity spillovers to domestic plants. The paper finds that foreign-controlled plants are more productive, more innovative, more technology intensive, pay higher wages and use more skilled workers. This foreign-ownership advantage is found to be a multinational advantage. What matters for economic performance is whether plants belong to multinational enterprises (MNEs) rather than ownership per se. Canadian multinationals are as productive as foreign multinationals. We also find that MNEs have accounted for a disproportionately large share of productivity growth in the last two decades. Finally, we find robust evidence for productivity spillovers from foreign-controlled plants to domestic-controlled plants arising from increased competition and greater use of new technologies among domestic plants.

The publication *The Canadian economy in transition* (Cat. no. 11-622-MIE2005009, free) is now available and was announced in ***The Daily*** on December 5, 2005.

John Baldwin and Wulong Gu, Micro Economic Studies and Analysis Division, Statistics Canada.

Key indicators in Canada

In recent years there has been considerable interest in key indicators, including the area of innovation. This paper surveys recent Canadian attempts to develop key indicators of economic, social, environmental or physical well-being. It classifies and discusses over forty such projects and publications in detail; briefly lists a further twenty projects; and provides references to a number of up-to-date surveys and annotated bibliographies which contain additional examples of indicator development in Canada. The paper provides information on a number of research centres working on indicator development and discusses international indicators which are relevant to the Canadian scene, either because they represent 'prototypes' of some particular kind of measure, or else might be regarded as constituting “best practice” in an area. The paper also examines the motivations behind indicator development and seeks to address the question of whether efforts to extend measurement outside the economic field constitute attempts to "measure the unmeasurable".

The publication, *Economic Analysis Research Paper Series: Key Indicators in Canada, no. 37,* (Cat. no. 11F0027MIE2005037) is now available (free) and was announced in ***The Daily*** on November 30, 2005.

Paul Warren, Analytical Studies Branch, Statistics Canada.

Strategies of small and mid-sized Internet service providers (ISPs)

This article compares the performance and characteristics of fast-growing small and mid-sized Canadian Internet service providers (ISPs) with those of their slower-growing counterparts. The study also examines the different strategies employed by the two groups as well as their differing perceptions of potential impediments to their growth.

The main findings relate to the effects of the two groups' business strategies on their core business and diversification, revenues and expenses, broadband and narrowband services, subscriber base and customer retention rates, connections options and growth impediments.

The publication *Strategies of small and mid-sized Internet service providers (ISPs)* (Cat. no. 63F0002XIE2005048) is now available (free) and was announced in ***The Daily*** on December 8, 2005.

Don Little and Alexander Nikolaev, Services Industry Division, Statistics Canada.

Skills, Innovation and Growth: Key Issues for Rural and Territorial Development: A Survey of the Literature – 1980-2003.

This report reviews the literature related to the spatial variation of skills and human capital and its implication for local innovation capacity and economic development. The report develops around three major themes 1) skills and human capital; 2) innovation and technological change; and 3) growth.

The working paper was released in the Nov. 15, 2005 issue of ***The Daily*** from the Agriculture and Rural Working Paper Series (21-601-MIE2005076, free).

Alessandro Alasia, Agriculture Division, Statistics Canada.

New economy indicators

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

	Units	2000	2001	2002	2003	2004	2005
General economy and population[1]							
GDP	$ millions	1,076,577	1,108,048	1,154,204	1,216,191	1,290,185	..
GDP implicit price index	1997=100	105.5	106.7	107.8	111.3	114.7	..
Population	thousands	30,689	31,021	31,373	31,669	31,974	32,271
Gross domestic expenditures on R&D (GERD)[2]	$ millions	20,531	22,733	22,370	23,293	24,487	..
"Real" GERD	$ millions 1997	19,559	21,749	21,690	21,556	22,022	..
GERD/GDP ratio	ratio	1.92	2.09	2.03	1.97	1.96	..
"Real" GERD/capita	$ 1997	634.13	686.81	661.44	661.42	667.69	..
GERD funding by sector							
Federal government	% of GERD	17.3	17.7	18.0	18.7	19.4	19.1
Provincial governments	% of GERD	4.3	4.5	5.1	5.8	6.1	6.3
Business enterprise	% of GERD	0.0	0.0	0.0	0.0	0.0	0.0
Higher education	% of GERD	44.9	50.3	51.3	49.3	47.9	47.1
Private non-profit	% of GERD	14.0	12.6	14.8	14.9	15.6	16.5
Foreign	% of GERD	2.2	2.3	2.7	2.6	2.7	2.9
GERD performance by sector							
Federal government	% of GERD	10.1	9.1	9.4	8.7	8.9	8.1
Provincial governments	% of GERD	1.2	1.3	1.3	1.3	1.4	1.4
Business enterprise	% of GERD	60.3	61.7	57.2	55.8	54.0	52.7
Higher education	% of GERD	28.1	27.7	31.9	33.9	35.4	37.5
Private non-profit	% of GERD	0.3	0.2	0.2	0.3	0.3	0.3
Federal performance as a % of federal funding	% of federal	58.4	51.3	52.0	46.3	46.1	42.6
"Real" federal performance of R&D	$ millions 1997	1,972	1,971	2,032	1,872	1,968	..
Information and communications technologies (ICT)							
ICT sector contribution to GDP - basic prices[3]							
ICT, manufacturing	$ millions	17,070	11,069	8,889	8,871	9,949	..
% of total ICT	% of total ICT	30.9	20.6	16.3	15.9	17.1	..
ICT, services	$ millions	38,316	42,349	45,016	46,093	47,465	..
% of total ICT	% of total ICT	69.4	78.6	82.4	82.8	81.7	..
Total ICT	$ millions	55,176	53,857	54,608	55,698	58,112	..
Total economy[4]	$ millions	943,738	957,257	986,070	1,008,945	1,040,779	..
ICT % of total economy	%	5.8	5.6	5.5	5.5	5.6	..
Total business sector	$ millions	798,412	808,811	834,533	854,425	884,924	..
ICT % of business sector	%	6.9	6.7	6.5	6.5	6.6	..
ICT adoption rates (private sector)							
Personal Computer	% of enterprises	81.4	83.9	85.5	87.4	88.6	..
E-Mail	% of enterprises	60.4	66.0	71.2	73.8	76.6	..
Internet	% of enterprises	63.4	70.8	75.7	78.2	81.6	..
Have a website	% of enterprises	25.7	28.6	31.5	34.0	36.8	..
Use the Internet to purchase goods or services	% of enterprises	18.2	22.4	31.7	37.2	42.5	..
Use the Internet to sell goods or services	% of enterprises	6.4	6.7	7.5	7.1	7.4	..
Value of sales over the Internet	$ millions	7,246	10,389	13,339	18,598	26,438	..

1. Source: Statistics Canada, 2003, *Canadian Economic Observer*, Cat. No. 11-010-XIB, June 2004, Ottawa, Canada.
2. Source: Statistics Canada, 2003, *Science Statistics*, Cat. No. 88-001-XIB, various issues, Ottawa, Canada.
3. Source: Statistics Canada, 2006, CANSIM Tables 379-0017 "Gross Domestic Product (GDP) at basic prices, by North American Industry Classification System (NAICS), annual" and 379-0020 "Gross Domestic Product (GDP) at basic prices, special industry aggregations based on North American Industry Classification System (NAICS), annual". www.statcan.ca, Ottawa, Canada.
4. The "total economy" is in chained-Fisher methods of deflation and therefore does not match GDP.

	Units	2000	2001	2002	2003	2004	2005
Information and communications technologies (ICT) continued							
ICT adoption rates (public sector)							
Personal Computer	% of enterprises	100.0	100.0	99.9	100.0	100.0	..
e-mail	% of enterprises	99.0	99.7	99.6	99.8	99.9	..
Internet	% of enterprises	99.2	99.7	99.6	100.0	99.9	..
Have a Web site	% of enterprises	72.6	86.2	87.9	92.7	92.4	..
Use the Internet to purchase goods or services	% of enterprises	49.1	54.5	65.2	68.2	77.4	..
Use the Internet to sell goods or services	% of enterprises	8.6	12.8	14.2	15.9	14.0	..
Value of sales over the Internet	$ millions current	111.5	354.8	327.2	511.4	1,881.5	..
Teledensity indicators							
Wired access (Voice Grade Equivalent - VGE)	per 100 inhabitants	66.1	66.8	64.5	63.2	60.8	..
Wireless access (VGE)	per 100 inhabitants	28.3	34.2	37.7	41.6	46.5	..
Total public switched telephone network (PSTN) (VGE)	per 100 inhabitants	94.4	101.0	102.2	104.8	107.3	..
Homes with access to cable	thousands	10,900.5	11,078.7	11,396.2	11,718.5	11,937.1	..
Homes with access to Internet by cable	thousands	7,609.7	9,341.8	10,058.8	10,705.6	11,156.4	..
Access indicators							
Total wired access lines (VGE)	thousands	20,347.0	20,805.1	20,300.8	20,067.6	19,470.5	..
Residential access lines (VGE)	thousands	12,871.7	12,854.2	12,752.1	12,648.2	12,488.1	..
Business access lines (VGE)	thousands	7,475.3	7,950.9	7,548.7	7,419.3	6,982.4	..
Total mobile subscribers	thousands	8,726.6	10,648.8	11,872.0	13,227.9	14,912.5	..
Digital cable television subscribers	thousands	387.2	808.4	1,150.1	1,382.4	1,843.5	..
Satellite and MDS subscribers	thousands	967.1	1,609.2	2,018.6	2,205.2	2,324.6	..
High speed Internet by cable subscribers	thousands	786.3	1,384.8	1,874.8	2,363.3	2,837.8	..
Investment indicators							
Investments by the telecommunications services industries (NAICS 517)	$ millions (current)	9,517.8	10,652.9	7,310.4	6,181.0	6,904.3	7,365.9
Investments by the telecommunications services industries (NAICS 517)	$ millions (constant)	9,866.2	11,146.5	7,586.8	6,947.3	8,124.0	8,796.7
Characteristics of biotechnology innovative firms[5]							
Number of firms	number	..	375	..	496	..	..
Total biotechnology employees	number	..	11,897	..	11,931	..	..
Total biotechnology revenues	$ millions	..	3,569	..	3,820	..	..
Expenditures on biotechnology R&D	$ millions	..	1,337	..	1,487	..	..
Export biotechnology revenues	$ millions	..	763	..	..	..	..
Import biotechnology expenses	$ millions	..	433	..	..	..	..
Amount of capital raised	$ millions	..	980	..	..	..	..
Number of firms that were successful in raising capital	number	..	134	..	..	..	..
Number of existing patents	number	..	4,661	..	..	..	..
Number of pending patents	number	..	5,921	..	..	..	..
Number of products on the market	number	..	9,661	..	..	..	..
Number of products/processes in pre-market stages	number	..	8,359	..	..	..	..
Intellectual property commercialization[6]							
Federal government							
New patents received	number	..	109[r]	133[p]	142[r]	..	..
Royalties on licenses	$ thousands	..	16,467	16,284[r]	15,509[r]	..	..
Universities and hospitals							
New patents received	number	..	381	..	347	396	..
Income from intellectual property	$ thousands	..	52,510	..	55,525	51,235	..

5. Source: Statistics Canada, 2003, *Features of Canadian biotech innovative firms: Results from the Biotechnology Use and Development Survey – 2001*, Science, Innovation and Electronic Information Division Working Paper Series, Cat. No. 88F0006XIE2003005, Ottawa, Canada.
6. Sources: Statistics Canada, Federal Science Expenditures and Personnel Survey, and Survey of Intellectual Property Commercialization in the Higher Education Sector (various years).