Catalogue 88-003-XIE

Innovation Analysis Bulletin

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

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- **Industrial research and development**
- **Intellectual property commercialization**
- **Advanced technology and innovation**
- **Biotechnology**
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Innovation Analysis Bulletin
Vol. 2, No. 2 (May 2000)

Catalogue Number 88-003-XIE
Aussi disponible en français, N° 88-003-XIF au catalogue

In this issue

Innovation analysis bulletin

ISSN 1488-433X

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

Special thanks to the contributors and Joan Healey (writer and co-ordinator).

Published by authority of the Minister responsible for Statistics Canada

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As of May 2000, there were:

- *Nine titles in Downloadable publications ($) including:*
  - *56-001-XIB **Broadcasting and telecommunications***
  - *56-002-XIB **Quarterly telecommunications statistics***
  - *56-203-XIB **Telecommunications in Canada***
  - *56-204-XIB **Radio and television broadcasting***
  - *56-205-XIB **Cable television***
  - *88-204-XIB **Federal scientific activities***
  - *88-001-XIB **Science statistics** (33 issues)*
  - *88-522-XIE **Science and technology activities and impacts: a framework for a statistical information system***
  - *88-523-XIE **A five-year strategic plan for the development of an information system for science and technology***
- Seven research papers, 36 working papers and 22 questionnaires in Downloadable Research papers (free) under Science, Innovation and Electronic Information Division.

Innovation in the engineering services industry

Products, services and production methods, like human beings, have limited life spans. As products move along the life cycle to maturity, competition among producers intensifies, sales growth slows and profit margins drop. Product modifications can protect a firm's market share in the short run, but the introduction of new products and better substitutes for existing products is crucial for long term growth and profitability. This article presents findings, from the 1996 Survey of Innovation, about the prevalence of innovation in the Canadian engineering services industry

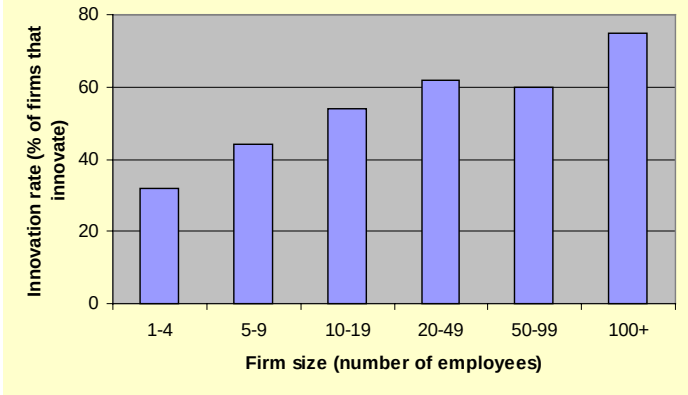
The engineering service industry occupies an important position in the economy. It is knowledge-based, and as a provider of inputs in the production of capital goods, plays an important role in the diffusion of up-to-date technologies. The data and analysis from the Survey of Innovation helps us to understand innovation and the characteristics of innovative and non-innovative firms.

Innovation, defined as the first commercial use of an idea, may take the form of a product or service, or a production process. It may also be an organizational change. Innovation is a relative concept. Products and technologies that were new a few years ago are commonplace, or even obsolete, today.

Large engineering firms more innovative than smaller firms

With the resource-based development of the Canadian economy, Canada's engineering services industry has a long history of designing and implementing projects related to natural resources. Large firms engaged in engineering projects related to the natural resources are very innovative as are firms specialising in transport engineering and telecommunications. Results show that three quarters of the industry's large firms (with 100 or more employees) introduced at least one innovation in the 1994-1996 period. The very small firms (with fewer than 5 employees), on the other hand, have low innovation rates. Only one-third reported introducing a new product, a different process or an organizational change.

Chart 1. Larger firms are more likely to innovate



Types of innovation

The type of innovation that a firm introduces reflects its competitive environment, its willingness to take risks and its strategy to compete. Firms focusing on improvements in processes generally compete in markets that are not expanding and therefore try to increase operational efficiencies in order to maintain or increase their market shares. Firms investing in product development, on the other hand, tend to be growth-oriented businesses that seek or create new markets.

Of the engineering services firms responding to the survey, 23% reported that they had introduced a ***process*** innovation in the 1994-96 period. ***Product*** innovations are more common. Some 31% of the engineering firms replaced an existing product, added a new product to their existing line, or diversified into new product lines. Most of these new product innovations were imitative, but a number of firms claimed innovations that were new to the world. Such original innovations reflect the advanced technological abilities of Canadian firms, establishing them as problem solvers.

Table 1. Engineering services firms' innovation rates, by type, 1994-96

Type of Innovation	Innovation rate (% of firms)
Firms introducing:	
Any innovation (product, process or organizational change)	40.7
Product innovation*	30.5
Process innovation*	23.2
Organizational change*	15.6
All three types of innovation	7.7
Product and process innovation	15.6
Product innovation and organizational change	12.0
Product innovation only (no other type of innovation)	10.7
Process innovation only (no other type of innovation)	6.6
Organizational change only (no other type of innovation)	2.5

Innovation rate is defined as the number of firms reporting an innovation expressed as a percentage of the total number of firms. The total number of engineering services establishments in this study was 6,435.

* Indicates that firms also introduced other types of innovations.

Source: Statistics Canada (Science, Innovation and Electronic Information Division), Survey of Innovation

Innovation ideas come from clients

There is much interest in knowing which sources, other than research, firms rely on to acquire knowledge. Of particular interest is how firms that do not undertake research nevertheless obtain information that leads to innovation. The Survey of Innovation covered several sources of such information ranging from small talk in social gatherings to research and development. Since firms may simultaneously use several sources, it was necessary to find out what importance they attached to each source. To assess this, respondents were asked not only to identify the sources of their information, but also to rank them from "least important" to "crucial". The data presented in Table 2 pertains to the percentage of innovative firms identifying a source as very significant or crucial.

Table 2 Sources of ideas for innovation, 1994-96

Sources of ideas	% of innovators rating as very important or crucial
Ideas internal to firm	
Management	48.1
Marketing division	38.2
Production workers	32.8
In-house R&D	50.0
Other	8.2
Ideas external to firm	
Clients	70.3
Competitors	41.7
Suppliers	36.6
Technology acquisition	27.5
Consultants	21.8
Ideas from generally available sources	
Conferences, meetings, publications	40.1
Fairs and exhibitions	15.6
Government information programs	20.2
Social gatherings	11.8
Patent literature	12.1
Ideas from education and research institutes	
Higher educational institutions	29.9
Private research institutes	13.4
Government research institutions	19.4

Source: Statistics Canada, Survey of Innovation

Barriers to innovation

As discussed in the article, ***Barriers to Innovation in Service Industries,*** on Page 5 of this bulletin, barriers to innovation can arise for many reasons. They can result from uncertainties regarding the financial feasibility of a project, the risk of it being rejected in the marketplace, and the functional characteristics of the firm undertaking. As with the sources of ideas, respondents were asked to indicate the importance of any barrier they encountered while developing new products, services and processes.

Table 3 Barriers to innovation, 1994-96

Barriers	% of innovators rating as very significant or crucial
Market-related	
High risk related to feasibility	34.6
Risk of product being rejected in the marketplace	34.3
Innovation easily imitated	30.1
Cost-related	
Cost difficult to predict	38.7
High cost	43.7
Long amortization period	32.8
Input-related	
Lack of equity capital	37.2
Lack of outside capital	35.5
Lack of qualified personnel	26.7
Lack of technical equipment	13.7
Institutional	
Internal resistance to innovation	5.8
Long administrative approval	7.1
Legislative or legal restrictions	9.8

Source: Statistics Canada, Survey of Innovation.

High costs, difficulties in forecasting expenditures and feasibility risks were among the most important barriers to innovation (see Table 3) for the engineering services industry (this industry was part of the service industry group reported on in the article on Page 5 of this bulletin.) The longer it takes to commercialize an idea, the more difficult it becomes to manage overruns and risks and to accurately forecast an outcome. Some respondents noted that ten years passed from when they first made significant human and capital investments to when a product or process became commercialized. Difficulties in obtaining equity capital and venture capital were also cited as important impediments.

The full paper entitled ***Innovation in the engineering services industry*** *was published on January 18, 2000 in the3rd quarter 1999 issue of* ***Services Indicators*** *Cat. No. 63-016-XIB).*

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Barriers to innovation in service industries

The 20th century saw an incredible level of technological innovation—and this pace is quickening exponentially. Globalization has forced companies to constantly adapt and has made competition fiercer than ever. Innovation, in terms of products, production processes or internal corporate organization is the basis for progress and the key to success for many organizations. Many studies have dealt with the conditions that promote technological innovation initiatives in Canadian firms. This new study from Statistics Canada looks at innovation from another angle, i.e. the barriers to innovation.

In their efforts to innovate, firms face a number of obstacles linked to feasibility and marketing risks, the high cost of innovation projects, issues of funding, the availability of resources needed to implement innovative projects, internal resistance to innovation and the regulatory environment.

The perceived barriers to innovation in Canadian business were assessed for the **communications**, **financial** and **technical business services** industries targeted by the first innovation survey conducted by Statistics Canada in the service sector in 1996.

Respondents were presented with a list of possible obstacles (Table 1) to innovation and asked to rank the significance of these obstacles from "insignificant" to "crucial".

The major obstacle in all three sectors was the high cost related to innovation

On average, 27% of the respondents found the barriers (see text box) to be unimportant. At the other extreme, 26% found them to be very important. The rest found the barriers either not relevant (25%) or moderately significant (22%).

Fourteen percent of the smallest firms (fewer than 20 employees) considered the barriers important. Only 2.2% of the largest firms (500 or more employees) saw the barriers as being important.

The technical services sector found the barriers most important (31%), followed by communications (26%) and financial services found them least important (22%).

Some barriers seemed to affect certain sectors more than others do. The communications sector was seen to be more sensitive to regulatory impediments, while the technical business services sector was more affected by barriers related to difficulties in finding qualified staff, and the financial services sector was more concerned about risks related to innovation.

Table 1. Main obstacles to innovation in service industries

Obstacles	Average score (1-5)
1. High risk related to the feasibility of an innovation project	2.89
2. High risk related to successful marketing of the innovation.	3.04
3. Innovation is easily copied by other firms.	2.71
4. Difficulty of predicting the costs of innovation.	2.99
5. High costs of innovation projects.	3.25
6. Long depreciation period for innovation.	2.66
7. Lack of equity capital for the implementation of innovative projects.	2.88
8. Lack of outside capital for innovation projects.	2.61
9. Shortage of qualified staff for innovation projects.	2.78
10. Lack of equipment for the implementation of innovation projects.	2.19
11. Internal resistance to innovation.	1.77
12. Prolonged administrative processing or authorization to implement innovation projects.	1.72
13. Legislation and regulations having an impact on	1.88

Financial services sector cautious about new technological developments due to feasibility risks and market outlets.

The striking feature of this sector was the low percentage of answers in the "crucial" category (3% on average) as compared to the other two sectors. The financial services sector felt moderately affected by impediments to innovation as a whole. The most significant impediments in this sector were barriers 1 to 5, with cost as a principal factor.

Technical business services sector more affected by barriers related to the difficulties in finding qualified staff

Generally, barriers to innovation were perceived more strongly in this sector. As compared to the other two sectors, barriers 7 to 9, i.e. the lack of equity capital, the lack of outside capital and the difficulties in finding qualified staff, were definitely perceived as obstacles.

Communications sector concerned more with regulatory environment

As with the other two sectors, cost was the most important barrier to innovation (obstacles 4 to 8). The next most significant obstacles were those related to legislation.

*The full research paper entitled **Barriers to Innovation in Services Industries in Canada** was published in November 1999 and is available electronically, free-of-charge through the Statistics Canada Web site. (See Page 2 of this bulletin for instructions.) The authors of this paper are **Pierre Mohnen**, Université du Québec à Montréal and CIRANO, and **Julio Rosa**, CIRANO.*

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Federal government personnel engaged in scientific and technological (S&T) activities, 1990-1991 to 1999-2000

The number of personnel in scientific and technological (S&T) activities in the federal government has declined by 15% since 1990-1991.

S&T activities consist of research and development (R&D) and related scientific activities (RSA). For 1999-2000, 67% of the estimated total personnel will be in Natural Sciences and Engineering, of which 66% will be engaged in R&D.

In contrast, personnel in Social Sciences and Humanities will account for 33%, of which only 5% will be engaged in R&D.

In the Natural Sciences and Engineering, four departments:

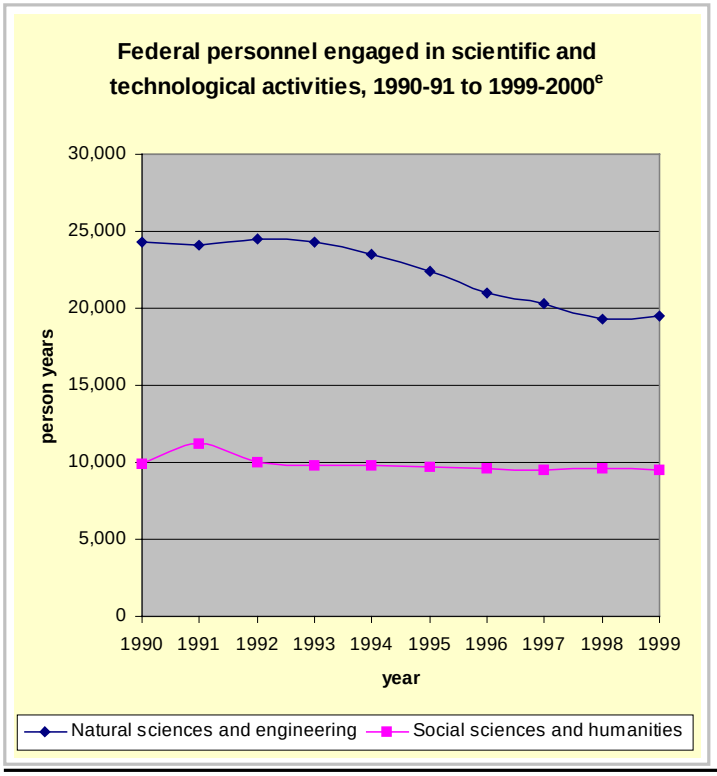
- Agriculture and Agri-food Canada
- Environment Canada,
- Natural Resources Canada and
- the National Research Council of Canada,

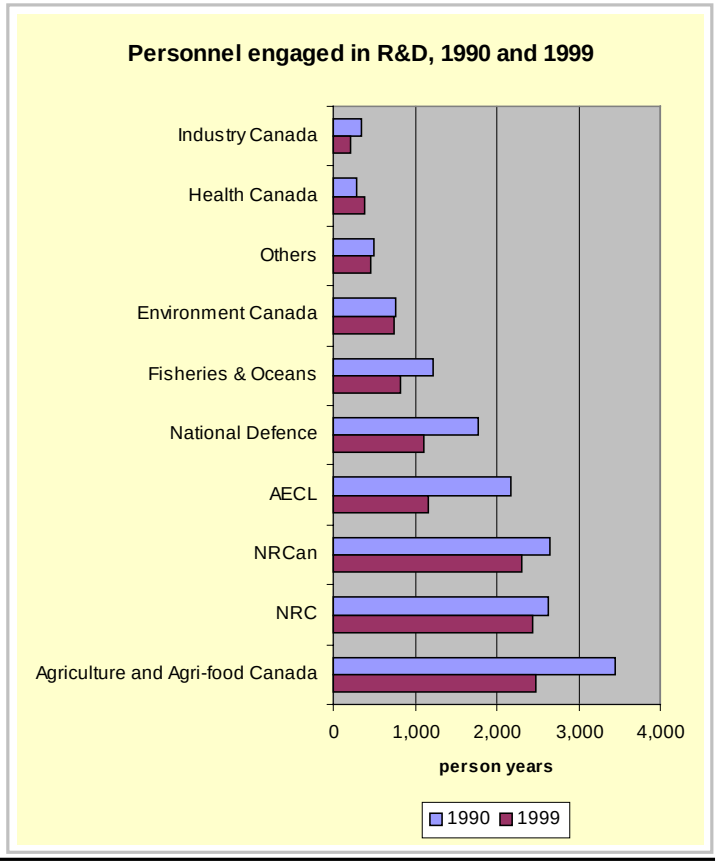
account for 57% of S&T personnel.

For the Social Sciences and Humanities, Statistics Canada remains the largest employer of personnel for S&T.

Detailed results of this annual survey are published in Science Statistics, Cat. No. 88-001-XIB, Vol. 24, No. 1 (March 2000).

Further information: Bert Plaus, Science and Innovation Surveys Section, (613) 951-6347. Bert.Plaus@statcan.ca.





Research and development in a service economy

The evolution of our economy from one dominated by agriculture and mining, through industrialisation, to one dominated by service industries is one of the most remarkable changes of our time. Simply walk through the core of any major Canadian city and you'll see the evidence: banks on every street corner, with fast food joints, overnight delivery services, and management consulting firms filling up the rest of the landscape. It's never been more important to understand this growing sector and its place in the Canadian economy. This article examines the economic structure of Canadian research and development and identifies areas of growth in private sector service industries.

The Canadian economy has been dominated by the service sector since the 1950's, and, not surprisingly, research and development (R&D) reflects that dominance. Over two-thirds of Canada's gross domestic product (GDP) and three-quarters of employment result from service activity, and close to 60% of the measured research and development is performed in the service sector.

Government and higher education accounted for 37% of R&D performance in 1996; an additional 20% was performed in private sector service industries, and some in private non-profit (PNP) institutions. Primary and secondary industries accounted for only about 40% of Canadian R&D.

The service economy

In 1996, 67% of GDP was attributed to services. Public services, education, health and government accounted for 12%, and 47% resulted mainly from services that could be sold in the marketplace. The distribution of GDP attributed to these services is given in Table 1.

R&D share of GDP and sector of performance

The gross domestic expenditure on R&D (GERD) has been a stable share of total GDP for many years, within a range of 1.4% to 1.5% of the total. Since the mid-eighties, the allocation of GERD to economic sectors was also stable. Table 2 shows a decline in the performance and funding of R&D by governments and institutions of higher education, while showing growth in the business sector.

Services play a key role in Canada's innovation system

Service industries have become major users, originators and agents for technology transfer and are leading the transformation of the Canadian economy into a knowledge-based economy. The dominant role of service industry firms in a service economy is not surprising. However, better understanding is needed of how they transfer technologies and ideas and how public institutions are involved in this transfer. This is the subject of a project being undertaken in SIEID that addresses the broader issue of the Canadian innovation system.

The full paper entitled ***Research and Development in a Service Economy,*** *Cat. No. 63F0002XPB No. 12 was published in July 1997 and is available electronically, free-of-charge through the Statistics Canada Web site.*

Further information: Dr. Fred Gault, Director SIEID, Statistics Canada, (613) 951-2198 Gaultfd@statcan.ca

Table 1. GDP by service industry, 1996

Industry	Percentage of GDP
Distributive services	16.6
Transportation and storage	4.4
Wholesale trade	6.3
Retail trade	5.9
Producer services	25.3
Communications	4.4
Finance, insurance and real estate	16.1
Business services	4.8
Consumer services	3.9
Accommodation and food	2.1
Amusement and recreation	1.0
Personal and household	0.8
Other services	1.5

Source: Statistics Canada (1996a), Gross Domestic Product by Industry, Catalogue No. 15-001.

Table 2. Percentage of GERD by sector for 1996 and 1993

Percentage of 1996[e] GERD by Sector[e]					
	Government	Business	Higher Education	PNP	Foreign
Performance	15	62	22	1	..
Funding	30	48	8	3	11
Percentage of 1993[e] GERD by Sector					
	Government	Business	Higher Education	PNP	Foreign
Performance	17	57	25	1	..
Funding	34	45	9	3	10

Note: Estimate for 1996

Source: Statistics Canada, 1996, Science Statistics, Catalogue No. 88-001-XIB Vol 20, No. 6 (*Total Spending on Research and Development in Canada, 1971 to 1996).*

Defining the information and communication technology sector: Part 2

This is a continuation of ***Defining the Information and Communication Technology (ICT) Sector***, which appeared in the last issue of this bulletin. Definition of this important sector is essential to its measurement and understanding. The new North American Industry Classification System (NAICS) based definition is the focus of this text.

The recent adoption by the OECD of a definition for the ICT (information and communications technology) sector and the adoption by the NAFTA countries of the new North American Industry Classification system (NAICS) has a considerable impact on the statistics used to describe this significant sector of the economy.

Until recently, the industry standard in use in Canada was the 1980 Canadian Standard Industrial Classification (1980 SIC). (This definition was detailed in the last edition of this bulletin.) Canadian ICT statistics are produced based on this standard. However, the 1980 SIC will gradually be replaced by the North American Industry Classification System (NAICS).

This new classification system has the advantage of recognising new industries, especially in computer services and telecommunications industries, two fast-growth areas.

The North American Industry Classification System is gradually being introduced into Statistics Canada's survey program.

For further information on this topic contact: Daniel April, Chief, Telecommunications Section, SIEID, Statistics Canada (613) 951-3177. Daniel.April@statcan.ca

NAICS based definition

Industry Group/ NAICS	Industry Title
Manufacturing	
33331	Commercial and service industry machinery manufacturing
33411	Computer and peripheral equipment manufacturing
33421	Telephone apparatus manufacturing
33422	Radio and television broadcasting and wireless communications equipment manufacturing
33431	Audio and video equipment manufacturing
33441	Semiconductor and other electronic component manufacturing
33451	Navigational, measuring, medical and controlling devices manufacturing
33592	Communication and energy wire and cable manufacturing
Goods related services	
41731	Computer, computer peripheral and pre-packaged software wholesaler-distributors
41732	Electronic components, navigational and communications equipment and supplies wholesaler-distributors
41791	Office and store machinery and equipment wholesaler-distributors
53242	Office machinery and equipment rental and leasing
Intangible services	
51121	Software publishers
51322	Cable and other program distribution
51331	Wired telecommunications carriers
51332	Wireless telecommunications carriers (except satellite)
51333	Telecommunications resellers
51334	Satellite telecommunications
51339	Other telecommunications
51419	Other information services
51421	Data processing services
54151	Computer systems design and related services
81121	Electronic and precision equipment repair and maintenance

Measuring the attractiveness of research and development tax incentives

In many countries, research and development (R&D) tax incentives are a significant element of technology and innovation policy and are used to stimulate private sector research spending. The federal government is an essential player in science and technology activities in Canada in which it invests over five billion dollars each year. In addition to this direct investment, an additional $1.3 billion of assistance is provided through the federal R&D tax incentive program. This article examines regional differences in science and technology activities in Canada.

This study uses a method developed by the Conference Board of Canada to compare the tax incentives to do research and development (R&D) in each of the provinces. The B-Index analysis (the minimum benefit-cost ratio at which an R&D investment becomes profitable) provides a means of comparing tax incentives in terms of favourability to companies that perform R&D. The more favourable the tax treatment of R&D, the lower the B-index.

Canada's combined federal-provincial corporate income tax system remains the most attractive in its treatment of R&D. No other country or U.S. state has a tax system as favourable to R&D as the tax systems of Canada and any of its provinces (Table 1).

The top ranking of Canada's R&D tax treatment internationally results from the combination of the federal tax incentive package plus the additional support that most provinces provide.

In 1990, there were only three provinces operating their own R&D incentives: Ontario, Quebec and Nova Scotia. In 1992, Manitoba joined this group, followed by New Brunswick in 1994, Newfoundland in 1996 and Saskatchewan in 1998. In September 1999, British Columbia followed suit. This means that companies located in these provinces, as opposed to Alberta and Prince Edward Island, could spend more on R&D because they require (thanks to increased government assistance) a lower rate of return to make a profit.

The provinces with the most attractive tax treatment for R&D (combining the federal and provincial incentives) are Quebec, Newfoundland and Saskatchewan. Table 2 provides a complete ranking of all provinces according to their B-index.

This study shows that Canada's federal tax support for R&D has not diminished over time and continues to be one of the most generous and stable offerings in the industrialized world (Table 1).

Table 1. International comparison of B-indexes and after-tax costs 1998 (for a large manufacturing company).

Country	ATC	B-index	Tax Credits	Expense Deduction[1]	CIT[2]
Canada—PQ	0.482	0.699	yes*	CUR, ME	31.00
Canada—ON	0.507	0.787	yes	CUR, ME	35.60
United States—CA[3]	0.521	0.879	yes	CUR	40.75
Australia	0.570	0.890	yes*	CUR, ME	36.00
France	0.533	0.914	yes	CUR	41.67
Korea	0.635	0.918	yes	CUR	30.80
Mexico	0.640	0.969	yes	CUR	34.00
United Kingdom	0.690	1.000	no	CUR, ME, B	31.00
Japan	0.525	1.010	yes	CUR	48.00
Sweden	0.731	1.015	no	CUR	28.00
Italy	0.647	1.027	no	CUR	37.00
Germany	0.456	1.051	no	CUR	56.60

Notes:

* Allowances from taxable income

[1] CUR = immediate current expense deduction
ME = immediate machinery and equipment cost deduction
B = immediate buildings cost deduction
NO = no immediate current expense or capital cost deduction

[2] CIT = statutory corporate income tax rate (per cent)

[3] This comparison assumes California's tax system for the United States (an 11 per cent tax credit).

The proportion of R&D expenditure is assumed to be 90 per cent (0.90) for current expenses (including 60 per cent [0.60] for wages and salaries), 5 per cent (0.05) for machinery and equipment, and 5 per cent (0.05) for buildings and structures.

A nominal discount rate of 10 per cent was used in calculating present values of depreciation allowances and incremental tax incentives. The present value of depreciation allowances was calculated using the end-of-period rule.

Source: The Conference Board of Canada.

Table 2. Ranking of Canada's provinces according to the value of the B-index: manufacturing firms, 1999

Province/Territory	Large company		Small company	
	B-index	Rank	B-index	Rank
*Quebec	0.699	1	0.369	1
*Newfoundland	0.709	2	0.582	2–3
*Saskatchewan	0.713	3	0.585	5
*Nova Scotia	0.717	4	0.582	2–3
*Manitoba	0.719	5	0.584	4
*British Columbia	0.730	6	0.604	7
*New Brunswick	0.757	7	0.614	8
*Ontario	0.787	8	0.591	6
Prince Edward Island	0.825	9	0.676	9–10
Alberta	0.831	10	0.676	9–10

* Provinces offering R&D tax credit

Source: The Conference Board of Canada.

For more information on the B-index model, see Donald G. McFetridge and Jacek P. Warda, Canadian R&D Tax Incentives: Their Adequacy and Impact *(Toronto: Canadian Tax Foundation, 1983); and Jacek P. Warda,* International Tax Competitiveness of Canadian R&D Tax Incentives: An Update *(Ottawa: The Conference Board of Canada, 1990).*

The full research paper entitled ***Measuring the Attractiveness of R&D Tax Incentives: Canada and Major Industrial Countries,*** *Cat. No. 88F0006XPB No. 10 was published in December 1999 and is available electronically, free-of-charge through the Statistics Canada web site. (See page 2 of this bulletin for instructions). The author of this paper is Jacek Warda, The Conference Board of Canada.*

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The working age population, by degrees

To understand the relationship between S&T skills and the labour market, it is important to know what skills people have and where those people are employed. Statistics Canada has produced two studies that provide some insight into where S&T skills are deployed. Both use field of study and level of post-secondary degree as an indicator of skills.

The first study, *A Dynamic Analysis of the Flows of Canadian Science and Technology Graduates into the Labour Market* was summarized in the first issue of the Innovation Analysis Bulletin (Vol. 1., No. 1). This study, based on an analysis of the National Graduate Survey, showed in which industries new S&T graduates were employed. The results indicated that the greatest and fastest growing concentration of recent S&T graduates was in business services industries. These industries include computer and related services, consulting engineering and management consulting services. But what about the stock of existing skills?

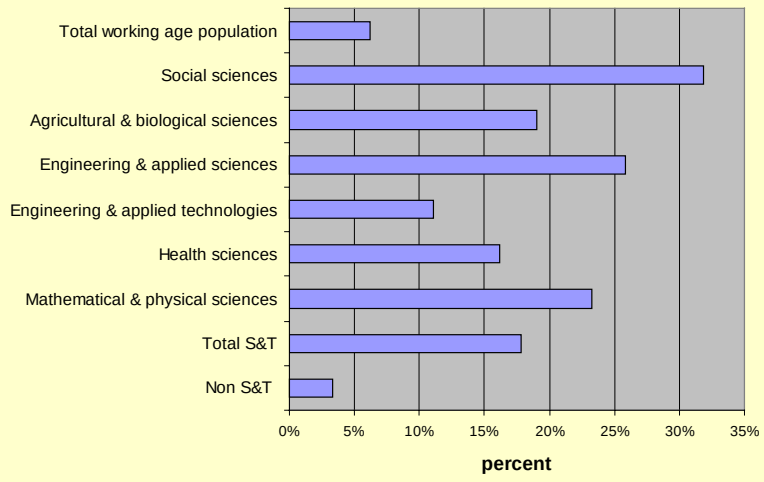
The second study, *An Analysis of Science and Technology Workers: Deployment in the Canadian Economy*, looks at the field of study of the working age (age 15 and over) population and their economic characteristics. The report, authored by Wendy Hansen of MERIT, provides a vast amount of detail on the industry and employment status of graduates in key S&T disciplines (see Table 1).

The number of people with S&T degrees is growing five times faster than the number with non-S&T degrees

For 1996, the number of persons with S&T degrees was 5.0 million. This accounted for about 22.1% of the total working age population and was 17.8% higher than in 1991. The working age population without S&T degrees (including persons with non-S&T degrees as well as persons with no post-secondary diploma) grew at only one-fifth of that rate.

The number of degree holders in social sciences increased by 31.9% between 1991 and 1996 (Figure 1). Not far behind were engineering and applied sciences (25.9%) and mathematical and physical sciences (23.2%). Together, these three fields accounted for three-quarters of the growth in S&T graduates.

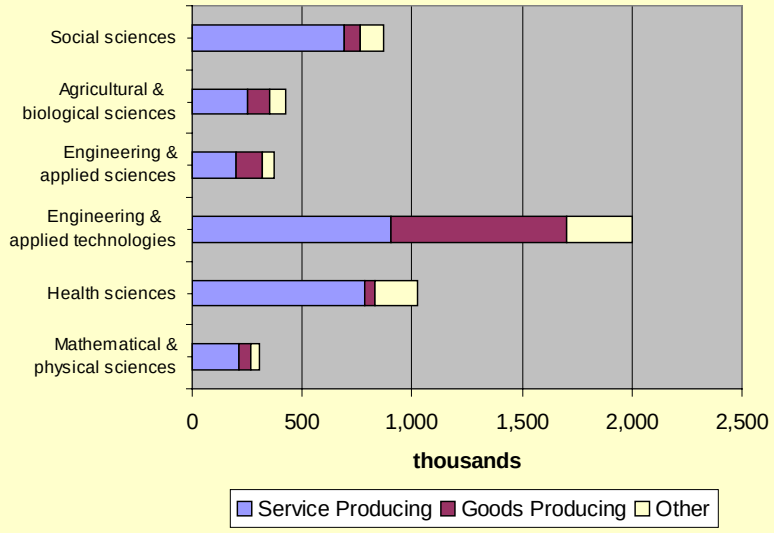
Figure 1. Degrees held by working age population, change 1991 to 1996



Service-producing industries (see Table 2 for a list of industries included in each sector) had about the same proportion of S&T graduates as goods producing industries–about a quarter of the persons in both sectors had S&T degrees. However, the service-producing industries employed about three times as many persons in total as goods-producing industries.

Degree holders in engineering and applied technologies accounted for two-thirds of the S&T degree holders in the goods-producing industries. In the service-producing industries, the degrees were more evenly distributed but with a predominance of persons with degrees in engineering and applied technologies, health sciences, and social sciences (see Figure 2).

Figure 2. S&T Degree Holders, 1996



The highest concentrations of S&T degree holders are in health sciences, business services and construction

The highest concentrations of S&T graduates are in health (52.0% have S&T degrees), business services (38.1%), and construction (34.4%). Further detail on industries and disciplines is shown in Table 3.

In addition to the general overview for all industries and all disciplines given in this report, the author produced three reports giving more detail on specific sectors:

- *The Work Force in the Computer Services Industry*,
- *The Work Force in the Telecommunication Carriers Industry*, and
- *The Work Force in the Communication and Electronic Equipment Industry*,

Each is subtitled *A Skill Base in Transition: 1986 to 1996*. These reports are posted on the Merit Web site at: http://meritbbs.unimaas.nl/publications/ict.html.

The full paper titled **An Analysis of Science and Technology Workers: Deployment in the Canadian Economy** *is available free of charge on the Statistics Canada Web site. Please see instructions on page 2 for downloading working papers.*

Further information, contact Claire Simard, SIEID Knowledge Indicators Section, Statistics Canada, (613) 951-1916, Claire.Simard@statcan.ca.

Table 1. Disciplines selected as S&T specializations

Social sciences [125-187]	**Engineering and applied science technologies and trades [302-369]**
Agriculture and biological sciences [221-266]	Chemical technologies [304-307]
Agricultural science and technology [221-238]	Electronic and electrical technologies [322-327]
Biochemistry [239]	Civil and general engineering technologies [333-339]
Biology [240-244]	Industrial engineering technologies [340-348]
Biophysics [245]	Mechanical engineering technologies [349-358]
Household science and related fields [249-254]	Primary industry and resource processing technologies [359-362]
Engineering and applied science [267-301]	Transportation technologies [363-368]
Architecture and architectural engineering [267-269]	**Health [370-441]**
Aerospace and aeronautical engineering [270]	Pharmaceutical sciences and pharmacy [412-413]
Biological engineering (includes biomedical and clinical) [272]	**Mathematics and physical sciences [442-480]**
Chemical engineering [273]	**Applied mathematics [442-447]**
Civil engineering [274]	Chemistry [448-454]
Design and systems engineering [275]	Geology and related fields [455-462]
Electrical and electronic engineering [276]	Mathematical statistics [463]
Industrial engineering [279]	Mathematics [464]
Mechanical engineering [280-282]	Metallurgy and materials science [465]
Mining, metallurgical and petroleum engineering [283-286]	Physics [471-478]
Forestry [294-298]	
Landscape architecture [299-301]	

Source: Statistics Canada, Culture, Tourism and the Centre for Education Statistics and, Census Dictionary of Terms.

Table 2. Industry classification list (1980 Standard Industrial Classification)

Goods-producing industries [011-449, 491-499]
- Agriculture and related industries [010-023]
- Fishing and trapping industries [031-033]
- Forestry and logging industries [041-051]
- Mining (including milling), quarrying and oil well industries [061-092]
- Manufacturing industries [101-399]
- Food industry [101-109]
- Beverage industry [111-114]
- Tobacco industry [121,122]
- Rubber products industry [151-159]
- Plastic products industry [161-169]
- Leather and allied products industry [171]
- Primary textile industry [181-183]
- Textile products industry [191-199]
- Clothing industry [243-249]
- Wood industry [251-259]
- Furniture and fixtures industry [261-269]
- Paper and allied products industry [271-279]
- Printing, publishing and allied industries [281-284]
- Primary metal industry [292-299]
- Fabricated metal products (excluding machinery and transportation equipment) [301-309]
- Machinery (except electrical machinery) industry [311-319]
- Transportation equipment industry [321-329]
- Electrical and electronic products industry [331-339]
- Non-metallic mineral products industry [351-359]
- Refined petroleum and coal products industry [361-369]
- Chemical and chemical products industry [371-379]
- Other manufacturing industries [391-399]
- Construction industries [401-449]
- Utilities (other) industries [491-499]

Service producing industries [451-484,501-999]
- Transportation and storage industries [451-479]
- Communication industries [481-484]
- Wholesale and retail trade industries [501-692]
- Finance and insurance industries [701-761]
- Business service industries [771-779]
- Computer and related service industries [772]
- Engineering and other scientific, architect and technical services [775]
- Government service industries [811-841]
- Educational service industries [851-859]
- Health and social service industries [861-869]
- Accommodation, food and beverage industries [911-922]

Source: Statistics Canada, 1989, Canadian Standard Industrial Classification for Companies and Enterprises, 1980. Cat. No. 12-570-XPE.

Table 3. Distribution of S&T degree holders by industry, 1996

		Service producing industries					
Field of study	Total	Wholesale and retail trade	Health and social services	Accommodation and food	Education	Business services	Other service producing industries
				thousands			
Total working age population	11,437	2,708	1,511	1,124	1,085	1,005	4,001
				percent			
Total working age population	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Non S&T	73.4%	79.6%	48.0%	87.4%	77.1%	61.9%	76.7%
Total S&T	26.6%	20.4%	52.0%	12.6%	22.9%	38.1%	23.3%
Social sciences	6.1%	3.0%	8.1%	2.8%	7.4%	10.9%	6.7%
Agricultural and biological sciences	2.2%	1.9%	2.5%	3.7%	2.9%	1.5%	1.8%
Engineering & applied sciences	1.8%	1.0%	0.3%	0.5%	1.9%	7.9%	1.6%
Engineering and applied technologies	7.9%	10.9%	2.2%	3.2%	3.9%	10.6%	9.7%
Health sciences	6.8%	2.4%	37.8%	1.6%	3.0%	1.9%	1.9%
Mathematical and physical sciences	1.9%	1.1%	1.1%	0.7%	3.8%	5.3%	1.7%

	Goods producing industries					
Field of study	Total	Manufacturing	Construction	Other goods producing industries	Other[1]	Total working age population
				thousands		
Total working age population	4,110	2,185	889	1,036	7,082	22,629
				percent		
Total working age population	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Non S&T	70.9%	72.1%	65.8%	72.7%	89.1%	77.8%
Total S&T	28.9%	27.4%	34.4%	27.3%	10.9%	22.1%
Social sciences	1.8%	1.9%	1.5%	1.6%	1.5%	3.8%
Agricultural and biological sciences	2.4%	1.6%	1.1%	5.3%	1.1%	1.9%
Engineering & applied sciences	2.9%	3.3%	2.0%	2.9%	0.7%	1.7%
Engineering and applied technologies	19.5%	17.9%	28.7%	14.8%	4.2%	8.8%
Health sciences	1.1%	1.1%	0.7%	1.4%	2.8%	4.5%
Mathematical and physical sciences	1.3%	1.6%	0.5%	1.4%	0.6%	1.4%

1. This includes persons who have never worked as well as those who did not specify an industry of employment.

Source: Statistics Canada. 1999. *An Analysis of Science and Technology Workers: Deployment in the Canadian Economy.* SIEID Working Paper Series, Cat. No. 88F0006XIB, No. 99-03. Ottawa, Canada.

What's new?

Recent and upcoming events in innovation analysis

Science and Innovation

S&T activities

Federal and provincial S&T

Federal science expenditures by province

Status: The following publications were recently released:

- ***Science Statistics***, Cat. No. 88-001, Volume 23, No. 10 (December 1999)
- ***Science Statistics***, Cat. No. 88-001, Volume 24, No. 1 (March 2000)
- ***Federal Scientific Activities***, Cat. No. 88-204 (May 2000)

Contact: Bert Plaus (613) 951-6347,
Bert.Plaus@statcan.ca

or: Janet Thompson (613) 951-2580
Janet.Thompson@statcan.ca

Industrial R&D

Research and development in Canadian Industry

Status: An annual publication***, Industrial Research and Development 1999 Intentions*** (with 1998 preliminary estimates and 1997 actual expenditures) Cat. No., 88-202-XPB will be released in May 2000.

Contact: Don O'Grady (613) 951-9923
Don.O'Grady@statcan.ca

Private non-profit organizations

R&D expenditures in private non-profit organizations

Status: The 1999 annual survey is in the field. Results are expected in fall 2000.

Contact: Robert Schellings (613) 951-6679
Robert.Schellings@statcan.ca

Human resources and intellectual property

The higher education sector

Intellectual Property Commercialization in the Higher Education Sector

Status: A working paper on the results will be released in May 2000.

Contact: Michael Bordt (613) 951-8585
Michael.Bordt@statcan.ca

or: Cathy Read (613) 951-3838
Cathy.Read@statcan.ca

Human resources in science and technology

Science and technology workers: deployment in the Canadian economy

Status: Further reports from this analysis are available on the Merit Web site: http://meritbbs.unimaas.nl/publications/ict.html.

Contact: Claire Simard (613) 951-1916
Claire.Simard@statcan.ca

Advanced technologies

Innovation and advanced technologies and practices in the construction and related industries

Status: A working paper on this topic is forthcoming in summer 2000.

Contact: Frances Anderson (613) 951-6307
Frances.Anderson@statcan.ca

Advanced technologies in natural resource industries

Status: The survey is under development.

Contact: Frances Anderson (613) 951-6307
Frances.Anderson@statcan.ca

Advanced technology in Canadian manufacturing

Status: Provincial estimates are expected in summer 2000.

Contact: Brenda Hutchinson (613) 951-3497
Brenda.Hutchinson@statcan.ca

Innovation

Innovation in manufacturing

Status: Data from the 1999 survey was released on January 31. This is the first survey of innovation in manufacturing since 1993. A working paper with detailed analysis of the results will be released in the summer Frances Anderson (SIEID, Statistics Canada) and Pierre Therrien (Marketplace Innovation, at

Industry Canada) presented preliminary results at the second annual meeting of the Innovation Systems Research Network on May 11.

Contact: Brian Nemes (613) 951-2530
Brian.Nemes@statcan.ca

Innovation in services

Status: A working paper titled ***Barriers to Innovation in Services Industries in Canada*** by Pierre Mohnen and Julio Rosa was released on November 26, 1999.

A paper titled ***Innovation in the Engineering Services Industry*** was published on January 18, 2000 in the 3rd quarter 1999 issue of ***Services Indicators*** (Cat. No. 63-016-XIB).

Contact: Daood Hamdani (613) 951-3490
Daood.Hamdani@statcan.ca

Biotechnology

Biotechnology in industry

Status: The questionnaire is currently in the field. Results from this survey are expected in fall 2000.

Biotechnology R&D in Canadian industries for 1997

Status: A service bulletin will be released on this topic shortly.

Federal S&T expenditures

Status: A paper will be released shortly.

Contact: Antoine Rose (613) 951-9919
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Connectedness

Coordinator: George Sciadas (613) 951-6389
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Telecommunications

Annual survey of telecommunications services

Status: The 1999 annual survey will be going into the field for collection shortly.

Quarterly telecommunications statistics

The third quarter, 1999 ***Quarterly Telecommunications Statistics*** is due for release by the end of May 2000. Starting the second quarter, of 2000 we will be using a new electronic questionnaire for collecting data.

Contact: Haig McCarrell (613) 951-5948
Haig.McCarrell@statcan.ca

Broadcasting

Annual surveys of cable, radio and television

Status: 1997/1998 publication is under development and will be released shortly.

Contact: Daniel April (613) 951-3177
Daniel.April@statcan.ca

Household Internet use

Status: Data from the 1999 survey will be released shortly.

An electronic product titled ***Internet Use in Canada*** (Cat. No. 56F0003XIE) was released in April. It contains an inventory of surveys conducted by Statistics Canada used to measure household/individual Internet use. It also includes survey names; descriptions (including information such as objective of survey, sample size, frequency, target group and response rate); user guides; charts and graphs.

It is online at:
http://www.statcan.ca/english/freepub/56F0003XIE/index.htm

Contact: Jonathan Ellison (613) 951-5882
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Business e-commerce

Annual survey of information and communication technologies and electronic commerce, 1999

Status: Data from this survey will be released in June 2000.

Contact: Cathy Bakker (613) 951-2929
Cathy.Bakker@statcan.ca

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Internet Use In Canada, 1999

Research Papers and Articles

63-016-XIB Services Indicators 1st. Quarter, 1999	Getting connected or staying unplugged: The growing use of computer communication services, 1998
11-008-XIE Canadian Social Trends	Plugged into the Internet (for year 1998)
11-001-XIE The Daily July 15, 1999 (for year 1998)	Internet use by households
11-001-XIE The DailyApril 23, 1999 (for year 1998)	Internet use by households
11-010-XIB Canadian Economic Observer	Canadians Connected, 1997
11-001-XIE The Daily June 17, 1998 (for year 1997)	Communicating by Computer
Analytical Paper # 13	Access to The Information Highway, The Sequel
Analytical Paper # 9	Access to The Information Highway

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