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As of October, 2003 there were:

- 9 publications for sale
- 11 free publications
- 12 research papers,
- 89 working papers, and
- 27 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

Global or multinational? It matters for innovation!

The trend towards the globalization of factor, product and financial markets is drawing an increasing amount of attention. Work is underway to develop methodologies and to harmonize among countries data on the economic activities of globally operating corporations. An understanding of their business models, corporate strategies and organizational structures is also needed to gather and, more importantly, interpret information about their innovation activities. This note identifies four main models of globally operating corporations according to their impact on technology transfer and innovation in host countries.

Globalization is a vaguely understood phenomenon but by any indicator currently available, it is clear that it is large and growing. Both national and international organizations are paying an increasing amount of attention to understanding the role and influence of the globally operating corporations.

Information gathering on the business activities of globally operating corporations has been evolving over time as their activities have diversified across industries and national borders, raising new policy issues. In the 1950s and 1960s, for example, the concern centred on the balance of payments effect of the foreign direct investment by industrialized countries. As inward and outward foreign direct investment continued to increase rapidly, other effects began to draw attention in the 1970s and 1980s. These included questions about its effect on international shifts in production resulting from the activities of the globally operating firms, changes in relative wage rates between the host and home countries, and job gains and job losses.

There are four identifiable types of globally operating corporations: **global, multinational, international and transnational**. Although these terms often get used synonymously, each represents a different business model and corporate strategy to cope with uncertainties of rapidly changing business environment and to participate in the world market.

More recently, interest in the impact of globally operating companies on technology transfer and innovation in host countries has also been growing. After the elimination of the traditional protectionist measures, knowledge has become the strategic asset. The resource-based approach to organization and management has shifted the focus from product and market shares to the development of competencies and capabilities as the source of sustainable competitive advantage. The process by which firms learn and create competitively valuable organizational knowledge has emerged as the primary function of the firm. Knowledge creation and management has become to corporate strategy what excellence was in the 1980s.

As globally operating corporations take a global perspective of inputs and location of production and research facilities, it is of interest to host countries to know to what extent they share in the development of competencies and benefit from the transformation of this knowledge into products.

There are four identifiable types of globally operating corporations: **global, multinational, international and transnational**. Although these terms often get used synonymously, 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. Needless to say, the types are not watertight; the focus of the corporation determines the type. A distinguishing mark is the corporation's strategy to participate in the world market. Their main distinguishing characteristics are outlined in the table below.

A corporation can choose to expand either by taking advantage of the economies of scale a borderless market offers or by introducing new products or processes of production and delivery. The former is performance-oriented, designed to perfect standardization while problem-solving is critical to the latter. A **global corporation** is an exemplar of the first strategy, while the **multinational corporations** focus on problem solving in each national market where they operate. **International** and **transnational** firms contain elements of both models.

Global firms

Global firms take advantage of the world markets by exploiting the economies of scale. Large volumes of standardized products and lower prices are at the core of their expansion plans. Therefore, knowledge and innovation activities are typically centralized. Innovations introduced by the national entities tend to be replications and duplications of an innovation already introduced by the firm elsewhere, usually the country of its nationality, with a minimal adaptation. The modifications may be performed at the centre or a regional headquarter, allowing for little, if any, technology transfer to the host country. Thus the principal units of analysis for decision-making are the global operating environment and worldwide consumer demand, not the product itself. Innovations introduced in host countries are typically of a low grade, and the scope for technology transfer tends to be insignificant.

Table 1. Classification of globally operating corporations according to their knowledge management and innovation strategies

Characteristics	Type of corporation			
	Global	Multinational	International	Transnational
Business strategy	Economies of scale	Expansion through new products and new markets	Efficiency and innovation, with emphasis on efficiency	Efficiency and innovation, with emphasis on innovation
Market selection	National markets chosen for their contribution to cost reduction	National markets chosen for their stand-alone potential	Market selection primarily driven by economies of scale	Market selection driven by cost reduction and innovation
Knowledge production and management strategy	Knowledge production is centralized	Knowledge produced and retained within each national entity	Knowledge production is centralized and transferred to national entities	Knowledge is developed jointly by the centre and national entities and shared worldwide
Configuration of assets and capabilities	Centralized	Decentralized and nationally self-sufficient	Core competencies centralized; complementary competencies decentralized	Capabilities are dispersed worldwide but are interdependent and specialized
Role of national entities	Implementing parent firm's strategies	Spotting and exploiting local (national) opportunities	Adapting and leveraging parent firm's competencies	Differentiated contributions by national entities to integrated worldwide operations
Product innovation	Minimal change to a core global product; adaptation occasionally in host country	Specialized for each national market; most work done in host country	Duplication of a global product with modification done in the host country	Varies between national and global
Process and delivery innovation	Innovation takes place in one country, not necessarily the headquarters worldwide	Nationally differentiated and largely independent for each national entity	Same processes worldwide with some national adaptation	Coordinated and independent; some aspects similar and some differentiated

Multinational corporations

Unlike the global corporation, which selects national markets with a view to maximizing economies of scale by increasing worldwide production of the same product, a **multinational corporation** selects markets on the basis of a particular need that already exists but is not satisfied or by creating a new market by altering purchasers' preferences. The multinational corporation is more like a portfolio of national entities. The focus is on seeking global advantage by identifying and developing products that satisfy a specific national market. The efforts are innovative, not routine, and most of the associated activities take place in the host country.

International corporations

An **international corporation** is a hybrid of global and multinational corporations. The parent has less control as compared with the global corporation and national entities are less independent than they are in the case of a multinational corporation. Unlike the global corporation, some knowledge transfer does take place. The international corporation is the closest approximation of the international product cycle model: technology and new products are developed and designed at the centre and then transferred to the national entities for modifications to suit individual national markets. The main difference between a global and international corporation from the point of view of technology is the degree of novelty added by the national entities. It is much more in the case of an international corporation than a global corporation.

Transnational corporations

While national entities in a **transnational** model are not as independent as in a multinational model, they play a crucial role in the success of the worldwide operations of the parent company. Far more knowledge and competencies are developed in host countries and innovations introduced by national entities contain a much larger component of novelty or technology than the international model. Flexibility in the worldwide functioning of the transnational corporation and interdependence of some competencies based in national entities allow host countries the freedom to experiment and excel in order to maximize their contribution to the overall functioning of the company.

Although all the four models described above are in existence today, over time the trends have been shifting. The transnational model is said to be the latest trend in the way globally operating firms participate in the borderless market.

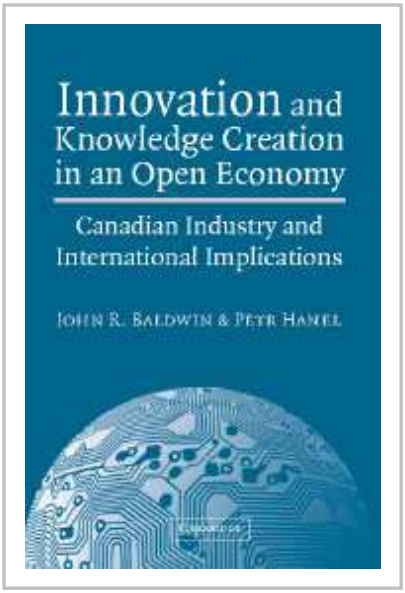
Daood Hamdani, SIEID, Statistics Canada.

Innovation and knowledge creation in an open economy: Canadian industry and international implications

Using a comprehensive survey of Canadian firms in the manufacturing sector (Statistics Canada's *1993 Survey of Innovation and Advanced Technology*), a new book by John Baldwin and Petr Hanel profiles a variety of actors that contribute to the innovation process. The authors describe a range of innovation types and the actors that participate in the innovation process thereby placing the R&D-centric knowledge creation process into context. The book shows that there are competing innovation systems at work and that some act as complements, while others act as substitutes for R&D. It also shows that the various parts of the innovation system fulfil different functions.

Introduction

The study asks whether there is a small number of archetypal participants in the innovation process, each of which fulfils a different but specific function, with a recognizable set of characteristics. It does so by investigating how innovations differ across size of firm, across industries, and across firms of different nationalities. It also focuses on differences in the production process across these dimensions. It finds that the innovation output of firms differs substantially across these dimensions. And it explains the different role that each participant plays.



The diversity of innovation types

Technological opportunity varies between industries and so does innovation intensity. A large proportion of innovations is created in a few core industries (chemical, petroleum refining, electronics, machinery, and instruments). The more mature industries in the secondary (transportation, primary metals, fabricated metals, non-metallic metal products, plastic, and rubber) and in the tertiary 'other' sector (clothing, food, textiles, leather, wood, paper, and other industries) receive their new materials, and intermediary inputs as well as new equipment and machinery from the core sector. Firms in the core sector are twice as likely to report innovations as firms in the tertiary 'other' sector. Almost half of Canadian core-sector firms introduced an innovation, while little more than 25% of firms in the least innovative industries of the tertiary 'other' sector did so. This difference emphasizes the importance of diffusion of innovation from the core set of industries to other sectors.

The study also shows that there is considerable specialization of function across different actors. While every third firm declared that it innovated over a three-year period, this overall average conceals large differences. The smallest firms (less than 20 employees) report innovations at about one-half the rate of the largest ones (more than 2000 employees). But small firms rely on large firms as part of an innovation network. This size effect is pervasive across most industries.

There is also a considerable difference between firms that are internationally oriented and those that just serve domestic markets. The rate of innovation by multinational firms (whether foreign-owned or domestic-owned internationally-oriented firms) was considerably greater than for purely domestic firms. Exporters are more intensive innovators than are non-exporters. This is strongly suggestive of a two-tiered economy—one that engages in innovation pushed by the highly competitive international market and the other which is less innovative and that operates in a protected domestic sector.

The impact of innovation

Innovations can be aimed at exploiting scale economies, or they can be directed primarily at improving the flexibility of the production process. They accomplish the latter by reducing the length of production runs required to exploit economies of scale, by allowing for the quick changeover of products, or by facilitating the more rapid customization of products.

The study finds that the innovation process in Canada had its greatest impact on a firm's ability to respond flexibly to customers' needs. Innovations increased production flexibility and sped up the response to changing customer requirements in more than half of all firms accounting for two-thirds of total industry employment. This confirms other information indicating that the adoption of advanced manufacturing information systems has increased the flexibility of production processes—from design and engineering, to automated control and inspection of materials, to assembly, and to final product inspection.

Innovation has tended to increase the demand for skilled relative to unskilled workers. Innovation, on balance, has been skill enhancing. Other studies show that skill enhancement is directly related to the degree of novelty of the innovation.[1] While innovations re-

[1] See, for example, Daood Hamdani, 2003. "Innovation and labour skills" in Fred Gault, *Understanding innovation in Canadian industry*, School of Policy Studies, Queen's University, Kingston and Montreal: McGill-Queen's University Press. Forthcoming.

duced unit labour costs in many firms, they were more frequently associated with increases than decreases in employment.

Finally, innovations were invariably associated with foreign market penetration. A significant proportion of the sales from innovations is exported. The more original world-first and Canada-first innovations were responsible for a higher proportion of export sales than the imitative innovations. The importance of export orientation is confirmed by the finding that, while there are large differences in the innovation intensity of foreign-controlled and domestic-controlled firms, once the export orientation of a firm is considered, these differences become statistically insignificant.

The innovation process

Sources of innovation

The innovation process is fed from multiple sources, some internal to the firm, others external to the business. Ideas for new and improved products and processes are generated in the course of market transactions with clients and suppliers, with related and unrelated firms and by other external sources. Ideas for new market opportunities are seized and adapted to a firm's advantage by the management, research, marketing and engineering personnel of the firm.

While there is a broad array of information sources used for innovation, research is cited as the most important source of new ideas after management. Management is the principal source of innovative ideas primarily in smaller firms. Large firms are more likely to use R&D along with other sources. The results also show that other sources are used to complement R&D. While the R&D-centric model is a relevant depiction of one mode of innovative activity, it needs to be modified to include an outward orientation to customers.

The study describes three clusters of firm types that combine external links with internal capabilities. The first two groups of firms rely on R&D. One builds networks with market partners. The other relies more on its own extensive resources and develops a capacity to ingest outside sources of knowledge by combining internal expertise in R&D with spillovers of outside knowledge derived from research institutions. A third cluster, an alternative to the R&D-based model, consists of those who focus on internal engineering and production expertise and combine this with knowledge spillovers derived from universities. Universities are an important part of the innovation process, in particular when it comes to supporting applied research.

The R&D process

While over two-thirds of firms were conducting some form of R&D[2], only about one-quarter of firms conduct R&D on an ongoing basis. It is this form of R&D that is most closely associated with innovation. Less than 10% of firms regularly perform R&D and do so in a dedicated facility. The R&D process then consists of a small core of firms conducting R&D regularly in a dedicated facility and a large group who do so only occasionally and most often in other departments of the firm. The Canadian economy is characterized by a relatively small group of intense innovators and of specialized R&D performers.

Technology acquisition

While only a few firms reported sales of disembodied innovations, the diffusion of technology occurs in other ways. About 60% of firms acquire some form of outside technical knowledge during their innovation process and 40% of these firms obtain their technology via a licensing agreement.

Technical transfers through licensing arrangements are used more frequently in situations where a firm's innovation does not originate in R&D. These transfers are often concluded by foreign affiliates to support the adaptation of innovations that have already been developed elsewhere in the world. While licensing supports Canada-first innovations in the core sector, joint ventures are more common for Canada-first innovations in all sectors.

Intellectual property rights

Intellectual property rights are meant to protect the investments in knowledge creation and acquisition. While being innovative is a prerequisite for the need for protection, not all forms of statutory protection are sought equally by innovative firms. After adjusting for variations in size, nationality, and industry, being innovative has its largest effect on the use of patents and trademarks. However, large and significant effects are also found on the use of industrial designs, trade secrets and copyrights. Innovative firms then concentrate on patents but also use a wide range of other statutory forms of protection.

The analysis shows that, while there is a close connection between innovation and patent use, the causal relationship is much stronger going from innovation to the decision to use patents than from the use of patents to innovation. This extends the findings, based on other survey evidence, that patents are not seen by firms to be a very efficacious means of protecting innovations, even though they tend to be used once an innovation occurs.

Financing

Knowledge investments require financing. Since financing of these soft assets associated with knowledge creation is difficult, governments tend to subsidize R&D spending. The study finds that innovative firms are frequently forced to rely on internal sources of funds for investments that create innovations. More than two thirds of all firms finance innovation entirely from internal sources.

Firms that are able to find outside funding (especially those that are Canadian-controlled) rely more on the federal government than other external sources. Financial institutions, provincial governments and related firms follow, by order of importance.

[2] Propensity to do R&D tends to be higher in innovation surveys as compared with the R&D surveys, partly because of the sampling strategy. For more details, see "Why do the surveys of innovation and R&D diverge? In *Innovation Analysis Bulletin, Vol. 2(3), September 2000. Cat.88-003-XIE.*

Venture capital is generally unimportant as a source of funds, except in the core sector.

Complementary strategies for innovative firms

Innovators differ from non-innovators in that they adopt a purposive stance to find new products and to adopt new processes. The Canadian manufacturing sector is not a world where most firms are engaged in intensive innovative activity, where some are rewarded by chance and others are not. It is a world that divides into firms that heavily stress an innovative strategy and those that do not.

While an R&D emphasis is important, developing capabilities in a number of different areas is also generally a prerequisite for innovation. In particular, firms that give a stronger emphasis to technological capabilities and to marketing competencies are more likely to be innovators. The importance of skills in marketing and production confirms that innovators need to develop a capacity for processing information and to adapt to ever changing market conditions.

Differences in innovation regimes across industries

The study finds that there is a substantial heterogeneity in the industry environment. The core group of industries focuses relatively more on product than on process innovations. The secondary and tertiary 'other' sectors typically compete more on price and downplay product innovation relative to process innovation[3]. Following are some of the other differences across industries.

The higher the industry is in the technology diffusion chain, the larger the firm, and the more original the innovation, the more frequent and important is the research and development activity of the firm as a source of innovation.

R&D partnerships and agreements are most concentrated in the core sector and least in the tertiary 'other' sector.

Both of the clusters involving R&D—the one that combines R&D with customers, the other with external R&D partners—can be found more frequently in the sectors that are higher up the innovation chain.

Firms in the core sector more frequently report experimental development and research departments as sources of technology solutions than they do production engineering in the case of product innovations.

Firms in core sector industries make greater use of almost all forms of statutory protection for intellectual property, particularly patents and trademarks.

Firms in the 'other' sector have more difficulties in financing their innovations than do firms elsewhere.

Government programs are used more frequently in the upstream than in the downstream sectors. Firms in the core sector focus more of their innovation expenditures on R&D, which means that they would naturally benefit more from subsidy programs that support R&D.

Differences in innovation regimes across firm size classes

Differences exist in the innovation regimes of small and large firms. The study demonstrates that, in Canada, small firms are less likely than large firms to introduce new products and processes. Similar differences are observed between large and small firms with regards to the frequency of R&D activity. Small firms are less likely to engage in R&D, just as they are less likely to innovate.

It is important to note that while small firms may be less likely to innovate but their relative size is so much smaller that their innovation rate per employee is greater than for large firms.

While the firm-size effect is related to differences in the degree to which firms are engaged in innovative activities like R&D, it is not completely explained by it. In the analysis that examined the propensity to innovate and that accounted for whether firms were R&D performers, or whether they were foreign-owned, or whether they had developed a wide range of competencies, the effect of firm size on the probability of being an innovator is always found to be positive and highly significant.

Differences in innovation regimes between more-novel and less-novel innovation types

This study focuses on both frontier innovations and more incremental innovations, finding that most reported innovation is of the imitative type. It also outlines the differences in the regimes that govern the production process in each case. To assess different types of innovations, it contrasts world-first innovations with Canadian-first and 'other' innovations.

Innovators in all three groups report similar effects on performance of the firm. Innovation contributes significantly to growth of firms in each group.

A major difference between world-first innovators and all other innovators lies in the extent to which world-firsts involve a combination of product and process innovation. Novelty is associated with more complexity, in that the production of the new or improved product also requires a change in the production process.

The world-firsts are more likely to use outside groups that complement their research and development facilities—related firms, industrial research firms, and universities—than are non-world-first firms. Non-world-firsts are more likely to use the services of consultants along with information garnered from publications.

World-firsts are more likely to increase the demand for workers than are non-world-firsts.

[3] Note the difference between the standard categories of primary, secondary and tertiary industries from the context in which these terms are used here. Please refer to Section 2 for explanation.

The areas that give innovators the greatest difficulty are the lack of skilled personnel, the lack of market information, and government standards and regulations. In each of these cases, world-first innovators generally reported that they experience these problems more frequently than non world first innovators. This suggests these problems do not block innovation as much as they accompany more radical innovative efforts.

Differences in innovation regimes by nationality

Since the Canadian manufacturing sector has more than half of its output under foreign control, its performance is affected by the multinationals operating in Canada. At issue is the extent to which multinationals operating in Canada have a truncated local capacity to innovate.

Multinational firms do not, in general, operate subsidiaries in Canada that are truncated relative to Canadian firms. They contribute significantly to innovation and technological progress in Canadian manufacturing by conducting relatively more R&D, by tapping local resources, and engaging in partnerships and contracts with customers, suppliers, unrelated firms and Canadian universities.

Foreign-owned multinationals are quite similar to Canadian-owned multinationals with regards to the likelihood that they conduct R&D and that they introduce innovations. It is therefore the international orientation of a firm that is the most important factor that differentiates firms by innovation regime.

Conclusions

The study concludes that there are a number of participants in the innovation process. 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 also differ across innovators.

John Baldwin, Micro-economic Analysis Division, Statistics Canada and Petr Hanel, University of Sherbrooke.

This article is taken from John Baldwin and Petr Hanel's book *Innovation and Knowledge Creation in an Open Economy*: *Canadian industry and international implications* published by Cambridge University Press, Cambridge in July 2003.

The book can be ordered on-line from http://www.cup.org/titles/catalogue.asp?isbn=0521810868.

The emergence of broadband Internet in Canada

Although broadband technologies have been around for awhile, it is now apparent that they have started to impact the way Canadians use the Internet. The increasing use of faster high speed access and "always-on" connections are changing Internet usage. Once reserved for large institutions in the private and public sector, with nearly 49% of Canadian households regularly using the Internet from home, Canadian households are clearly beginning to embrace broadband technologies.

Most popular types

Cable modems and Digital Subscriber Lines (DSL) are by far the most popular types of broadband Internet technologies in Canada. In the business sector, T1 lines are sometimes also used, particularly in large institutions with the need for high capacity service. Other methods of Internet access—such as wireless methods and ISDN—currently represent a very small fraction of Internet users in Canada. For the purpose of analysis in this article, comparison is made between the use of traditional "dial-up" Internet connections and all other connection types grouped together as broadband.

Canadian households among world leaders in broadband use

Nearly one-half (48.7%) of Canadian households that regularly use the Internet from home have a broadband connection (Table 1). 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 (OECD 2002).

Within Canada, the proportion of high-speed Internet subscribers increases as one travels from east to west. In each of the Western regions (Manitoba/Saskatchewan, Alberta, and British Columbia), the number of high-speed subscribers outnumbered households using traditional dial-up methods of Internet access.

Strong growth in cable connections

Cable modems continue to be the most popular type of broadband technology, used by nearly 65% of Canadian households with high-speed Internet access in 2001 (CRTC 2002). Since 1999, subscribership has soared from approximately 364 thousand, to over 1.75 million by the end of 2001.

The family of DSL technologies is the other type of broadband connection commonly used by Canadian households. While

cable companies achieved early entry into the broadband household market, DSL has emerged as a competitive alternative for consumers in many communities, and in some areas is the primary source of broadband. The broadband household market is characterized by intermodal competition between providers of these two technologies (CRTC, 2002; OECD, 2002).

Businesses take-up has been rapid

The shift to broadband Internet access has also occurred very quickly in the private sector. Between 2000 and 2002, the proportion of businesses using "dial-up" and broadband technologies nearly reversed, so that the majority of enterprises accessing the Internet now use broadband (Table 2).

Information and cultural industries lead the way

As is the case with other ICTs, including personal computers, websites and Internet use generally, the Information and Cultural industries have emerged as early leaders in the adoption of broadband technology (85.7%). However, these industries are not alone. In most other sectors, the majority of firms accessing the Internet do so using broadband technologies (Figure 1).

Broadband a standard business tool among large enterprises

Traditionally, large enterprises have tended to use the Internet more than small- or medium-size enterprises (SMEs). This firm size gap is magnified with respect to broadband penetration. While penetration among large firms appears to have levelled in 2001 and 2002 (at about 84%), broadband penetration rates are substantially lower among SMEs, and are still rising from year to year (Figure 2). In addition, the position of broadband as a standard business tool among large firms is reinforced by its high level of penetration in large firms in every sector. However, considerable variation still exists in penetration rates among SMEs across sectors.

Table 1. Internet use at home by speed of access, as a percent of all households, 2001

Province of household	High-speed	Low-speed	Regular home Internet use[1]	High-speed as a % of regular home Internet use
	% of all households			
Atlantic	15.4	23.6	39.9	38.6
Quebec	17.9	24.1	42.7	42.0
Ontario	25.1	27.3	53.4	47.1
Manitoba / Saskatchewan	22.5	18.7	41.6	54.1
Alberta	28.7	22.3	51.8	55.4
British Columbia	32.6	19.7	53.7	60.8
Total	23.7	24.1	48.7	48.7

[1] Regular home Internet use households are households where the respondent indicated that at least one household member uses the Internet at home in a typical month.

Note: High and low speed do not necessarily add to regular home Internet use due to non-response for type, speed or cost of connection.

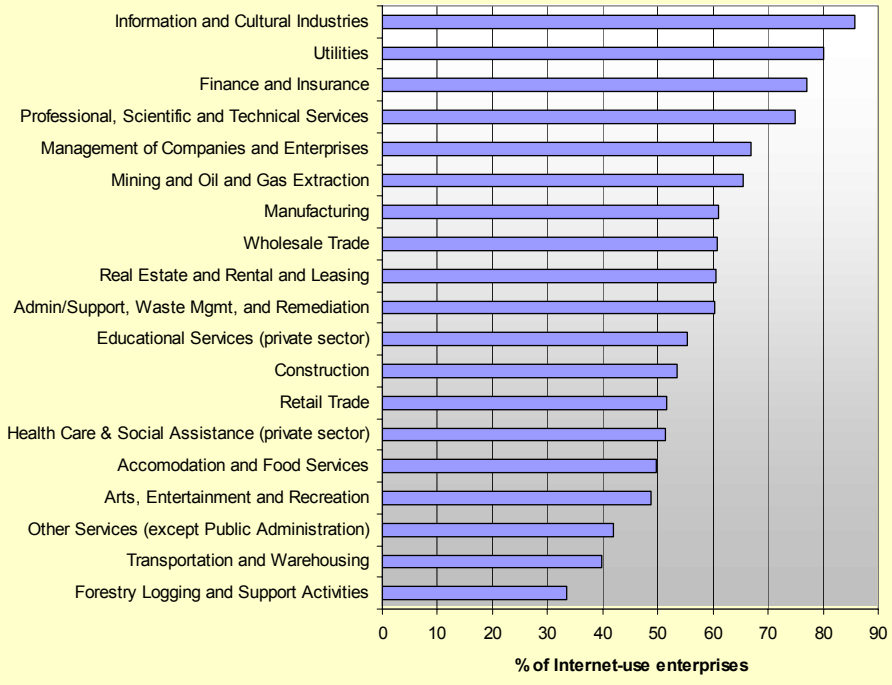
Source: Statistics Canada, Household Internet Use Survey, 2001.

Table 2. Types of Internet connections used by private sector enterprises

Connection type (fastest method of access)	2000	2001	2002
	% of Internet-use enterprises		
Regular dial-up line using a standard modem	59.6	46.8	36.6
High-speed (Cable, DSL/ISDN lines, T1 line or greater)	34.7	48.4	58.4

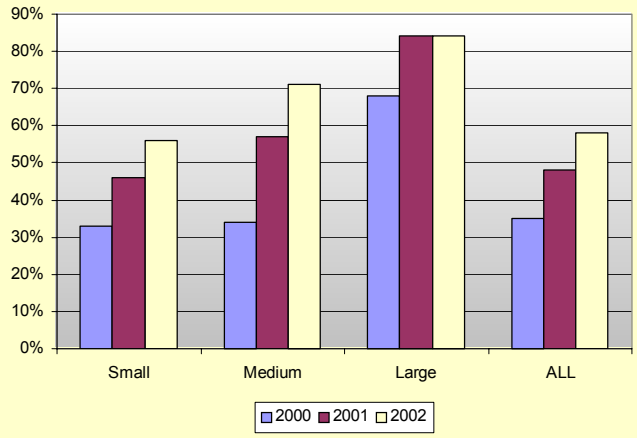
Source: Statistics Canada, Survey of Electronic Commerce and Technology, 2000-2002.

Figure 1. Percentage of private sector enterprises accessing the Internet through broadband, by industry, 2002



Source: Statistics Canada, Survey of Electronic Commerce and Technology (SECT), 2002

Figure 2. Percentage of private sector enterprises accessing the Internet through broadband, by firm size, 2000–2002



Source: Statistics Canada, Survey of Electronic Commerce and Technology, 2000-2002.

Broadband deployment in Canada—connecting all communities

The Government of Canada has set the goal of making Internet by broadband widely available to all communities in Canada by 2005. Although the vast majority of the Canadian population (86%) has access to such services as of July 2003, these Canadians are largely concentrated in urban areas. Measured differently, only a minority of communities (28%) is served and the remaining communities, located mostly in rural and remote areas, do not have access (Industry Canada, 2003). Canada's unique geography therefore plays an important role in efforts to connect all communities to broadband technologies.

The cost of providing broadband services in rural and remote areas is typically higher than in urban areas. Given a smaller customer base and the reality that customers are dispersed over long distances, building the infrastructure needed to provide services, often, does not make economic sense for broadband providers. One of the goals of the National Broadband Task Force was to identify those communities which, without government intervention, would not likely be served by broadband access (NBTF, 2001). In such situations, a variety of models have been developed to accelerate deployment, making use of varying arrangements of public and private funding. Two broad strategies underlying these models include "infrastructure support", where incentives are offered to broadband providers to expand existing services, and "community aggregation", where demand is pooled among various groups that could potentially benefit from broadband Internet services.

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The cable and satellite industry in the information age

Information and communication technologies (ICTs) are changing the way individuals and organisations access, exchange and use information. The Internet puts a wealth of information and entertainment at its user's fingertips, wireless technologies allow communication and information exchange from almost anywhere at any time, and broadband networks pave the way for applications unheard of only a few years ago.

The impact of ICTs on our daily activities is quite obvious, whether at home or at work. Perhaps less obvious to most is the impact these technologies are having on our industrial structure. New industries appear and new products and services become available. The emergence of the wireless telecommunications industry and the introduction of on-line newspapers are examples of such changes. Existing industries and products are also being transformed. The cable industry is a good example. This industry depends on its investments in ICTs and on its customer's propensity to use ICTs.

This article[1] looks at some of the fundamental changes that have affected the cable industry in the recent past and examines some of the challenges and opportunities it faces in coming years.

Competition and technology are redefining the industry

The birth of the cable industry in Canada dates back to the early 1950s. The first systems were introduced in London, Vancouver and Montreal at a time when there were only 146 thousand television sets in Canada. Since then, television has become part of the daily life of almost all Canadian households and the cable industry has expanded its reach to more than 90% of them.

During much of the period since its inception, the industry functioned under stable market conditions and with the same basic technology. The industry consisted of territorial monopolies engaged in the delivery of analogue video programming services using a one-way broadcasting system. The growth of the industry was based on its ability to attract a growing number of customers and to supply a wider array of programming services.

The opening of the multi-channel video market to competition from wireless providers in the second half of the 1990s has changed this drastically. Cable operators were no longer the only game in town and wireless providers needed to build a critical mass of subscribers to ensure their financial viability.

In this new competitive environment where the loss of customers was unavoidable for cable operators, their financial viability depended largely on their capacity to generate more revenue per subscriber. In order to do so, they needed to offer new services. The one-way analogue-based cable network imposed serious limits on their ability to do so. New technology became necessary.

An expanding customer base

The arrival of new suppliers and increased programming choices[2] has led a growing number of Canadians to subscribe to multi-channel video programming services. The number of subscribers grew by 5.9% in 2001 to reach 9.5 million[3]. This was the largest yearly increase since 1986. Since 1998, the year in which the impact of wireless entrants became evident, growth in subscriptions has accelerated every year and has outpaced the growth in the number of households.

Wireless providers (satellite and MDS) are taking a greater than ever share of that growing market. They had captured 17.0% of the market at the end of August 2001, up significantly from 10.8% in 2000 and more than double their share of approximately 6.5% in 1999. The market share of Canadian wireless operators is approaching the level attained by operators in the United States (21.9% at the end of December 2001) despite the fact that they have been in operation for a shorter period of time.

Cable operators offering Internet access services and digital cable fared better in the new competitive environment. They maintained a higher penetration rate than those who did not provide these services (71.6% compared to 66.5%) and generated 17.0% more revenue per subscriber.

This period of market growth followed a period of stagnation. In the years leading to the introduction of competition, subscriptions to multi-channel video programming grew at a rate similar to the growth in the number of households. In 1996 and 1997, the yearly increase in subscriptions had fallen to about 1%.

[1] The statistics for Canada presented in this article are from the following sources: **Statistics Canada,** Annual Return of Broadcasting Distribution Licensees, Annual and Quarterly Surveys of Telecommunications, Survey of Household Spending, Survey of Household Internet Use. **CRTC,** Status of Competition in Telecommunications Markets. The statistics for the United States are taken from various reports published by the **National Cable and Telecommunications Association** (www.ncta.com)

[2] In 1996, the year prior to the introduction of competition, the average subscriber to multi-channel video services had access to 53 channels. In 2001, the same subscriber had access to 94 channels.

[3] Subscribers to the services of cable, DTH, MDS and STV systems.

Going digital[4]

The popularity of direct-to-home satellite television and the recent introduction of digital cable are resulting in the gradual digitisation of the broadcasting distribution system. Despite its relatively recent introduction to the market, more than 25% of the 9.5 million subscribers to multi-channel video services were receiving their service in digital mode in 2001, up from 15.2% in 2000. Two out of three subscribers to digital television were clients of wireless operators.

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 where approximately 35.0%[5] of customers to programming services received a digital package at the end of 2001. The longer history of satellite television and the higher penetration of digital cable (20.0 % of cable customers compared to 10.0 % in Canada) in the United States largely explains this gap.

Cable leading the transition to high-speed Internet

In reaction to the strong competition in their traditional market, cable operators first turned to high-speed Internet as a means to retain customers and generate additional revenue per subscriber.

The rate of adoption of Internet by cable has progressed rapidly. Almost 15% of homes with access to cable Internet had adopted it as of August 31, 2001, up from 10.3% a year earlier. By comparison, the penetration rate in the United States had reached about 8% of homes capable of receiving the service by mid-year 2001.

The number of subscribers to Internet by cable surpassed 1.7 million at the end of 2001[6]. Close to 65% of residential subscribers to high speed Internet had chosen cable Internet, most of the remaining subscribed to DSL services. Some wireless operators were offering high speed Internet access services in 2001. Their offering was at an early stage of development and market penetration was not yet material.

The introduction of high-speed Internet has had a significant impact on the results of cable operators. Revenues from these services accounted for 12.0% of the revenues of cable operators providing it in 2001.

Competition is creating a downward pressure on profits

The introduction of competition in an industry often results in a decline in profitability for incumbent firms and entrants often support losses until they have a critical mass of customers. Both phenomena can be observed in this industry.

The profit margin (before interest and taxes) of cable operators was 16.1% in 2001, down from 19.5% in 2000 and 21.7% in 1999. The significant expenses incurred to promote existing and new services partly explain the decline in profitability. In 2000 and 2001, sales and promotion expenses have grown 3 times faster than revenues. Those expenses represented 6.9 % of operating expenses in 2001, compared to 6.1 % and 5.2 % the previous two years.

Wireless operators sustained losses in those 3 years, but their losses are declining. In 2001, their loss (before interest and taxes) was $293 million or $182 per subscriber, considerably less than in 2000 when it was $393 million or $406 per subscriber. Wireless operators have also aggressively promoted their products. They have in fact spent more on promotion than cable operators in the last 3 years. However, the 10.9% decline in sales and promotion expenses in 2001 partly explains the lower losses incurred by this segment of the industry.

Challenges and opportunities

Canadians have an appetite for television and have shown a readiness to pay for the service. Cable or satellite television is already present in more than 86% of homes. This means that the potential for growth for this industry largely lies in its ability to convince existing customers to purchase a broader range of programming and non-programming services. In order to do so, the industry is attempting to change the way customers use their television and to build niches in non-traditional markets. Much of this depends on technological innovation.

While technological innovation provides opportunities for the industry, it also poses a threat. The use of satellite technology is difficult to control. The availability of non-authorised satellite dishes and decoding hardware and software has led to the creation of sizeable grey and black markets[7]. Recapturing that market may well be the industry's most important challenge in the short term. The following sections examine some opportunities and challenges for the industry.

Changing the way consumers use their television

Digital and two-way communications capability can transform the television set into an interactive device. Today, some Canadians can use their television to send and receive e-mail, to surf the

[4] Digital technology allows cable and wireless operators to deliver 4 to 12 video signals in the space occupied by one analogue channel. It also opens the door to applications such as interactive program guides and parental controls not possible with analogue technology.

[5] DBS, MMDS and digital cable customers.

[6] Household Internet Use Survey

[7] The grey market refers to the situation where consumers obtain U.S. addresses that enable them to purchase U.S. satellite services not licensed to operate in Canada. The black market refers to the situation where consumers purchase electronic cards allowing them to obtain Canadian or U.S. satellite signals at no cost.

Web, to chat, to pay bills, to order goods and services, to access video programming of their choice at the time of their choice, and to participate in their favourite program. While these services are at an early stage of market development, most Canadians will likely be able to subscribe to them in a few years. The most promising interactive applications for the near future are video-on-demand (VOD) and TV-based web access.

VOD turns the television into a virtual video club. It enables a client to order video at their convenience and to pause, rewind or fast-forward as one would with their video or DVD player. The popularity of video rental provides an indication of the market potential for VOD. In 2001, 60 % of Canadians households rented videos and spent close to $1.2 billion on this service.

TV-based web access offers customers an opportunity to get a broadband connection to the Internet through their television set. The underlying conditions for this application to become an important offering of the industry are in place:

- 99.2 % of households have at least one television set in their home. By comparison, 59.9 % of households have a computer.
- More households are already connected to a broadband network through their television than through their computer; 68.3 % of households are connected to a cable network and 18.4 % to a satellite network. By comparison, 20.4 % of households have a computer connected to a broadband network.

Cable telephony

Despite many economic, technological and market challenges, telephony by cable is becoming a reality. This service is offered in parts of the Maritimes with some success, and market trials are underway or scheduled in other parts of the country.

Telephony provides cable operators an opportunity to become a player in a market twice the size of its current markets. The local access and related revenues of wireline telecommunications services providers exceeds $10 billion. About half of that revenue comes from the residential market, and cable operators already have a presence in 7 out of 10 homes.

The addition of telephony to the suite of available services would also provide the cable industry an opportunity to bundle telephony, Internet access and home entertainment services. Canadian households spent an average of $1,323 on these services in 2001, representing a total expenditure of $15.3 billion.

The grey and black markets

Technology is changing the industry and providing it with opportunities for growth. It also provides consumers the ability to choose the black market.

The exact magnitude of the grey and black market is unknown. By some estimates, there are between 565 and 715 thousands households using unauthorised satellite services[8]. Statistics on the use and supply of such services supports an estimate at the lower end of this range.

Whatever the magnitude, it is clear that this is not a trivial phenomenon. The potential annual loss of subscription revenues for the industry ranges from $275 to $345 million[9], or between 39% and 49% of the revenues generated by licensed wireless operators in 2001.

In reaction to this situation, a coalition of concerned broadcasters, content providers and distributors has engaged in public awareness, legal and lobbying activities intended to eliminate the illegal use of satellite signals. These efforts are crucial to the industry. Janet Yale, president of the CCTA, in an address to the Broadcast Executive Society summarised what is at stake for the industry with the following words: “You can’t compete with free”.

Conclusion

Through time Canadians have adopted ICTs with enthusiasm. The telephone, radio, television, cable, computers, wireless communication devices and the Internet all became mass consumption items at different times in the last 100 years. The adoption of these technologies has changed the way people communicate, access information and spend their leisure time. It has also led to the creation of industries that create wealth and employ many thousands of Canadians.

There is little doubt that innovation in information and communications technologies and applications will continue to change our lives. In short and medium term, they may well revolutionise the way individuals shop, educate themselves and obtain health services.

Communication networks have played, and continue to play, a central role in bringing the benefits of these technologies to the mass market. Many of the newer applications work best with broadband networks. The cable and satellite industry is preparing to be part of that evolution.

Daniel April, SIEID, Statistics Canada.

[8] The Strategic Council – A Report to the Canadian Cable Television Association – April 2002

[9] The Coalition Against Satellite Signal Theft estimates the annual loss to the broadcasting system at $400 million. This includes losses incurred by programming undertakings and copyright holders as well as loss of subscription revenues by cable and satellite operators.

Commercializing the results of research in Canadian universities and hospitals: an update

Many people in the federal and provincial governments, in universities, hospitals and other organizations are asking the same questions about the commercialization of university research: Is it increasing? What are the benefits? How do universities and regions compare? Statistics Canada's 2001 *Survey of Intellectual Property Commercialization in the Higher Education Sector* shows that commercialization activities took a giant leap between 1999 and 2001.

Important questions

- What challenges are universities and research hospitals facing in attempting to identify, protect, promote and commercialize their intellectual property (IP)?
- In terms of university commercialization, how does one province or region of the country compare with the others? How do Canadian institutions measure up to their counterparts in the US and other countries?
- How can governments ensure that the results of university research are commercialized in Canada for the benefit of Canadians?
- What can all interested parties, from governments to institutions to private industry, do to foster innovation and economic growth in Canada?

These are some of the policy issues that spawned the *Survey of Intellectual Property Commercialization in the Higher Education Sector*. The 2001 or third edition of the survey covers 85 universities and 31 university-affiliated research hospitals, for the year ending March 31, 2001. This article includes the results for universities only.

Major increases between 1999 and 2001

In recent years, the Government of Canada has made substantial new investment in university research as part of Canada's *Innovation Strategy: Achieving Excellence*. Between 1999 and 2001, total sponsored research funding rose from $2.2 to $3.3 billion (49%). In this period, many indicators of the outcomes of university research also increased (see Table 1).

Royalties from licensing 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. While most university commercialization projects have modest financial returns, technology transfer offices are in place in 62% of universities across the country to capture the benefits of research.

In both 2000 and 2001, private industry contributed 16% of university research funding via donations, grants and contracts. When universities negotiate to conduct research on behalf of private industry, the rights to the resulting IP are an important consideration for the university.

To date, universities have created a total of 655 spin-off companies. In 2002, these companies had revenues of $2.5 billion and employed 18,737 people. The spin-offs cover a wide range of industries, for example, research and development, computer systems design, engineering and medical devices manufacturing.

Between 1999 and 2001, universities started 56 new companies, of which 19 were in the health sciences field.

At the end of 2001, universities reported holding $45 million in equity in spin-offs, down from $54.5 million in 1999. The decline reflects the beginning of a bear market for stocks, especially for high-tech companies.

Table 1. 1999-2001 comparison of IP commercialization outcomes: universities

	Unit of measure	1999	2001	% change
Universities in survey	number	84	85	1
Actively managing IP	number	52	58	12
Inventions disclosed	number	829	1,005	21
Inventions protected	number	509	625	23
New patent applications	number	616	867	41
Patents issued	number	325	339[r]	4
Total patents held	number	1,826	1,994[r]	9
New licenses	number	218	320	47
Total active licenses	number	1,109	1,338	21
Royalties from licensing	$ thousands	18,900	44,397	135
Sponsored research[1]	$ millions	2,241	3,329	49

[1]Source: Statistics Canada, Center for Education Statistics.

Table 2. Regional differences in IP commercialization: universities[1]

	Universities	Sponsored research 2000/01	Royalties from licensing	Inventions		Patents held	Licenses		Spin-offs
				Reported	Protected		New	Total active	
	No.	$ millions		Number					
Atlantic	16	157	X	54	X	X	X	X	X
Quebec	18	917	X	221	136	348	94	417	81
Ontario	25	1,349	9.8	303	157	557	93	305	198
Prairies	15	638	11.0	227	133	466	67	329	134
BC	11	267	X	200	X	X	X	X	X
Total	**85**	**3,328**	**44.4**	**1,005**	**625**	**1,994**	**320**	**1,338**	**655**
	Percentage of national total								
Atlantic	19	5	X	5	X	X	X	X	X
Quebec	21	28	X	22	22	18	29	31	12
Ontario	29	40	22	30	25	28	29	23	30
Prairies	18	19	25	23	21	23	21	24	21
BC	13	8	X	20	X	X	X	X	X
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	Percentage of national total								
Atlantic and BC	32	13	X	25	32	31	21	22	37

[1] As always, caution should be used in interpreting these results, as in some cases, they may be due to incomplete submission of data.

Regional differences

Research funding varies widely from university to university and from region to region. For example, the 16 universities in the Atlantic region, which are mainly small, received total research funding of $157 million in 2001. This compares to 25 universities in Ontario that received a total of $1.3 billion in research funding. Regional differences in IP commercialization may therefore be studied in proportion to research funding.

For example, universities in the Prairie Provinces received 19% of total research funding but a disproportionate 25% of royalties from licensing (Table 2). The Prairie universities also accounted for 23% of inventions reported, 21% of inventions protected, 23% of patents held, 21% of new licenses, 24% of total active licenses and 21% of spin-off companies created to date. In summary, on every indicator, they had better than 19%.

In contrast, Ontario universities received 40% of all research funding but had a lesser proportion of all indicators: 22% of royalties, 30% of inventions reported, 25% of inventions protected, 28% of patents held, 29% of new licenses, 23% of total active licenses and 30% of spin-off companies created to date.

In Quebec, the indicators were mixed. Quebec universities received 28% of all research funding and reported a higher proportion of new and total active licenses (29% and 31% respectively). Although the exact numbers are confidential, Quebec universities also had better results in the area of royalties from licensing. However, on four indicators, Quebec universities had less than 28%: inventions reported and inventions protected (both 22%), patents held (18%) and spin-offs created to date (12%).

For confidentiality reasons, separate results for the Atlantic region and British Columbia are not available. However, the two regions were studied in aggregate.

British Columbia and Atlantic universities combined received 13% of research funding and a higher proportion of all other published indicators. The two regions account for 25% of inventions reported, 32% of inventions protected, 31% of patents held, 21% of new licenses, 22% of total active licenses and 37% of spin-offs created to date. In the farthest regions of the country, there may be more of a tendency to spin off companies than to license technologies to established companies. A report by the University of British Columbia (Livingstone, 1997) cites a lack of suitable licensees within the region, due for example to an economy based on natural resource extraction and processing and tourism.

Further study would be required to determine why IP commercialization varies across the country. Some possible factors are: years of experience in technology transfer, IP policies and university size.

The full report for the 2001 *Survey of Intellectual Property Commercialization in the Higher Education Sector* is now available on the Statistics Canada Web site. Please refer to page 2 for instructions on downloading our working papers.

Cathy Read, SIEID, Statistics Canada.

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Measuring concentration of R&D spending by industry

Although there were over 8,000[1] companies in Canada reporting R&D expenditures in 2000, only 30 of these accounted for over half of all business R&D spending[2]. The result is that only a small number of companies in key industries have a significant impact on Canada's total $11.4 billion 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.

Industry R&D spending variation—Communications equipment leads the way

In Canada during the year 2000, the degree of concentration of industrial R&D activities varied significantly between industries. Amongst the most concentrated industries, the top five R&D performers accounted for over 90% of all spending in that industry, while in the least concentrated industries the top five accounted for only 26%.

The communications equipment industry showed the highest degree of concentration of any industry (Table 1). Other industries that had concentrated R&D activities were petroleum and coal products, electrical power, forestry and logging, beverages and tobacco and oil and gas extraction. With the exception of communications equipment, these industries did not report high R&D intensities.[3] All of these industries have a lower than average number of firms engaging R&D but a wide variation in the average amounts spent on R&D per enterprise. Together these six industries account for 31% of all industrial R&D spending, but the communications equipment industry alone accounts for 28%, leaving the remaining five industries accounting for only 3% of all industrial R&D.

At the other end of the spectrum, computer systems design and related services reported the lowest level of concentration of R&D activities. Other low concentration industries were scientific R&D services, fabricated metals manufacturing, information and cultural services, plastic products and food. All of these industries reported a higher than average number of R&D performers, but lower than average spending per enterprise. These six industries account for 12% of all industrial R&D.

Other industries that account for substantial portions of Canada's total industrial R&D have widely differing degrees of concentration. Aerospace (8% of total industrial R&D) ranked 7th, semiconductors (7%) ranked 15th, pharmaceuticals (6%) ranked 33rd and wholesale trade[4] (4%) ranked 37th.

R&D spending doubles over a decade; strategies for improving R&D performance

Between 1990 and 2000, R&D spending by business has grown from $5.2 billion or 50% of all R&D done in Canada to $11.4 billion or 58%.[5] Even factoring out inflation, the amount spent by business on R&D in Canada almost doubled in that period.[6] The federal government has identified increasing Canada's R&D performance as an important goal for this decade. Looking at those countries that have managed to significantly improve their R&D performance (as measured by R&D spending as a percentage of GDP) it is clear that their advances were driven by increases in business R&D[7]. Business R&D has also been identified by the Organisation for Economic Co-operation and Development as a key component of the innovation process which brings new products (goods and services) to the market[8]. Any indicator that would shed further light on this activity would be useful to improving understanding of the nature and scope of R&D spending in Canada and to support strategies to increase R&D spending in industry.

Different approaches to measuring concentration

Measuring the degree of concentration can be accomplished in a number of ways. One approach would be to calculate the number of firms that make up 50%, or some other proportion, of all spending within an industry. Another possible measure is to calculate the proportion of R&D done by a particular number of companies. Statistics Canada publishes figures for the proportion of total business R&D done by the top 10, 25, 50, 75 and 100 companies[9]. A final alternative is to apply the Hirfindahl-Hirschmann Index[10], a measure that is most commonly used by

[1] This number is preliminary. It is likely that there are about 9,500 companies in Canada engaged in R&D. However, due to the methodology of the survey, only the larger companies and those who file their application for tax credits early are counted within a year of the reference period. The number is generally revised upward by about 1,000 to 1,500 in the subsequent publication. This revision will have little impact on the concentration measures.

[2] Statistics Canada, 2002, *Industrial Research and Development, 2002 Intentions*, Cat. No. 88-202-XPB, p. 18.

[3] R&D Intensity can be measured in a variety of ways: (R&D spending / Revenues) or (R&D spending / Value-added) for either all R&D performers or all enterprises regardless of whether they do R&D. In this paper, R&D intensity is: (R&D spending / Revenues for all R&D-performing enterprises) × 100.

[4] Note that pharmaceutical wholesalers account for more than half of all R&D done by companies in this industrial category.

[5] Statistics Canada, 2003, *Science Statistics: Total Spending on Research and Development in Canada, 1990 to 2002, and Provinces,* Vol. 26 No. 7, pg. 3, Cat. No. 88-001 XIB.

[6] Ibid.

[7] Lonmo, Charlene and Frances Anderson, 2003, *A Comparison of International R&D Performance: An Analysis of Countries That Have Significantly Increased Their GERD/GDP Ratios During the Period 1989-1999,* Statistics Canada Working Paper, Cat. No. 88F0006XIE2003001.

[8] OECD, 2001, *Science, Technology and Industry Outlook, Innovative Network: Co-operation in National Innovation Systems*, and Remoe, Svend, 2002, *Dynamising National Innovation Systems*, OECD, Paris.

[9] Statistics Canada, 2002, *Industrial Research and Development, 2002 Intentions*, Cat. 88-202-XPB, Table 1.5, p.19.

[10] For more information about the application of the Hirfindahl-Hirschmann Index, see *The state of telecommunications services in*

Table 1. Concentration of R&D expenditures by industry and other measures of R&D activity, 2000

Industry	Concentration Rank	R&D performers		R&D expenditures		R&D Intensity
		number	% of national	($ millions)	% of national	
Communications Equipment	1	105	1.3	3,257	28.5	16.8
Petroleum and Coal Products	2	19	0.2	40	0.3	0.1
Electric Power	3	9	0.1	179	1.6	0.7
Forestry and Logging	4	25	0.3	17	0.2	0.4
Beverage and Tobacco	5	17	0.2	9	0.1	0.1
Oil and Gas Extraction	6	26	0.3	112	1.0	0.5
Aerospace Products and Parts	7	54	0.7	899	7.9	7.2
Other Computer and Electronic Products	8	30	0.4	18	0.2	5.6
Wood Products	9	100	1.3	34	0.3	0.4
Transportation and Warehousing	10	41	0.5	32	0.3	0.2
Primary Metal (Non-Ferrous)	11	36	0.5	151	1.3	1.2
Mining	12	31	0.4	30	0.3	0.3
All Other Transportation Equipment	13	49	0.6	20	0.2	1.6
Rubber Products	14	50	0.6	28	0.2	1.2
Semiconductor and Other Electronic Components	15	122	1.5	771	6.7	6.9
Primary Metal (Ferrous)	16	35	0.4	18	0.2	0.2
Architectural, Engineering and Related Services	17	498	6.3	398	3.5	12.3
Motor Vehicle and Parts	18	111	1.4	349	3.0	0.3
Finance, Insurance and Real Estate	19	90	1.1	125	1.1	0.4
Computer and Peripheral Equipment	20	75	0.9	189	1.6	4.3
Health Care and Social Assistance	21	83	1.1	290	2.5	40.5
Paper	22	74	0.9	126	1.1	0.4
Retail Trade	23	135	1.7	33	0.3	0.5
Other Manufacturing Industries	24	254	3.2	110	1.0	1.3
Fishing, Hunting and Trapping	25	25	0.3	4	0.0	13.7
Agriculture	26	148	1.9	41	0.4	4.5
Electrical Equipment, Appliance and Components	27	161	2.0	202	1.8	3.0
Navigation, Measuring, Medical & Control Instruments	28	225	2.8	408	3.6	9.6
Other Chemicals	29	277	3.5	266	2.3	1.1
Other Utilities	30	37	0.5	5	0.0	0.6
Construction	31	200	2.5	36	0.3	4.8
All Other Services	32	472	6.0	177	1.5	1.2
Pharmaceutical and Medicine	33	83	1.1	707	6.2	8.7
Printing	34	58	0.7	7	0.1	0.9
Management, Scientific and Technical Consulting	35	202	2.6	39	0.3	15.1
Furniture and Related Products	36	57	0.7	5	0.0	1.3
Wholesale Trade	37	588	7.4	498	4.4	2.4
Textile	38	104	1.3	33	0.3	1.7
Non-Metallic Mineral Products	39	86	1.1	12	0.1	1.9
Machinery	40	659	8.3	330	2.9	3.6
Food	41	201	2.5	61	0.5	0.3
Plastic Products	42	193	2.4	52	0.5	1.6
Information and Cultural Industries	43	309	3.9	321	2.8	1.7
Fabricated Metal Products	44	336	4.3	61	0.5	1.5
Scientific Research and Development	45	389	4.9	324	2.8	64.5
Computer systems design and related services	46	1,018	12.9	624	5.5	14.5
All industries		**7,897**	**100**	**11,449**	**100**	**2.1**

Rank: 1 = most concentrated, 46 = least concentrated
R&D Intensity = R&D spending / Revenues * 100 for all R&D performing firms
Source: Statistics Canada, Research and Development in Canadian Industry survey (RDCI), special tabulations by the author.

competition regulators to determine the degree of concentration of market shares of companies within an industry. The major problem with the index (and indeed for the other proposed measures) is that for highly concentrated industries the values would provide too much information about the R&D spending of the largest firm. The data used by competition regulators are public but the data collected by Statistics Canada are confidential. To avoid this problem, industries are ranked instead of releasing the actual figures. All three methods produce similar results when the industries are ranked. For this publication, the rankings from all three methods were averaged.

Canada, Innovation Analysis Bulletin Vol. 4, No. 3, May 2001.

Degrees of concentration and spending

There are no clear patterns with respect to concentrations of R&D spending by sectors (see Figure 1). It can be said that there are more primary industries with high concentrations of R&D spending and more service industries at the other end of the scale. Industries with high R&D intensities appear throughout the list from the top to the bottom.

The number of companies within an industry reporting R&D was related to the R&D concentration within the industry. Those industries with fewer than 55 companies almost exclusively reported higher degrees of concentration of R&D spending. The total amount of money spent by an industry was not related to the degree of concentration of R&D spending within that industry.

Figure 1. R&D intensity by R&D concentration—R&D performers in manufacturing industries, 2000

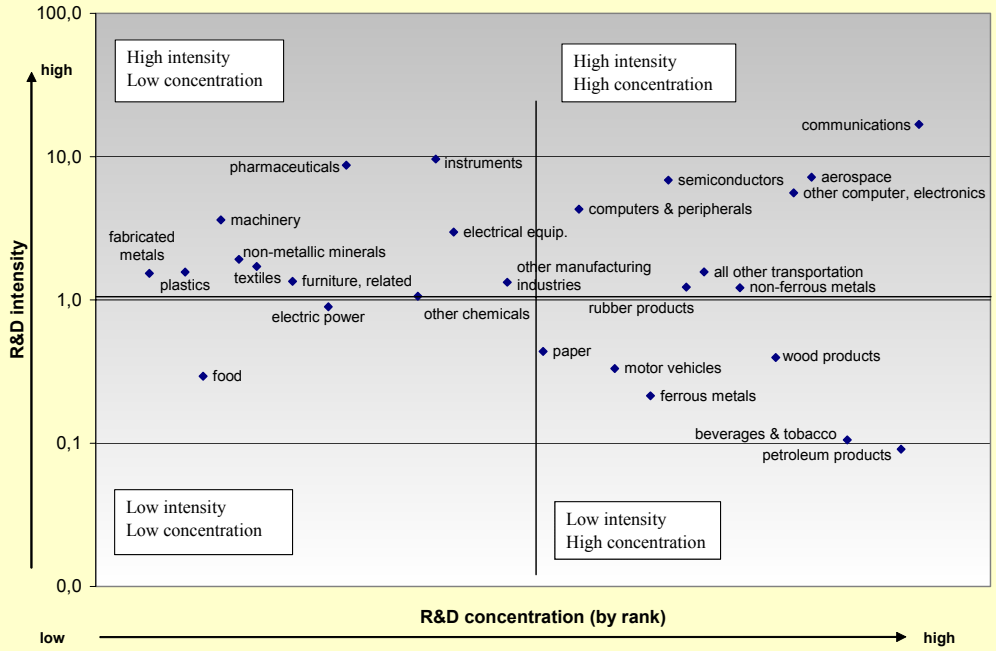
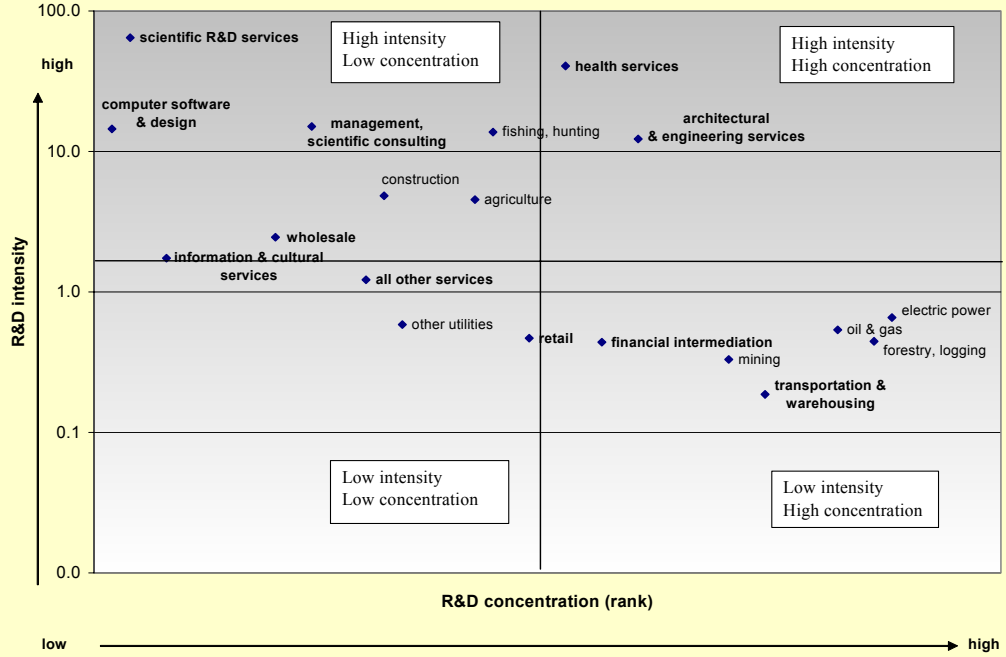


Figure 2. R&D intensity by ranked R&D concentration—all non-manufacturing R&D performers, 2000



Source: Statistics Canada, Research and Development in Canadian Industry survey (RDCI), special tabulations by the author.

The average amount spent by firms within each industry is loosely related to the concentration of R&D spending within that industry. The top 10 industries in terms of the average amount spent on R&D per company had an average Hirfindahl-Hirschmann Index of 0.26 while the bottom ten industries had an average Hirfindahl-Hirschmann Index of 0.07. Within these groups of industries however, there were exceptions. The most notable exception was pharmaceutical industry, which reported high average spending per company with a low degree of concentration.

Two-thirds of manufacturing industries have R&D intensities below the average. High intensity industries are divided into two groups. The first group report lower than average concentration ranking. This group consists of instruments, pharmaceuticals, machinery and electronic equipment manufacturers. The second group reports higher than average concentration rankings. This group is composed of communications, aerospace, semiconductors, computers and peripherals and other computer and electronics industries.

R&D intensities for R&D performing firms in non-manufacturing industries were generally higher[11]. Service industries (highlighted in bold in Figure 2) tend to report higher R&D intensities and lower degrees of concentration. Scientific R&D services, computer design services and management and scientific consulting services report high R&D intensity and low concentrations while health services and architectural and engineering services report high R&D intensity with somewhat higher than average rank in concentration[12]. There are no exceptionally concentrated service industries with high R&D intensities; there are however resource and energy industries (electric power, oil and gas and forestry and logging) which report high degrees of concen-

[11] It is worth remembering that about two-thirds of all industrial R&D in Canada is done by manufacturing companies and that the intensities are not calculated for the industry as a whole but only for those firms that do R&D.

[12] Note that if the pharmaceutical companies within the wholesale category were put into a separate category, their position would look much like the pharmaceutical manufacturers. The remainder of the category would report a comparatively low R&D intensity and concentration.

tration, but quite low levels of R&D intensity.

Further measures

Further measures that would add to understanding differences between industries would include a measure of the propensity of firms within a given industry to do any R&D at all. Other measures could include looking at the degree of concentration of capital and labour. Does R&D concentration simply reflecting the concentrations of these other factors of production in different industries? Answers to such questions would enable a more comprehensive assessment of the enterprises engaged in R&D in Canada.

Charlene Lonmo, SIEID, Statistics Canada.

Why non-innovators don't innovate

Statistics Canada's Survey of Innovation 1999 collected information on the innovation activities of firms in Canadian manufacturing and selected natural resource industries. The results provide insight into why a firm chooses to take the path of innovation or opts to be a non-innovator. For most non-innovators, the perception is that innovation is not required or is irrelevant to their industry.

Defining the non-innovators

The Survey of Innovation 1999[1] found that 1 in 5 Canadian manufacturing firms did not introduce any new or significantly improved products or processes during the period 1997 to 1999. For the selected natural resources industries sector, the percentage of firms that did not introduce any new or significantly improved products or processes ranged from one third to one half of the total.[2] The definition of innovation used in the survey is based on the OSLO Manual (OECD 1996). Non-innovative firms analyzed here are those that did not introduce a new or significantly improved product or process in the previous three years and which did not carry out any innovative activities during the survey period.

Hearing the "Why not?" from non-innovators[3]

Non-innovating manufacturing and selected natural resource industry based firms were asked the direct question, "Why did your firm not develop or introduce new or significantly improved products (goods or services) or production/manufacturing processes?"

As shown in Table 1, the perception for many non-innovating manufacturing firms is that innovation is not part of their function. Forty-five percent of respondents stated there is "no need" to innovate. An additional 20% responded that there is "no demand" for innovation. The perception is that innovation is not required and it is not what they do. An additional and different reason cited by 14% of respondents was of a monetary nature (lack of financial resources).

Table 1. Reasons non-innovators give for not innovating, manufacturing firms

Reason stated by respondent	%
No need	45
No demand - market does not require innovation	20
Lack of financial resources	14
The firm is a user of technology, not an innovator	5
Changes to the company	5
Innovation happened outside of specified timeframe	3
Slow rate of change within the industry	2
Company feels too small to need to innovate	1
Other	5

Source: Statistics Canada, Survey of Innovation 1999

Table 2. Reasons non-innovators give for not innovating, selected natural resources firms

Reason stated by respondent	%
No need	60
No demand - market does not require innovation	9
Too small	9
Lack of financial resources	6
Changes to the company	5
Slow rate of change within the industry	4
Innovation happened outside of specified timeframe	2
Other	5

Source: Statistics Canada, Survey of Innovation 1999

The findings are similar for selected natural resources industries (see Table 2). An even higher percentage of firms (60%) responded that there is "no need" to innovate. An additional 9% stated "there is no demand - market does not require innovation".

The remaining responses varied with the largest being 9% stating their firm as being too small to pursue innovation. Other reasons included lack of financial resources, changes to the company and slow rate of change within the industry.

[1] Approximately 6,000 manufacturing industries and 800 firms in the natural resources industries were surveyed. These firms had revenues of at least $250,000 and a minimum of 20 employees. The survey response rate was 95% for total manufacturing industries and 94% for total selected resources industries.

[2] The selected natural resources industries included logging, coal mining, metal ore mining, non-metallic mineral mining, and electric power generation, transmission and distribution.

[3] The percentage of non-innovators responding to this question: Manufacturing firms - 82%; Selected Natural Resources Industries firms - 81%. Note: percentages in tables are unweighted estimates.

Firms explain why they are non-innovators

The two major reasons cited by respondents for not innovating can be categorized as "no need" or "no demand" to innovate. Typical responses were:

Reason: "No need to innovate"

- "The industry is pretty standard and does not require the introduction of new products or processes to operate"
- "Our product is simple, there is nothing to change"
- "There is no identifiable need in our industry at this time"
- "The way we do things works just fine"
- "We are operating at full capacity, no time, no need"
- "There is nothing to improve"

Reason: "No Demand"—the market does not require innovation

- "There is no demand for innovation, we are a custom manufacturing business and we produce what the client wants"
- "What is being produced has not changed in years"
- "Change is not required by existing customers"
- "The marketplace and customer demand do not call for it"
- "The demand is for our existing products"
- "Clients do not demand any change"

Recurring perception that there is no reason for change

The perception from non-innovators is striking. Two-thirds of respondents perceived that innovation is not needed or that innovation is irrelevant to their industry. Non-innovators in general, perceive that they know their market and function to provide their client with the product required. From their perspective, there is no reason for change.

Rad Joseph, SIEID, Statistics Canada

Private radio broadcasting, 2002

The oldest electronic medium—radio, continues to steadily 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 with the industry's profits (before interest and taxes) representing 15.9% of their revenues, essentially unchanged from the previous two years.

Continued solid financial performance

The radio industry achieved relatively good financial results in 2002 despite a slowdown in the growth of its revenues. Revenues were up 2.7% reaching $1.1 billion, compared to 4.4% and 5.3% growth, the previous two years. The slowdown affected AM and FM stations and stations in large and small markets.

The 2002 financial performance confirmed a turnaround in the industry's fortunes after many difficult years in the late '80s and most of the 90's. The industry's profit margin has been close to 16.0% for the last three years. Private radio broadcasters have outperformed private conventional television broadcasters for the fourth consecutive year in terms of revenue growth and profitability.

FM stations lead the way

The performance of FM stations is at the root of the sustained level of profits for the private radio industry in recent years. In 2002, FM stations achieved an impressive 24.3% profit margin with 70% of stations realizing a profit.

The stellar performance of FM radio is also changing the face of the industry. Since 1999 the number of AM stations has steadily declined and the number of FM stations has steadily increased. In 2002, 3 of every 5 stations was an FM station, and their revenues accounted for 73.0% of the industry's revenues.

Large markets sustain lead in profitability

Radio stations in large markets continue to outperform those operating in smaller markets in terms of profitability in 2002. The profit margin for stations operating in the five largest Census Metropolitan Areas was 18.8% compared to 13.2% for stations outside these markets.

Employment stabilized after a period of growth

The industry's employment level increased marginally to reach 9,410 after two years of relatively strong growth. Labour costs represented 43.7% of the industry's revenues.

The data are available on CANSIM: table 357-001. More detailed information is available in the July 2003 issue of *Broadcasting and telecommunications*, Vol. 33, No. 2 (56-001-XIE, $10/$32).

Data in this article were originally released in the July 3, 2003 issue of the Statistics Canada Daily.

Daniel April, SIEID, Statistics Canada

Television broadcasting, 2002

The expansion of the Canadian television broadcasting industry continued in 2002 with the launch of 47 digital channels. This happened when growth in the advertising market was sluggish. The rapid growth of pay and specialty television has increased the dependence of the Canadian television broadcasting system on subscription revenues while strong competition for advertising dollars and audiences has impacted profit margins during a period when television broadcasters spent a greater proportion of their revenues on programming and production.

Broadcasting industry expands

Canadian television entered a new era of digital networks in 2002. These specialty programming channels became available to those subscribing to the services of a direct-to-home satellite, digital cable or digital MDS operator. Forty-seven digital specialty channels were launched, adding to the existing specialty channels and 14 pay channels. The number of Canadian pay and specialty services has now surpassed the number of private conventional television services. This happened when growth in the advertising market was sluggish. Canadian broadcasters were left competing for available advertising dollars and struggling to maintain profit margins.

Slowdown in growth continues

The airtime sales of television broadcasters grew a modest 2.0% in 2002, less than half of the growth achieved in 2001. The relative importance of airtime sales has steadily declined since 1999. Airtimes sales represented 54.7% of revenues in 2002 compared to 59.9% in 1999.

A changing industry model

The days of so-called free television when broadcasters depended almost exclusively on airtime sales and grants as sources of revenues are gone. The rapid growth of pay and specialty television has increased the dependence of the Canadian television broadcasting system on subscription revenues. Subscription revenue has now surpassed the $1 billion mark and represented 24.4% of all revenues of television broadcasters in 2002.

Profit margins declining

Strong competition for advertising dollars and audiences has impacted profit margins. Both the conventional and specialty television segments saw their profit margin decline in 2002. The profit margin of private conventional broadcasters fell below 10.0%, the first time since 1991. The specialty segment's profit was 8.4% compared to 17.3% of the previous year. This was largely a result of the almost $55 million losses incurred by the new digital networks. The pay television segment was the most profitable of the industry. Its profit before interest and taxes represented 24.2% of its revenues in 2002.

Programming and production expenses increase

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. The growth in these expenses outpaced the growth in revenues in all segments of the industry in 2002.

Available on CANSIM: table 357-001.

More detailed information is available in the June 2003 issue of the Broadcasting and telecommunications bulletin, Vol. 33, No. 1 (56-001-XIE, $10/$32).

Data in this article were originally released in the June 18, 2003 issue of the Statistics Canada Daily.

Daniel April, SIEID, Statistics Canada.

The growing importance of business R&D

One of the most commonly used measures of R&D performance is the GERD/GDP ratio or total R&D expenditures (Gross Domestic Expenditures on Research and Development) as a percentage of Gross Domestic Product (GDP). How does Canada compare to the other members of the G-7 and the OECD in terms of its GERD/GDP ratio? During the period 1989 to 1999 Canada reported the highest level of growth amongst G-7 countries.

Measuring R&D activities

The GERD/GDP ratio has a number of advantages, chief among them, that it avoids any unit of measure (as both the numerator and the denominator are in the local currency) facilitating comparisons between countries. The Organization for Economic Cooperation and Development (OECD) has been collecting R&D data since the mid 1960s.

How does Canada compare to other members of the G-7[1] and the OECD in terms of its GERD/GDP ratio? During the period 1989 to 1999 Canada increased its GERD/GDP ratio from 1.47 to 1.80. This was the highest level of growth reported amongst G-7 countries. There were however, seven of the 29 other members of the OECD that reported higher absolute growth in GERD/GDP: Austria, Denmark, Finland, Iceland, Ireland, Korea and Sweden. These countries will be referred to as the "high R&D performing countries".

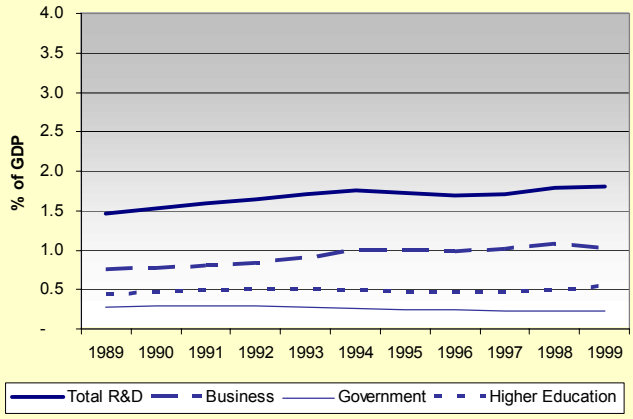
Research and development activities in all OECD countries are performed primarily by three sectors: business, institutions of higher learning[2] and government institutions. Data on R&D performed by non-profit institutions is also collected but only two OECD countries have ever reported R&D expenditures by non-profit institutions over 5% of total GERD.

Areas of growth in R&D

What is most notable about the data from the 1990s is the growing importance of business R&D amongst the high R&D performing countries. Figures 1 and 2 illustrate that in Canada and Sweden, growth in GERD was driven by growth in business R&D (BERD). This is also true for all the high R&D performing countries. The reverse was also true: the countries that reported declines in GERD/GDP ratios consistently reported declines in the proportion of GDP going to business R&D.

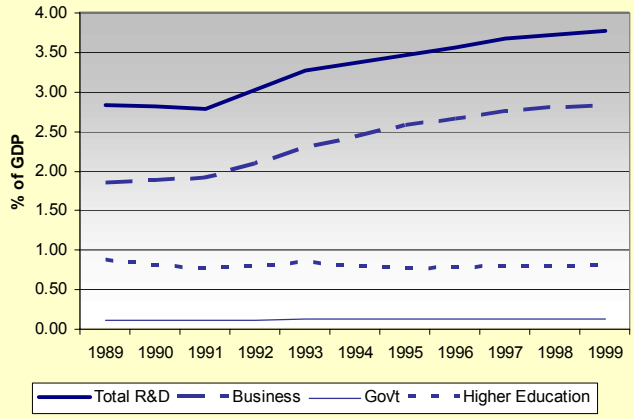
In 1989, most of the high R&D performing countries reported that 20% to 30% of total R&D was done in institutions of higher learning, government facilities accounted for around 20% and the remainder was done by business. By 1999, R&D in universities was still about 20% of the total, government R&D had generally declined to between 10% and 15%, and business R&D rose to account for between 65% and 75% of total R&D. In almost all cases the increase in the proportion of R&D activity by businesses was matched by a decrease in the proportion of government-performed R&D. At the OECD level, the overall proportion of GERD made up of BERD did not change due in part to changes in membership during the 1990s and to declines in BERD reported by some of the larger members (most notably the UK, Germany and Italy).

Figure 1. GERD concentration, Canada 1989-1999



Source: OECD, 2002, Main Science and Technology Indicators (MSTI) database, July 2002

Figure 2. GERD concentration, Sweden 1989-1999



Source: OECD, 2002, Main Science and Technology Indicators (MSTI) database, July 2002

[1] Members of the G-7 are: Canada, France, Germany, Italy, Japan, the United Kingdom and the United States. All of these countries are also members of the OECD.

[2] This category consists primarily of universities but also includes hospitals that conduct research.

Table 1. Percentage of total business R&D by selected industries, 1999

Country	aerospace	electronics	office machinery and computers	pharmaceuticals	instruments	services	all other
High R&D performing countries							
Austria[a]	…	26.6	0.2	5.7	2.2	22.4	42.8
Denmark[a]	0.0	6.6	0.4	20.2	4.5	36.7	31.7
Finland	0.0	47.5	0.3	4.1	2.0	11.7	34.4
Iceland[c]	0.0	0.1	…	2.5	5.8	70.8	20.9
Ireland[b]	0.3	30.4	5.1	14.4	5.1	12.8	32.1
Korea[d]	3.0	39.8	5.5	2.0	0.7	13.3	35.8
Sweden	2.9	23.4	0.7	16.5	5.7	12.8	38.0
G-7 countries							
Canada	**11.6**	**27.1**	**4.8**	**6.4**	**1.3**	**29.2**	**19.6**
France	11.8	12.5	1.9	13.2	6.7	9.1	44.9
Germany	6.6	10.5	2.2	6.4	4.8	5.4	64.2
Italy	11.2	20.2	0.9	8.6	2.9	18.7	37.4
Japan	1.0	17.9	10.7	6.5	4.6	2.7	56.6
United Kingdom	10.9	7.7	1.0	22.4	4.2	17.4	36.4
United States	7.9	9.7	5.1	6.7	10.7	31.2	28.7

[a] 1998
[b] 1997
[c] electronics 1997, pharmaceuticals 1988
[d] aerospace 2000
Source: OECD, Main Science and Technology Indicators (MSTI) database, July 2002

R&D in selected industries

Six industry sectors have been identified by the OECD as being of particular interest in terms of business R&D. These industries consist of the manufacturing industries that have traditionally reported the highest R&D intensities[3] (aerospace, electronics, computers and office machinery, pharmaceuticals, instruments) and services, which reported rapid growth in R&D activities over the last decade in several member countries.

Each country has a distinct profile with different industries accounting for a different proportion of business R&D, but looking at the countries with high R&D performance, in each case the most R&D intensive area is either the electronics industry or the service sector[4]. These two areas combined account for half of business R&D, except in Denmark and Sweden, both of which have strong pharmaceutical R&D efforts. In all of the high R&D performance countries, electronics, services and pharmaceuticals account for over half of all industrial R&D. This also holds true for Canada. Unlike all of the high R&D performance countries, Canada also has a strong aerospace R&D sector.

Amongst G-7 countries, the selected industries represented a slightly lower proportion of all business R&D spending. These countries also tended to have a more equal mix of R&D spending amongst the selected industry categories. This may well be due to the fact that their economies are generally larger rather than due to any explicit strategy. Compared with the United States, Canada reports similar proportions of business R&D by industry with two exceptions: electronics, where Canada reports a much higher proportion of industrial R&D, and instruments, where the United States reports much higher figures.

Canada reports one industry (electronics), which accounts for over one-quarter of all industrial R&D, but it has avoided the extreme concentrations of R&D reported by Finland. Given the changes in the world market for communications electronics, time will tell what impact this has on these countries' industrial R&D performance.

For further details including tables of R&D performance in all OECD countries, see: Lonmo, Charlene and Frances Anderson, 2003, *A Comparison of International R&D Performance: An Analysis of Countries that Have Significantly Increased Their GERD/GDP Ratios During the Period 1989-1999*; SIEID Working Paper Series, Cat. No. 88F0006XIE No. 01. This paper was originally released in the February 28, 2003 edition of the Statistics Canada Daily.

Charlene Lonmo, SIEID, Statistics Canada.

[3] R&D intensity is R&D spending as a proportion of sales (for companies) or value added (for industries).

[4] The services sector can encompass a broad range of activities (including contract R&D, software design, computer services, communications, finance and transportation and storage). Note also that there may be issues with respect to the comparability international data on R&D in services, see F.D. Gault, 1997, *Research and Development in a Service Economy*, Statistics Canada, Cat. No. 63F0002XPB No. 12, p. 10.

Update on economic analysis

On July 9, 2003, Statistics Canada announced a new Internet publication *Updates on Economic Analysis* (11-623-XIE, free)**.** The publication provides a concise summary of ongoing research programs in micro-economics and national accounts.

Update on economic analysis includes data on such topics as

- business dynamics (entry, exit, merger activity);
- productivity;
- innovation;
- competition;
- investment;
- small producers;
- technology and technological change;
- Canada/United States price differences;
- economic geography and trade;
- international trade;
- the importance of multinationals;
- problems in small-firm financing;
- firm strategies that are associated with superior economic performance;
- and eco-efficiency, the environment, and the knowledge economy.

For each theme, the purpose and scope of the research program are described, along with the major analytical issues that are addressed in supporting studies. It also presents a summary of major findings. The publication will be updated periodically, as new research studies become available. Electronic links to supporting documents are included when possible.

The *Update on economic analysis* (11-623-XIE, free) is now available on Statistics Canada's website (*www.statcan.ca*). From the *Our products and services* page, under *Browse our Internet publications*, choose *Free*, then *National accounts*.

The publication was originally announced in the July 9, 2003 issue of Statistics Canada's ***The Daily***.

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

The Daily by subject

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New economy indicators

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

	Units	1997	1998	1999	2000	2001	2002
General economy and population[1]							
GDP	$ millions	882,733	914,973	980,524	1,064,995	1,092,246	1,122,712
GDP implicit price index	1997=100	100.0	99.6	101.2	105.2	106.3	..
Population	thousands	29,987	30,248	30,509	30,791	31,111	31,414
Gross domestic expenditures on R&D (GERD)[2]	$ millions	14,639	16,082	17,465	19,585	20,828	20,744
"Real" GERD	$ millions 1997	14,639	16,147	17,258	18,617	19,594	..
GERD/GDP ratio	ratio	1.66	1.76	1.78	1.84	1.91	1.85
"Real" GERD/capita	$ 1997	488.2	533.8	565.7	604.6	629.8	..
GERD funding by sector							
Federal government	% of GERD	19.2	17.6	18.4	18.2	18.4	19.1
Provincial governments	% of GERD	4.5	4.0	4.4	4.5	4.5	4.9
Business enterprise	% of GERD	48.1	45.7	44.3	42.5	41.9	40.0
Higher education	% of GERD	13.5	14.5	15.2	14.5	15.0	16.5
Private non-profit	% of GERD	2.5	2.3	2.2	2.3	2.3	2.6
Foreign	% of GERD	12.3	15.9	15.6	18.1	17.8	16.9
GERD performance by sector							
Federal government	% of GERD	11.7	10.8	10.6	10.6	10.6	10.7
Provincial governments	% of GERD	1.5	1.3	1.3	1.3	1.2	1.3
Business enterprise	% of GERD	59.7	60.2	58.6	58.5	57.5	54.2
Higher education	% of GERD	26.5	27.2	29.1	29.3	30.3	33.5
Private non-profit	% of GERD	0.6	0.5	0.4	0.3	0.3	0.3
Federal performance as a % of federal funding	% of federal	61.1	61.6	57.8	58.5	57.8	56.1
"Real" federal performance of R&D	$ millions 1997	1,720	1,750	1,837	1,977	2,086	..
Information and communications technologies (ICT)							
ICT sector contribution to GDP - basic prices[3]							
ICT, manufacturing	$ millions	8,228	9,720	13,168	18,062	12,788	10,608
% of total ICT	% of total ICT	25.2	25.8	27.7	31.2	22.3	18.1
ICT, services	$ millions	24,487	28,020	34,340	39,870	44,457	48,063
% of total ICT	% of total ICT	74.8	74.3	72.3	68.9	77.7	81.9
Total ICT	$ millions	32,715	37,734	47,464	57,858	57,222	58,670
Total economy[4]	$ millions	816,081	848,414	892,870	933,713	947,039	977,322
ICT % of total economy	%	4.0	4.4	5.3	6.2	6.0	6.0
Total business sector	$ millions	679,562	710,188	752,197	791,306	801,870	828,842
ICT % of business sector	%	4.8	5.3	6.3	7.3	7.1	7.1
ICT adoption rates (private sector)							
Personal Computer	% of enterprises	..	..	81.9	81.4	83.9	85.5
E-Mail	% of enterprises	..	..	52.6	60.4	66.0	71.2
Internet	% of enterprises	..	..	52.8	63.4	70.8	75.7
Have a website	% of enterprises	..	..	21.7	25.7	28.6	31.5
Use the Internet to purchase goods or services	% of enterprises	..	..	13.8	18.2	22.4	31.7
Use the Internet to sell goods or services	% of enterprises	..	..	10.1	6.4	6.7	7.5
Value of sales over the Internet	$ millions	..	..	4,180	7,246	10,389	13,339

[1] Source: Statistics Canada, 2003, *Canadian Economic Observer*, Cat. no. 11-010-XIB, May 2003, vol.16 no. 05, 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	1997	1998	1999	2000	2001	2002
Information and communications technologies (ICT) continued							
ICT adoption rates (public sector)							
Personal Computer	% of enterprises	..	..	100.0	100.0	100.0	99.9
e-mail	% of enterprises	..	..	96.6	99.0	99.7	99.6
Internet	% of enterprises	..	..	95.4	99.2	99.7	99.6
Have a Web site	% of enterprises	..	..	69.2	72.6	86.2	87.9
Use the Internet to purchase goods or services	% of enterprises	..	..	44.2	49.1	54.5	65.2
Use the Internet to sell goods or services	% of enterprises	..	..	14.5	8.6	12.8	14.2
Value of sales over the Internet	$ millions current	..	..	244.6	11.5	354.8	327.2
Teledensity indicators							
Wired access (Voice Grade Equivalent - VGE)	per 100 inhabitants	62.2	63.8	64.9	66.1	65.2	63.4
Wireless access (VGE)	per 100 inhabitants	14.0	18.5	23.7	29.4	34.8	37.6
Total public switched telephone network (PSTN) (VGE)	per 100 inhabitants	76.7	82.3	88.6	95.5	100.0	101.0
Homes with access to cable	thousands	10,422.4	10,564.6	10,725.2	10,896.1	11,107.4	..
Homes with access to Internet by cable	thousands	..	..	..	7,609.7	9,391.4	..
Access indicators							
Total wired access lines (VGE)	thousands	18,659.9	19,293.7	19,806.2	20,347.0	20,335.9	19,962.1
Residential access lines (VGE)	thousands	12,427.4	12,601.5	12,743.9	12,922.0	12,852.3	12,755.8
Business access lines (VGE)	thousands	6,232.6	6,692.2	7,062.4	7,425.0	7,483.6	7,206.3
Analogue mobile subscribers	thousands	450.1	1,406.4	2,592.0	4,444.0	6,950.6	8,943.6
Digital mobile subscribers	thousands	..	3,939.0	4,318.3	4,282.6	3,911.0	2,905.4
Digital cable television subscribers	thousands	..	..	..	390.4	811.7	..
Satellite and MDS subscribers	thousands	..	..	..	967.5	1,609.4	..
High speed Internet by cable subscribers	thousands	..	..	..	786.3	1,387.8	..
Network investment indicators[5]—Capital expenditures							
Wireline public telecommunication networks	$ millions	3,615.6	4,629.1	4,258.7	4,989.9	5,078.7	3,979.5
Wireless public telecommunication networks	$ millions	1,892.3	1,462.6	1,374.1	2,005.7	2,642.4	1,718.3
Cable networks	$ millions	819.1	773.2	1,110.8	1,523.9	2,124.6	..
Satellite and MDS networks	$ millions	7.7	30.6	194.1	158.1	521.2	..
Characteristics of biotechnology innovative firms[6]							
Number of firms	number	282	..	358	..	375	..
Total biotechnology employees	number	9,019	..	7,748	..	11,897	..
Total biotechnology revenues	$ millions	813	..	1,948	..	3,569	..
Expenditures on biotechnology R&D	$ millions	494	..	827	..	1,337	..
Export biotechnology revenues	$ millions	311	..	718	..	763	..
Import biotechnology expenses	$ millions	..	..	234	..	433	..
Amount of capital raised	$ millions	467		2,147		980	
Number of firms that were successful in raising capital	number	109		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	1,758		6,597		9,661	
Number of products/processes in pre-market stages	number	7,166		10,989		8,359	
Intellectual property commercialization[7]							
Federal government							
New patents received	number	..	130	89	..	110	..
Royalties on licenses	$ thousands	..	6,950	11,994	..	16,467	..
Universities							
New patents received	number		143	325		339	
Royalties on licenses	$ thousands		15,600	18,900		44,397	

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

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

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

What's new?

Recent and upcoming events in connectedness and innovation analysis.

Connectedness

Research and analyses on issues of the information society continue. A new paper in the *Connectedness Series* entitled "High Speed on the Information Highway: Broadband in Canada" was released in September (Cat. No. 56F0004MIE2003010, free).

Telecommunications

Annual survey of telecommunications service providers

Annual data for 2001 will be available in Fall 2003.

Quarterly survey of telecommunications service providers

Quarterly data for the 1st and 2nd quarters for 2003 will be available in the fall.

Broadcasting

The service bulletin *Broadcasting and Telecommunications - "Private Radio Broadcasting*", No. 56-001-XIE volume 33, no. 2 was released in July 2003.

Household Internet use

Data on *Penetration rates of household use of the Internet for 2002* was released in September

Household electronic commerce rates for 2002 will be released in the fall of 2003.

Business e-commerce

Survey of electronic commerce and technology

The 2003 *Survey of Electronic Commerce and Technology* will be mailed out in November.

Science and innovation

S&T activities

Research and development in Canada

Volume 27, No 5, *Industrial research and development 1999 to 2003*, was released in July 2003.

Volume 27, No. 6, *Estimates of total spending on research and development in the health field in Canada, 1988 to 2002*, was released in September 2003.

Federal and provincial S&T

Federal science expenditures

No updates

Higher Education Sector R&D

No updates.

Provincial research organizations

No updates.

Human resources and intellectual property

Federal intellectual property management

Federal science expenditures and personnel 2001-2002, intellectual property management, fiscal year 2000/2001

No updates.

The higher education sector

Intellectual property commercialization in the higher education sector

The working paper based on the results of the 2001 survey was released in the Statistics Canada Daily in October. Consultations regarding the content of the 2003 survey are also underway.

Innovation

Innovation in manufacturing

No updates.

Innovation in services

The 2003 *Survey of Innovation in Selected Service Industries* is in the field and estimates are anticipated by March 2004.

Biotechnology

No updates.

Knowledge management practices

Coming soon from the School of Policy Studies, Queen's University: *Understanding Innovation in Canadian Industry*. This collection of articles provides in-depth analysis of innovation in Canada based largely on the Statistics Canada's *Survey of Innovation 1999*. This volume, edited by Fred Gault, will be published in November by McGill-Queen's University Press.

NESTI Notes

NESTI is the OECD's Working Party of National Experts on Science and Technology Indicators. The group is responsible for, among other things, overseeing the production of the manuals

that guide the collection of statistics on R&D, innovation and human resources in Science and Technology. These manuals are named after the cities in which the definitive meetings were held:

- The Frascati Manual provides guidelines on the collection of R&D statistics. The most recent revision was released in 2002 (OECD, 2002, Frascati Manual 2002, Paris).
- The Oslo Manual gives direction on innovation statistics. The most recent revision, a joint undertaking with EuroStat, was released in 1997 (OECD/EuroStat, 1997, Oslo Manual, Paris).
- The Canberra Manual advises on the collection of statistics on human resources in science and technology. It was first published in 1995 and was also a joint project with EuroStat (OECD, 1995, Manual on the measurement of human resources devoted to S&T: "Canberra manual", Paris).

In June 2003, NESTI decided to undertake a revision of the Oslo Manual. The revisions will take into account broadening the definition of innovation to include non-technological innovation. The definitional change will have an impact on how we collect and analyse innovation statistics.

Furthermore, the past seven years' experience has lead to a wealth of new knowledge about how to conduct and interpret innovation surveys. This experience will guide the revision of the treatment of outputs of innovation, expenditures on innovation and inputs to innovation, linkages between innovation and other business measures (such as revenues from innovations) as well as the overall methodology guidelines.

NESTI members anticipate having a draft revision by June 2004 and completing the manual by June 2005.

The federal S&T community

The federal S&T Community is made up of numerous government departments and agencies with distinct mandates and specializations, all united by their need for skilled, committed, innovative science and technology professionals. The new Web site at www.sciencetech.gc.ca offers a comprehensive view of what they do.

Canada enjoys a long and proud history of achievement in science and technology. Many milestones in that history have, in fact, resulted directly from the research, programs and initiatives of the Federal S&T Community.

That groundbreaking work has been—and continues to be—driven by a genuine need for science in the everyday life of Canada. It's a need with many causes: the pressures of globalization; the public's expectation that government decisions will be based on the best available information; and the transition to a knowledge-based economy.

The work carried out by the Federal S&T Community provides support for government decision making, policy development, and regulatory activities—for example, stock assessments and fisheries biology help the government manage the country's fish stocks.

The S&T Community's work, which often involves international networking and collaboration, also contributes to the development and management of standards, and helps answer the country's health, safety, environmental, and defence needs.

Here's where you can learn more about some of the remarkable achievements of Canada's S&T Community, and about the exciting scope of its continuing work.