

Catalogue no. 88-001-X

Science Statistics

Industrial Research and
Development, 2006 to 2010



December 2010 Edition



Statistics
Canada

Statistique
Canada

Canada

How to obtain more information

For information about this product or the wide range of services and data available from Statistics Canada, visit our website at www.statcan.gc.ca, e-mail us at infostats@statcan.gc.ca, or telephone us, Monday to Friday from 8:30 a.m. to 4:30 p.m., at the following numbers:

Statistics Canada's National Contact Centre

Toll-free telephone (Canada and the United States):

Inquiries line	1-800-263-1136
National telecommunications device for the hearing impaired	1-800-363-7629
Fax line	1-877-287-4369

Local or international calls:

Inquiries line	1-613-951-8116
Fax line	1-613-951-0581

Depository Services Program

Inquiries line	1-800-635-7943
Fax line	1-800-565-7757

To access this product

This product, Catalogue no. 88-001-X, is available free in electronic format. To obtain a single issue, visit our website at www.statcan.gc.ca and browse by "Key resource" > "Publications."

Standards of service to the public

Statistics Canada is committed to serving its clients in a prompt, reliable and courteous manner. To this end, Statistics Canada has developed *standards of service* that its employees observe. To obtain a copy of these service standards, please contact Statistics Canada toll-free at 1-800-263-1136. The service standards are also published on www.statcan.gc.ca under "About us" > "The agency" > "Providing services to Canadians."

Statistics Canada
Business Special Surveys and Technology Statistics Division

Science Statistics

Industrial Research and Development, 2006 to 2010

December 2010 Edition

Published by authority of the Minister responsible for Statistics Canada

© Minister of Industry, 2010

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

December 2010

Catalogue no. 88-001-X, vol. 34, no. 6

ISSN 1209-1278

Frequency: Irregular

Ottawa

Cette publication est également disponible en français.

Note of appreciation

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

User information

Symbols

The following standard symbols are used in Statistics Canada publications:

- . 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

Additional symbols used in this publication:

- A excellent (0 to 4.9% coefficient of variation)
- B very good (5.0% to 9.9% coefficient of variation)
- C good (10.0% to 14.9% coefficient of variation)
- D acceptable (15.0% to 24.9% coefficient of variation)

Table of contents

Highlights	4
Analysis	5
Related products	7
Statistical tables	
1 Total intramural research and development expenditures	10
1-1 By industry	10
1-2 By provinces	11
1-3 By major industrial sectors, Canada	11
1-4 By major industrial sectors, Atlantic Canada	12
1-5 By major industrial sectors, Quebec	12
1-6 By major industrial sectors, Ontario	12
1-7 By major industrial sectors, Manitoba	12
1-8 By major industrial sectors, Saskatchewan	13
1-9 By major industrial sectors, Alberta	13
1-10 By major industrial sectors, British Columbia	13
2 Sources of funds for intramural research and development, by industrial sector 2008, with total values for 2007	14
3 Number of full time equivalent personnel engaged in research and development, by occupational category	14
Data quality, concepts and methodology	15

Highlights

Spending on industrial research and development

- Businesses performing industrial research and development (R&D) in Canada anticipated spending \$14.8 billion (in current dollars) in 2010. This is down 6.2% from actual spending reported in 2008 and 2.6% from 2009 planned spending estimates.
- In 2008, companies spent \$15.8 billion on industrial R&D, down \$852 million for a 5.1% decline from 2007.
- In 2010, 43% of industrial R&D spending was performed in the following five industries: scientific research and development services (\$1.6 billion), communications equipment industry (\$1.3 billion), wholesale trade (\$1.2 billion), computer system design and related services industry (\$1.1 billion), and information and cultural industries (\$1.1 billion).
- Spending in 2008 in Ontario amounted to \$7.6 billion, or 48% of the industrial R&D total. Businesses in Quebec spent \$4.6 billion, or 29% of the total.
- R&D activities provided employment to an estimated 158,926 full-time equivalent positions in 2008, an increase of 15% in research effort from five years previously.

Note:

Data for 2008 on employment in R&D activities, sources of funds for R&D, and industrial R&D spending distributed by provinces are also available.

Revised R&D spending intentions for 2009 are also available. Spending intentions for 2009 and 2010 are preliminary indications of the direction of R&D investments. They do not represent absolute values of R&D spending, and should be used with caution.

Analysis

Businesses performing industrial research and development (R&D) anticipated spending \$14.8 billion (in current dollars) in 2010 down slightly from 2008, which marks the generally-accepted date of the start of the global financial crisis.

The 2008 downturn of the global financial markets is echoed in the industrial R&D spending, which saw a decrease of \$852 million, or a 5.1% decline, from 2007.

Current intramural expenditures for industrial R&D include wages and salaries and other current expenditures. On average, wages and salaries continue to represent about 60% of current intramural R&D expenditures.

In 2008, the most recent year for which counts of R&D personnel are available, R&D activities provided employment to 158,926 full-time equivalent (FTE) positions, an increase of 15% in research effort from five years previously (138,213 FTE positions).

Industry Classification of Research and Development (R&D) Enterprises

In 2010 five industries are anticipated to exceed \$1 billion dollars in R&D expenditures. The scientific research and development services industry estimates investing \$1.6 billion, followed by the communications equipment industry at \$1.3 billion, the wholesale trade industry at \$1.2 billion, the computer system design and related services industry at \$1.1 billion, and information and cultural industries at \$1.1 billion. Together these industries are expected to represent 43% of total industrial R&D spending.

The industrial classification of firms performing R&D is annually updated based upon the North American Industry Classification System (NAICS) code indicated on Statistics Canada's Business Register, the master frame for business sector surveys. About 100,000 businesses are reviewed annually for NAICS updating – and if their industry classifications change then the industrial distribution of R&D also changes.

The Research and Development in Canadian Industry (RDCI) surveys enterprises. An enterprise is defined as a business unit that directs and controls the allocation of resources relating to its operations, and for which consolidated financial and balance sheet accounts are maintained. The activity with the most economic weight or importance determines the NAICS code that Statistics Canada assigns to the enterprise.

The economic importance of activities undertaken by enterprises can vary year to year due to changes in market conditions, including commodity price changes that may affect the value of an enterprise's revenues or exchange rate changes that may affect the value of an enterprise's import costs or export revenues.

Industries illustrating movements between NAICS codes due to changes in the influence of activities include pharmaceuticals. From year to year, the most important economic activity of these enterprises can move among pharmaceutical and pharmacy supplies wholesaler-distributors (NAICS 414510), pharmaceutical and medicine manufacturing (NAICS 325410) and scientific research and development services in the physical, engineering and life sciences (NAICS 541710).

Enterprises with economic activities related to fossil fuels, specifically oil and gas and their refined products also often show movement between NAICS codes. For example, enterprises performing R&D can move between oil and gas extraction (NAICS 2111) and petroleum and coal product manufacturing (NAICS 3241).

Sources of Funds for Industrial Research and Development (R&D)

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

Overall, the same pattern of financing of industrial R&D continued for 2008 with the majority (79% or \$12.5 billion) of funding coming from within the performing firms themselves. Industrial R&D performers received 13% or \$2.0 billion from foreign sources, with the federal government funding 2% or \$292 million and the remainder of funds coming from other sources.

Provincial Distribution of Industrial Research and Development (R&D)

In 2008 industrial R&D spending continued to be highest in Ontario, where it amounted to \$7.6 billion, or 48% of the national total, and in Quebec, at \$4.6 billion or 29% of the total. Remaining provincial R&D expenditures in descending order follow: British Columbia (which includes the three Territories) at \$1.5 billion (9.8%); Alberta \$1.5 billion (9.4%); Manitoba \$160 million (1.0%); Saskatchewan \$132 million (0.8%). Together the four Atlantic provinces made up the remainder of \$317 million (2.0%).

Provinces varied with respect to the industrial sectors performing R&D. In British Columbia and the Territories, R&D in the services sector exceeded R&D performed in the manufacturing sector. This was also the case for the first time in 2008 for Quebec.

In Manitoba, Ontario and the Atlantic provinces, manufacturing remained the leading sector for R&D performance, although the share for the services sector continued to be a close second to manufacturing.

Alberta alone reported the largest share of its industrial R&D in the resource sector.

Counts of Industrial Research and Development (R&D) Performers

The counts of industrial R&D performers are available to 2007. The number of firms performing R&D in Canada continues to grow, reaching 22,314 in 2007.

R&D firms can perform their R&D in multiple locations and therefore can be counted in more than one province. For 2007, the count of R&D performers including those making R&D expenditures in more than one province was 23,429. Based on location of the R&D performance, the majority of R&D performers are located in the two central provinces, Quebec 8,899 (38%) and Ontario 9,372 (40%). There were 824 (3.5%) R&D performers in the Atlantic provinces; 423 (1.8%) in Manitoba; 267 (1.1%) in Saskatchewan; 1,372 (5.9%) in Alberta; and 2,272 (9.7%) in British Columbia and the Territories.

Note to readers

Also available are data on revised R&D spending intentions for 2009. Spending intentions for 2009 and 2010 are preliminary indications of the direction of R&D investments. They do not represent absolute values of R&D spending, and should be used with caution.

Data Processing & Methodology Updates: A new stratified sampling methodology was implemented for reference year 2008 to improve industrial coverage. Quality indicators have been added for reference year 2008, reflecting new edit and imputation processes. Finally, for this release Statistics Canada processed Scientific Research and Experimental Development (SR&ED) tax incentive program data from two Canada Revenue Agency forms for 2008.

In November 2008 the Canada Revenue Agency changed the SR&ED form, which discontinued the need to report the nature of R&D activities and the area of specialization of R&D activities. CRA introduced the need to report R&D expenditures by science type, which will become available for reference year 2010.

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 (GERD), and the Provinces
88-522-X	Science and Technology Activities and Impacts: A Framework for a Statistical Information
88F0006X	Business Special Surveys and Technology Statistics 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
358-0142	Federal expenditures on science and technology and its components in current dollars and 2002 constant dollars, annual
358-0143	Federal expenditures on science and technology and its components, by type of science and performing sector, annual
358-0144	Federal expenditures on science and technology and its components, by activity and performing sector, annual
358-0145	Federal intramural expenditures on science and technology and its components, by type of science for the National Capital Region, annual
358-0146	Federal personnel engaged in science and technology activities, by type of science and personnel category, annual
358-0147	Federal personnel engaged in science and technology and its components, by type of science and personnel category, annual
358-0148	Federal personnel engaged in science and technology and its components, by type of science, personnel category, Canada, provinces and territories, annual

358-0149	Federal expenditures on science and technology and its components, by type of science, performing sector, Canada, provinces and territories, annual
358-0150	Federal extramural expenditures on science and technology and its components, by type of science, performing sector, type of payment, Canada, provinces and territories, annual
358-0151	Federal expenditures on science and technology and its components, by socio-economic objectives, 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
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

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

Statistical tables

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

	2006 ^r	2007 ^r	2008 ^p	2009 ^p	2010 ^p
	millions of dollars				
Total all industries	16,474	16,644	15,792^A	15,202^A	14,808^A
Total agriculture, forestry, fishing and hunting	118	172	106^A	112^A	116^B
Agriculture	94	94	93 ^A	97 ^A	102 ^B
Forestry and logging	20	72	6 ^A	7 ^B	7 ^C
Fishing, hunting and trapping	4	6	6 ^A	7 ^B	7 ^C
Total mining and oil and gas extraction	731	662	1,035^B	681^E	F
Oil and gas extraction	663	603	994 ^B	648 ^E	F
Mining	68	59	41 ^A	34 ^D	47 ^E
Total utilities	313	265	184^A	160^A	166^A
Electric power	296	239	167 ^A	x	x
Other utilities	18	26	17 ^A	x	x
Construction	85	101	120^A	89^C	F
Total manufacturing	8,850	8,407	7,300^A	7,296^A	6,929^B
Food	152	151	159 ^A	174 ^A	142 ^B
Beverage and tobacco	19	25	14 ^A	x	13 ^B
Textile	58	49	43 ^A	49 ^A	33 ^C
Wood products	126	111	195 ^A	F	F
Paper	565	265	133 ^A	F	F
Printing	42	44	43 ^A	46 ^B	43 ^C
Petroleum and coal products	224	219	148 ^A	x	154 ^D
Pharmaceutical and medicine	1,085	1,045	738 ^B	761 ^A	768 ^A
Other chemicals	191	185	246 ^A	228 ^A	217 ^C
Plastic products	155	130	111 ^A	125 ^B	125 ^B
Rubber products	39	89	35 ^A	37 ^D	39 ^C
Non-metallic mineral products	76	77	60 ^A	61 ^C	67 ^D
Primary metal (ferrous)	54	53	77 ^A	F	69 ^E
Primary metal (non-ferrous)	255	299	254 ^A	195 ^C	211 ^C
Fabricated metal products	230	250	236 ^A	236 ^C	223 ^B
Machinery	576	543	520 ^A	521 ^A	520 ^D
Computer and peripheral equipment	112	109	102 ^A	93 ^C	99 ^C
Communications equipment	1,480	1,487	1,466 ^A	1,716 ^B	1,324 ^C
Semiconductor and other electronic components	847	846	448 ^A	414 ^A	386 ^B
Navigational, measuring, medical and control instruments	451	402	406 ^A	418 ^A	414 ^B
Other computer and electronic products	15	24	19 ^A	F	21 ^E
Electrical equipment, appliance and components	177	258	150 ^A	154 ^B	164 ^B
Motor vehicle and parts	608	506	401 ^A	336 ^D	306 ^E
Aerospace products and parts	972	912	990 ^A	889 ^C	966 ^C
All other transportation equipment	68	67	67 ^A	58 ^D	57 ^E
Furniture and related products	36	41	40 ^A	35 ^B	31 ^B
Other manufacturing industries	236	220	196 ^A	202 ^B	227 ^D
Total services	6,376	7,037	7,048^A	6,864^A	6,730^A
Wholesale trade	813	974	1,329 ^A	1,204 ^A	1,219 ^A
Retail trade	36	55	44 ^A	41 ^B	41 ^D
Transportation and warehousing	63	74	75 ^A	54 ^C	41 ^D
Information and cultural industries	1,483	1,462	1,264 ^A	1,161 ^D	1,120 ^D
Finance, insurance and real estate	462	457	418 ^A	428 ^D	422 ^D
Architectural, engineering and related services	462	487	412 ^A	404 ^A	388 ^B
Computer system design and related services	1,178	1,268	1,193 ^A	1,298 ^B	1,140 ^C
Management, scientific and technical consulting	61	73	65 ^A	54 ^B	55 ^C
Scientific research and development services	1,160	1,284	1,561 ^A	1,585 ^B	1,637 ^B
Health care and social assistance	339	349	304 ^C	265 ^B	308 ^B
All other services	318	555	383 ^A	369 ^B	358 ^B

Table 1-2
Total intramural research and development expenditures — By provinces

	2004 ^r	2005 ^r	2006 ^r	2007 ^r	2008 ^p
millions of current dollars					
Canada	15,144	15,638	16,474	16,644	15,792 ^A
Sub-total, Atlantic provinces	213	292	323	325	317 ^B
Newfoundland and Labrador	30	86	101	95	108 ^C
Prince Edward Island	7	11	12	13	13 ^C
Nova Scotia	94	97	106	102	94 ^C
New Brunswick	82	99	104	115	101 ^D
Quebec	4,326	4,170	4,830	4,941	4,595 ^A
Ontario	7,833	8,204	8,153	7,965	7,564 ^A
Manitoba	182	200	188	205	160 ^B
Saskatchewan	113	153	174	190	132 ^D
Alberta	1,139	1,208	1,422	1,425	1,479 ^A
British Columbia ¹	1,337	1,412	1,384	1,594	1,545 ^B
millions of 2002 constant dollars					
Canada	14,206	14,203	14,579	14,274	13,008 ^A
Sub-total, Atlantic provinces	200	265	286	279	261 ^B
Newfoundland and Labrador	28	78	89	81	89 ^C
Prince Edward Island	7	10	11	11	11 ^C
Nova Scotia	88	88	94	87	77 ^C
New Brunswick	77	90	92	99	83 ^D
Quebec	4,058	3,787	4,274	4,238	3,785 ^A
Ontario	7,348	7,451	7,215	6,831	6,231 ^A
Manitoba	171	182	166	176	132 ^B
Saskatchewan	106	139	154	163	109 ^D
Alberta	1,068	1,097	1,258	1,222	1,218 ^A
British Columbia ¹	1,254	1,282	1,225	1,367	1,273 ^B

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

Table 1-3
Total intramural research and development expenditures — By major industrial sectors, Canada

	2004 ^r	2005 ^r	2006 ^r	2007 ^r	2008 ^p
millions of dollars					
Canada	15,144	15,638	16,474	16,644	15,792 ^A
Agriculture, forestry, fishing and hunting	102	111	118	172	106 ^A
Mining and oil and gas extraction	389	480	731	662	1,035 ^B
Utilities	243	270	313	265	184 ^A
Construction	56	72	85	101	120 ^A
Manufacturing	8,281	8,367	8,850	8,407	7,300 ^A
Services	6,073	6,339	6,376	7,037	7,048 ^A

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

	2004 ^r	2005 ^r	2006 ^r	2007 ^r	2008 ^p
millions of dollars					
Atlantic Canada	213	292	323	325	317^B
Agriculture, forestry, fishing and hunting	3	x	x	15	7 ^A
Mining and oil and gas extraction	x	1	x	x	F
Utilities	x	x	1	2	x
Construction	0 ^s	1	2	x	x
Manufacturing	122	178	181	180	194 ^A
Services	81	104	124	116	108 ^A

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

	2004 ^r	2005 ^r	2006 ^r	2007 ^r	2008 ^p
millions of dollars					
Quebec	4,326	4,170	4,830	4,941	4,595^A
Agriculture, forestry, fishing and hunting	37	39	42	43	x
Mining and oil and gas extraction	x	x	31	15	x
Utilities	x	x	x	121	x
Construction	x	28	x	36	x
Manufacturing	2,351	2,244	2,655	2,412	2,149 ^A
Services	1,815	1,743	1,957	2,313	2,241 ^A

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

	2004 ^r	2005 ^r	2006 ^r	2007 ^r	2008 ^p
millions of dollars					
Ontario	7,833	8,204	8,153	7,965	7,564^A
Agriculture, forestry, fishing and hunting	31	32	43	79	40 ^A
Mining and oil and gas extraction	33	32	28	26	F
Utilities	17	24	29	38	45 ^A
Construction	22	33	41	42	64 ^A
Manufacturing	4,865	4,926	5,013	4,764	4,123 ^A
Services	2,865	3,157	2,999	3,016	3,279 ^A

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

	2004 ^r	2005 ^r	2006 ^r	2007 ^r	2008 ^p
millions of dollars					
Manitoba	182	200	188	205	160^B
Agriculture, forestry, fishing and hunting	x	1	x	x	3 ^A
Mining and oil and gas extraction	x	x	x	x	x
Utilities	x	x	x	x	x
Construction	1	x	1	x	2 ^A
Manufacturing	104	117	115	117	92 ^A
Services	74	78	69	84	60 ^A

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

	2004 ^r	2005 ^r	2006 ^r	2007 ^r	2008 ^p
	millions of dollars				
Saskatchewan	113	153	174	190	132^D
Agriculture, forestry, fishing and hunting	x	3	x	x	x
Mining and oil and gas extraction	x	x	x	x	F
Utilities	x	x	x	x	x
Construction	0 ^s	x	x	1	0 ^{sA}
Manufacturing	41	53	53	108	47 ^A
Services	39	37	38	38	46 ^A

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

	2004 ^r	2005 ^r	2006 ^r	2007 ^r	2008 ^p
	millions of dollars				
Alberta	1,139	1,208	1,422	1,425	1,479^A
Agriculture, forestry, fishing and hunting	4	x	x	10	5 ^A
Mining and oil and gas extraction	x	x	575	467	692 ^C
Utilities	x	x	x	84	x
Construction	x	4	x	15	x
Manufacturing	325	362	321	295	360 ^A
Services	389	347	392	554	380 ^A

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

	2004 ^r	2005 ^r	2006 ^r	2007 ^r	2008 ^p
	millions of dollars				
British Columbia¹	1,338	1,412	1,384	1,594	1,545^B
Agriculture, forestry, fishing and hunting	21	23	17	18	10 ^A
Mining and oil and gas extraction	24	21	47	105	258 ^E
Utilities	x	4	4	x	3 ^A
Construction	x	4	5	x	5 ^A
Manufacturing	473	486	512	532	335 ^A
Services	811	873	798	915	934 ^A

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

Table 2
Sources of funds for intramural research and development, by industrial sector 2008, with total values for 2007

	Canadian performing company	Federal government ¹	Other Canadian sources ²	Foreign sources	Total
millions of dollars					
Total 2008 ^P	12,506 ^A	292 ^A	1,011 ^A	1,983 ^A	15,792 ^A
Agriculture, forestry, fishing and hunting	x	1 ^A	x	x	106 ^A
Mining and oil and gas extraction	827 ^B	x	208 ^D	x	1,035 ^B
Utilities	176 ^A	x	x	x	184 ^A
Construction	x	x	x	0 ^A	120 ^A
Manufacturing	5,955 ^A	227 ^A	211 ^A	907 ^A	7,300 ^A
Services	5,378 ^A	63 ^A	557 ^A	1,050 ^A	7,048 ^A
Total 2007 ^r	13,191	256	786	2,411	16,644

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 3
Number of full time equivalent personnel engaged in research and development, by occupational category

	2004 ^r	2005 ^r	2006 ^r	2007 ^r	2008 ^P
number					
Total	138,213	142,025	151,726	164,103	158,926 ^D
Professionals	81,349	84,408	88,226	92,758	90,303 ^A
Supporting staff	56,864	57,617	63,500	71,345	68,623 ^A
Technicians	39,872	40,405	44,510	50,820	47,173 ^A
Other	16,992	17,212	18,990	20,525	21,450 ^A

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

Data quality, concepts and methodology

1- Survey methodology

The 2008 survey

The 2008 survey collected data on four years. The four years were:

- 2007 for which the data are expected to be final;
- 2008 for which the data are expected to be close to final,
- 2009 for which the data are planned expenditures, and
- 2010 for which the data are a forecast of spending intentions.

Estimates are not available for administrative data for 2009 and 2010. 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 2008 survey was mailed out in July 2009. The largest performers by industry group were selected, along with a random sample of small and medium R&D performers. Particulars of these changes are elaborated below.

The mailing list of companies was made up of firms which had reported R&D in the previous surveys, firms claiming an R&D income tax incentive for 2008, firms reported by government respondents as R&D contractors or grantees for 2008 to 2009, firms reported by other companies as funding or performing of R&D, and firms indicated in some other way, such as newspaper or journal articles or provincial directories. These larger performing and/or funding companies received the Research and Development in Canadian Industry questionnaire, covering R&D performing expenditures for: 2007, 2008, 2009 and 2010.

Upcoming and recent changes to survey methodology

The RDCI is continuing through an ongoing process of change. There have been a series of changes in methodology over the past few reference years and will experience changes going forward. These changes are itemized below by reference year in which they are being or were implemented.

Changes implemented for the 2009 reference year

Data users are advised that the RDCI will be formally linked to the Business Register (BR) for reference year 2009. The BR is the survey frame for all industry-based surveys. As part of the linking process some statistical entities which were treated as enterprises for the RDCI universe are in fact companies on the BR (<http://www.statcan.gc.ca/concepts/units-unites-eng.htm>). Steps are being taken to ensure consistency of the data at the industry level, but there may be some impact in the distribution R&D expenditures and personnel at the industry level.

Changes implemented for the 2008 reference year

For reference year 2008 the survey sample methodology was revised to improve the quality of forecast estimates at the industry level. The entire population of all known R&D performing enterprises and firms which fund or purchase technologies were sorted by NAICS-based industrial categories and then divided into the following groups:

1. Special entities were included on a “must-take” list. These entities included industrial non-profit organizations, known R&D performers that do not file scientific research and experimental development SR&ED tax credit applications, and technology purchasers or vendors.
2. The largest R&D performers in each industrial category (the “take-all” list). These large firms cover about two-thirds of R&D expenditures in the given industry group.
3. Mid-size R&D performers in each industrial category were placed on the “take-some” list, which meant that these units were randomly selected within each industrial category.
4. The smallest R&D performers in each industrial category were placed on a “take-none” list and excluded from the sample so as to reduce response burden for the smallest firms. 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.

Changes implemented for the 2007 reference year

For reference year 2007, all companies believed to be performing or funding one and a half million dollars or more of 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 2007, of firms reported by government respondents as R&D contractors or grantees for 2007 to 2008, of firms reported by other companies as funding or performing of R&D, and of firms indicated in some other way, such as newspaper or journal articles or provincial directories. These larger performing and/or funding companies received the Research and Development in Canadian Industry questionnaire, covering R&D performing expenditures for: 2006, 2007, 2008 and 2009.

Changes implemented for the 2006 reference year

To relieve respondent burden, the survey threshold was raised from one million dollars to one and one half million dollars in the survey year 2006, thereby reducing the number of surveyed firms. 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.

Beginning reference year 2005, 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.

Beginning reference year 2006, 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.

2008 Canada Revenue Agency (CRA) changes to the Scientific Research and Experimental Development (SR&ED) tax forms

In 2008, the Canada Revenue Agency (CRA) introduced new tax forms for applicants to the Scientific Research and Experimental Development (SR&ED) investment tax credit program. These changes have impacted the data produced from the Research and Development in Canadian Industry (RDCI) survey. The new forms went into effect in November 2008. SR&ED applicants have been given the opportunity to use either the new or the old forms for their financial years ending in 2008. Please see the CRA's web-site for copies of the new and old SR&ED tax forms (<http://www.cra-arc.gc.ca/E/pbg/tf/t661/README.html>).

The CRA changes that impact data continuity include:

- February 25, 2008, the federal budget provided for a change in the SR&ED tax qualified expenditures for wages and salaries of R&D activities performed outside of Canada that was directly performed by employee(s) of the applicant; “the employee who performed the SR&ED work was a resident of Canada at the time the expense was incurred; the SR&ED work carried on by the employees outside Canada was an integral part and solely in support of the SR&ED work for a project carried on in Canada; and salary or wages paid were not subject to income or profits tax from another country.” (Guide to Form T661 – Scientific Research and Experimental Development (SR&ED) Expenditures Claim, <http://www.cra-arc.gc.ca/E/pub/tg/t4088/t4088-e.html>, accessed December 09, 2008).
- The nature of R&D activities, are no longer available.
- The area of specialization of R&D activities (biotechnology, software development, and environmental protection, found in *Industrial Research and Development Intentions, 2009* (88-202-X) in tables 15-1 15-2 and 15-3) are no longer available.
- R&D personnel are not clearly identified as required in full-time equivalent on the SR&ED form which may impact related tables.

Other changes to the SR&ED forms which impact data processing for 2008 reference year are:

- R&D expenditures are by project rather than program.
- Selected type of R&D activity by project is included.
- Science type has been added.
- Type of location used for R&D has been added.

For the 2008 R&D expenditures, SR&ED tax data was processed from two forms, therefore, data availability for 2008 is limited when compared with data from previous years.

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 performing or funding companies 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) tax incentive program. In an effort to reduce respondent burden, Statistics Canada stopped surveying the small performing and funding companies (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 tax incentive program. In the 2006 survey year this threshold was raised to \$1.5 million thereby further reducing respondent burden.

When first implemented, this administrative data 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 imputation system was subsequently put into place to impute values for outstanding administrative data. This imputation system confirms the company is active using Statistics Canada's extensive Business Register, and then applies an imputation based on industry trends.

Recent developments in R&D spending are important economic signals, desired promptly by a variety of users. Because the small imputation 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, 2009/2010*, (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 sampling unit is the enterprise while the reporting unit may, in some cases, be the company. The survey is designed to reflect the structure of the enterprise as it appears on the Business Register and the structure of the enterprise as it reports its R&D activities (including reporting R&D expenditures for the SR&ED tax incentive program). This procedure creates a problem when classifying data by industry. An enterprise can only be assigned to one industry although that enterprise may have companies or 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 enterprise or 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 2008 “base year” survey is shown below.

For 2008, the response rate was 65%. Survey questionnaires were mailed to 1,991 firms: 1,065 were returned; 256 indicated no research and development activity; 66 were out of business and 15 were included with another respondent.

Interpretation of Research and Development (R&D)

Generally speaking, industrial R&D is intended to result in an invention which may subsequently become a technological innovation. An essential requirement is that the outcome of the work is uncertain, i.e., that the possibility of obtaining a given technical objective cannot be known in advance on the basis of current knowledge or experience. Hence much of the work done by scientists and engineers is not R&D, since they are primarily engaged in “routine” production, engineering, quality control or testing. Although they apply scientific or engineering principles their work is not directed towards the discovery of new knowledge or the development of new products and processes. However, work elements which are not considered R&D by themselves but which directly support R&D projects, should be included with R&D in these cases. Examples of such work elements are design and engineering, shop work, computer programming, and secretarial work.

If the primary objective is to make further technical improvements to the product or process, then the work comes within the definition of R&D. If however, the product, process or approach is substantially set and the primary objective is to develop markets, to do pre-production planning or to get a production or control system working smoothly, then the activity can no longer be considered as part of R&D even though it could be regarded as an important part of the total innovation process. Thus, the design, construction and testing of prototypes, models and pilot plants are part of R&D. But, when necessary modifications have been made and testing has been satisfactorily completed, the boundary of R&D has been reached. Hence, the costs of tooling (design and try-out), construction drawings and manufacturing blueprints, and production start-up are not included in development costs.

Pilot plants may be included in development only if the main purpose is to acquire experience and compile data. As soon as they begin operating as normal production units, their costs can no longer be attributed to R&D. Similarly, once the original prototype has been found satisfactory, the cost of other “prototypes” built to meet a special need or fill a very small order are not to be considered as part of R&D.

Table A
Specific cases and their treatment

Activity	Treatment	Remarks
Prototypes, pilot plants	Include	As long as the primary objective is to make further improvements.
Contracts for Research and Development	Include	All contracts which require Research and Development. For contracts which include other work, report only the Research and Development costs.
Economic research, market research, management studies	Exclude	All activities in the social sciences.
Quality control, routine testing, style changes, minor adaptation of a product to meet a customer's specific requirements	Exclude	Even if carried out by staff normally engaged in Research and Development.
Prospecting, exploratory drilling, development of mines, oil or gas wells	Exclude	Except for Research and Development projects concerned with new equipment or techniques in these activities, such as in-situ and tertiary recovery research.
Engineering	Exclude	Engineering unless it is in direct support of Research and Development.
Design and drawing	Exclude	Design and drawing unless it is in direct support of Research and Development.
Tooling up, trial production, trouble shooting	Exclude	Although Research and Development may be required as a result of these steps.
Patent and licence work	Exclude	All administrative and legal work connected with patents and licences.

Reliability of the data

There are two main origins of error: sampling errors and non-sampling errors. Within these two varieties there are a series of different types of errors. These types of errors are specified below.

Non-sampling errors

The four main types of non-sampling error are:

- Coverage error
- Measurement error
- Non-response error
- Processing error

Coverage

"Coverage errors are introduced whenever the sampling frame...does not adequately represent the target population at the time of the survey."¹ They "consist of omissions, erroneous inclusions, duplications and misclassifications of units in the survey frame."² Coverage is a minor source of error.

Survey questionnaires are sent to all known and suspected, large R&D performing and/or funding companies i.e., those believed to have the largest R&D expenditures within their industry group.

1. "A compendium of methods of error evaluation in censuses and surveys", Statistics Canada, 1978, Catalogue No. 13-564E (paper only).
2. "Survey methods and practices", Statistics Canada, 2003, Catalogue No. 12-587-XPE.

Administrative data are used for the remaining R&D performing or funding companies which are not included in the questionnaire coverage. Companies have up to 18 months after their fiscal year end to claim a tax credit for their R&D expenditures. Underreporting due to this time lag is estimated to be less than 8%, and is largely corrected by imputation based on industry trends for all known performers who have not yet submitted their claim.

Measurement

"Measurement error is the difference between the recorded response to a question and the 'true' value... One of the main causes of measurement error is misunderstanding on the part of the respondent or interviewer."³

As a result of a reconciliation of federal and industrial accounts of government grants and contracts, we think that industrial R&D performance estimates may be slightly low. This is caused by the non-reporting of industrial R&D funded by contract. Such work is sometimes not distinguishable from non-R&D contract work.

The accuracy of the company's estimates of future expenditures has also been a problem in the past, particularly in the wells and petroleum products industries.

Non-response

"Non-response occurs when information required for a survey unit is missing. This could happen because the unit cannot be contacted, because the unit is unable to provide the information requested, or because the unit refuses to cooperate in the survey."⁴

Non-response is a potential problem in three areas. One is the estimate of R&D expenditures two years past the base year. If no response is provided, editing rules are applied and a response is imputed based on the response of a similar firm in the same industry group.

The second involves the administrative data used for the smaller R&D performers. These represent 20% of all R&D performed by businesses. Certain information is not asked of them. However, the missing data are imputed from the replies of the sampled performers in the same industry.

Failure of surveyed companies to reply is the third type of non-response. We believe non-response error to be minor and may result in a minor under-estimation of R&D expenditures.

Processing

"Processing errors can occur during data coding, data capture, editing or imputation... Coding entails either assigning a code or comparing a response to a set of codes and selecting the one that best describes the response ... Data capture errors result when the data are not entered into the computer exactly as they appear on the questionnaire ... Editing is the application of checks to identify missing, invalid or inconsistent entries that point to data records that are potentially in error. Imputation is a process used to determine and assign replacement values to resolve problems of missing, invalid or inconsistent data."⁵

Processing errors are often monitored and controlled using quality control techniques.

Data capture

"The data capture operation in a census or survey consists of converting the data received on questionnaires (e.g., respondent answers) to a machine readable format."⁶

All data received from respondents are captured into a database application for further processing.

3. Ibid.

4. "A compendium of methods of error evaluation in censuses and surveys", Statistics Canada, 1978, Catalogue No. 13-564E (paper only).

5. "Survey methods and practices", Statistics Canada, 2003, Catalogue No. 12-587-XPE.

6. Ibid.

Significant uncorrected data capture errors are unlikely because of the examination of numerous tables and listings prepared for data validation and analysis before publication tables are created.

Edit and imputation

"The edit procedure usually consists of: (i) checking each field of every record to ascertain whether it contains a valid code or entry; (ii) checking codes or entries in certain predetermined combinations of fields to ascertain whether codes or entries are consistent with one another... The imputation procedure consists of changing values in some of the fields in records which failed the edit rules with a view to ensuring that the resultant data records satisfy all edit rules."⁷

Although there are a number of edits, all cases of failed edit checks are corrected after review. Automatic imputations are made for the administrative SR&ED tax data portion of the universe as well as for non-response and invalid response within the questionnaire portion of the universe.

Sampling

"Sampling error (is) defined as the error that results from estimating a population characteristic by measuring a portion of the population rather than the entire population."⁸

Although a complete enumeration is carried out of known and suspected R&D performing and/or funding companies, records received from the administrative data do not provide as much information as does the sampled universe. Certain data are imputed for records from the administrative file based on the patterns of survey response in the same industry.

2 - Technical notes

Data availability

Data for the reference year 2008 are available for all tables with the exception of counts of companies.

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 2008.

Terminology

The following terminology is used within the publication:

Performing company: is the organization which carried out the R&D. 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.

7. Ibid.

8. Ibid.

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. Included are industrial non-profit organizations and trade associations, R&D performed by consortia, and R&D performed by non-residents without associated commercial enterprises and funded principally from abroad.

Country of control: In most cases of foreign control, the country of control is the country of residence of the ultimate foreign controlling parent corporation, family, trust, estate or related group. Each subsidiary within the global enterprise is assigned the same country of control as its parent. A company whose voting rights are equally owned by Canadian-controlled and foreign-controlled corporations is Canadian-controlled. If two foreign-controlled corporations jointly own an equal amount of the voting rights of a Canadian resident company, the country of control is assigned according to an order of precedence based on their aggregate level of foreign control in Canada. For example, United States takes precedence over all other foreign countries because it has the highest level of aggregate foreign control in Canada.

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.

Full-time equivalent (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

North American Industry Classification System (NAICS) is the standard industrial classification system used for presenting R&D expenditures data for the business enterprise sector. One important limitation is due to enterprises with activities 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 enterprises. In order to prevent disclosure of individual respondents NAICS codes may be combined 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.

3 - Definitions

Research and development

For the purpose of this survey, 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 technological 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.