

Catalogue no. 88-001-X

Science Statistics

Industrial Research and
Development, 2004 to 2008



September 2008 edition



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Statistics Canada
Science, Innovation and Electronic Information Division

Science Statistics

Industrial Research and Development, 2004 to 2008

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Published by authority of the Minister responsible for Statistics Canada

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September 2008

Catalogue no. 88-001-X, vol. 32, no. 5

ISSN 1209-1278

Frequency: Irregular

Ottawa

La version française de cette publication est disponible sur demande (n° 88-001-X au catalogue).

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- . not available for any reference period
- .. not available for a specific reference period
- ... not applicable
- 0 true zero or a value rounded to zero
- 0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- p preliminary
- r revised
- x suppressed to meet the confidentiality requirements of the *Statistics Act*
- E use with caution
- F too unreliable to be published

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Highlights

Spending on industrial research and development 2008 (Intentions)

- Companies that perform industrial research and development anticipate spending \$16.3^E billion on industrial R&D in 2008, up slightly from the \$16.2 billion spending intentions for 2007.
- Industrial research and development spending intentions indicate that R&D expenditures by the information communication technologies (ICT) sector are expected to reach \$6.2 billion this year, about 40% of the total. Spending by the health sector is expected to represent 10%.
- The six leading industries performing R&D in 2008 are expected to remain unchanged from 2007. Together, information and cultural industries (\$1.7^E billion), communications equipment (\$1.6^E billion), scientific research and development services (\$1.4 billion), computer system design and related services (\$1.1^E billion), pharmaceutical and medicine (\$1.1 billion), and aerospace products and parts (\$0.9 billion) will represent almost half (48.2%) of all industrial R&D expected to be performed in 2008.

Analysis

Industrial research and development, 2004 to 2008

In 2008, research and development (R&D) expenditures are expected to show a slight growth of \$157 million to reach \$16.3E billion, in current dollars (table 1-1).

The six leading industries performing R&D in 2008 are expected to remain unchanged from 2007. Together, information and cultural industries (\$1.7E billion), communications equipment (\$1.6E billion), scientific research and development services (\$1.4 billion), computer system design and related services (\$1.1E billion), pharmaceutical and medicine (\$1.1 billion), and aerospace products and parts (\$0.9 billion) will represent almost half (48.2%) of all industrial R&D to be performed in 2008 (table 1-1).

The manufacturing sector will continue to account for over half (53%) of all industrial R&D performance in 2008, although its share will be down from 2004 (55%) (table 1-1).

R&D spending intentions for 2008 indicate that industrial R&D performed by the health sector (\$1.6 billion) is expected to represent 10% of total industrial R&D in 2008 down from 12% in 2004 (table 1-2). The pharmaceutical and medicine industry will account for two-thirds (67%) of the industrial R&D spending in the health sector in 2008 (table 1-2).

R&D expenditures by the information communication technology sector, comprised of a number of industries, are expected to reach \$6.2E billion in 2008 or 38% of total industrial R&D spending intentions (table 2).

The largest enterprises have historically performed the greatest share of industrial R&D in Canada. When size is measured by the revenues of the firm, the share of industrial R&D performed by those firms with \$400 million or more in revenues is expected to increase from 42% in 2004 to 45% in 2008 (table 1-12). When size is measured by the number of employees the picture is similar. Firms with 2,000 or more employees accounted for 33% of all industrial R&D performed in 2004 and are anticipated to account for 35% in 2008 (table 1-13).

Estimates for industrial R&D spending distributed by province are now available to 2006.

Industrial R&D spending in 2006 was highest in Ontario, where it amounted to \$8.0 billion, or 50% of the total, and in Quebec spending hit \$4.6 billion, or 28% (table 1-3).

Newfoundland and Labrador has experienced rapid growth in industrial R&D performance between 2002 and 2006, from \$22 million to \$88 million in constant dollars. Industrial R&D expenditures in Prince Edward Island have also experienced rapid growth moving \$4 million in 2002 to \$12 million in 2006, in constant dollars (table 1-3).

For New Brunswick, industrial R&D expenditures in constant dollars went from \$62 million in 2002 to \$90 million in 2006. For the same period in real terms, Alberta saw its industrial R&D expenditures move from \$782 million to \$1.1 billion, while Saskatchewan went from \$112 million to \$148 million and British Columbia and Territories increased from \$1.1 billion to \$1.4 billion. Industrial R&D expenditures in constant dollars for Manitoba went from \$155 million in 2002 to \$163 million in 2006 whereas in Nova Scotia, R&D spending in 2002 stood at \$93 million in 2002 and was almost unchanged at \$94 million in 2006 (table 1-3).

Provinces varied considerably with respect to the types of industries performing R&D. These variations can be attributed to the differences in their respective economies overall.

British Columbia was unique in that 63% of its industrial R&D was performed by firms in the service sector – the only province to report a majority performed by this sector (table 1-11).

Ontario and Manitoba reported similar distributions of R&D in 2006, with manufacturing accounting for just over 60% and services just over 35%, and the other sectors making up the remainder. The difference between these two

provinces lies in the changes in these distributions since 2002. In Ontario, manufacturing firms dropped from 69% of all industrial R&D performed in 2002, while in Manitoba its share rose from 56% (tables 1-7 and 1-8).

The distribution of industrial R&D in Quebec and Atlantic was similar to Ontario and Manitoba, but the share performed by manufacturing was somewhat lower and correspondingly, the share performed by firms in service industries was somewhat higher than in Ontario and Manitoba. For Quebec and Atlantic Canada the share performed by manufacturing firms was 53% and 55% respectively, and for services industries firms it was 42% and 39% respectively (tables 1-5 and 1-6).

Source of funds information for industrial R&D spending estimates are now available for 2006.

Funding for R&D performed by businesses can come from a variety of sources: from within the company, from the federal government, from foreign sources (which includes intra-corporate transfer by multi-national corporations) and “other” which includes funds from provincial governments, higher education organizations and private non-profit organizations.

Overall, 78% of all funding for industrial R&D came from within Canadian businesses. Industrial R&D performers received 15% of their funding from foreign sources. Funds from the federal government account for less than 2% and the remaining funds come from “other” sources (table 3).

There are different levels of reliance on sources of funding for R&D by firms in various sectors. The two largest sectors, manufacturing and services, report similar but not identical funding profiles. Manufacturing relies on internal Canadian sources for 82% of funding, while the corresponding figure for the service sector firms is 73%. The remainder in both cases is composed primarily of foreign sources of funds (table 3).

Industrial R&D personnel information is now available for 2006.

Firms performing R&D in Canada in 2006 employed the equivalent of 148,813 full-time personnel. This represents an increase of 25.7% over 2002 (table 4).

Of the 148,813 full-time equivalent employees engaged in R&D in 2006, 87,577 had a university degree. This was a 19.6% increase in degree-holding researchers from the 73,202 in 2002. The number of R&D support personnel, while lower in number, increased more rapidly with a 35.6% change between 2002 and 2006 (table 4).

The category of research employee that changed the most was degree-holding researchers with a Master’s degree, with a 53.4% increase between 2002 and 2006 (table 4).

The nature of research and development activities for 2006 are now available.

Research and development, as defined by the Frascati Manual, comes in three main varieties: basic research, applied research and experimental development. Basic research is focussed on discoveries of new knowledge of underlying phenomena, without consideration of how this knowledge could be used in practice. Applied research, as the name implies, is research that is more focussed on a specific practical purpose or application. Experimental development is typically “closest to the market”, that is, work that is focussed on adapting scientific discoveries to a very particular application, typically a new or significantly improved product or process.

Emphasis on the type of R&D typically varies by reporting sector with universities and non-profit laboratories most focussed on basic and applied research. Businesses, by contrast, tend to do more experimental development work. The proportion of R&D performed by Canadian business that was experimental development has remained stable from 2002 to 2006 at 83% (table 5).

About half of all experimental development R&D focussed on the development of new products and another quarter focussed on the improvement of existing products (table 5).

The proportion of activity which is basic research in 2006 was 5%, while activities in applied research were 13% (table 5).

The counts of R&D performers are available to 2005.

The number of firms performing R&D in Canada continues to show signs of growth, reaching 19,087 in 2005.

R&D firms can perform their R&D in multiple locations and therefore can be counted in more than one province. For 2005, the count of R&D performers including those making expenditures in more than one province was 19,435. Based on the location of the R&D performance, the majority of R&D performers are located in the two central provinces, Quebec 7,739 (40%) and Ontario 7,484 (39%). There were 637 (3%) of R&D performers in Atlantic Canada, 403 (2%) in Manitoba, 224 (1%) in Saskatchewan, 1,167 (6%) in Alberta and 1,781 (9%) in British Columbia and the Territories.

Related products

Selected publications from Statistics Canada

88-202-X	Industrial Research and Development: Intentions
88-204-X	Federal Scientific Activities
88-221-X	Gross Domestic Expenditures on Research and Development in Canada and the Provinces
88-522-X	Science and Technology Activities and Impacts: A Framework for a Statistical Information
88F0006X	Science, Innovation and Electronic Information Division Working Papers
88F0017M	Science, Innovation and Electronic Information Division Research Papers

Selected CANSIM tables from Statistics Canada

358-0001	Gross domestic expenditures on research and development, by science type and by funder and performer sector, annual
358-0024	Business enterprise research and development (BERD) characteristics, by industry group based on the North American Industry Classification System (NAICS), annual
358-0026	Intellectual property management, by federal departments and agencies indicators, annual

Selected surveys from Statistics Canada

4201	Research and Development in Canadian Industry
4204	Research and Development of Canadian Private Non-Profit Organizations
4208	Provincial Research Organizations (PRO)
4209	Provincial Government Activities in the Natural Sciences
4210	Provincial Government Activities in the Social Sciences
4212	Federal Science Expenditures and Personnel, Activities in the Social Sciences and Natural Sciences
5109	Higher Education Research and Development Estimates

Selected summary tables from Statistics Canada

- *Research and development performed by the business enterprise sector*
- *Domestic spending on research and development (GERD), funding sector, by province*
- *Domestic spending on research and development (GERD), performing sector, by province*
- *Domestic spending on research and development (GERD)*

Statistical tables

Table 1-1
Total intramural research and development expenditures — By industry

	2004 ^r	2005 ^r	2006 ^p	2007 ^p	2008 ^p
	millions of dollars				
Total all industries	15,299	15,791	16,137	16,159	16,316^E
Total agriculture, forestry, fishing and hunting	102	109	115	114^E	102^E
Agriculture	78	80	91	89 ^E	80 ^E
Forestry and logging	19	19	20 ^E	F	F
Fishing, hunting and trapping	5	10	4	F	F
Total mining and oil and gas extraction	371	433	578	489	500
Oil and gas extraction	314	386	515	x	x
Mining	58	47	63	F	F
Total utilities	243	271	318	x	x
Electric power	230	258	301	299	310
Other utilities	13	13	17	F	F
Construction	56	69	69	F	F
Total manufacturing	8,343	8,435	8,563	8,426	8,607
Food	136	136	141	140 ^E	142 ^E
Beverage and tobacco	x	19	17	19	F
Textile	57	55	x	48 ^E	49 ^E
Wood products	80	100	122	105 ^E	91
Paper	420	343	374	311	314 ^E
Printing	35	39	x	F	F
Petroleum and coal products	190	214	202	239	239
Pharmaceutical and medicine	1,190	1,177	1,077	1,081	1,090
Other chemicals	220	199	189	208 ^E	198 ^E
Plastic products	124	129	135	F	F
Rubber products	26	31	x	25	25
Non-metallic mineral products	44	73	75	81 ^E	67 ^E
Primary metal (ferrous)	47	x	x	x	x
Primary metal (non-ferrous)	225	250	272	236	244
Fabricated metal products	202	214	238	F	F
Machinery	498	551	592	527 ^E	624 ^E
Computer and peripheral equipment	165	156	141	139 ^E	116 ^E
Communications equipment	1,510	1,410	1,506	1,556 ^E	1,631 ^E
Semiconductor and other electronic components	811	840	826	893	905
Navigational, measuring, medical and control instruments	370	473	441	410	428
Other computer and electronic products	22	28	x	19 ^E	17 ^E
Electrical equipment, appliance and components	148	142	160	160 ^E	158 ^E
Motor vehicle and parts	657	638	608	568	590
Aerospace products and parts	x	857	x	x	928
All other transportation equipment	45	x	63	x	x
Furniture and related products	31	31	x	x	x
Other manufacturing industries	182	x	216	227 ^E	215 ^E
Total services	6,183	6,473	6,494	6,743	6,720
Wholesale trade	794	828	814	859	823 ^E
Retail trade	31	40	x	F	F
Transportation and warehousing	52	57	x	64	61
Information and cultural industries	1,390	1,585	1,669	1,800 ^E	1,744 ^E
Finance, insurance and real estate	331	412	428	377	F
Architectural, engineering and related services	515	445	418	419	441
Computer system design and related services	1,168	1,137	1,179	1,197 ^E	1,127 ^E
Management, scientific and technical consulting	69	71	56	F	F
Scientific research and development services	1,225	1,215	1,152	1,218	1,350
Health care and social assistance	364	400	378	421	421 ^E
All other services	244	283	293	295 ^E	273 ^E

Table 1-2
Total intramural research and development expenditures — In the pharmaceutical and medicine industries

	2004 ^r	2005 ^r	2006 ^p	2007 ^p	2008 ^p
	millions of dollars				
Total pharmaceutical and medicine research and development	1,884	1,845	1,615	1,615	1,625
Pharmaceutical and medicine (manufacturing)	1,190	1,177	1,077	1,081	1,090
Wholesale trade (pharmaceutical)	301	325	311	316	305 ^E
Scientific research and development services (pharmaceutical)	393	343	227	218 ^E	230 ^E

Table 1-3
Total intramural research and development expenditures — By provinces

	2002 ^r	2003 ^r	2004 ^r	2005 ^r	2006 ^p
	millions of current dollars				
Canada	13,540	14,123	15,299	15,791	16,137
Sub-total, Atlantic Provinces	181	181	213	295	320
Newfoundland and Labrador	22	31	30	86	99
Prince Edward Island	4	7	7	11	13
Nova Scotia	93	79	94	102	106
New Brunswick	62	64	82	96	102
Quebec	4,154	4,202	4,340	4,199	4,598
Ontario	7,064	7,468	7,871	8,250	8,033
Manitoba	155	150	183	199	184
Saskatchewan	112	88	113	152	167
Alberta	782	861	1,131	1,193	1,236
British Columbia ¹	1,094	1,174	1,447	1,503	1,600
	millions of 2002 constant dollars				
Canada	13,540	13,672	14,352	14,329	14,293
Sub-total, Atlantic Provinces	181	175	200	268	283
Newfoundland and Labrador	22	30	28	78	88
Prince Edward Island	4	7	7	10	12
Nova Scotia	93	76	88	93	94
New Brunswick	62	62	77	87	90
Quebec	4,154	4,068	4,071	3,810	4,073
Ontario	7,064	7,229	7,384	7,486	7,115
Manitoba	155	145	172	181	163
Saskatchewan	112	85	106	138	148
Alberta	782	833	1,061	1,083	1,095
British Columbia ¹	1,094	1,136	1,357	1,364	1,417

1. Includes the Yukon Territory, Northwest Territories and the Nunavut.

Table 1-4
Total intramural research and development expenditures — By major industrial sectors, Canada

	2002 ^r	2003 ^r	2004 ^r	2005 ^r	2006 ^p
	millions of dollars				
Canada	13,540	14,123	15,299	15,791	16,137
Agriculture, forestry, fishing and hunting	107	94	102	109	115
Mining and oil and gas extraction	253	283	371	433	578
Utilities	131	130	243	271	318
Construction	49	48	56	69	69
Manufacturing	8,241	8,225	8,343	8,435	8,563
Services	4,758	5,343	6,183	6,473	6,494

Table 1-5
Total intramural research and development expenditures — By major industrial sectors, Atlantic Canada

	2002 ^f	2003 ^f	2004 ^f	2005 ^f	2006 ^p
	millions of dollars				
Atlantic Canada	181	181	213	295	320
Agriculture, forestry, fishing and hunting	x	x	x	x	x
Mining and oil and gas extraction	x	x	x	x	x
Utilities	x	x	x	x	x
Construction	2	0 ^s	x	x	x
Manufacturing	85	98	123	178	177
Services	84	72	81	107	126

Table 1-6
Total intramural research and development expenditures — By major industrial sectors, Quebec

	2002 ^f	2003 ^f	2004 ^f	2005 ^f	2006 ^p
	millions of dollars				
Quebec	4,154	4,202	4,340	4,199	4,598
Agriculture, forestry, fishing and hunting	37	33	37	x	44
Mining and oil and gas extraction	x	x	x	x	x
Utilities	x	x	x	x	x
Construction	x	x	x	x	29
Manufacturing	2,427	2,389	2,352	2,258	2,459
Services	1,562	1,647	1,826	1,760	1,921

Table 1-7
Total intramural research and development expenditures — By major industrial sectors, Ontario

	2002 ^f	2003 ^f	2004 ^f	2005 ^f	2006 ^p
	millions of dollars				
Ontario	7,064	7,468	7,871	8,250	8,033
Agriculture, forestry, fishing and hunting	28	29	31	32	41
Mining and oil and gas extraction	x	30	27	22	13
Utilities	x	x	x	24	24
Construction	x	x	x	31	30
Manufacturing	4,871	4,867	4,919	4,987	4,941
Services	2,115	2,508	2,856	3,155	2,983

Table 1-8
Total intramural research and development expenditures — By major industrial sectors, Manitoba

	2002 ^f	2003 ^f	2004 ^f	2005 ^f	2006 ^p
	millions of dollars				
Manitoba	155	150	183	199	184
Agriculture, forestry, fishing and hunting	2	1	2	1	x
Mining and oil and gas extraction	x	x	x	x	x
Utilities	x	x	x	x	x
Construction	x	x	x	x	x
Manufacturing	87	89	104	116	113
Services	62	58	74	78	66

Table 1-9
Total intramural research and development expenditures — By major industrial sectors, Saskatchewan

	2002 ^f	2003 ^f	2004 ^f	2005 ^f	2006 ^p
	millions of dollars				
Saskatchewan	112	88	113	152	167
Agriculture, forestry, fishing and hunting	x	x	5	2	x
Mining and oil and gas extraction	x	16	x	x	x
Utilities	x	0	x	x	x
Construction	0	x	0 ^s	x	x
Manufacturing	32	34	x	53	48
Services	40	33	39	37	37

Table 1-10
Total intramural research and development expenditures — By major industrial sectors, Alberta

	2002 ^f	2003 ^f	2004 ^f	2005 ^f	2006 ^p
	millions of dollars				
Alberta	782	861	1,131	1,193	1,236
Agriculture, forestry, fishing and hunting	x	x	x	x	x
Mining and oil and gas extraction	179	213	x	335	440
Utilities	x	1	x	x	x
Construction	x	x	x	x	x
Manufacturing	300	322	x	392	305
Services	292	320	389	342	355

Table 1-11
Total intramural research and development expenditures — By major industrial sectors, British Columbia

	2002 ^f	2003 ^f	2004 ^f	2005 ^f	2006 ^p
	millions of dollars				
British Columbia¹	1,094	1,174	1,447	1,503	1,600
Agriculture, forestry, fishing and hunting	23	20	21	x	17
Mining and oil and gas extraction	20	x	24	27	49
Utilities	x	x	x	x	x
Construction	x	5	x	x	x
Manufacturing	438	426	474	452	520
Services	603	704	919	994	1,006

1. Includes the Yukon Territory, Northwest Territories and Nunavut.

Table 1-12
Total intramural research and development expenditures — By performing company revenue size

	2004 ^f	2005 ^f	2006 ^p	2007 ¹	2008 ¹
	millions of dollars				
Total	15,299	15,791	16,137	16,159	16,316^E
Non-commercial firms	196	186	202	169 ^E	187 ^E
Less than \$1,000,000	1,221	1,060	1,102	1,124 ^E	1,135 ^E
\$1,000,000 to 9,999,999	2,165	2,397	2,383	2,398 ^E	2,429 ^E
\$10,000,000 to 49,999,999	1,895	1,775	2,017	2,084 ^E	2,057 ^E
\$50,000,000 to 99,999,999	834	1,038	943	990 ^E	938 ^E
\$100,000,000 to \$399,999,999	2,547	2,386	2,272	2,326 ^E	2,273 ^E
Greater than \$399,999,999	6,441	6,949	7,218	7,068 ^E	7,296 ^E

1. Values for 2007 and 2008 are estimated based on revenue size as reported for 2006 fiscal year.

Table 1-13
Total intramural research and development expenditures — By performing company employment size

	2004 ^r	2005 ^r	2006 ^p	2007 ¹	2008 ¹
	millions of dollars				
Total	15,299	15,791	16,137	16,159	16,316^E
Non-commercial enterprise	196	186	202	169 ^E	187 ^E
1 to 49	2,585	2,706	2,909	2,949 ^E	2,982 ^E
50 to 99	1,337	1,279	1,197	1,214 ^E	1,199 ^E
100 to 199	1,152	1,260	1,200	1,269 ^E	1,241 ^E
200 to 499	1,282	1,322	1,452	1,477 ^E	1,442 ^E
500 to 999	1,397	1,458	1,487	1,433 ^E	1,429 ^E
1,000 to 1,999	2,238	2,043	2,072	2,074 ^E	2,091 ^E
Greater than 1,999	5,113	5,536	5,618	5,574 ^E	5,746 ^E

1. Values for 2007 and 2008 are estimated based on employment size as reported for 2006 fiscal year.

Table 2
Research and development expenditures and personnel in the information and communications technology sector

	2004 ^r	2005 ^r	2006 ^p	2007 ^p	2008 ^p
	millions of dollars				
All industries					
Total research and development expenditures	15,299	15,791	16,137	16,159	16,316^E
Current	14,220	14,696	15,028	15,159	15,349 ^E
Capital	1,078	1,095	1,109	1,000	968 ^E
Information and communications technology industries					
Total research and development expenditures	5,631	5,825	6,000	6,247^E	6,221^E
Current	5,290	5,492	5,583	5,829 ^E	5,844 ^E
Capital	341	334	417	418 ^E	376 ^E
Industries other than information and communications technology					
Total research and development expenditures	9,667	9,965	10,137	9,912	10,096
Current	8,930	9,204	9,445	9,330	9,505 ^E
Capital	738	761	692	582	591 ^E
	number				
All industries					
Total research and development personnel	138,113	140,610	148,813	..	..
Professional	81,295	83,689	87,577	..	..
Technicians	39,828	39,796	44,284	..	..
Other	16,990	17,125	16,952	..	..
Information and communications technology industries					
Total research and development personnel	51,414	53,562	57,115	..	..
Professional	36,646	39,149	41,472	..	..
Technicians	10,572	10,328	12,523	..	..
Other	4,196	4,085	3,120	..	..
Industries other than information and communications technology					
Total research and development personnel	86,699	87,048	91,698	..	..
Professional	44,649	44,540	46,105	..	..
Technicians	29,256	29,468	31,761	..	..
Other	12,794	13,040	13,832	..	..

Note(s): Personnel counts are reported as full-time equivalents.

Table 3
Sources of funds for intramural research and development, by industrial sector 2006, with total values for 2005

	Canadian performing company	Federal ¹ government	Other ² Canadian sources	Foreign sources	Total
millions of dollars					
Total 2006^P	12,651	261	774	2,452	16,137
Agriculture, forestry, fishing and hunting	75	x	x	x	115
Mining and oil and gas extraction	456	x	x	x	578
Utilities	290	x	x	x	318
Construction	65	2	2	0	69
Manufacturing	7,021	183	351	1,008	8,563
Services	4,744	69	296	1,385	6,494
Total 2005^r	12,269	322	658	2,542	15,791

1. Taxes foregone as a result of income tax incentives for research and development are not considered direct government support and are not attributed to the Federal Government according to international standards.
2. Includes funds from related companies, from research and development contracts for other firms and grants and contracts from the provincial governments.

Table 4
Number of full time equivalent personnel engaged in research and development, by occupational category and by degree level

	2002 ^r	2003 ^r	2004 ^r	2005 ^r	2006 ^P
number					
Total	118,370	127,058	138,113	140,610	148,813
Professionals	73,202	76,458	81,295	83,689	87,577
Bachelor's	58,888	58,298	61,434	63,446	66,845
Master's	9,692	12,531	14,087	14,396	14,867
Doctorate	4,622	5,629	5,774	5,847	5,865
Supporting staff	45,168	50,600	56,818	56,921	61,236
Technicians	31,586	34,567	39,828	39,796	44,284
Other	13,582	16,033	16,990	17,125	16,952

Note(s): Personnel counts are reported as full-time equivalents.

Table 5
Distribution of current intramural research and development expenditures by type of activity

	2002 ^r	2003 ^r	2004 ^r	2005 ^r	2006 ^P
millions of dollars					
Total	12,489	13,140	14,220	14,696	15,028
Basic research	438	496	585	586	727
Applied research	1,679	1,689	1,772	1,932	1,907
New product development	5,842	5,760	6,057	5,921	6,170
Existing product improvement	2,339	2,431	2,835	3,252	3,062
New process development	758	898	1,160	928	1,038
Existing process improvement	988	1,187	1,109	1,126	1,211
New technical services development	310	485	465	680	684
Existing technical services improvement	134	194	238	271	230

Note(s): Due to rounding, components may not add to the totals.

Data quality, concepts and methodology

Survey methodology

The 2006 survey

The 2006 survey collected data on four years. The four years were: 2005 for which the data are expected to be final; 2006, for which the data are expected to be close to final, 2007 for which the data are planned expenditures, and 2008 for which the data are a forecast of spending intentions.

Data from the surveyed firms in 2006 represent approximately 80% of the total expenditures. Estimates are not available for administrative data for 2007 and 2008. Therefore, based on the percentage increase or decrease by industry reported by the surveyed firms, forecasts are made for planned expenditures and spending intentions based on the administrative data.

The 2006 survey was mailed out in September 2007. All companies believed to be performing or funding one and a half million dollars or more in R&D were sent a questionnaire. The mailing list of companies was made up of firms which had reported R&D in the previous survey, of firms claiming an R&D income tax incentive for 2006, of firms reported by government respondents as R&D contractors or grantees for 2006 to 2007, of firms reported by other companies as funders or performers of R&D, and of firms indicated in some other way, such as newspaper or journal articles or provincial directories. These larger performers and funders received "long forms", covering four years, 2005, 2006, 2007 and 2008.

Recent changes to survey methodology

To further relieve respondent burden, the 2006 survey threshold was raised from one million dollars to one and one half million dollars, thereby reducing the number of surveyed firms by 481. These firms continue to be included in our tabulations as their R&D data is imputed using CRA administrative data from the SR&ED program.

To improve data quality for two of the survey's classification variables - Revenues in Canada and Number of Employees in Canada - administrative sources were used to replace missing or inconsistent data.

Revenue figures for the SR&ED tax filers were adjusted to reflect corporate income tax data for the corresponding filer. These tax data are from T2 corporate income tax data mapped to the Statistics Canada Chart of Accounts (COA) classification, by firm, from Tax Data Division. The variable COA4 comprises (Total) Revenue for firms. COA4 values were used to improve data quality for missing total revenues data from reference year 1997 through the current year. Inconsistent reported total revenue data were also examined by subject matter experts with reference to COA4 data. Within the publication, the revisions have impacted the revenue size groups. It is believed the revisions have substantially improved the quality of the revenue variable.

Canada Revenue Agency (CRA) Payroll Deductions total employment data (PD7) was used to improve the quality of missing or inconsistent total employment data for survey years 2001 through the current survey year. Payroll Deduction data are monthly data, therefore an annual average is calculated from CRA monthly Payroll Deduction data for all business enterprises that reported having one or more employees in at least one of the twelve months of the tax year.

The survey's history

Data on R&D in the business enterprise sector, covering commercially oriented enterprises (privately or publicly owned), industrial non-profit organizations and trade associations, have been collected since 1955. Until 1969,

the survey was biennial. From 1970 to 1981, all known performers or funders of industrial R&D were surveyed for odd-numbered years and a sample, including the leading performers, were surveyed for even-numbered years. From 1982 to 1991, a full survey was conducted annually.

Because of reductions in the science and technology program, only the top 100 R&D performers (accounting for 64% of all industrial R&D) were surveyed for the 1992 and 1994 reference years. However, as a result of a cost-sharing agreement with the province of Quebec, the 1992 and 1994 industrial R&D survey results also included small firms having R&D activities in the province of Quebec.

Prior to 1997, Statistics Canada surveyed all firms that performed or funded R&D in Canada. Virtually all of these firms also provided information to CRA in order to claim tax benefits under the Scientific Research and Experimental Development (SR&ED) program. In an effort to reduce respondent burden, Statistics Canada stopped surveying the small performers and funders (those with less than \$1 million of R&D in Canada) and instead, imputes their R&D data using CRA administrative data from the SR&ED program. In the 2006 survey year this threshold was raised to \$1.5 million thereby further reducing respondent burden.

When first implemented, this initiative resulted in an understatement of the total value of intramural expenditure and of the total number of R&D personnel. Under the current tax regulations, firms must file their application to the SR&ED program within 18 months of expenditure. Once claims are submitted, they are processed and forwarded to Statistics Canada. As a result, data may not arrive for up to two years after the incurrence of expenditures. To remedy the situation, an estimation system was subsequently put into place to impute values for outstanding administrative data. This estimation system confirms the company is active using Statistics Canada's extensive Business Register, and then applies an estimate based on industry trends.

Recent developments in R&D spending are important economic signals, desired promptly by a variety of users. Because the small estimation of outstanding CRA data does not seriously influence overall trends, the R&D data are published as soon as possible after the survey is conducted, and revised in subsequent publications.

Data quality

One of the problems in a survey of this type is to ensure that the quality of the data is satisfactory. It cannot be expected that all firms funding R&D will be surveyed, will respond and will report correctly. There are sources of information such as federal government grant and contract lists to aid in identifying firms and editing returns. In addition, complete coverage cannot be assured. This is especially true for the smaller companies in the service industries. The term, R&D, in spite of survey guidelines, can be misinterpreted.

Different interpretations of the definition of R&D also result in discrepancies between federal government reporting of funds to industry (the business enterprise sector) for R&D and industry's reporting of such funds. For example, a federal government department may regard a contract to industry for the building of a prototype (e.g., communications satellite) as R&D. The contractors and subcontractors, however, may only use a portion of the R&D contract and even that portion may not be reported because the contract is considered as part of the firm's "routine" contract work. Differences may also arise for contracts awarded to industry for services or equipment required for a government in-house project which are reported by the federal sponsor as industrial R&D contracts. Therefore, the totals for R&D grants and contracts from the federal government to industry shown in this publication do not agree with those reported in Federal Science Activities, 2007/2008, (Catalogue no. 88-204-X-).

Other notes

The business enterprise sector is the only sector in which data are not collected on R&D in the social sciences and humanities.

In this survey, the reporting unit is generally the company or enterprise. This unit has been used because a company, which may have several establishments or subsidiaries, will often have a centralized research unit. In the case of a company with decentralized research units, the reporting unit may be the division, if the accounting system enables divisions to supply the required data. This procedure creates a problem when classifying data

by industry. A company can only be assigned to one industry although that company may have establishments in several industries. The assignment is based on the activity from which the firm derived the greatest portion of its income. Thus, comparisons between R&D data collected at the company level and other data collected at the establishment level, such as “census value added”, may be misleading. Since industrial R&D is highly concentrated, the use of the company/enterprise as the main reporting unit also means that classification cannot be very detailed, to avoid disclosing individual company data.

The survey response

The response for the 2006 “base year” survey is shown below.

For 2006 the response rate was 66 %. Survey questionnaires were mailed to 1,017 firms: 670 were returned; 613 were data captured as long forms, 39 were data captured and changed to short forms, 9 indicated no research and development activity; 6 were out of business; 3 were included with another respondent; and 347 were estimated.

An additional 164 firms were added to the survey universe from the 2006 Scientific Research & Experimental Development tax file.

Technical notes

Data for the reference year 2006 are available for all tables with the exception of counts of companies. However, in the even years prior to 1982 and for 1992 and 1994, the estimation procedures did not permit the preparation of tables based on revenue size, employment size, sources of funds and country of control of companies.

Regional data on research and development (R&D) expenditures and personnel are only available for 1977, 1979 and 1981 to 2006.

Terminology

The following terminology is used within the publication:

Performing company: The organization which carried out the R&D and submitted the return. In the case of a consolidated return, performing company could include several companies. It also includes divisions of an enterprise which send separate returns or organizations such as industrial non-profit organizations.

Related companies: Includes parent, subsidiary and other affiliated companies. In the case where a consolidated return is submitted, “related companies” would exclude companies included in the consolidation.

R&D contracts for other companies: R&D contract work performed by the reporting company for other companies.

Federal grants: Federal R&D grants and the R&D portion of any other federal grants; it excludes funds or tax credits for R&D tax incentives.

Federal contracts: Federal R&D contracts and the R&D portion of any other federal contracts.

Provincial sources: Provincial R&D grants and contracts, and the R&D portion of any provincial grants and contracts; it excludes funds or tax credits for R&D tax incentives.

Other Canadian sources: Includes funds from universities and from levels of government other than federal and provincial.

Intramural expenditures: Expenditures for R&D work performed within the reporting company, including work financed by others.

Current intramural expenditures: Labour costs, fringe benefits and other current costs for R&D, including non-capital purchases of materials, supplies and equipment but excluding capital depreciation. Current intramural expenditures also include contracts for services required to carry out R&D (e.g. contracts awarded for drilling needed for heavy oil R&D).

Capital expenditures: Expenditures on fixed assets used in the R&D program, classified into land, buildings, and equipment.

Revenues: Revenues resulting from the sale of products and services (after deducting sales and excise taxes), and other revenues such as those generated from investment and rentals.

Non-commercial firms: R&D performers without a directly affiliated Canadian commercial base. Includes industrial non-profit organizations and trade associations, R&D establishments set up by consortia, and R&D establishments set up by non-residents without associated commercial establishments and funded principally from abroad.

R&D personnel: Calculated in full-time equivalent (FTE). R&D may be carried out by persons who work solely on R&D projects or by persons who devote only part of their time to R&D, and the balance to other activities such as testing, quality control and production engineering. To arrive at the total effort devoted to R&D in terms of person-years, it is necessary to estimate the full-time equivalent of these persons working only part-time in R&D.

FTE = number of persons who work solely on R&D projects + estimate of time of persons working only part of their time on R&D.

Example calculation:

If out of five scientists engaged in R&D work, one works solely on R&D projects and the remaining four devote only one quarter of their working time to R&D, then: $FTE = 1 + 1/4 + 1/4 + 1/4 + 1/4 = 2$ scientists.

Federal government funds for industrial R&D: Federal support consists of grants and contracts for R&D to be performed by business enterprises. Taxes foregone as a result of income tax incentives for R&D are not considered direct government support and are not attributed to the federal government.

Industrial classification

The natural classification to use within the business enterprise sector is the North American Industry Classification System (NAICS). There are, however, problems with its use. A major problem is caused by companies with establishments in more than one industry (e.g., companies which both refine petroleum and extract oil). Another is caused by the concentration of the R&D activity among a few companies. In order to prevent disclosure of individual respondents many industries must be grouped together to provide sufficient observations for publication.

A third problem is that the classification, chosen to represent general industrial activity, may not be entirely suitable for identifying companies chosen only for their involvement in R&D.

There are some restrictions on the application of the NAICS, for example, industrial non-profit organizations will be assigned to the industry they support.

The R&D activities of other sectors such as the federal government, provincial governments, higher education, and private non-profit organizations are covered in other reports.

Definitions

Research and development

Research and development (R&D) is systematic investigation carried out in the natural and engineering sciences by means of experiment or analysis to achieve a scientific or commercial advance.

Research is original investigation undertaken on a systematic basis to gain new knowledge.

Development is the application of research findings or other scientific knowledge for the creation of new or significantly improved products or processes. If successful, development will usually result in devices or processes which represent an improvement in the “state of the art” and are likely to be patentable.

Example:

The investigation of electrical conduction in crystals was research. The application of this knowledge to the creation of a new amplifying device - the transistor - was development. The application of the device to the construction of new electrical circuits for television receivers was development. The formulation of new plastic cases for a television receiver is design, not development.

Research and development may be carried out either by a permanent R&D unit (e.g., R&D division) or by a unit generally engaged in any non-R&D activity such as engineering or production. In the first case, the R&D unit may spend part of its time on routine testing or trouble shooting or on some other activities which should not be included in R&D. In the second, only the R&D portion of such units' total activity should be considered.

Research and development should be considered to be "Scientific Research and Experimental Development" as defined in Section 37, Regulation 2900 of the Income Tax Act; this section specifically excludes the following:

- (i) market research, sales promotion,
- (ii) quality control or routine analysis and testing of materials, devices or products,
- (iii) research in the social sciences or the humanities,
- (iv) prospecting, exploring or drilling for or producing minerals, petroleum or natural gas,
- (v) the commercial production of a new or improved material, device or product or the commercial use of a new or improved process,
- (vi) style changes, or routine data collection,

Note:

Although the definition of "Scientific Research and Experimental Development" is considered to be the same as R&D, certain expenditures for scientific research cannot be claimed for income tax purposes (e.g., land, building). All expenditures attributable to R&D are included in this report.