Catalogue No. 88-003-XIE

Innovation Analysis Bulletin

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

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

Innovation Analysis Bulletin
Vol. 7, No. 2 (June 2005)
Catalogue Number 88-003-XIE
Aussi disponible en français, N° 88-003-XIF au catalogue

In this issue

Science Innovation and Electronic Information Division, Statistics Canada is pleased to announce that, beginning July 1st, 2005, the following publications will be available **free of charge**:

- *88-001 Science Statistics*
- *88-202 Industrial Research and Development*
- *88-204 Federal Science Activities*

The first publication to be released will be 88-001-XIE, Volume 29 No. 4. Science Innovation and Electronic Information Division wishes to thank all of our clients for purchasing these publications and we encourage you to continue to obtain them for free. If you would like to be notified by e-mail when a new issue of any of the above publications is available please contact (613) 951-2199.

Innovation analysis bulletin

ISSN 1488-433X

Please address all enquiries to the Editor, Innovation Analysis Bulletin

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

The **Innovation Analysis Bulletin** is an occasional publication of the Science, Innovation and Electronic Information Division of Statistics Canada. It is available, free of charge, on the Statistics Canada Web site (http://www.statcan.ca) under Our Products and Services, in the area Free publications, under the category **Science and Technology**.

The ***Innovation Analysis Bulletin*** is produced under the direction of Fred Gault and edited by Michael Bordt. Special thanks to the contributors, Rad Joseph and Claire Racine-Lebel (editing and coordination).

Published by authority of the Minister responsible for Statistics Canada

© Minister of Industry, 2005

All rights reserved. The content of this publication may be reproduced, in whole or in part, and by any means, without further permission from Statistics Canada, subject to the following conditions: that it is done solely for the purposes of private study, research, criticism, review, newspaper summary, and/or for non-commercial purposes; and that Statistics Canada be fully acknowledged as follows: Source (or "Adapted from", if appropriate): Statistics Canada, name of product, catalogue, volume and issue numbers, reference period and page(s). Otherwise, no part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopy, for any purposes, without the prior written permission of Licensing Services, Marketing Division, Statistics Canada, Ottawa, Ontario, Canada K1A 0T6.

Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

Standards of service to the public

Statistics Canada is committed to serving its clients in a prompt, reliable and courteous manner and in the official language of their choice. To this end, the agency has developed standards of service which its employees observe in serving its clients. To obtain a copy of these service standards, please contact Statistics Canada toll-free at 1 800 263-1136.

The paper used in this publication meets the minimum requirements of American National Standard for Information Sciences—Permanence of Paper for Printed Library Materials, ANSI Z39.48-1984.

Downloadable publications

To obtain PDF versions of the papers and questionnaires mentioned in this bulletin, please visit the Statistics Canada Internet site:

Start at the main Statistics Canada page: http://www.statcan.ca

- Our papers are in two areas:
  1. *Studies*

     Find studies: Free

     Documents are under the categories: *Science and Technology* and *Communications*
  2. *Our products and services*

     Browse our Internet publications: For sale

     Documents are under the category: *Science and technology* and *Communications*
- Sample questionnaires are in the section
  - *Definitions, data sources and methods* in the area
    - *Questionnaires – List by subject* under
      - *Communication* and
      - *Science and technology*

Subscription request

If you would like to receive a printed version, or if you would like e-mail notifications of new issues, please contact the editor by e-mail.

Get connected with us

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

As of February, 2005 there were:

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

Symbols

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

Innovation and industry clusters

Does innovation thrive best in industry clusters? That is, is a company more likely to be innovative if it is located close to many of its rivals? And what role does research at a local university play on industrial innovation? A recent study based on data from a Statistics Canada innovation survey, finds that firms located near their rivals or universities are no more innovative than other firms in the same industry are, except at extremely short distances.

Some regions have thriving high-tech industries. US examples include Silicon Valley's computer industries and Boston's bioscience industries. Some Canadian examples include the computer industries in Waterloo, and Montreal's cluster of pharmaceutical companies. Observations of these and other clusters have led Harvard business professor Michael Porter (1990) and many others to assert that clusters and local universities foster innovation. This theory has influenced policy-makers all over the world, including in Canada. However, while there is little doubt that high-tech industries tend to cluster, the assertion that clusters *foster* innovation is open to question. A recent study based on data from a Statistics Canada innovation survey, finds little support for this claim.

Testing the theory - measuring innovation and geographic clusters

An empirical test of this theory faces two significant challenges—how to measure innovation and how to measure geographic clusters.

This study takes advantage of an extremely useful source of data–Statistics Canada's ***Survey of Innovation 1999***. This survey asked a sample of over 5,000 Canadian manufacturers about their innovation activities. Firms were defined as innovative if they reported introducing new or significantly improved products to the market or new or significantly improved processes to the production process during the previous three years–in this case from 1997 through 1999.

Besides a measurement of innovation, the study requires a measurement of geographic clusters. This study uses detailed Statistics Canada data on each Canadian business establishment's location and industry code. Based on these data, a measure of proximity-to-rivals can be computed for each manufacturer in the survey. The proximity-to-rivals measurement is computed as the proportion of the manufacturer's rivals (weighted by revenues) that are located within a specified number of kilometres from the particular manufacturer.

For example, if the specified number of kilometres is 100 km, one could imagine drawing a circle centred on the manufacturer with a 100 km radius. The proximity-to-rivals measurement equals the proportion of the Canadian establishments with the same industry code that lie in that circle. However, the 100 km distance is only one of many different radii explored. The statistical tests are repeated using various radii–as large as 200 km, and as small as 0.1 km.

Using these measures of innovation and clustering, the statistical tests produce results that challenge Porter's theory. The tests show no statistically significant relationship (at the 5% level) between proximity-to-rivals and innovation, except where proximity-to-rivals is computed using a radius of 0.1 km or 0.2 km. When computing proximity-to-rivals using radii of 0.5 km or more, there is no evidence of any relationship between proximity-to-rivals and innovation.

This outcome suggests that the innovation-advantages of clustering are limited to very short distances, such as might be found within an industrial park.

The study also explores alternative definitions of innovation. For the purposes of the innovation survey, an innovation need not have been original. A firm was counted as an innovator even when it might have simply imitated someone else's innovation. In fact, about 80% of all firms reported some type of innovation.

Fortunately, the innovation survey asked respondents whether their most important innovation was a world-first. This question permits the study to repeat the statistical tests using a higher threshold of innovation. Using the higher threshold, a manufacturer is treated as an innovator if it reported that it had an innovation (under the old definition) *and* its most important innovation was a world-first.

Statistical tests using this definition of innovation show no statistically significant connection between proximity-to-rivals and innovation at all. This result holds even when proximity-to-rivals is based on a small circle of 0.1 km or 0.2 km radius.

Since the statistically significant results at small distances disappear when we raise the threshold of innovation, it appears that close proximity helps manufacturers to copy innovations more effectively, but not generate original innovations. Of course, non-original innovations are by no means worthless; they still improve a firm's product lines or processes, and thus make the firm more competitive. But those innovations are unlikely to be a source of competitive advantage over the firm's rivals.

Importance of firm proximity to universities

Porter and others have also asserted that firms are more innovative if they are near universities that conduct *related* world-class

research. This study therefore explores whether proximity-to-universities affects innovation levels. The proximity-to-university measurement follows the same pattern as the proximity-to-rivals measurement, by computing the proportion of universities (weighted by research funding) that are within a specified distance.

Using the first definition of innovation, there is no statistically significant relationship between proximity-to-universities and innovation, regardless of how large a circle is used to measure proximity-to-universities.

However, using the higher threshold definition of an innovator, which only counts manufacturers that rate their most important innovation as a world first, there is a statistically significant relationship between proximity-to-universities and innovation, but only when using a 1 km radius. Radii of 0.5 km or less show no such relationship (probably because manufacturers rarely are that close to the centre of a university) nor do radii of 2 km or more.

Overall, then, the study finds 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. And even at these small distances, proximity only affects certain types of innovation. Close proximity-to-rivals appears to foster imitation rather than original innovation, while close proximity-to-universities appears to foster original innovation rather than imitation.

*This article is based on the forthcoming research paper—**Innovators and their Neighbours** by Don Wagner. The paper is a result of a Facilitated Access Project. Facilitated Access is a Statistics Canada program that permits qualified researchers to access anonymized databases to run statistical models. Researchers can submit a proposal containing the following elements: a brief synthesis of the research literature, a hypothesis, a model, a description of the data and how it will be used in the model and the plans for publication of the final paper. Proposals using data from the Science, Innovation and Electronic Information Division are reviewed by an internal review committee, an external reviewer who is an expert in the field and finally, by the Business Analysis Co-ordination Committee.*

Don Wagner, University of Prince Edward Island.

References

Porter, Michael. 1990. *The competitive advantage of nations*, Harvard Business Review, March-April 1990.

The impact of R&D tax credits on innovation: An empirical analysis based on a survey on innovation in Canadian manufacturing

In a recent study using data from the Canadian ***Survey of Innovation 1999***, the authors examined the effect of R&D tax credits on innovation activities of Canadian manufacturing firms. They found positive effects on the propensity of firms to perform R&D activities such the introduction to the market of a new product or process that was a world first. However, there is no significant effect on more general firm performance indicators such as profitability, domestic market share or international market share.

Understanding the impact of tax credit programme

In Canada, the Scientific Research and Experimental Development (SR&ED) tax credit programme is a key instrument of public support to R&D. Contrary to grants, tax credits minimize the discretionary decision involved in project selection by the government.

In the Canadian context, Hanel, (2003), using the same data as the current study, found that firms using R&D tax credits in Canada are more likely to introduce world-first innovations.

The authors of the present study analysed the innovation and economic performance of firms that used tax credits. Three closely related research questions focusing exclusively on the effect of R&D tax credits were addressed in this study.

First, do R&D tax credits increase the propensity of firms to perform R&D? Second, knowing that the importance of the R&D input to innovation increases with the originality of innovation, do firms that use R&D tax credits introduce original Canadian and world-first innovations more frequently than other firms? Third, are users of tax credits performing better on a series of economic indicators than the non-users?

The matching method

Modern evaluation techniques have been developed to identify treatment effects[1] when the available observations on individuals or firms are subject to a selection bias. This typically occurs when the characteristics of recipient of public incentives differ from non-recipient. In this context, a recipient is part of the group of firms that use tax credits and the non-recipients are the firms that do not use tax credits. These two groups could be systematically different due the fact that the recipient group show more absorptive capacity or more successful innovation activities, for example. In this case, even in the hypothetical situation of absence of tax credit program, the recipients might have shown more absorptive capacity or more innovative activities than the non-recipient due to other characteristics driving both the R&D engagement and the probability of receiving R&D tax credits.

To overcome this selection bias problem, the method of matching estimators was used (for details on methodology see Czarnitzki et al., 2004). Fundamentally, this method addresses directly the question **"What would a treated firm with given characteristics have done if it had not been treated?"** In our context a treatment is the receipt of R&D tax credits.

Using the Canadian 1999 Survey of Innovation conducted by the Science, Innovation and Electronic Information Division of Statistics Canada, we compared observations on treated firms with non-treated firms, but not with all non-recipients but a selected group with similar characteristics.

Figure 1. Mean differences between R&D tax credits recipients and potential control group in percentage (full sample), before the matching

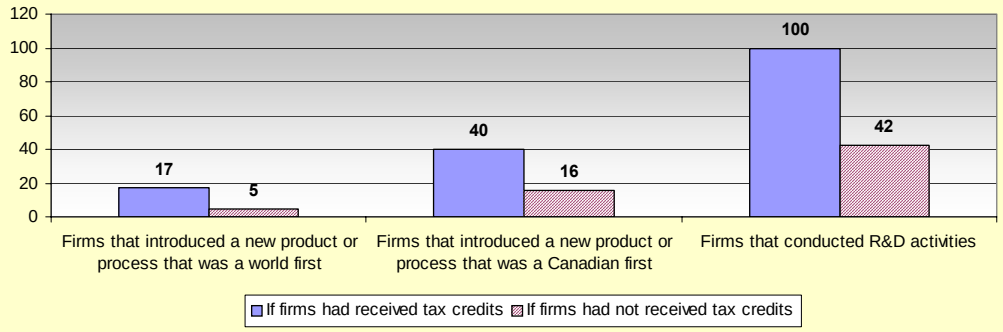


Figure 2. Mean differences between R&D tax credits recipients and potential control group in percentage (full sample), after the matching

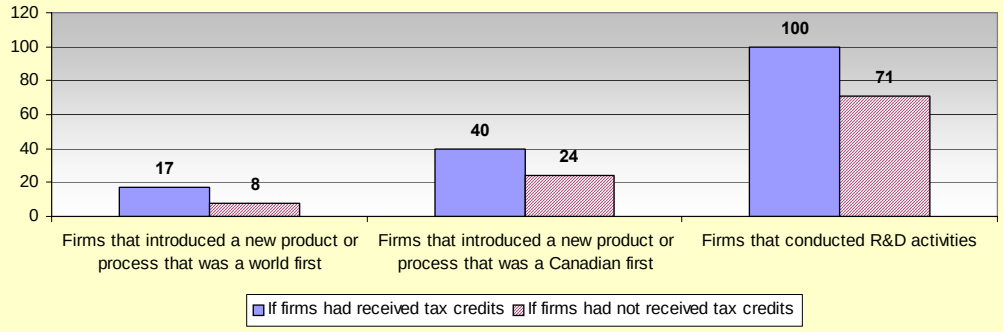
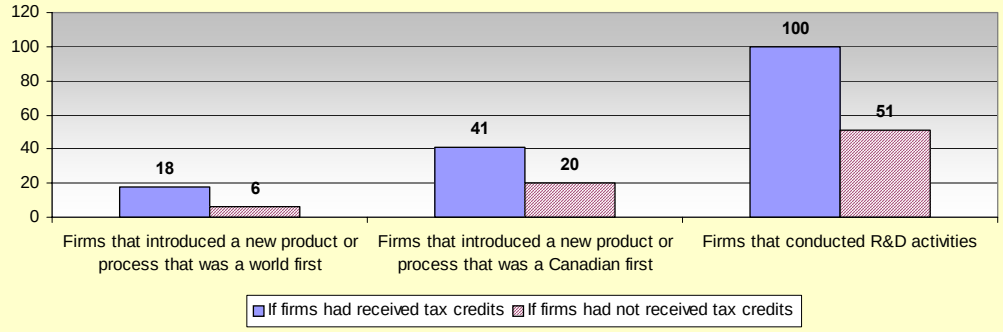


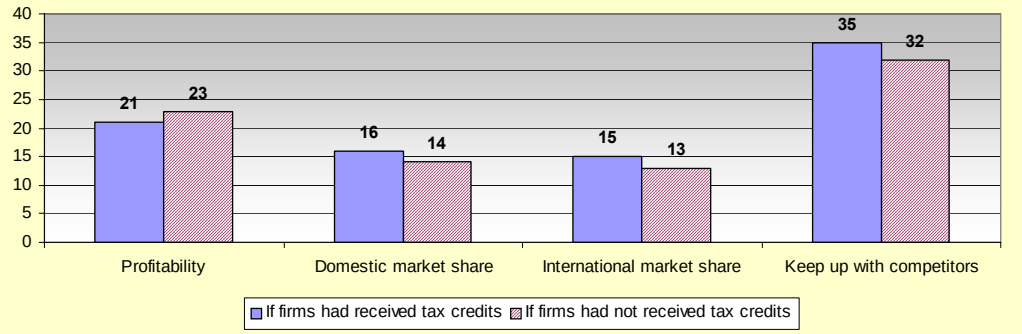
Figure 3. Mean differences between R&D tax credits recipients and potential control group in percentage (Subsample of innovating firms), after the matching



These comparisons are carried out on two sets of data: first on the complete sample of observations, where the potential control group are innovative and non-innovative firms. Secondly, the potential control group is restricted to innovative firms in order to check the robustness of the previous estimation.

1. The treatment effect addresses the question whether performance of firms that use tax credits differs from their performance in the hypothetical situation in absence of tax credits.

Figure 4. Mean differences between R&D tax credits recipients and potential control group in percentage, (Subsample of innovating firms), after the matching



The impact of R&D tax credit on Innovation

Figure 1 shows the results in terms of innovation outcome before the application of the matching method. We can observe that the recipient group is more likely to introduce a new product or process that was a world or Canadian first innovation than the group of non-recipients respectively 17% and 40% versus 5% and 16%. The same is true for firms that conducted R&D activities, where 100% of recipient group conduct R&D versus 42% for the potential control group.

The mean differences in control variables between both groups suggest that tax credit recipients are substantially different from the control group. However, a simple comparison of means suffers from a potential sample selection bias.

Figure 2 displays the same comparison after applying the matching analysis to address the selection bias problem. As we can see, the proportion for the recipient group is still the same, but for the potential control group all outcome proportions have increased.

After matching, we still find differences in the outcome variables. Hence, we can assign such differences to the treatment, i.e. to tax credits. It shows that policy incentives have a positive impact on the R&D activities of firms and novelty of innovation.

Figure 3 provides the same analysis but for the subsample of innovating firms. The differences between the two groups are less pronounced but still obvious. The likelihood to receive R&D tax credits is significantly different among groups, on average. About 18% (41%) of tax credit recipients introduced a world-first (Canada-first) innovation. If they had not received a tax credit, these proportions would only be 6% (20%).

Finally, we provide the results for the sub-sample of innovating firms for several performance indicators (Figure 4). These estimates show that neither profitability, nor domestic and international market share are significantly different between the two groups. Only the difference in the mean for the question "keeping up with competitors" is moderately statistically significant.

Conclusion

We find 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. However, there is no effect on more general firm performance indicators like profitability, domestic market share, etc. This is due to the fact that the impacts on innovation of the performance indicators may take longer than the three years period imposed by the questionnaire.

Julio Rosa, SIEID, Statistics Canada.

References

Czarnitzki, D., Hanel, P. and Rosa, J. M. 2004. *Evaluating the impact of R&D tax Credits on innovation: A microeconometric Study on Canadian Firms*, ZEW Discussion Paper 04-77, Mannheim.

Hanel, P. 2003. *Impact of Government Support Programs on Innovation by Canadian Manufacturing Firms*, Centre interuniversitaire de recherche sur la science et la technologie (CIRST), research paper # 2003-09, Montreal.

Top-3 selected innovative service industries by province, 2003

Results from the Survey of Innovation 2003, which examined innovation in selected service industries, show that establishments in ICT service industries are most likely to be innovative. In Canada, the three industries with the highest rates of innovation were all ICT industries.

The ***Survey of Innovation 2003*** surveyed establishments in 36 services industries with a view to better understand innovation in the service sector. The services industries surveyed included information and communications technology industries (ICT); selected professional, scientific and technical services, selected natural resources industries and selected transportation industries.

Defining innovation

The Oslo Manual[1], which provides guidelines for the measurement of innovation, defines innovation as the introduction of new or significantly improved product to the market or the introduction of new or significantly improved processes to the firm, during a given three year period. The manual identifies two types of technological innovation—product and process.

Product innovation and innovation processes

In the case of product innovation, the product is a new or significantly improved one and must be new to the firm and to have been introduced to the market. The term "product" includes both goods and services as innovation outputs. Changes to a firm's existing products that are purely aesthetic or that involve only minor modifications are not considered to be innovations.

Innovative processes involve the introduction of new or significantly improved production/manufacturing methods, procedures, systems, machinery or equipment into the firm. The term "process" also includes improved ways of delivering goods or services. This process must be new to the firm and differ significantly from the firm's previous processes. Significantly improved processes involve significant changes to existing processes which may be intended to produce new or significantly improved products or processes. Minor or routine changes to processes are not considered to be innovations.

Firms that have introduced new or significantly improved products or processes within the three year interval are innovators and those that have not are non-innovators.

ICT sector has highest rate of innovation

Table 1 presents the top-three industries for each province in terms of the propensity of establishments to innovate. In most cases, the service industry with the highest rate of innovation is an ICT industry. At the Canada level, all three of the top selected service industries are members of the ICT services group; this is also the case for Quebec and British Columbia. Two of the top-three industries are related to software development. "Computer systems design and related services" are firms engaged in custom computer application design for a client, while "Software publishers" publish non-custom software for the market. "Satellite telecommunications" is also part of the ICT group of industries.

By province, "Computer systems design and related services" is among the top three industries for all provinces for which data are available[2]. "Software publishers" were among the top three innovative industries in the four largest provinces. "Office and professional equipment wholesaler-distributor" was also a frequently indicated industry, among the top three in four provinces: two in Atlantic Canada and two on the Prairies. "Engineering services" was frequently amongst the top three in Atlantic Canada[3].

The remaining industries among the top three were reported only in a single province. In Newfoundland the top-three were the only three industries[4] for which data were available. In New Brunswick, "Total management, scientific and technical consulting services" made the list as one of seven industries for which data were available, while in Nova Scotia, "Total research and development services" was a top-three also from a group of seven industries. In Ontario all establishments in "Geophysical surveying and mapping" were innovative. "Research and development services reported high levels of innovative establishments in Saskatchewan, while in Alberta; establishments in "Other scientific and consulting services" were among the most likely to report being innovative.

Rapid technological transformation in ICT is evident to the consumer through the increased power and capabilities combined with high rates of obsolescence and dropping prices for a wide variety of ICT products. These forces of change transforming telecommunications industries are also reflected in the high propensities to innovate reported by establishments in ICT services. The only other services industries to report comparable, but

1. OECD/Eurostat, *Proposed Guidelines for Collecting and Interpreting Technological Innovation Data* (Oslo Manual), Paris, 1997.

2. In the case of Prince Edward Island and Newfoundland and Labrador, the estimates were confidential, and therefore not available for publication.

3. Note that this may be due to the reliability of the data for this industry and not to particularly high rates of innovative establishments.

4. Total ICT services industries were not treated as "an industry".

somewhat lower levels of innovation, were selected knowledge-intensive professional business services.

Find detailed tables on a wide range of aspects of innovation in selected service industries in Canada and the provinces and territories, are available on the CD-ROM entitled Survey of Innovation 2003: Statistical Tables for Selected Service Industries, catalogue number 88-524-XCB. ($50.00)

Charlene Lonmo, Frances Anderson and Adele St. Pierre, SIEID, Statistics Canada.

Table 1. Percentage of innovative firms during the period, 2001-2003 top three of selected service sector industries by province

	Innovators	
	Percent	Reliability[1]
CANADA		
Satellite telecommunications	100.0	A
Software publishers	94.3	A
Computer systems design and related services	87.2	B
Newfoundland and Labrador		
Computer systems design and related services	75.0	E
Engineering services	26.3	B
N/A	…	…
Prince Edward Island		
N/A	…	…
N/A	…	…
N/A	…	…
Nova Scotia		
Computer systems design and related services	89.5	B
Office and professional equipment wholesaler-distributor	52.2	B
Engineering services	48.1	B
New Brunswick		
Computer systems design and related services	81.8	B
Engineering services	55.0	B
Management consulting services	37.5	E
Office and professional equipment wholesaler-distributor	37.5	E
Quebec		
Computer systems design and related services	86.2	B
Software publishers	86.0	B
Computer and communications equipment and supplies wholesaler-distributor	80.0	E
Ontario		
Software publishers	100.0	A
Geophysical surveying and mapping	100.0	A
Computer systems design and related services	88.4	B
Manitoba		
Computer systems design and related services	84.2	B
Office and professional equipment wholesaler-distributor	63.3	B
Office and store machinery and equipment wholesaler-distributors	56.7	B
Saskatchewan		
Office and professional equipment wholesaler-distributor	85.7	B
Computer systems design and related services	72.7	E
Research and development	70.3	E
Alberta		
Software publishers	88.9	B
Computer systems design and related services	88.3	B
Other scientific and technical consulting services	76.9	E
British Columbia		
Software publishers	100.0	A
Internet service providers	88.9	B
Computer systems design and related services	86.4	B

Source: Statistics Canada, Survey of Innovation 2003

1. Estimates with a quality indicator of A are very reliable; B reliable; E to be used with caution and estimates with a quality indicator of F have very poor reliability and have been suppressed.

Communications on the run—Sustaining growth in the telecommunication services sector

It is difficult to imagine, particularly for younger Canadians, that mobile telecommunications devices were a curiosity only 20 years ago. In fact, mobile communications were not that common as recently as 10 years ago when fewer than 2 million devices were connected to our wireless networks.

The sight of a person speaking on a mobile phone at the bus stop or checking e-mails on a personal digital assistant at the restaurant is pretty common these days. There were 13.2 million subscribers to mobile communication services at the end of 2003, more than 10 times the number at the end of 1993. And it keeps growing. The number of subscribers surpassed 14 million between July and September of 2004.

The ever increasing popularity of mobile communications has translated into booming revenues for the industry since its inception. The 15.2% jump in revenues from 2002 to 2003 continued that trend.

Mobile average revenue per subscriber increases

The most encouraging sign for the long term success of the wireless industry may well be the steady increase in average revenue per subscriber in recent years. From an average of $46.72 per month in 2001, it climbed to $50.62 in 2002 and $52.32 in 2003. So Canadians are not only adopting mobile communications in greater numbers, they are also spending more on average for these services. The recent introduction of new data applications such as text messaging, instant messaging and mobile e-mail will likely breathe new life into this trend.

Fixed connections decline

The rapid rise in mobile communications has been accompanied by a decline in the number of connections to the wireline telephone network in 2002 (-2.4%) and 2003 (-1.1%). The loss of clients combined with strong price competition has led to decreases in the wireline industry's revenues of 1.2% in 2002 and 6.2% in 2003. The recent and upcoming entry of new players in the local telephony market, in particular cable operators, will no doubt add to these pressures.

Changing dynamics

The increased competition in traditional wireline markets and technological substitutions are changing the dynamics of the telecommunications services sector. The downward pressures on revenues are visible. In 2003, the revenues of the sector were down 1.0% to $32.9 billion following a modest 2.7% increase in 2002. Without the contribution of the wireless industry, the sector's revenues would have decreased in both 2002 (-1.4%) and 2003 (-5.5%). And without the strong growth in the Internet access and satellite television markets, those revenues would have dropped 4.9% in 2002 and 9.2% in 2003.

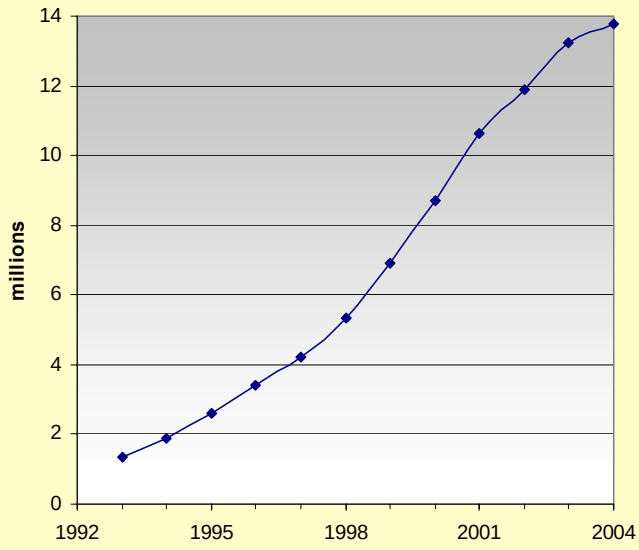
Further growth potential

While the rate of adoption of the Internet in Canada is one of the highest in the world and the rate of adoption of satellite television is showing signs of a slowdown, there still seems to be considerable potential for growth in the wireless telecommunications industry. 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). The arrival of a new supplier and the dependence of the telecommunications sector on the wireless market for growth, may well lead to a closing of that gap.

The information in this article was first released in Statistics Canada's The Daily on March 17, 2005.

Daniel April, SIEID, Statistics Canada.

Figure 1. Subscribers to mobile telephony



Note: Number of subscribers at year end except for 2004 (end of third quarter).

Characteristics of growth firms: a benchmarking framework

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?" We have also adapted two well-known frameworks to better assess where a company is in its evolution—and what actions might get it to the next stage.

Background

Statistics Canada has been working with NRC-IRAP on a series of projects to better understand the characteristics of growth firms. The first phase was summarized in the October 2004 issue of the *Innovation Analysis Bulletin*. Previous studies had suggested that to grow, technology businesses required R&D, alliances, expertise in funding, IP protection and a non-competitive market. The first phase of this project found that, while these factors were important, many businesses could still make the transition even if they had none of these characteristics. It also suggested additional growth factors: access to business advice, formal organization, formal business planning, and access to business development funding, incrementally innovative products and adaptability to rapidly-changing conditions.

The first phase of the study also concluded that one needed to take into account a company's stage in its lifecycle, its industry and even the "management style" to better understand how these growth factors applied.

Continuing the investigation

In the first phase, the companies we interviewed were largely medium-sized firms in ICT and biotechnology. Many of them did not make growth their highest priority and perhaps many of them could have made an easier transition from small to medium if they had been in possession of more of the growth factors.

To offset this bias, the interviewees for the second phase were chosen to have achieved certain growth criteria (that is, growth of at least 20% in employment over 5 years) rather than a specific transition from small to medium. They were also chosen to cover a broader variety of industries: many of them were in manufacturing and many were developing specialized products for specific clients.

The interviews were also re-designed to place the interviewee in a specific business lifecycle stage (based on Greiner, 1998), and to better assess the growth factors suggested in the first phase.

Findings

The second set of interviews largely confirmed the importance of the growth factors developed in the first phase: R&D, alliances, expertise in funding, IP protection and a non-competitive market are important in establishing the technology. To establish and grow the business they also need business advice, formal organization, formal business planning, and access to business development funding, incrementally-innovative products and adaptability to rapidly-changing conditions.

The firms interviewed for the second part of this study were largely high-technology firms with niche-market products. These firms preferred to work with a few long-term clients that were financially stable. For these clients, the firms were willing to develop custom products. Growth firms were generally unwilling to build new products for new clients.

New issues that emerged include:

- The Greiner model introduced a new dimension to the analysis: that is matching managers' skills with the stage of evolution of the firm. Several respondents mentioned having to deal with "legacy employees", sometimes a CEO, who had led them through one stage and is lacking the necessary skills to advance them to the next stage.
- Small businesses attempting to develop for the mass market have more challenges ahead than if they simply focused on solving the problems of one large client.
- Business advice is useful but if taken out of context, it can be counter-productive. Some firms that followed the advice of some of the best-known gurus found themselves hiring inappropriate leaders or formalizing too early.
- Many of the firms diversified by developing expertise in new technologies that could solve "horizontal problems" for their main clients.
- As they developed new technologies for existing clients, they found they could sell the same technologies to new clients.

It was often this combination of (a) creating a new product for existing client and (b) finding new clients for a proven product that led to growth.

A combined growth framework

The growth framework presented in Table 1 borrows from Greiner (1998) and Goldsmith (1995) to help map out the activities that take place in three characteristics of the business (technology, business and management) over five stages of growth.

The framework is better applied to business lines than to the firm overall. Small businesses may focus on one project but larger ones simultaneously pursue several business lines at various stages of development. In this respect, the framework may be

viewed as cyclical with new technologies being developed and becoming new business lines as the business diversifies.

A business line could be in different stages for each characteristic. For example, a technologically-mature business line may still have underdeveloped market or management characteristics. Therefore, rather than classifying a firm into a single growth stage, as Greiner might, we can classify a business line into growth stages for each of three characteristics. This can be done by assessing the answers to the characteristic questions in the boxes. If, for example, the "yes" responses are mostly in Stage 1 and Stage 2, the business line would be in Stage 2 for that characteristic.

There are other factors besides growth stage that differentiate business lines. Firms in different industries (e.g., biotechnology versus ICT); in different stages of the technology development cycle (technology developers versus technology users) and with different management styles (e.g., control versus growth) would require different sets of characteristic questions. Further refinement would contain separate the questions for each of these archetypes.

Table 1. A combined growth framework for technology-based projects

Growth Stage (Quotes are from Greiner, 1998)	**Characteristics**		
	Technology (Knowledge)	**Business (Market)**	**Management (People)**
Phase 1 – Creativity *"In the birth stages of an organization, the emphasis is both on creating a product and a market"*	Are there multiple sources of new ideas? Do you conduct technical feasibility studies on new ideas before you turn them into products? Is the technology incrementally innovative?	Do you have existing clients? Do you conduct market feasibility studies on new ideas before they are produced? If you are a small business, do you target small, specific clients? Do you collaborate with clients to produce the product?	Do you have access to scientific and technical skills? Do you have access to business (marketing and financing) skills? Do you have access to experienced business advice?
Phase 2 – Direction "*Those companies that survive the first phase by installing a capable business manager usually embark on a period of sustained growth under able, directive leadership."*	Do you undertake formal IP protection? Do you construct prototypes? Do you conduct proof-of-concept studies? Do you collaborate with universities? Do you collaborate with federal laboratories?	Do you have access to business development funding? Do you have a formal business plan? Do you have access to sufficient capital for growth? Do you have a specific growth plan? Do you establish advisory or collaborative relationships with your suppliers? Do you conduct analyses of competing technologies? Do you assess export potential?	Is one of the management team an experienced businessperson? Does the management team establish personal networks to obtain financing and skilled human resources? Does the management team have access to knowledge of the regulatory environment? Does the management team have access to legal skills for managing IP?
Phase 3 – Delegation *"The next era of growth evolves from the successful application of a decentralized organizational structure."*	Do you license technologies to or from other firms? Do you conduct scale-up or production feasibility tests?	Do you have a formal strategic plan? Do you apply for government business assistance (including R&D, technology development, tax incentives) programs? Do you seek sources of venture capital? Has the firm gone public to raise funds for growth? Do you engage in alliances with clients or suppliers or other "complementary" firms?	Does the management team have access to skills for team-building? Does the management team have access to skills for project management? Does the management team have access to skills for communication? Has the firm developed a decentralized decisionmaking structure?
Phase 4 – Coordination *"The evolutionary period of the coordination phase is characterized by the use of formal systems for achieving greater coordination by top-level executives taking responsibility for the initiation and administration of these new systems."*	Do you investigate alternative locations for production? Do you conduct production analysis to lower costs?	Do you establish or use distribution networks?	Does the firm have separate groups for sales, marketing and distribution? Has the firm diversified its client base beyond one industry (or market?
Phase 5 – Collaboration *"The last observable phase emphasizes strong interpersonal collaboration in an attempt to overcome the red tape crisis".*	Do you monitor new technologies to replace the ones you originally developed? Do you monitor other industries for opportunities for new applications for your technology? Do you monitor your competitors to determine IP infringement? Do you litigate IP infringements? Do you conduct continual R&D to maintain your world-first position?	Do you engage in branding the company image? Do you work with existing clients to develop solutions in new technology areas?	Does the management team still have technical skills to oversee the development of new technologies?

References

Anderson, Frances and Michael Bordt. 2004. *Characteristics of firms that grow from small to medium size*. Innovation Analysis Bulletin, Statistics Canada Cat. No. 88-003-XIE, October 2004.

Bordt, Michael, Louise Earl, Charlene Lonmo and Robert Joseph. 2004. *Characteristics of firms that grow from small to medium size: Growth factors-interviews and measurability*, SIEID working paper series, Statistics Canada Cat. No. 88F0006XIE—No. 2004-021. Ottawa, Canada.

Greiner, Larry E. 1998. *Evolution and revolution as organizations grow*, Harvard Business Review, May-June 1998.

Goldsmith, H. Randall, *A Model for Product Commercialization*, Oklahoma Alliance for Manufacturing Excellence, Tulsa, OK, 1995.

A working paper based on this work is in progress and will be released in the fall of 2005.

Michael Bordt, Frances Anderson, Louise Earl, Charlene Lonmo, SIEID, Statistics Canada; Denise Guillemette, NRC-IRAP.

Canadian biotech activity in 2003

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.

In 2003, biotechnology firms spent $1.5 billion in biotechnology R&D, an 11% increase from 2001. For each dollar invested in biotechnology R&D, firms generated $2.57 in biotech revenue, compared to $1.65 in 1997, $2.36 in 1999 and $2.67 in 2001.

To support this growth, firms needed additional capital. In 2003, 254 firms attempted to raise capital for biotechnology activities and 178 were successful: these firms raised a total of $1.7 billion in capital, a 73% increase from 2001. Among the firms that raised capital in 2003, almost 53% reached their target compared to 56% in 2001. Small firms, however, continue to face difficulties in raising capital compared to their counterparts. In 2003, of the 139 small firms that said they succeeded in raising capital, nearly 49% said they reached their target. That compares with a rate of 69% for medium-size firms and 70% for large firms.

Biotechnology firms reported 17,065 products/processes at all stages of development in 2003, a 5% decrease from 2001 but a 91% increase from 1997. Of the 17,065 products/processes, 29% were in research and development stages and 71% were approved, in production or in the market. Part of the reasons for the changes in the pipeline data can be summarized as follows:

- Small firms that decided to focus only on developing concepts and products to the point that they could be sold to larger entities for clinical trials and final commercialization;
- Firms that restructured their operations and that no longer develop products, but, instead sell biotechnology products or products developed in part using biotechnology processes;
- Firms that were acquired by foreign firms; their presence in Canada has been modified;
- Firms that restructured the composition of their product's line, reducing the number of products/processes in some of the projects or categories of products.

This article is based on information from the working paper, Overview of the Biotechnology Use and Development Survey, 2003 *which was released in The Daily on April 27, 2005.*

Lara Raoub, Annalisa Salonius and Chuck McNiven, SIEID, Statistics Canada.

Canadians connected in many ways

Canada has been a connected nation for many years. The penetration of basic telephone service and of cable services have been and remain amongst the highest in the world.

The networks most used by Canadians are the wireline telephone network, the cable television network, the wireless telephone network, the Internet, and the satellite and MDS television networks. This article highlights the amazing speed at which connectivity is evolving.

Diversity of methods for connecting

The number of fixed telephone lines per 100 persons is one of the most broadly used indicators of the connectivity of a nation. By that measure, Canada's connectivity is on the decline; it stood at 63.4 at the end of 2003 after 2 years of decline, and was below the 65.1 level attained at the end of 1999. But that measure does not reflect the diversity of methods for connecting to networks available to Canadians, their propensity to adopt several of them, and significant shifts towards new technologies.

The networks most used by Canadians are the wireline telephone network, the cable television network, the wireless telephone network, the Internet, and the satellite and MDS television networks. The table below shows the amazing speed at which connectivity is evolving.

Continued growth

At the end of 2003 there were 13.2 million subscribers to mobile telephony, 6.3 million more or almost twice as many than there were at the end of 1999. During the same period the number of subscribers to high speed Internet surged from 582 thousand to 4.5 million and the number of subscribers to satellite and wireless cable television jumped from 554 thousands to 2.2 million subscribers. Basic cable television and dial-up Internet lost subscribers over that period.

While a story lies behind each of these indicators, the composite indicator tells a story of its own. The number of network 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. The 24.4% increase over that short period of time is a testament to the willingness of Canadians to be connected. And a positive sign for the industries that compete to supply the connections.

The information in this article was first released in Statistics Canada's The Daily *on March 17, 2005.*

Daniel April, SIEID, Statistics Canada.

Table 1. Connections by type

Connections by type	1999	2000	2001	2002	2003
Fixed telephone lines[1]	19,806,248	20,347,014	20,805,058	20,300,831	20,067,563
Mobile telephony [1]	6,911,038	8,726,636	10,648,824	11,872,050	13,227,851
Residential Internet access[2]	3,367,000	4,324,000	5,706,000	6,547,000	7,013,000
Dial-up[2]	2,785,000	2,969,000	3,149,000	3,020,000	2,500,000
High speed[2]	582,000	1,355,000	2,558,000	3,527,000	4,513,000
Cable TV[3]	8,019,000	7,983,000	7,848,000	7,623,000	7,573,000
Satellite and wireless cable TV[3]	554,000	967,000	1,609,000	2,019,000	2,204,000
Total	**38,657,286**	**42,347,650**	**46,616,882**	**48,361,881**	**50,085,414**
Connections by type per 100 person					
Fixed telephone lines	65.1	66.3	67.1	64.7	63.4
Mobile telephony	22.7	28.4	34.3	37.8	41.8
Residential Internet access	11.1	14.1	18.4	20.9	22.2
Dial-up	9.2	9.7	10.2	9.6	7.9
High speed	1.9	4.4	8.2	11.2	14.3
Cable TV	26.4	26.0	25.3	24.3	23.9
Satellite and wireless cable TV	1.8	3.2	5.2	6.4	7.0
Total	**127.1**	**138.0**	**150.3**	**154.2**	**158.2**

1. Statistics Canada, Annual Survey of Telecommunications.
2. CRTC, *Status of Competition in Canadian Telecommunications Markets*, November 2004.
3. Statistics Canada and the CRTC, *Annual Return for Broadcasting Distribution Licensees*.

What's new?

Recent and upcoming events in connectedness and innovation analysis.

Connectedness

No updates to report.

Telecommunications

Annual survey of telecommunications service providers

Selected national and provincial statistics for 2003 were released March 17, 2005 in *Broadcasting and telecommunications, Telecommunications 2003*, Catalogue No. 56-001-XIE, Vol. 35, No. 1.

Quarterly survey of telecommunications service providers

Selected statistics on the telecommunications services industries for the fourth quarter of 2004 were released in *The Daily* on May 16, 2005. The fourth quarter 2004 issue of *Quarterly telecommunications statistics* (56-002-XIE) was released May 18, 2005.

Broadcasting

Selected 2004 national and provincial statistics for television industries were released in *The Daily* on June 2, 2005.

The release in *The Daily* of selected 2004 national and provincial statistics for the radio industry is planned for early July 2005.

More detailed information will be made available on the day of release in *The Daily* or soon after in *Broadcasting and telecommunications*, Catalogue No. 56-001-XIE, Vol. 35, No. 2 and No. 3.

Household Internet use

No updates to report.

Business e-commerce

Survey of electronic commerce and technology

Data from the 2004 ***Survey of Electronic Commerce and Technology*** were released on April 20, 2005.

Science and innovation

S&T activities

Research and development in Canada

The service bulletin *R&D Personnel in Canada, 1993 to 2002* (88-001 Vol. 29, No. 2) was released on May 3rd, 2005. A related working paper called *Estimates of research and development personnel in Canada, 1979 to 2002* (88F0006XIE2005008) was also released that day.

Industrial research and development

A new working paper *Industrial R&D statistics by region, 1994 to 2002* (88F0006XIE2005002) was released on January 27, 2005.

Industrial R&D statistics from 1994 to 2004 have been loaded onto the CANSIM data base and released March 23rd, 2005. The table number is 358-0024 and includes the following variables: intramural research and development; current and capital expenditures; wages and salaries; and full-time equivalents under the 2002 NAICS (North American Industry Classification System). Tables were also created and put on the STC Canadian Statistics website under the Science and Technology heading. These data were released on May 20th, 2005.

Federal science expenditures

The working paper *Federal government expenditures and personnel in the natural and social sciences, 1995-96 to 2004-2005p* (88F0006XIE2005001) was released on January 19, 2005.

The service bulletin *Distribution of federal expenditures on science and technology by province and territories, 2002-2003* (88-001 Vol. 29, No. 1) was released on January 25th, 2005. A related working paper *Provincial distribution of federal expenditures and personnel on science and technology, 1996-97 to 2002-03* (88F0006XIE2005002) was released the same day.

The service bulletin *Biotechnology scientific activities in the federal government, 2003-2004* (88-001 Vol. 29, No. 3) was released on May 11th 2005.

Higher Education Sector R&D

No updates to report.

Provincial research organizations

No updates to report.

Human resources and intellectual property

Federal intellectual property management

Federal science expenditures and personnel, intellectual property management annex

The 2003-04 and 2004-05 surveys are in the field.

The higher education sector

Intellectual property commercialization in the higher education sector

The 2004 survey is in the field.

Innovation

Innovation in manufacturing

No updates to report.

Innovation in services

Four descriptive working papers will be released this summer in the Daily, providing an overview of the incidence, nature and novelty of innovations, as well as aspects of innovation such as innovation activities, information sources and impacts of innovation, in four groups of industries. The papers are entitled:

- *Innovation in the Information and Communications Technology (ICT) services sector industries: Results from the Survey of Innovation 2003,*
- *Innovation in Selected Industries Serving the Mining and Forestry Sectors: Results from the Survey of Innovation 2003,*
- *Innovation in Selected Professional, Scientific and Technical Services: Results from the Survey of Innovation 2003, and*
- *Innovation in Selected Transportation Industries: Results from the Survey of Innovation 2003.*

A CD-ROM entitled *Survey of Innovation 2003: Statistical Tables for Selected Service Industries*, Catalogue No. 88-524-XCB, is now available from Statistics Canada at a cost of $50.00. The CD-ROM contains over 1,000 tables on incidence and aspects of innovation for selected industries from the service sector, including all ICT services industries, selected transportation industries, selected professional services industries and selected natural resource support services industries. The data are presented at the national and provincial levels.

Two new facilitated access projects have been approved. The first, a collaboration between William Strange and Walid Hejazi, of the University of Toronto, and Jianmin Tang of Industry Canada, will examine *The Uncertain City: Agglomeration, Competitiveness, and Strategic Perceptions*. The second project, entitled *Innovation and Export Performance: Evidence from Canadian Service Firms*, will be undertaken by Ram Acharya and Pierre Therrien, both of Industry Canada.

Community innovation

No updates to report.

Commercialization

A survey of business incubators in Canada is in the preparation stage. Business incubators are instrumental in assisting local and regional economies to diversify and grow stronger, acting as catalysts for the creation of small and medium-sized businesses. The survey is expected to be mailed out in August with preliminary data available in late Fall 2005.

The report from a research workshop *Summary: Joint Statistics Canada—University of Windsor workshop on intellectual property commercialization indicators, Windsor* (88F0006XIE2005006) was released on March 18, 2005. The workshop placed the performance of commercialisation in the context of recent federal policy and history.

The report *Summary: Meeting on commercialization measurement, indicators, gaps and frameworks, Ottawa* (88F0006XIE2005007) was released on March 18, 2005. The report summarizes an expert meeting on commercialisation.

Biotechnology

The report *Overview of the Biotechnology Use and Development Survey—2003* (88F0006XIE2005009) was released April 27, 2005.

The service bulletin *Science Statistics: Biotechnology Scientific Activities in Federal Government Departments and Agencies, 2003/04*, Vol. 29, no. 3 (88-001-XIE) was released May 11, 2005.

The report *Access to Financing Capital by Canadian Innovative Biotechnology Firms* (88F0006XIE200510) was released in The Daily on April 29, 2005.

Technological change

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.

Knowledge sharing succeeds: how selected service industries rated the importance of using knowledge management practices to their success

The study suggests that understanding how business units are managed, and their perception of the value of management practices, may indicate whether they will be innovative. It also may indicate to some extent the type of innovation.

This study, which analysed data from the 2003 Survey of Innovation in selected service industries, assessed the importance of five sets of practices for managing knowledge on a business unit's success. The results suggest that the adoption of management practices by business units in selected services plays a role in the innovation process.

These management practices were: knowledge codification, such as updating databases; knowledge development, such as training; knowledge strategies; practices encouraging a knowledge sharing culture; and the acquisition and retention of knowledge, such as hiring skilled workers.

This article first appeared in Statistics Canada's The Daily *on February 9, 2005. The working paper* Knowledge sharing succeeds: How selected service industries rated the importance of using knowledge management practices to their success *(88F0006XIE2005004, free) is available online.*

Louise Earl, SIEID, Statistics Canada.

Trends and conditions in census metropolitan areas: Labour markets, business activity and population growth and mobility in Canadian Census Metropolitan Areas

The report examines employment, unemployment, work activity, earnings, industrial structure, industry concentration and diversity, and human capital and population growth due to immigration and inter-CMA mobility in Census Metropolitan Areas (CMAs) between 1981 and 2001.

Employment and unemployment rates of Census Metropolitan Area residents in 2001 were at similar levels as twenty years earlier. This despite major changes in the structure of urban economies and in particular the declining importance of manufacturing, and rising employment of business services industries.

The labour market strength of Canada's largest urban areas varied tremendously in 2001, although the difference between the CMAs with the strongest and weakest labour markets had declined since 1981.

Immigrants, low-paid workers and young workers lost ground in the labour market between 1981 and 2001. Over the same period women made gains in employment and earnings relative to men.

University degree holders were highly concentrated in CMAs in 2001. Recent immigrants made a substantial contribution to the growth in the human capital pool in some CMAs between 1996 and 2001. Many small CMAs lost highly educated and young persons to larger CMAs over the same period.

The sixth research paper in the new series *Trends and Conditions in Census Metropolitan Areas* entitled *Labour Markets, Business Activity and Population Growth and Mobility in Canadian Census Metropolitan Areas* (89-613-MIE2005006, free) was announced in The Daily on April 26, 2005.

Andrew Heisz, Sébastien Larochelle-Côté and Sudip Das, Business and Labour Market Analysis Division, Statistics Canada.

Michael Bordt, SIEID, Statistics Canada.

Access to financing capital by Canadian innovative biotechnology firms

This paper looks into Canadian innovative biotechnology firms' access to financing capital. Results show that over 70% of biotech firms that attempted to raise financing capital were successful. Funds were primarily sought for R&D activities and came primarily from Canadian venture capitalists. Harsher market conditions were the main reasons put forward by investors to limit or reject biotechnology firms' funding requests.

This paper appeared in Statistics Canada's The Daily *on April 29th, 2005. The working paper* Access to financing capital by Canadian innovative biotechnology firms *(88F0006XIE2005010, free) is available online.*

Namatié Traoré, SIEID, Statistics Canada.

Manitoba postsecondary graduates from the class of 2000: How did they fare?

According to a new report, graduates from Manitoba's postsecondary institutions were just as likely to be employed as graduates in the rest of the country. However, they tended to earn lower incomes, a reflection of the province's labour market.

In addition, Manitoba's graduates were less likely to have incurred debt during their studies than graduates somewhere else in Canada and their average debt was lower.

The report used data from the National Graduates Survey (Class of 2000) conducted in 2002. It provides a statistical portrait of the graduates of Manitoba's universities and colleges, what they do after graduation and how well they integrate into the labour market. It also includes an analysis of Aboriginal graduates.

This article first appeared in Statistics Canada's The Daily on May 18, 2005. The report Manitoba Postsecondary Graduates from the Class of 2000: How did they Fare? *(81-595MIE2005029, free) is available online.*

Chantal Vaillancourt, Culture, Tourism and the Centre for Education Statistics, Statistics Canada

Death in the industrial world: plant closures and capital retirement

Plant deaths arise from failure when firms exit an industry. Plant deaths are also associated with renewal when incumbent firms close down plants and modernize their production facilities and start-up new plants.

The rate of plant deaths affects the amount of change that occurs in labour and capital markets. Plant deaths result in job losses and incur significant human costs as employees are forced to seek other work. The death process also gives rise to capital losses—to the loss of earlier investments that the industrial system had made in productive capacity. This paper makes use of the plant-death date to provide new information on the likely length of life of capital invested in plants.

This paper measures the death rate over a forty year period for new plants in the Canadian manufacturing sector. It develops a profile of the death rate for entrants as they age.

This paper first appeared in Statistics Canada's The Daily on May 4, 2005. The research paper Death in the Industrial World: Plant Closures and Capital Retirement *(11F0027MIE2005033, free) is available online.*

John Baldwin, Economic Analysis 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	1999	2000	2001	2002	2003	2004
General economy and population[1]							
GDP	$ millions	982,441	1,076,577	1,108,200	1,157,968	1,218,772	1,293,289
GDP implicit price index	1997=100	101.3	105.5	106.7	107.8	111.2	114.8
Population	thousands	30,404	30,689	31,021	31,373	31,660	31,946
Gross domestic expenditures on R&D (GERD)[2]	$ millions	17,638	20,531	22,733	22,370	23,293	24,487
"Real" GERD	$ millions 1997	17,412	19,461	21,306	20,751	20,947	21,330
GERD/GDP ratio	ratio	1.80	1.91	2.05	1.93	1.91	1.89
"Real" GERD/capita	$ 1997	572.68	634.13	686.81	661.44	661.42	667.69
GERD funding by sector							
Federal government	% of GERD	18.2	17.3	18.0	18.9	19.3	19.3
Provincial governments	% of GERD	4.3	4.3	4.6	5.3	5.5	5.8
Business enterprise	% of GERD	44.9	39.7	49.4	49.3	47.5	46.2
Higher education	% of GERD	15.0	14.1	12.9	15.4	16.5	17.6
Private non-profit	% of GERD	2.2	2.2	2.3	2.8	3.0	3.2
Foreign	% of GERD	15.3	17.6	12.8	8.4	8.1	7.9
GERD performance by sector							
Federal government	% of GERD	10.5	10.1	9.3	9.8	9.6	9.1
Provincial governments	% of GERD	1.3	1.2	1.4	1.4	1.4	1.3
Business enterprise	% of GERD	59.0	60.1	60.9	55.4	53.0	51.2
Higher education	% of GERD	28.8	28.2	28.3	33.2	35.7	38.1
Private non-profit	% of GERD	0.4	0.3	0.2	0.2	0.3	0.3
Federal performance as a % of federal funding	% of federal	57.8	58.4	51.4	51.9	49.8	47.2
"Real" federal performance of R&D	$ millions 1997	1,835	1,972	1,971	2,032	2,013	1,946
Information and communications technologies (ICT)							
ICT sector contribution to GDP - basic prices[3]							
ICT, manufacturing	$ millions	13,621	17,070	10,926	8,690	8,586	9,612
% of total ICT	% of total ICT	28.4	30.9	30.9	15.8	15.0	15.8
ICT, services	$ millions	34,355	38,316	38,316	44,616	46,540	49,492
% of total ICT	% of total ICT	71.7	69.4	69.4	81.1	81.5	81.2
Total ICT	$ millions	47,891	55,176	53,301	54,994	57,076	60,986
Total economy[4]	$ millions	896,069	943,737	959,620	991,870	1,013,899	1,045,100
ICT % of total economy	%	5.3	5.8	5.6	5.5	5.6	5.8
Total business sector	$ millions	753,617	798,411	810,823	839,885	858,512	888,028
ICT % of business sector	%	6.4	6.9	6.6	6.5	6.6	6.9
ICT adoption rates (private sector)							
Personal Computer	% of enterprises	81.9	81.4	83.9	85.5	87.4	..
E-Mail	% of enterprises	52.6	60.4	66.0	71.2	73.8	..
Internet	% of enterprises	52.8	63.4	70.8	75.7	78.2	..
Have a website	% of enterprises	21.7	25.7	28.6	31.5	34.0	..
Use the Internet to purchase goods or services	% of enterprises	13.8	18.2	22.4	31.7	37.2	..
Use the Internet to sell goods or services	% of enterprises	10.1	6.4	6.7	7.5	7.1	..
Value of sales over the Internet	$ millions	4,180	7,246	10,389	13,339	18,598	..

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

	Units	1999	2000	2001	2002	2003	2004
Information and communications technologies (ICT) continued							
ICT adoption rates (public sector)							
Personal Computer	% of enterprises	100.0	100.0	100.0	99.9	100.0	..
e-mail	% of enterprises	96.6	99.0	99.7	99.6	99.8	..
Internet	% of enterprises	95.4	99.2	99.7	99.6	100.0	..
Have a Web site	% of enterprises	69.2	72.6	86.2	87.9	92.7	..
Use the Internet to purchase goods or services	% of enterprises	44.2	49.1	54.5	65.2	68.2	..
Use the Internet to sell goods or services	% of enterprises	14.5	8.6	12.8	14.2	15.9	..
Value of sales over the Internet	$ millions current	244.6	111.5	354.8	327.2	511.4	..
Teledensity indicators							
Wired access (Voice Grade Equivalent - VGE)	per 100 inhabitants	65.1	66.3	67.1	64.7	63.4	61.3
Wireless access (VGE)	per 100 inhabitants	22.7	28.4	34.3	37.9	41.8	46.5
Total public switched telephone network (PSTN) (VGE)	per 100 inhabitants	87.8	94.7	101.4	102.6	105.2	107.8
Homes with access to cable	thousands	10,725.2	10,903.8	11,082.5	11,402.7	11,729.4	..
Homes with access to Internet by cable	thousands	..	7,609.7	9,343.4	10,091.0	10,670.0	..
Access indicators							
Total wired access lines (VGE)	thousands	19,806.3	20,347.0	20,805.1	20,300.8	20,067.6	19,627.8
Residential access lines (VGE)	thousands	12,743.9	12,871.7	12,854.2	12,752.1	12,648.2	12,489.2
Business access lines (VGE)	thousands	7,062.4	7,475.3	7,950.9	7,548.7	7,419.3	7,138.6
Total mobile subscribers	thousands	6,910.3	8,726.6	10,648.8	11,872.0	13,227.9	14,905.3
Digital cable television subscribers	thousands	..	387.2	806.5	1,150.8	1,392.6	..
Satellite and MDS subscribers	thousands	..	967.1	1,609.2	2,018.6	2,204.4	..
High speed Internet by cable subscribers	thousands	..	786.3	1,387.8	1,874.7	2,363.5	..
Investment indicators							
Investments by the telecommunications services industries (NAICS 517)	$ millions (current)	8,679.2	9,517.8	10,720.5	7,425.8	6,347.9	6,959.7
Investments by the telecommunications services industries (NAICS 517)	$ millions (constant)	8,847.6	9,864.2	11,240.7	7,693.2	7,037.7	7,944.3
Characteristics of biotechnology innovative firms[5]							
Number of firms	number	358	..	375	..	496	..
Total biotechnology employees	number	7,748	..	11,897	..	11,931	..
Total biotechnology revenues	$ millions	1,948	..	3,569	..	3,820	..
Expenditures on biotechnology R&D	$ millions	827	..	1,337	..	1,487	..
Export biotechnology revenues	$ millions	718	..	763	..	..	..
Import biotechnology expenses	$ millions	234	..	433	..	..	..
Amount of capital raised	$ millions	2,147	..	980	..	..	..
Number of firms that were successful in raising capital	number	138	..	134	..	..	..
Number of existing patents	number	3,705	..	4,661	..	..	..
Number of pending patents	number	4,259	..	5,921	..	..	..
Number of products on the market	number	6,597	..	9,661	..	..	..
Number of products/processes in pre-market stages	number	10,989	..	8,359	..	..	..
Intellectual property commercialization[6]							
Federal government							
New patents received	number	89	..	109[r]	133[p]	142[r]	..
Royalties on licenses	$ thousands	11,994	..	16,467	16,284[r]	15,509[r]	..
Universities							
New patents received	number	349	..	381	..	337[p]	..
Royalties on licenses	$ thousands	21,100	..	47,584	..	51,000[p]	..

[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).