APPENDICES

The State of Science and Technology in Canada, 2012

The Expert Panel on the State of Science and Technology in Canada

Council of Canadian Academies
Conseil des académies canadiennes

Science Advice in the Public Interest

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Description of Bibliometric Data and Indicators

Appendix 1 Description of Bibliometric Data and Indicators

This appendix provides additional details on the bibliometric data and indicators used in this assessment. The indicators were produced for Canada, its provinces, and leading countries by field, sub-field and over time (1999–2004 and 2005–2010 aggregated; and 1997–2010 by year) unless otherwise indicated. Data for all indicators were only produced where appropriate considering the lower thresholds at which data would become unreliable or uninformative; generally, no statistics were computed for bodies of research with a sample size of less than 30 papers.

Data Source

The Scopus database from Elsevier was selected to generate the bibliometric data used for this assessment. Scopus was selected instead of Thomson Reuters' Web of Science (WoS) primarily due to its broader coverage of the scientific literature in the humanities, arts, and social sciences. Scholars in these fields publish more in their own languages and in journals with national distribution than do researchers in the natural sciences. Because the linguistic bias of Scopus towards scientific literature authored in English is less pronounced than it is in the WoS, it is more suited to the assessment of the work in the social sciences, humanities, and arts. In addition, Scopus links the authors of papers to their institutional addresses, which significantly reduces the time required to build researchers' publication portfolios as well as the risk of falsely assigning a paper to a researcher. As such, the investigation of researchers' migration patterns is easier and more reliable with Scopus. Finally, conference proceedings are broadly covered in Scopus, whereas in the WoS they are not covered extensively.

Only documents that were peer-reviewed prior to being accepted for publication were retained in computing the bibliometric indicators used in this report. The peer-review process ensures that the research is of good quality and constitutes an original contribution to scientific knowledge. These documents are mainly articles, conference papers, and reviews collectively referred to in this appendix as "papers."

Number of Publications

This is a count of the number of scientific publications (journal articles) based on full counting of papers. In the full counting method, each paper is counted once for each entity listed in the address field. For example, if a paper is authored by two researchers from the Universidad Complutense de Madrid, one from University College London, and one from the University of Liverpool, the paper will be counted once for the Universidad Complutense de Madrid, once for the

University College London and once for the University of Liverpool. It will also be counted once for Spain and once for the U.K. (double counting by country is avoided). Data might be presented based on shares of publications where appropriate (e.g., Canada's share of world publications in discipline X or discipline X's share of Canadian publications). (Raw paper counts were also generated in the research for the number of publications as these are required to compute an accurate Specialization Index).

Average Relative Citations (ARC)

This is an indicator of the scientific impact of papers (as measured by citations) produced by a given entity (e.g., the world, a country, an institution) relative to the world average (i.e., the expected number of citations). The number of citations received by each publication is counted for the year in which it was published and for all subsequent years. For papers published in 2000, for example, citations received in the 2000–2010 period are counted. To account for different citation patterns across fields and sub-fields of science (e.g., there are more citations in biomedical research than in mathematics) and for differences in the age of publications (e.g., older papers have accumulated citations over a longer period), each publication's citation count is divided by the average citation count of all publications of the corresponding document type (i.e., a review would be compared to other reviews, whereas an article would be compared to other articles) that were published the same year in the same sub-field to obtain a relative citation count. In general, papers in the social sciences and humanities come within reach of a citation peak (i.e., the highest number of citations received by papers over a one-year period) four years after publication. To ensure that all social science and humanities papers in the samples had the chance to accumulate citations up to this point, this indicator was only computed for papers published up to 2006. In the natural sciences and engineering and the health sciences, a two-year citation window is generally sufficient, which allows for the computation of the ARC over a longer period (for papers published up to 2008).

The ARC of a given entity is the average of the relative citations of the papers belonging to it. An ARC value above 1.0 means that a given entity is cited more frequently than the world average, while a value below 1.0 means the opposite.

Specialization Index (SI)

The SI is an indicator of research intensity in a given entity (e.g., a country) for a given research area (e.g., a field), relative to the intensity in a reference entity (e.g., the world, or the entire output as measured by the database) for the same research area. In other words, when a country is specialized in a field it places more emphasis on that field at the expense of other research areas. Specialization

is therefore said to be a zero sum game: the more one specializes somewhere, the less one does elsewhere. To ensure that it is a real zero sum game, the publication numbers used to compute the SI are based on fractional counting.

Fractional counting is used so that a single paper is not counted several times. This approach avoids the use of total numbers across entities (e.g., researcher, institution, region, country) that add up to more than the total numbers of papers, as is the case with full counting. Ideally, each author listed on a paper should be attributed a fraction of the paper that corresponds to his or her level of participation in the experiment compared to the other authors. Unfortunately, no reliable means exists for calculating the relative effort of authors on SI.

The SI is formulated as follows:

$$SI = \frac{(X_S/X_T)}{(N_S/N_T)}$$

Where:

X_S = Publications from entity X in a given research area (e.g., Canadian papers in biology);

X_T = Publications from entity X in a reference set of papers (e.g., total Canadian papers);

N_S = Publications from reference entity N in a given research area (e.g., world papers in biology);

N_T = Publications from reference entity N in a reference set of papers (e.g., total world papers).

An index value above 1.0 means that a given entity is specialized relative to the reference entity, whereas an index value below 1.0 means the reverse.

Number of Co-Publications

A co-publication is defined as a publication that was co-authored by different authors. When counting the number of co-publications from a country in which the co-authors are from at least two different countries, the number of international co-publications for this country is obtained. When counting the number of co-publications from a province in which the co-authors are from at least two different provinces, the number of inter-provincial co-publications for this

province is obtained. The number of international co-publications of Canada and other leading countries was computed as well the number of inter-provincial co-publications of Canadian provinces.

Finally, co-authorship across the departmental affiliations of researchers is used to investigate patterns in multidisciplinary research (e.g., trends in the number of papers involving inter-departmental collaboration by field and sub-field, trends in the average number of departments involved in scientific publications by field and sub-field). These analyses are performed where appropriate for Canada and its provinces by field and sub-field. When counting the number of co-publications of an entity in which the co-authors are from at least two different academic departments, the number of inter-departmental co-publications for this entity is obtained. Science-Metrix's analysts have spent an appreciable amount of time cleaning the departmental affiliation of Canadian researchers in Scopus, making it easy and affordable to produce these data. The number of co-publications of an entity can be expressed in absolute terms or as a percentage of the entity's total scientific output. Full counting is used.

Collaboration Index (CI)

Analyses of patterns in scientific collaboration are performed using the CI indicator. There is often a power law relationship between an entity's (e.g., country) number of papers and its number of co-publications (or collaborations). In cases where a power law relationship exists between two variables, scale-independent indicators are preferable over straight percentages to appropriately take account of the relative size of entities being compared; percentages, like the percentage of publications authored in collaboration, assume a linear relationship. When both indicators are log transformed, power law relationships can be analyzed using linear regression models. Therefore, the approach used to compute the CI consists of performing a log-log linear regression analysis between the number of co-authored publications and the number of publications at a specific aggregation level (e.g., countries) in order to estimate the constants ("a" and "k") of the power law relationship:

Expp (M) = a*(M^k)

Where:

Expp = the expected number of co-authored papers of an entity (e.g., country) based on the regression model; and

M = the observed number of publications of the entity (e.g., country) being measured.

The log-log linear regression analysis is performed using reduced major axis (RMA) to estimate the constants ("a" and "k") of the regression model. The indicator is simply the ratio of observed-to-expected co-authored publications.

When the indicator is above 1.0, an entity produces more publications in collaboration than expected based on the size of its scientific production, while an index value below 1.0 means the reverse. This indicator was computed for Canada and other countries at the field level (data for the years 2005–2010 were aggregated). It was also computed asymmetrically for Canada to identify the countries with which Canada has the strongest positive affinities and the strongest negative affinities for collaboration by field (data for the years 2005–2010 were aggregated).

Growth Index (GI)

To identify areas of growing research activity in Canada and its provinces, a growth index (GI) was calculated. The GI represents the ratio in the output (measured in whole counts) of a given entity (e.g., a country) between the 1999–2004 period and the 2005–2010 period. In other words, the GI is a measure of the increase in the number of publications obtained using counts of publications. A GI value above 1.0 means that a given entity experienced an increase in its output in this research area during the second half of the study period compared to the first half; an index value below 1.0 means the reverse. The GI value for a given entity can then also be compared to the GI calculated for the world in this research area in order to ascertain whether the increase experienced by the entity has kept pace with the world. GI can be calculated using fractional or full counts. For this assessment, full counting was used.

Researcher Migration

An analysis of researcher migration in Canada was performed by examining the country of affiliation of authors on their scientific publications indexed in Scopus during the 1997 to 2010 period. Changes in the institutional affiliations of authors can potentially be used to analyze patterns in researcher migration. However, because the name of a given author often appears under many different forms in Scopus (e.g., Rogers D., Rogers D.M., and Rogers Daniel M. all denote Daniel Michael Rogers) and because one name can match many authors (e.g., Rogers D. can refer to Daniel Michael Rogers as well as David Rogers), the names of authors as they appear in the database cannot be used to investigate migration unless they are thoroughly cleaned to match authors with their own papers.

To obtain a sample of the Canadian population of researchers, Science-Metrix used the author identifiers (AUIDs) found in the Scopus database. AUIDs have been produced by Elsevier to disambiguate (i.e., clean) the names of researchers in the Scopus database. However, the procedure used by Elsevier to produce the AUIDs is imperfect. It generates a large amount of isolates (i.e., where one or a few papers belonging to a given author have been grouped under a new, alternative AUID) that, if used, result in an underestimation of migration rates. It also generates a moderate amount of false assignments (i.e., papers erroneously attributed to a given AUID) which can potentially result in an overestimation of migration rates.

Several steps were taken to mitigate these potential sources of error in the analysis undertaken for this assessment. First, papers with two or more addresses for a sole AUID were removed because they could distort migration rates (e.g., how to classify a paper from a researcher with an address in Canada and another in the U.S.). Second, AUIDs with less than 10 papers were rejected for this process to avoid underestimation of the migration. Third, to be able to observe movement over time, an AUID had to have published for at least three different years between 1997 and 2010.

About 22,000 AUIDs, for which at least one paper was published in Canada, were selected as a sample. For each researcher, the proportions of his or her Canadian and foreign papers in a given year were computed for each year in the period. A researcher is considered Canadian when the difference between these proportions (i.e., proportion of Canadian papers in year y minus the proportion of foreign papers in year y) is positive. A migration is indicated when the sign of this difference changes over time (e.g., the sign of this difference is positive for author A in 1997 and becomes negative in 2001, indicating that author A was a Canadian researcher who emigrated). Following the sequence of changes in the sign of this difference allows all possible migration patterns for each AUID in the sample to be computed.

Based on these migration patterns, it is then possible to compute the rates of immigration, emigration and two other cases of migration: the neutral migration of Canadians, in which the emigrant returned to Canada, and the neutral migration of foreigners, in which the immigrant left Canada. Finally, a net migration rate was computed. A positive net migration rate means that there has been more immigration than emigration. When it is negative, the opposite is true.

Migration patterns were also analyzed at the field level to uncover trends in different areas of research. The method used for this analysis was similar to that described above. However, this requires associating an AUID with a specific field of research. One field of research was associated with each AUID using a combination of the distribution of its papers across fields and a measure of the kurtosis of the scientific production towards one field. By constructing vectors of the author's share of production for each field and by computing the kurtosis of each of these vectors, AUIDs were selected where the scientific production peaked around a single field. Using this technique, a large number of the researchers from the overall analysis presented earlier were assigned a specific field of research. Migration was then computed at the field level using these samples. This process resulted in lower numbers of usable AUIDs because some of the AUIDs could not be assigned to a specific field. To ensure the analysis was sufficiently robust, only the fields with at least 1,000 AUIDs were used in this analysis. This left seven fields for which researcher migration data was available: Information and Communication Technologies; Engineering; Chemistry; Clinical Medicine; Physics and Astronomy; Biomedical Research; and Enabling and Strategic Technologies.

Cluster Analysis of Research Topics

An analysis of clusters of related scientific research was also conducted for this study, which provides an alternative approach to relying on traditional discipline classification systems. Through an analysis of citation patterns, a cluster-based classification of research topics was produced to supplement more traditional journal-based classifications of science used for the majority of the bibliometric analysis in this report. Using an algorithm for the rapid unfolding of communities in large networks, Science-Metrix clustered 86 per cent of papers in the Scopus database (i.e., 16.1 million out of 18.8 million papers). These papers were grouped into about 48,000 clusters of related research, the majority (i.e., 98 per cent) of which are smaller than 1,000 papers.

To then identify the topical clusters that are interdisciplinary, researchers at Science-Metrix computed the interdisciplinarity of each cluster's respective papers based on the distribution of all references listed in each paper across the sub-fields (or disciplines) of the traditional journal-based classification used in this study. This is measured by defining a reference network and comparing it to a vector for all scientific sub-fields. (In this study, the reference network is the citation network of all Scopus papers published between 1996 and 2010). The vector of a given cluster is composed of the number of papers in the reference list of all the papers it contains in each sub-field, based on the selected classification. The result of this calculation is the interdisciplinary indicator for each topical cluster. As the interdisciplinarity indicator approaches 1.0, the cluster (or topic)

is considered highly interdisciplinary given the diversity of disciplines in its reference list. Inversely, when the indicator approaches zero, the cluster (or topic) is considered not at all interdisciplinary. Subsequently, using the same performance indicators as those used for the bibliometric study (number of papers, ARC, GI, and SI), Science-Metrix identified multidisciplinary research topics in which Canada had strengths.

To label the topical clusters in the network, an analysis of the semantic content of each cluster was performed. This allowed the scientific words and/or noun phrases (e.g., the combination of scientific terms describing a single concept or object, such as carbon nanotubes) that are highly specific to a given cluster to be identified, thereby providing the information required for its labelling. This included identifying both general keywords used by the authors of papers in that cluster to describe their work, as well as specific terms that appeared with a high-degree of frequency within papers in this area.

Appendix 2
The Science-Metrix Classification of Research Fields and Sub-Fields

Appendix 2 The Science-Metrix Classification of Research Fields and Sub-Fields

Many classifications of scientific domains, fields and sub-fields have been developed for the retrieval and analysis of scientific articles in bibliographic databases and the production of statistics on science. The Council's 2006 report on *The State of Science and Technology in Canada* relied on a well-known discipline classification system used by the U.S. National Science Foundation (NSF) in its *Science and Engineering Indicators*. After significant deliberation this Panel decided to use a classification of research fields recently developed by Science-Metrix as the basis for the bibliometric analysis in this assessment. The newer classification system of fields and sub-fields better reflects the current landscape of scientific research than the NSF system which is now several decades old.

THE DEVELOPMENT OF THE SCIENCE-METRIX ONTOLOGY

The main sources of inspiration for Science-Metrix's ontology were threefold: (1) the classification used by the NSF in the *Science and Engineering Indicators*, originally designed by CHI Research and now maintained by the Patent Board; (2) the journal classification developed by the Institute for Scientific Information (ISI, which is now part of Thomson Reuters); and (3) the Excellence in Research for Australia's Ranked Journal List by the Australian Research Council. Like the approach privileged by the NSF, Science-Metrix's Ontology of Scientific Journals provides a mutually exclusive classification, and like that of Thomson Reuters and the Australian Research Council, this ontology covers both traditional and modern fields of scientific enquiry.

A three-level taxonomy of scientific publications was built, based on scientometric analyses, as well as an algorithmic study of inter-field citations, which helped to consolidate sub-fields by considering not only their logical structure but also by reflecting the dynamics of science. More than 34,000 journals and proceedings were carefully studied using Elsevier's Scopus database as well as Thomson Reuters' Web of Science. Each database provides half a billion references indexed from over 20 million source items (scientific papers, conference proceedings, and a lesser number of book series). These data were used to assign journals to specific sub-fields through six iterative rounds. Each round was followed by an expert review of journal assignments.

Some journals were manually forced into categories; for instance, nanotechnology and biotechnology formed a corpus in large part because of a manual selection of journals. Many journals in education and nursing were also assigned systematically

to their respective sub-fields. Other fields that had great internal coherence and large numbers of journals, which themselves had large number of references, were left to populate themselves more liberally according to the assignment suggested by the algorithm used by Science-Metrix. (A peer-reviewed conference paper providing a full description of the methods was published in the conference proceedings of the 13th ISSI Conference 2011.) The full listing of the fields and sub-fields developed for this ontology is provided in Table 2.1 of the report.

Table A2.1

Number of Journals in Each Field for the Bibliometric Analysis

Field	Number of Journals
Agriculture, Fisheries & Forestry	565
Biology	791
Biomedical Research	987
Built Environment & Design	158
Chemistry	669
Clinical Medicine	3,810
Communication & Textual Studies	233
Earth & Environmental Sciences	477
Economics & Business	815
Enabling & Strategic Technologies	804
Engineering	955
General Arts, Humanities & Social Sciences*	43
General Science & Technology*	75
Historical Studies	375
Information & Communication Technologies	567
Mathematics & Statistics	476
Philosophy & Theology	148
Physics & Astronomy	594
Psychology & Cognitive Sciences	535
Public Health & Health Services	654
Social Sciences	1,225
Visual & Performing Arts	51
Total Number of Journals Included in Study	15,007

*General Science and Technology and General Arts, Humanities and Social Sciences are fields formed for the bibliometric classification to capture articles published in general journals such as Nature or Science.

Appendix 3
Country-Level Comparisons of Key Bibliometric Indicators by Field

Appendix 3 Country-Level Comparisons of Key Bibliometric Indicators by Field

The tables below present data on key bibliometric indicators (number of papers, Average Relative Citations (ARC), Specialization Index (SI), and Collaboration Index (CI)) at the field-level for selected countries. Only the top 19 countries by the total number of papers produced in that field are shown. Countries are ranked in descending order by ARC for the 2005–2010 period. Numbers of papers published are presented in whole counts. (See Appendix 1 for complete definitions of all variables.)

Agriculture, Fisheries, and Forestry

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Netherlands	5,387	1.59	0.81	4,369	1.54	0.92	1.50
Belgium	4,621	1.50	1.41	3,149	1.27	1.33	1.30
United Kingdom	14,197	1.49	0.63	12,888	1.49	0.73	1.54
Spain	13,560	1.45	1.53	7,651	1.36	1.35	0.99
Sweden	4,010	1.37	0.99	3,773	1.43	1.10	1.28
France	11,343	1.31	0.77	9,469	1.23	0.83	1.37
Australia	11,061	1.31	1.39	9,293	1.18	1.83	1.13
Canada	15,880	1.25	1.38	13,094	1.25	1.69	1.20
United States	64,452	1.24	0.83	55,334	1.25	0.88	0.97
Germany	13,826	1.19	0.68	11,730	0.99	0.73	1.24
Italy	9,616	1.18	0.90	5,107	1.23	0.64	0.92
Rep. of Korea	5,829	0.92	0.69	2,367	0.86	0.52	0.90
China	28,400	0.80	0.57	7,727	0.79	0.45	0.67
Japan	15,982	0.80	0.81	14,975	0.68	0.83	0.78
Turkey	8,611	0.78	2.09	4,178	0.62	2.00	0.34
Iran	4,465	0.74	1.47	644	0.69	1.08	0.57
Brazil	21,173	0.73	3.40	6,418	0.78	1.95	0.41
Poland	6,820	0.58	1.71	4,178	0.53	1.55	0.46
India	15,591	0.50	1.75	11,813	0.33	2.43	0.30
World	**297,996**	**1.00**	**1.00**	**207,357**	**1.00**	**1.00**	

Biology

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Switzerland	5,979	1.81	0.99	4,028	1.48	1.02	1.43
United Kingdom	26,490	1.56	0.89	22,450	1.36	1.04	1.48
Netherlands	7,727	1.51	0.87	5,886	1.36	0.98	1.40
Germany	22,362	1.48	0.85	16,466	1.18	0.83	1.36
Sweden	6,695	1.48	1.19	5,448	1.35	1.22	1.31
France	17,217	1.46	0.85	13,107	1.21	0.89	1.42
Canada	18,227	1.34	1.18	12,870	1.18	1.29	1.17
United States	93,150	1.34	0.93	72,366	1.32	0.92	0.98
Australia	20,037	1.32	1.99	13,163	1.19	2.08	1.05
Spain	14,626	1.27	1.22	8,870	1.05	1.22	1.09
Japan	18,892	1.10	0.76	14,994	0.94	0.67	0.74
Italy	11,550	1.03	0.82	7,049	0.91	0.71	0.95
South Africa	5,981	1.01	3.22	4,075	0.79	3.70	1.10
Argentina	5,966	0.84	3.63	3,425	0.77	2.75	0.83
Brazil	16,123	0.82	2.16	6,726	0.76	1.88	0.59
Mexico	6,929	0.77	2.66	3,953	0.69	2.46	0.95
China	34,458	0.68	0.55	9,956	0.66	0.47	0.59
Poland	5,930	0.66	1.16	4,260	0.47	1.27	0.65
India	15,338	0.47	1.43	9,393	0.42	1.58	0.36
World	**348,408**	**1.00**	**1.00**	**242,296**	**1.00**	**1.00**	

Biomedical Research

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Switzerland	13,980	1.44	1.22	11,376	1.33	1.19	1.44
Denmark	8,622	1.40	1.50	7,202	1.31	1.43	1.27
Netherlands	17,572	1.37	1.11	14,247	1.29	1.06	1.30
United Kingdom	57,491	1.30	1.12	51,480	1.25	1.07	1.29
Belgium	9,956	1.29	1.14	7,778	1.21	1.04	1.30
United States	231,269	1.26	1.31	210,795	1.26	1.22	0.88
Sweden	13,171	1.23	1.31	11,951	1.17	1.18	1.26
Australia	19,236	1.19	0.98	14,482	1.14	0.97	1.11
Canada	31,326	1.18	1.12	25,060	1.11	1.09	1.10
Germany	52,523	1.14	1.15	45,573	1.11	1.02	1.22
France	40,871	1.08	1.20	37,958	1.00	1.18	1.19
Italy	27,397	1.01	1.06	22,409	0.87	0.98	0.96
Spain	23,268	1.00	1.08	17,140	0.88	1.06	0.95
Japan	50,942	0.84	1.13	52,552	0.82	1.04	0.68
Rep. of Korea	16,354	0.81	0.89	8,366	0.74	0.72	0.62
Brazil	16,076	0.73	1.16	8,135	0.74	0.98	0.63
China	49,312	0.69	0.41	18,878	0.59	0.40	0.65
India	17,694	0.64	0.87	10,221	0.55	0.75	0.48
Russia	13,864	0.38	1.05	12,838	0.32	0.86	0.63
World	**631,678**	**1.00**	**1.00**	**544,957**	**1.00**	**1.00**	

Built Environment and Design

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Switzerland	712	1.69	0.85	295	1.17	0.59	1.64
Sweden	977	1.50	1.36	603	1.31	1.15	1.04
Greece	627	1.42	1.37	301	1.10	1.33	0.77
India	1,006	1.35	0.52	479	1.12	0.54	0.80
Rep. of Korea	1,459	1.35	0.81	601	1.10	0.83	1.33
Netherlands	1,742	1.30	1.50	996	1.07	1.43	1.35
Belgium	752	1.27	1.15	319	1.46	0.85	1.42
Australia	1,848	1.25	1.16	923	1.24	1.04	1.32
Turkey	1,720	1.25	1.93	566	0.87	1.58	0.55
France	2,064	1.24	0.74	1,042	1.18	0.53	1.31
United Kingdom	6,321	1.20	1.65	4,872	1.19	1.88	1.26
United States	15,860	1.19	1.00	11,850	1.10	1.11	1.17
Spain	1,670	1.18	0.94	678	1.24	0.70	1.01
Canada	3,152	1.17	1.36	2,102	1.08	1.62	1.39
Italy	1,830	0.96	0.84	798	0.98	0.60	1.12
Germany	2,791	0.92	0.74	1,565	0.65	0.63	1.02
Japan	1,917	0.88	0.46	1,226	0.69	0.38	1.06
Brazil	726	0.86	0.54	312	0.91	0.60	0.94
China	12,422	0.86	1.22	3,888	1.00	1.40	0.72
World	**63,750**	**1.00**	**1.00**	**36,547**	**1.00**	**1.00**	

Chemistry

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Netherlands	9,053	1.53	0.58	7,979	1.58	0.70	1.39
United States	120,312	1.50	0.64	101,155	1.49	0.65	0.96
Switzerland	10,584	1.47	1.03	8,445	1.43	1.12	1.41
Germany	48,925	1.37	1.05	41,524	1.19	1.08	1.39
United Kingdom	33,496	1.36	0.65	30,338	1.25	0.74	1.37
Australia	10,526	1.31	0.52	7,641	1.15	0.58	1.21
Canada	17,653	1.27	0.63	13,111	1.23	0.66	1.13
Spain	25,922	1.25	1.15	19,243	1.11	1.34	1.18
France	33,023	1.21	0.92	27,860	1.12	0.97	1.48
Italy	24,502	1.21	0.93	19,612	1.12	1.00	1.13
Rep. of Korea	22,405	0.99	1.17	13,442	0.89	1.37	0.66
China	145,031	0.84	1.25	58,516	0.72	1.50	0.40
Brazil	14,024	0.81	0.98	7,837	0.83	1.10	0.58
Iran	13,412	0.79	1.95	4,073	0.76	3.24	0.38
Japan	64,568	0.79	1.42	55,262	0.95	1.27	0.53
India	45,313	0.76	2.14	24,385	0.70	2.02	0.52
Turkey	9,981	0.76	0.98	5,119	0.78	0.97	0.49
Poland	14,755	0.71	1.45	11,468	0.65	1.61	0.83
Russia	26,680	0.35	1.97	25,516	0.31	1.95	0.69
World	**690,586**	**1.00**	**1.00**	**503,883**	**1.00**	**1.00**	

Clinical Medicine

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Belgium	31,716	1.64	1.22	24,177	1.27	1.26	1.51
Sweden	38,482	1.60	1.25	33,546	1.40	1.22	1.61
Canada	88,354	1.59	0.98	61,294	1.49	0.94	1.57
Netherlands	65,213	1.58	1.48	46,538	1.41	1.33	1.41
Switzerland	42,388	1.58	1.29	31,157	1.38	1.23	1.78
United States	646,023	1.52	1.15	522,867	1.47	1.05	1.13
Australia	61,930	1.47	1.04	41,809	1.25	1.02	1.37
United Kingdom	175,375	1.42	1.19	141,740	1.32	1.12	1.47
Italy	110,770	1.21	1.40	83,462	0.98	1.34	1.12
Germany	171,887	1.18	1.24	145,606	0.97	1.21	1.30
France	108,955	1.11	1.12	95,874	0.92	1.13	1.12
Spain	75,000	0.90	1.17	51,271	0.77	1.16	0.85
Rep. of Korea	45,937	0.89	0.81	18,617	0.85	0.57	0.59
Japan	154,171	0.84	1.10	151,905	0.75	1.07	0.63
Brazil	51,536	0.78	1.14	23,233	0.68	0.94	0.69
Poland	34,238	0.60	1.15	19,904	0.46	0.92	0.55
Turkey	52,758	0.54	1.76	28,173	0.51	1.74	0.30
India	52,389	0.53	0.83	27,582	0.43	0.72	0.42
China	175,860	0.52	0.48	62,241	0.59	0.48	0.60
World	**2,159,622**	**1.00**	**1.00**	**1,659,542**	**1.00**	**1.00**	

Communication and Textual Studies

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
New Zealand	436	1.92	2.25	177	1.58	1.98	1.30
Netherlands	1,090	1.43	1.28	394	1.23	0.97	1.88
Israel	556	1.31	1.60	268	1.34	1.43	1.07
Sweden	413	1.28	0.77	177	0.79	0.61	1.45
United States	20,194	1.22	1.79	9,776	1.33	1.66	0.90
United Kingdom	5,993	1.21	2.21	2,457	1.11	1.71	1.25
Australia	1,546	1.13	1.42	529	1.09	1.13	1.23
Belgium	797	1.07	1.82	259	0.52	1.27	1.28
Canada	2,686	1.04	1.73	1,221	0.91	1.76	1.02
Denmark	366	0.84	1.26	134	0.81	0.96	1.44
Germany	2,202	0.82	0.85	983	0.78	0.71	1.45
Rep. of Korea	354	0.80	0.25	102	1.02	0.23	2.18
China	1,720	0.73	0.21	378	1.39	0.23	1.38
Japan	942	0.73	0.30	631	0.58	0.36	1.39
Switzerland	373	0.67	0.71	173	0.46	0.67	1.25
Italy	692	0.65	0.45	251	0.68	0.36	0.85
South Africa	607	0.65	3.15	168	0.58	2.08	1.32
Spain	1,750	0.52	1.39	717	0.31	1.42	0.75
France	2,307	0.33	1.25	963	0.69	0.99	0.71
World	**52,085**	**1.00**	**1.00**	**24,089**	**1.00**	**1.00**	

Earth and Environmental Science

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Switzerland	6,332	1.90	1.28	3,632	1.64	1.08	1.45
Netherlands	6,674	1.54	0.91	4,358	1.40	0.90	1.35
Sweden	4,770	1.50	1.00	3,227	1.36	0.86	1.31
United Kingdom	23,344	1.50	1.00	17,068	1.36	1.00	1.38
France	17,999	1.48	1.10	12,313	1.34	1.00	1.44
Germany	21,378	1.48	0.97	15,294	1.28	0.92	1.45
Norway	5,162	1.48	2.30	2,829	1.25	2.15	1.33
Australia	10,897	1.41	1.24	6,742	1.38	1.23	1.17
Canada	15,788	1.29	1.23	10,683	1.31	1.30	1.22
United States	85,077	1.29	1.09	62,513	1.33	1.01	0.94
Spain	8,542	1.23	0.89	4,766	1.08	0.83	1.04
Italy	12,419	1.17	1.09	7,419	1.13	0.91	1.03
Japan	15,135	1.05	0.70	10,866	0.91	0.57	0.97
Rep. of Korea	4,465	1.00	0.49	2,165	0.93	0.50	0.96
Brazil	4,398	0.89	0.66	2,256	0.91	0.71	0.88
China	42,445	0.81	0.88	17,455	0.71	1.12	0.60
Turkey	3,910	0.81	0.95	1,929	0.92	0.92	0.44
India	10,879	0.56	1.27	6,849	0.47	1.47	0.41
Russia	12,141	0.45	2.11	10,906	0.35	2.10	0.69
World	**272,605**	**1.00**	**1.00**	**189,881**	**1.00**	**1.00**	

Economics and Business

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Netherlands	6,846	1.36	1.60	3,435	1.19	1.57	1.46
Switzerland	2,782	1.35	0.94	1,145	1.26	0.77	1.58
United States	75,768	1.29	1.41	47,521	1.30	1.51	0.97
Sweden	3,541	1.19	1.38	1,702	1.22	1.09	1.10
Belgium	2,668	1.14	1.08	1,295	1.04	1.01	1.55
United Kingdom	25,221	1.12	1.79	13,700	1.06	1.70	1.41
Canada	10,161	1.11	1.21	5,397	1.06	1.33	1.42
Finland	2,370	1.11	1.70	851	0.95	1.04	0.92
Germany	10,685	1.05	0.78	4,392	0.81	0.58	1.39
Italy	5,723	1.00	0.73	2,374	0.89	0.59	1.21
Spain	6,766	1.00	1.10	2,498	0.87	0.87	0.96
Australia	10,770	0.95	2.01	4,752	0.84	1.84	1.16
China	23,245	0.93	0.65	4,368	0.93	0.47	0.75
New Zealand	2,443	0.92	2.34	1,019	0.91	1.94	1.38
France	7,613	0.90	0.77	3,384	0.86	0.58	1.24
Rep. of Korea	2,994	0.83	0.43	1,201	0.87	0.49	1.51
Brazil	2,350	0.80	0.55	448	0.69	0.29	0.68
Japan	4,353	0.65	0.31	2,320	0.61	0.25	0.82
India	3,353	0.55	0.52	1,550	0.49	0.61	0.68
World	**211,904**	**1.00**	**1.00**	**107,338**	**1.00**	**1.00**	

Enabling and Strategic Technologies

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Switzerland	9,555	1.64	0.71	5,981	1.78	0.77	1.51
Netherlands	11,188	1.61	0.56	7,165	1.41	0.61	1.41
Spain	19,803	1.56	0.67	10,741	1.34	0.71	1.23
Turkey	10,267	1.56	0.78	4,004	1.18	0.73	0.50
Australia	16,021	1.41	0.62	7,821	1.37	0.58	1.29
United Kingdom	39,971	1.40	0.60	29,087	1.30	0.69	1.45
Germany	49,962	1.38	0.82	35,501	1.30	0.88	1.41
Canada	26,896	1.36	0.75	13,961	1.41	0.69	1.13
France	35,141	1.33	0.77	23,596	1.24	0.80	1.46
United States	184,460	1.29	0.76	134,047	1.31	0.85	0.93
Italy	21,648	1.28	0.62	13,376	1.21	0.65	1.17
Iran	10,844	1.12	1.20	1,598	0.88	1.13	0.47
India	33,554	1.08	1.22	17,346	0.85	1.38	0.50
Japan	74,062	0.99	1.23	62,574	0.98	1.38	0.68
Rep. of Korea	39,790	0.95	1.62	19,584	1.00	1.92	0.73
Brazil	13,625	0.92	0.72	7,047	0.86	0.95	0.68
Poland	9,902	0.89	0.74	7,119	0.75	0.95	0.96
China	266,050	0.79	1.81	78,355	0.73	1.95	0.35
Russia	23,472	0.52	1.28	22,119	0.50	1.60	0.78
World	**908,140**	**1.00**	**1.00**	**526,793**	**1.00**	**1.00**	

Engineering

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Singapore	10,241	1.62	1.77	6,494	1.39	2.53	1.18
Australia	18,213	1.57	0.74	10,453	1.42	0.87	1.29
Turkey	9,766	1.49	0.73	4,542	1.23	0.90	0.68
Spain	18,990	1.48	0.70	8,538	1.21	0.66	1.09
Netherlands	13,439	1.47	0.71	8,202	1.38	0.80	1.40
Canada	34,927	1.37	1.01	21,004	1.21	1.17	1.20
United Kingdom	40,536	1.34	0.65	29,334	1.23	0.80	1.39
Italy	27,845	1.33	0.87	15,612	1.28	0.88	0.98
United States	189,079	1.30	0.80	132,668	1.30	0.93	0.91
France	32,912	1.27	0.78	20,138	1.20	0.79	1.34
Germany	38,787	1.21	0.70	23,412	1.14	0.68	1.16
India	22,843	1.19	0.84	9,406	1.06	0.80	0.58
Rep. of Korea	29,572	1.13	1.22	15,829	1.09	1.69	0.75
Brazil	11,530	0.94	0.62	5,877	0.95	0.89	0.75
Iran	13,131	0.88	1.46	2,367	0.88	1.82	0.61
Japan	62,734	0.85	1.01	45,981	0.82	1.06	0.62
China	272,431	0.75	1.91	77,872	0.71	2.16	0.37
Poland	12,518	0.70	1.04	5,612	0.63	0.88	0.53
Russia	12,636	0.50	0.74	10,171	0.40	0.80	0.64
World	**891,620**	**1.00**	**1.00**	**477,945**	**1.00**	**1.00**	

Historical Studies

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
United Kingdom	10,811	1.50	2.35	6,044	1.38	1.83	0.94
China	1,860	1.43	0.12	751	1.23	0.17	1.54
United States	20,424	1.37	1.11	12,832	1.41	0.99	0.73
Switzerland	1,198	1.35	1.03	615	1.49	0.82	1.58
Canada	3,512	1.28	1.26	2,054	1.41	1.22	0.99
Netherlands	1,924	1.27	1.30	1,058	1.44	1.14	1.10
Australia	2,881	1.20	1.54	1,920	1.02	1.88	0.90
Sweden	1,146	1.14	1.09	776	1.40	1.03	1.36
Germany	5,598	1.06	1.18	3,676	1.08	1.16	1.22
Belgium	1,256	0.99	1.64	672	0.82	1.36	1.00
Brazil	1,187	0.94	0.82	273	1.03	0.37	0.56
Japan	1,491	0.92	0.27	1,122	0.86	0.25	1.00
France	5,738	0.91	1.73	3,056	1.01	1.26	1.10
Italy	2,817	0.90	1.09	1,650	0.85	1.02	0.88
Argentina	1,345	0.83	4.33	730	0.81	3.52	0.81
Spain	3,310	0.79	1.54	1,628	0.81	1.37	0.90
Russia	1,797	0.60	1.23	1,251	0.62	1.07	0.83
Croatia	1,387	0.56	9.22	616	0.56	7.43	0.37
Poland	2,355	0.48	2.53	1,721	0.39	3.19	0.52
World	**73,752**	**1.00**	**1.00**	**45,174**	**1.00**	**1.00**	

Information and Communication Technologies

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Switzerland	10,376	2.05	0.80	3,544	1.85	0.80	1.74
United States	180,559	1.64	0.73	93,315	1.61	1.01	1.22
Netherlands	14,895	1.43	0.78	5,512	1.30	0.83	1.47
Singapore	12,019	1.41	1.92	4,918	0.95	2.92	1.41
United Kingdom	48,750	1.33	0.76	18,178	1.15	0.76	1.57
Canada	40,529	1.30	1.12	15,332	1.17	1.32	1.41
Italy	31,022	1.21	0.92	11,884	1.01	1.04	1.23
France	41,208	1.20	0.95	13,589	1.00	0.84	1.49
Germany	48,907	1.13	0.87	17,007	1.03	0.77	1.32
Greece	10,742	1.10	1.48	3,357	0.94	1.75	0.98
Australia	23,200	1.05	0.94	7,574	0.99	0.98	1.33
Spain	27,663	1.03	0.99	8,069	0.83	0.98	1.21
Poland	9,185	0.80	0.72	2,551	0.74	0.58	0.82
China	257,134	0.75	1.71	41,341	0.68	1.77	0.46
India	26,665	0.74	0.94	5,576	0.73	0.73	0.58
Rep. of Korea	37,180	0.74	1.51	11,318	0.68	1.95	0.66
Iran	11,356	0.69	1.23	998	0.51	1.24	0.55
Brazil	11,746	0.67	0.61	3,288	0.65	0.78	0.90
Japan	48,349	0.63	0.78	22,999	0.49	0.88	0.72
World	**931,001**	**1.00**	**1.00**	**302,756**	**1.00**	**1.00**	

Mathematics and Statistics

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
United States	51,959	1.26	0.85	40,418	1.39	0.84	1.03
France	17,087	1.20	1.61	13,569	1.19	1.63	1.22
United Kingdom	12,622	1.20	0.78	10,530	1.16	0.85	1.33
Iran	3,618	1.18	1.65	732	0.81	1.85	0.50
Germany	14,016	1.17	0.94	11,487	1.11	0.97	1.33
Netherlands	2,829	1.17	0.59	2,190	1.19	0.63	1.29
China	33,983	1.15	0.89	14,291	1.05	1.14	0.65
Spain	9,160	1.14	1.31	6,015	1.02	1.38	1.13
Canada	8,951	1.11	0.91	6,046	1.09	0.92	1.47
Italy	11,156	1.07	1.35	7,479	1.02	1.25	1.06
Australia	4,363	1.06	0.65	3,442	1.08	0.82	1.41
Israel	3,041	1.04	1.47	2,703	1.05	1.54	1.31
Rep. of Korea	5,356	0.95	0.82	2,974	0.86	0.93	0.96
Brazil	3,804	0.92	0.76	2,270	1.01	0.97	1.05
Japan	8,767	0.90	0.58	7,240	0.82	0.53	0.70
Turkey	3,753	0.85	1.15	1,463	0.77	0.92	0.59
Poland	4,505	0.75	1.37	3,026	0.75	1.34	0.93
India	5,720	0.71	0.81	3,033	0.66	0.78	0.71
Russia	12,607	0.41	2.88	8,479	0.45	1.98	0.54
World	**213,955**	**1.00**	**1.00**	**147,212**	**1.00**	**1.00**	

Philosophy and Theology

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Sweden	423	1.78	1.25	174	1.50	0.77	1.17
Netherlands	909	1.36	1.64	443	1.51	1.42	1.75
United Kingdom	4,223	1.36	2.34	2,330	1.38	2.09	1.58
Belgium	636	1.31	2.21	306	0.64	1.94	1.12
Norway	298	1.31	1.79	105	1.33	1.30	1.39
United States	13,087	1.28	1.74	7,419	1.23	1.60	0.96
Australia	1,044	1.24	1.43	601	1.20	1.67	1.38
Canada	2,024	0.93	1.94	960	0.88	1.74	1.28
Switzerland	363	0.90	0.99	125	0.63	0.59	1.60
China	721	0.80	0.13	151	1.56	0.11	0.95
Germany	1,265	0.74	0.73	739	0.66	0.68	1.08
Israel	651	0.74	3.02	362	0.80	2.58	0.56
Italy	641	0.64	0.62	196	0.60	0.34	1.17
Spain	613	0.58	0.70	270	0.47	0.65	1.07
South Africa	673	0.52	5.12	340	0.71	5.25	1.65
France	1,209	0.41	0.99	515	0.59	0.67	0.77
Slovakia	360	0.38	6.91	162	0.24	5.10	0.08
Czech Republic	270	0.35	1.57	87	0.24	1.02	0.18
Romania	342	0.34	3.21	71	0.18	2.25	0.32
World	**34,295**	**1.00**	**1.00**	**18,557**	**1.00**	**1.00**	

Physics and Astronomy

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Switzerland	23,060	1.61	1.15	17,056	1.53	1.14	1.48
Netherlands	20,884	1.43	0.72	16,558	1.33	0.79	1.35
Canada	30,890	1.42	0.60	19,967	1.26	0.55	1.19
United States	240,093	1.40	0.79	191,602	1.47	0.74	0.96
United Kingdom	70,834	1.40	0.79	54,098	1.29	0.74	1.32
Germany	108,001	1.34	1.34	86,376	1.25	1.27	1.35
Australia	19,131	1.33	0.54	12,141	1.27	0.52	1.21
Spain	36,893	1.25	0.87	23,458	1.16	0.88	1.31
Sweden	15,629	1.22	0.85	13,261	1.21	0.87	1.33
France	79,284	1.21	1.29	60,352	1.13	1.20	1.34
Belgium	15,358	1.17	1.03	11,092	1.10	1.03	1.35
Italy	55,144	1.14	1.16	41,724	1.07	1.18	1.24
Japan	109,668	0.97	1.51	95,293	0.94	1.38	0.62
India	36,906	0.97	1.07	20,152	0.87	0.98	0.60
Rep. of Korea	42,705	0.96	1.41	23,953	0.93	1.50	0.62
Poland	25,543	0.91	1.38	19,715	0.82	1.44	1.09
Brazil	18,965	0.90	0.76	14,649	0.79	1.22	0.86
China	177,954	0.88	0.99	70,726	0.75	1.14	0.42
Russia	70,538	0.67	2.97	62,355	0.61	2.70	0.89
World	**1,018,777**	**1.00**	**1.00**	**741,672**	**1.00**	**1.00**	

Psychology and Cognitive Sciences

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Netherlands	6,887	1.32	2.19	3,804	1.21	1.62	1.23
United States	73,366	1.20	1.81	56,418	1.21	1.65	0.69
Switzerland	2,972	1.16	1.25	1,251	0.98	0.75	1.52
Belgium	2,721	1.15	1.56	1,290	1.00	1.01	1.27
Canada	12,319	1.13	1.96	8,250	1.09	1.93	1.21
Germany	12,451	1.13	1.22	7,750	1.01	0.95	1.14
United Kingdom	20,749	1.12	1.94	14,625	1.11	1.74	1.25
Sweden	2,320	1.10	1.13	1,672	1.04	0.97	1.08
Israel	2,410	1.06	1.82	1,682	1.00	1.51	0.96
Australia	7,104	1.01	1.68	4,299	0.98	1.54	1.10
Finland	1,478	1.01	1.31	935	0.97	1.07	1.05
Italy	4,328	0.93	0.70	2,338	0.83	0.54	1.16
New Zealand	1,563	0.93	1.91	1,061	0.88	1.88	1.25
Norway	1,536	0.92	1.55	785	0.93	1.23	1.16
China	3,466	0.90	0.11	1,271	0.86	0.12	1.15
Spain	5,074	0.83	1.06	2,538	0.59	0.80	0.88
Brazil	1,465	0.73	0.43	655	0.58	0.41	0.75
France	7,170	0.67	1.01	4,379	0.70	0.77	0.88
Japan	4,055	0.55	0.37	2,980	0.54	0.29	0.70
World	**161,220**	**1.00**	**1.00**	**115,916**	**1.00**	**1.00**	

Public Health and Health Services

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Belgium	2,121	1.41	0.79	955	0.94	0.65	1.29
Denmark	2,317	1.37	1.37	1,033	1.20	0.98	1.19
Switzerland	2,755	1.34	0.74	1,316	1.17	0.62	1.54
Netherlands	7,428	1.32	1.74	3,625	1.15	1.41	0.97
Finland	2,392	1.28	1.49	1,536	1.18	1.52	0.99
Sweden	6,230	1.26	2.28	3,701	1.22	1.97	1.00
Canada	15,298	1.24	1.82	7,636	1.17	1.64	0.98
Italy	3,679	1.20	0.41	2,099	0.95	0.42	1.07
Norway	2,829	1.20	1.98	1,103	1.24	1.53	1.14
United States	99,828	1.16	1.82	62,355	1.13	1.72	0.58
Australia	13,556	1.14	2.47	6,146	1.07	2.09	0.84
United Kingdom	27,646	1.12	1.97	17,888	1.06	1.98	0.91
Rep. of Korea	1,910	1.07	0.28	462	1.04	0.16	0.86
China	7,408	0.96	0.18	2,504	0.88	0.22	0.96
Germany	6,825	0.95	0.47	4,077	0.77	0.46	1.00
Spain	5,255	0.75	0.76	1,878	0.78	0.52	0.74
France	6,342	0.69	0.63	3,019	0.72	0.45	0.77
Japan	4,561	0.66	0.31	2,404	0.67	0.21	0.51
Brazil	9,888	0.55	2.31	1,368	0.67	0.78	0.34
World	**222,273**	**1.00**	**1.00**	**125,277**	**1.00**	**1.00**	

Social Sciences

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Netherlands	5,850	1.79	1.32	2,799	1.43	1.14	1.46
Belgium	2,433	1.62	1.00	953	1.26	0.71	1.55
United Kingdom	33,304	1.31	2.34	17,534	1.24	1.96	1.09
Sweden	2,805	1.30	1.00	1,197	1.21	0.64	1.23
Norway	2,235	1.23	1.70	937	1.19	1.47	1.20
Australia	11,330	1.17	1.99	4,989	1.06	1.71	1.07
United States	108,880	1.14	1.83	65,451	1.19	1.74	0.65
Canada	12,355	1.10	1.44	6,313	1.15	1.39	1.22
Israel	3,097	1.07	1.72	1,810	1.07	1.53	0.98
South Africa	2,473	1.02	2.41	1,217	0.81	2.37	1.01
China	8,536	1.01	0.20	3,133	1.05	0.31	1.15
New Zealand	2,588	1.00	2.45	1,302	0.90	2.26	1.34
Spain	5,746	0.98	0.85	1,535	0.72	0.47	1.03
Germany	8,684	0.94	0.62	5,250	0.68	0.63	1.19
Italy	3,347	0.94	0.40	1,290	0.94	0.28	1.20
Turkey	3,962	0.85	1.19	400	0.93	0.30	0.50
France	5,862	0.57	0.58	3,538	0.43	0.58	1.02
Japan	2,478	0.53	0.15	1,583	0.45	0.15	0.99
Brazil	2,930	0.48	0.61	652	0.61	0.37	0.72
World	**263,467**	**1.00**	**1.00**	**139,916**	**1.00**	**1.00**	

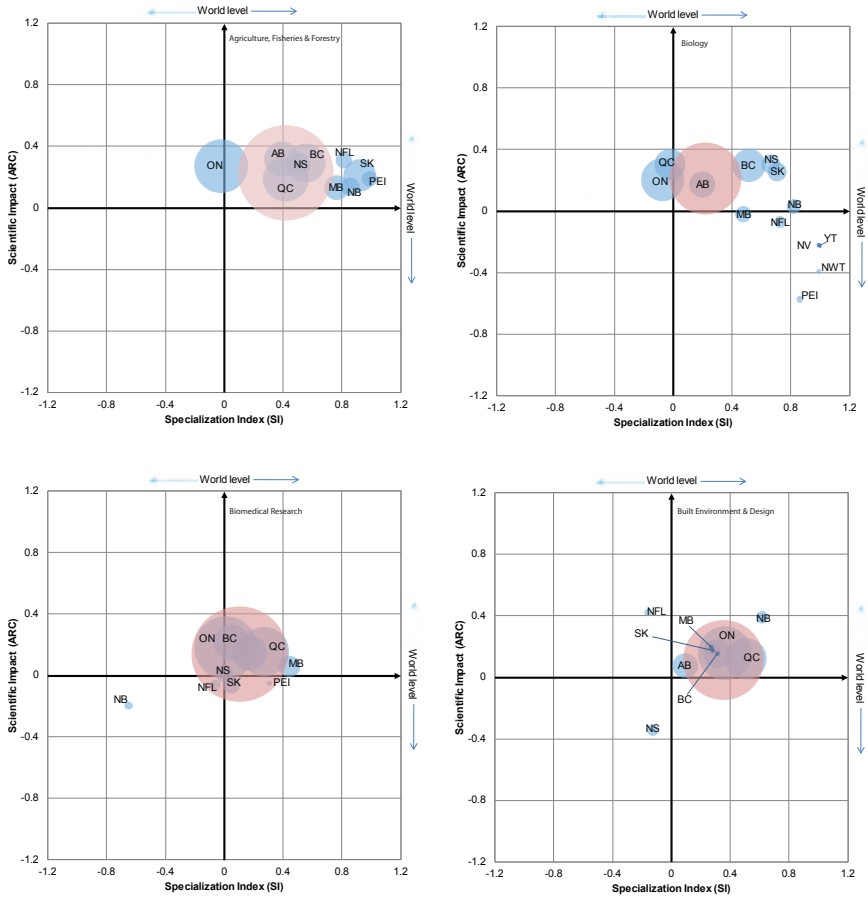
Visual and Performing Arts

Country	2005–2010			1999–2004			CI
	# of Papers	ARC	SI	# of Papers	ARC	SI	
Germany	249	2.57	0.75	105	0.62	0.63	1.30
Canada	286	2.09	1.37	100	1.43	1.10	1.83
United Kingdom	881	1.33	2.45	397	1.29	2.24	1.56
Australia	251	1.32	1.77	88	1.02	1.53	0.95
United States	2,686	1.25	1.81	1,128	1.42	1.53	1.05
Italy	130	0.86	0.62	42	1.40	0.45	1.57
France	252	0.84	1.02	130	0.88	1.08	1.14
Spain	243	0.69	1.48	154	0.53	2.45	0.82
Belgium	61	–	1.09	17	–	0.69	0.92
Brazil	70	–	0.57	14	–	0.36	0.84
China	75	–	0.07	24	–	0.12	1.03
Czech Republic	92	–	2.66	26	–	1.98	0.20
Hungary	92	–	4.43	29	–	3.03	0.60
Netherlands	142	–	1.32	46	2.62	1.01	1.33
New Zealand	57	–	2.37	13	–	1.17	0.41
Rep. of Korea	84	–	0.51	7	–	0.11	0.95
Sweden	93	–	1.37	45	1.16	1.30	1.28
Switzerland	74	–	1.12	18	–	0.63	1.04
Turkey	77	–	0.93	9	–	0.38	–
World	**7,700**	**1.00**	**1.00**	**3,744**	**1.00**	**1.00**	

Appendix 4
Analyzing S&T Strengths in the Provinces

Appendix 4 Analyzing S&T Strengths in the Provinces

Bibliometric indicators can be used to analyze research strengths at the provincial level, though, in some cases, the number of publications in each field may be too small to allow for meaningful analysis. (In general, no bibliometric indicators were computed in this study where there were fewer than 30 publications.) With this caution, however, these results are provided in this appendix as they may provide a starting place for more detailed investigations at the provincial level. Figure A4.1 provides an alternate way of visualizing the data in Figure 9.4 in the report, by plotting the provinces position for each field.



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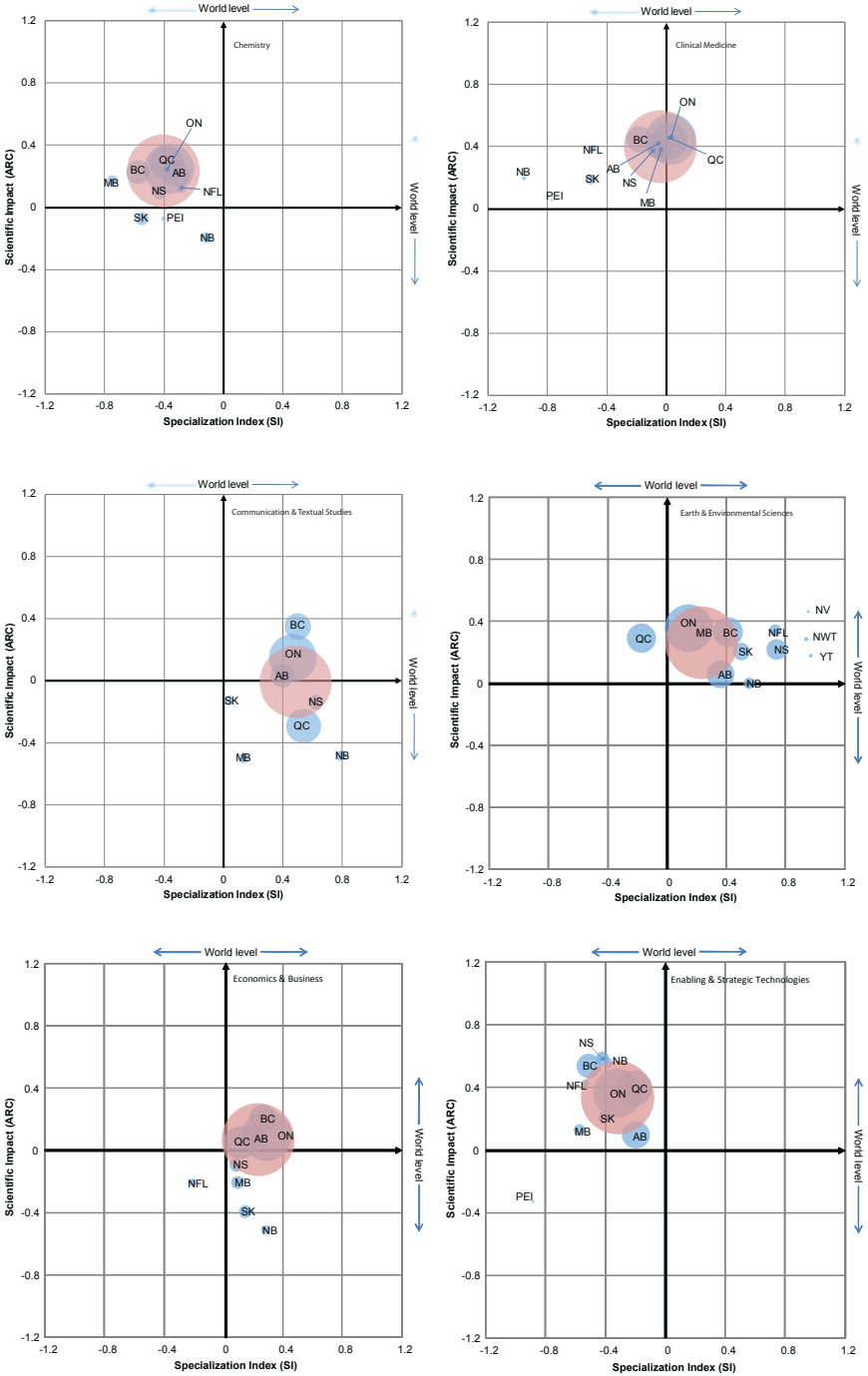

Data source: Calculated by Science-Metrix using Scopus Database (Elsevier)

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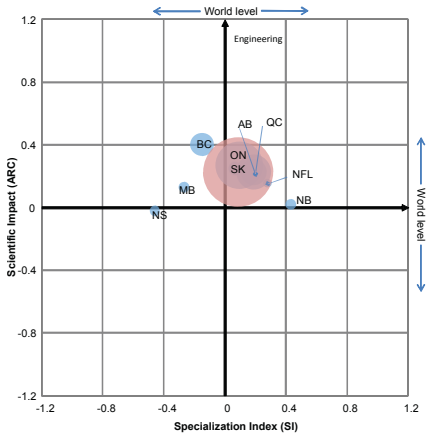

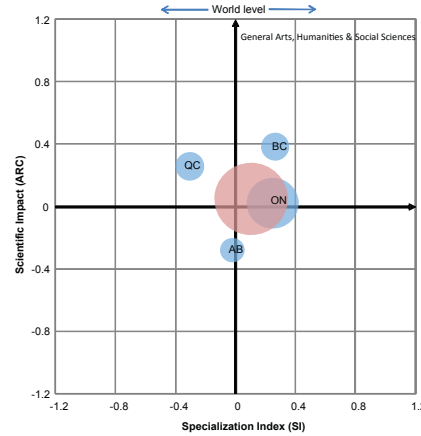

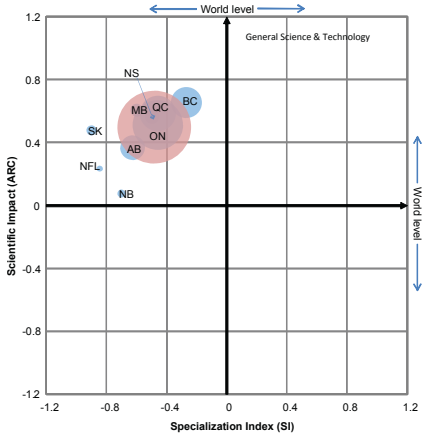

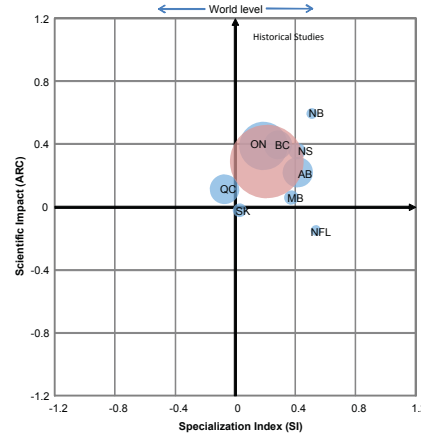

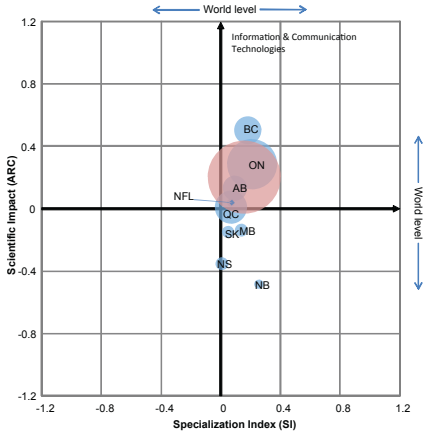

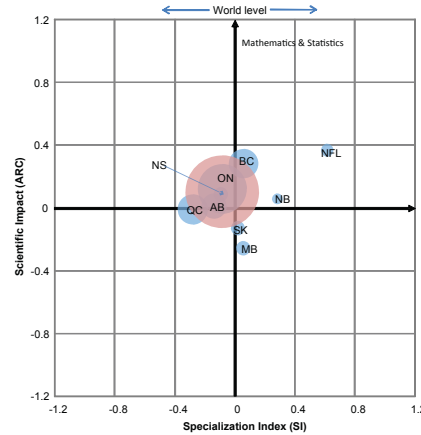

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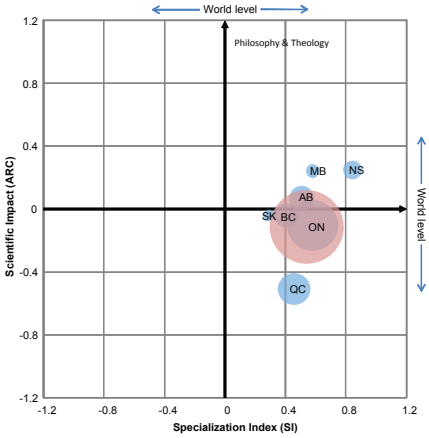

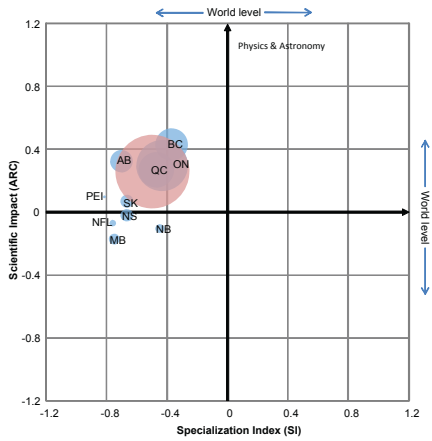

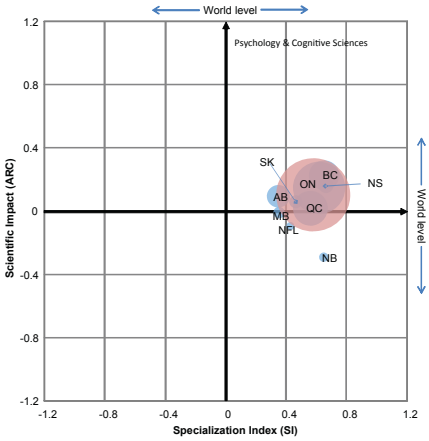

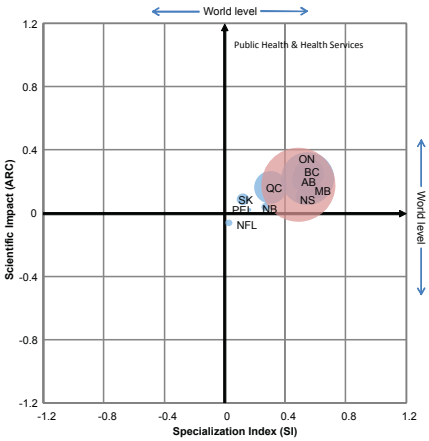

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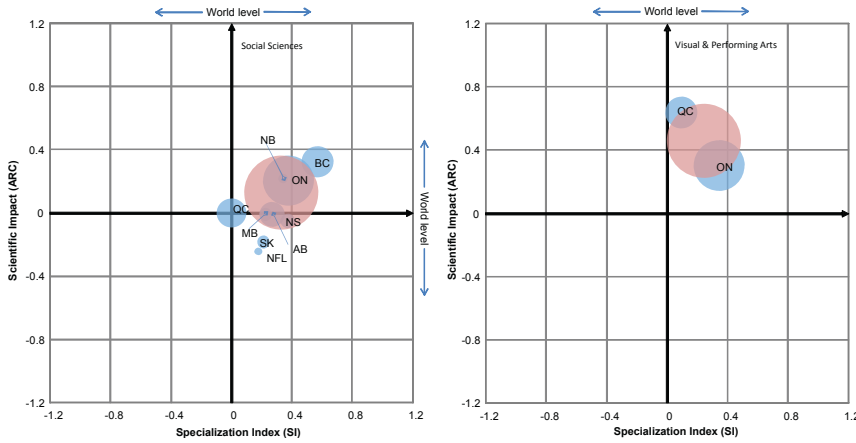

Figure A4.1

Positional Analysis of Canadian Provinces in 22 Fields of Research, 1997–2010

The pink circle shows Canada's overall position. The smaller blue circles indicate the position of individual provinces. The size of the circle is proportional to the number of publications included in the analysis. Provinces with a larger number of publications have more of an impact on Canada's overall position. The vertical axis is the important measure as provinces higher than the Canadian (pink) bubble have a scientific impact, on average, that is above the Canadian average (and vice versa). Anything with a positive value on the vertical axis has an impact, on average, that is above the world average. The horizontal axis is a measure of the proportion of S&T in that discipline compared to the world average. ARC and SI data have been converted to the hyperbolic tangent of the natural logarithm.

Table A4.1 lists the top 10 sub-fields in each province by research impact (i.e., ARC) and by the Specialization Index (SI), compared with the rest of the world for the 2005–2010 period. A number of trends emerge from this data. For example, Canada's overall strength in Clinical Medicine appears to be relatively equally distributed across the country with respect to research impact. Many provinces show strength in these sub-fields, with General and Internal Medicine the leading sub-field by ARC in 8 of the 10 provinces. Several other sub-fields of medical research also appear across multiple provinces. Likewise, Canada's comparatively high level of research output in fields related to Agriculture, Fisheries, and Forestry also emerges, with many provinces showing high levels of specialization in these fields as well as in other natural resource related sub-fields such as Energy, and Mining and Metallurgy.

Each province also possesses more unique characteristics of research output. For example, Alberta appears to have high-impact research in Industrial Engineering and Automation. British Colombia has a high impact in natural resources sub-fields,

such as Energy, and Mining and Metallurgy, and in high-tech sub-fields, such as Biotechnology, and Aerospace and Aeronautics. Manitoba has notable strength in Environmental Sciences and Biotechnology. New Brunswick has both high specialization and high impact in Fisheries, and Marine Biology and Hydrobiology, and relatively high levels of research output in several sub-fields of the humanities and social sciences, including Family Studies, Gender Studies, History, and Literary Studies. Newfoundland and Labrador has high-impact research in areas related to Energy, Food Science, and Nutrition and Dietetics. Nova Scotia has strength in Optoelectronics and Photonics, and Paleontology. Ontario has produced high-impact research in Physics, Automobile Design and Engineering, and Classics. The focus of research in PEI on Agriculture and Veterinary Sciences is readily apparent. Quebec appears to have strength in General Physics, Chemistry, and Logistics and Transportation. Saskatchewan has a high level of specialization in Veterinary Science, Ornithology, and Agronomy and Agriculture.

Table A4.1

Top 10 Sub-Fields by ARC and SI for Canadian Provinces

Alberta			
Top 10 Sub-fields by ARC		**Top 10 Sub-fields by SI**	
General & Internal Medicine	5.30	Geology	3.80
Industrial Engineering & Automation	2.94	Sport, Leisure & Tourism	3.18
Urology & Nephrology	2.25	Automobile Design & Engineering	3.04
General Physics	2.23	Accounting	2.99
Dermatology & Venereal Diseases	2.18	Medical Informatics	2.84
Gastroenterology & Hepatology	2.17	Physiology	2.80
Surgery	1.94	Nursing	2.72
Aerospace & Aeronautics	1.90	Sport Sciences	2.63
Forestry	1.79	Health Policy & Services	2.52
Dairy & Animal Science	1.76	Forestry	2.50
British Columbia			
Top 10 Sub-fields by ARC		**Top 10 Sub-fields by SI**	
General & Internal Medicine	4.88	Forestry	7.27
Energy	3.06	Fisheries	3.80
Mining & Metallurgy	3.04	Oceanography	3.71
Astronomy & Astrophysics	2.68	Geography	3.47
Aerospace & Aeronautics	2.55	Substance Abuse	3.36
Biotechnology	2.46	Ornithology	3.36
Dermatology & Venereal Diseases	2.28	Automobile Design & Engineering	3.17
Anesthesiology	2.27	Urban & Regional Planning	3.16
Automobile Design & Engineering	2.25	Gender Studies	3.05
Information Systems	2.18	General Phsychology & Cognitive Sciences	2.98

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Manitoba			
Top 10 Sub-fields by ARC		**Top 10 Sub-fields by SI**	
General & Internal Medicine	3.68	Agronomy & Agriculture	4.58
Surgery	2.69	Physiology	4.33
Allergy	2.54	Gerontology	4.33
Environmental Sciences	2.03	Food Science	4.10
Biotechnology	1.86	Nursing	3.76
Gastroenterology & Hepatology	1.73	Allergy	3.49
Respiratory System	1.57	Urban & Regional Planning	3.07
Pediatrics	1.55	Ornithology	2.99
Dairy & Animal Science	1.49	Microbiology	2.67
Arthritis & Rheumatology	1.48	Criminology	2.65
New Brunswick			
Top 10 Sub-fields by ARC		**Top 10 Sub-fields by SI**	
Mechanical Engineering & Transports	1.80	Forestry	14.84
General Physics	1.56	Fisheries	12.05
Marine Biology & Hydrobiology	1.53	Marine Biology & Hydrobiology	6.79
Operations Research	1.26	Geology	5.60
Agronomy & Agriculture	1.26	Ornithology	5.00
Microbiology	1.23	Family Studies	4.55
Geochemistry & Geophysics	1.22	Gender Studies	4.36
Fisheries	1.15	History	3.98
Environmental Sciences	1.10	Literary Studies	3.87
Chemical Engineering	1.07	Gerontology	3.81
Newfoundland and Labrador			
Top 10 Sub-fields by ARC		**Top 10 Sub-fields by SI**	
General & Internal Medicine	2.98	Fisheries	14.09
Food Science	2.42	Oceanography	11.58
General Mathematics	2.42	Civil Engineering	7.73
Electrical & Electronic Engineering	2.03	Ornithology	7.46
Energy	1.79	Geology	7.16
Networking & Telecommunications	1.74	Marine Biology & Hydrobiology	6.30
Mechanical Engineering & Transports	1.45	Folklore	6.16
Nutrition & Dietetics	1.37	Behavioural Science & Comparative Psychology	5.18
Oncology & Carcinogenesis	1.35	Industrial Relations	5.10
Artificial Intelligence & Image Processing	1.26	Physiology	4.08

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Nova Scotia			
Top 10 Sub-fields by ARC		**Top 10 Sub-fields by SI**	
General & Internal Medicine	5.08	Oceanography	7.46
Gastroenterology & Hepatology	3.40	Fisheries	7.30
Obstetrics & Reproductive Medicine	2.70	Geology	7.10
Energy	2.24	Applied Ethics	6.97
Anesthesiology	2.13	Marine Biology & Hydrobiology	5.85
Respiratory System	1.82	Horticulture	5.09
Optoelectronics & Photonics	1.81	Developmental & Child Psychology	3.94
Nursing	1.62	Medical Informatics	3.92
Paleontology	1.59	Religions & Theology	3.90
Surgery	1.54	Literary Studies	3.89
Ontario			
Top 10 Sub-fields by ARC		**Top 10 Sub-fields by SI**	
General & Internal Medicine	4.28	Drama & Theater	3.36
Gastroenterology & Hepatology	2.32	Sport, Leisure & Tourism	2.85
Dermatology & Venereal Diseases	2.32	Rehabilitation	2.75
Astronomy & Astrophysics	2.28	Gender Studies	2.61
Classics	2.14	Criminology	2.56
Automobile Design & Engineering	2.08	Experimental Psychology	2.43
Mycology & Parasitology	2.03	Literary Studies	2.42
Nuclear & Particles Physics	2.02	Human Factors	2.39
General Physics	1.92	Physiology	2.33
Anesthesiology	1.89	Health Policy & Services	2.32
Prince Edward Island			
Top 10 Sub-fields by ARC		**Top 10 Sub-fields by SI**	
Veterinary Sciences	1.18	Veterinary Sciences	31.67
Fisheries	1.02	Fisheries	27.78
Agronomy & Agriculture	0.74	Horticulture	10.00
		Mycology & Parasitology	9.91
		Agronomy & Agriculture	7.94
		Music	6.24
		Dairy & Animal Science	5.98
		Toxicology	5.74
		Classics	4.93
		Entomology	4.83

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Quebec			
Top 10 Sub-fields by ARC		**Top 10 Sub-fields by SI**	
General & Internal Medicine	5.95	Forestry	4.33
Logistics & Transportation	3.44	Industrial Relations	2.57
General Physics	2.43	Religions & Theology	2.55
Anesthesiology	2.31	Developmental & Child Psychology	2.54
Mining & Metallurgy	2.11	Econometrics	2.47
Dermatology & Venereal Diseases	2.04	Automobile Design & Engineering	2.44
Gastroenterology & Hepatology	2.02	Literary Studies	2.42
General Chemistry	2.01	Rehabilitation	2.28
Pathology	1.98	Experimental Psychology	2.18
Medical Informatics	1.91	Speech-Language Pathology & Audiology	2.17
Saskatchewan			
Top 10 Sub-fields by ARC		**Top 10 Sub-fields by SI**	
General & Internal Medicine	4.15	Veterinary Sciences	7.87
Marine Biology & Hydrobiology	1.90	Ornithology	7.55
Ornithology	1.89	Agronomy & Agriculture	7.13
Chemical Engineering	1.85	Dairy & Animal Science	4.32
Optoelectronics & Photonics	1.68	Agricultural Economics & Policy	4.26
Forestry	1.66	Environmental Engineering	4.19
Ecology	1.60	Geology	4.04
General Physics	1.58	Sport Sciences	3.58
Nursing	1.51	Social Sciences Methods	3.51
Behavioural Science & Comparative Psychology	1.49	Plant Biology & Botany	3.27

Notes: ARC = Average Relative Citations, a measure of the citedness of research where 1.0 is equal to the world average. SI = Specialization Index, a measure how much research is produced in that area in the province relative to world averages, where 1.0 is equal to the world average. Data is shown for the 2005 to 2010 period.

Data source: Calculated by Science-Metrix using Scopus database (Elsevier)

Appendix 5
Survey of Top-Cited International Researchers

Appendix 5 Survey of Top-Cited International Researchers

This appendix provides a transcript of the questions asked in the survey of top-cited researchers from around the world, as well as key data. The full database in SPSS format is available on request from the Council of Canadian Academies by contacting **info@scienceadvice.ca**.

A5.1 SURVEY QUESTIONS

According to a 2011 analysis, you are an author of one of the top 1% most highly cited papers in your field worldwide. We are contacting you as a leading researcher to request your opinion on the geographical distribution of research strengths in your field of study.

The following questionnaire has been developed to gather data for an assessment report by the **Council of Canadian Academies** — a not-for-profit corporation that supports independent, evidence-based, expert assessments that inform public policy development in Canada. **This survey consists of seven multiple choice questions and should take less than five minutes to complete**. The results will be used, along with the results of bibliometric analysis and other methods, to report on the state of your field of research in the Council of Canadian Academies' assessment of the State of Science and Technology in Canada, to be published in 2012.

These questions ask for your informed opinion on research strengths in your area of expertise, we do not expect you to do any research to answer the questionnaire. All responses are anonymous.

Please complete your questionnaire by October 14.

For more information on this assessment or the Council of Canadian Academies please visit: **www.scienceadvice.ca** or contact, Eleanor Fast, Program Director, at **eleanor.fast@scienceadvice.ca**

For technical issues related to the survey please contact: Derek Jansen at **djansen@ekos.com**

Question 1:

Which of the following general fields most closely matches your area of expertise?

- ❒ Agriculture, Fisheries & Forestry
- ❒ Built Environment & Design
- ❒ Enabling & Strategic Technologies
- ❒ Engineering
- ❒ Information & Communication Technologies
- ❒ Communication & Textual Studies
- ❒ Historical Studies (includes anthropology and archaeology)
- ❒ Philosophy & Theology
- ❒ Visual & Performing Arts
- ❒ Economics & Business
- ❒ Social Sciences
- ❒ Biomedical Research
- ❒ Clinical Medicine
- ❒ Psychology & Cognitive Sciences
- ❒ Public Health & Health Services
- ❒ Biology
- ❒ Chemistry
- ❒ Earth & Environmental Sciences
- ❒ Mathematics & Statistics
- ❒ Physics & Astronomy

To facilitate analysis, we have adopted a taxonomy of major fields and sub-fields that corresponds with the bibliometric taxonomy being used. This seeks an adequate degree of "granularity" but inevitably involves compromises.

Which of the following sub-fields most closely matches your area of expertise?

sub-field 

Question 2:

In your area of expertise, what are the five (5) leading countries in terms of research strength? In other words what five countries are host to research programs widely acknowledged to be world leading in terms of originality, impact, and rigour?

❒	Argentina	❒	Japan
❒	Australia	❒	Korea
❒	Brazil	❒	Mexico
❒	Canada	❒	Netherlands
❒	Chile	❒	New Zealand
❒	China	❒	Norway
❒	Denmark	❒	Russia
❒	Egypt	❒	Singapore
❒	Finland	❒	South Africa
❒	France	❒	Spain
❒	Germany	❒	Sweden
❒	Iceland	❒	Switzerland
❒	India	❒	Turkey
❒	Israel	❒	United Kingdom
❒	Italy	❒	United States
❒	Other: (Please specify up to 5 choices including those ticked above)		

Question 3:

What is your opinion of Canada's research strength in your discipline? Please compare with other advanced countries. Please use the following scale when rating Canada's relative strength:

7	Research that is widely acknowledged to be world-leading within its field in terms of originality, impact and rigour. (Very Strong)
6	Research that is internationally acknowledged to be above world standards in its field in terms of originality, impact and rigour but which falls short of the highest standards of excellence.
5	Research that is recognized to be generally above world standards in its field in terms or originality, impact and rigour.
4	Research that is recognized to be at the level of world standards in its field in terms of originality, impact and rigour. (About The Same)
3	Research that may be regarded as below world standards in its field with respect to originality, impact and rigour.
2	Research that is generally acknowledged as below world standards with respect to originality, impact, and rigour.
1	Research is that is widely acknowledged to be below world standards with respect to originality, impact and rigour. (Very Weak)

Very Strong 7	6	5	About The Same 4	3	2	Very Weak 1	Don't Know
❒	❒	❒	❒	❒	❒	❒	❒

Question 4:

In your research career, have you visited, worked or studied at a Canadian university or research institution, or collaborated with Canadian researchers? Please tick as many as apply:

❒	No, never
❒	Yes, I have visited
❒	Yes, I have worked as a researcher in a Canadian university, college or government laboratory
❒	Yes, I have worked as a researcher in a Canadian business
❒	Yes, I have studied in Canada
❒	Yes, I have collaborated with Canadian researchers
❒	Don't know/No response

Do you have any comments about your experience with a Canadian university or researcher?

❒	❒ No comments

Question 5:

In your opinion, does Canada have particular infrastructure or research programs that are of worldwide importance?

❒ Yes	❒ No	❒ Don't know

What infrastructure or research program(s) do you believe are of worldwide importance?

<type answer here>

Question 6:

What country do you currently reside in?

❒ Argentina	❒ Japan
❒ Australia	❒ Korea
❒ Brazil	❒ Mexico
❒ Canada	❒ Netherlands
❒ Chile	❒ New Zealand
❒ China	❒ Norway
❒ Denmark	❒ Russia
❒ Egypt	❒ Singapore
❒ Finland	❒ South Africa
❒ France	❒ Spain
❒ Germany	❒ Sweden
❒ Iceland	❒ Switzerland
❒ India	❒ Turkey
❒ Israel	❒ United Kingdom
❒ Italy	❒ United States
❒ Other: (Please specify)	
❒ No response	

Question 7:

What is your current age? (Please specify range)

- ❒ Under 35 years
- ❒ 35–44 years
- ❒ 45–54 years
- ❒ 55–64
- ❒ 65 years or older
- ❒ No response

Thank you for taking the time to complete this questionnaire.

If you are interested in receiving the final report, please visit the Council of Canadian Academies' website at **www.scienceadvice.ca** or email **eleanor.fast@scienceadvice.ca**.

Table A5.2

Distribution of Respondents by Country of Residence

(Unweighted)			(Weighted)		
Country	Frequency	Percent	Country	Frequency	Percent
Argentina	7	0.1	Argentina	5	0.1
Australia	156	3.0	Australia	120	2.3
Austria	37	0.7	Austria	27	0.5
Belgium	59	1.1	Belgium	43	0.8
Brazil	28	0.5	Brazil	20	0.4
Canada	360	7.0	Canada	223	4.3
Chile	7	0.1	Chile	5	0.1
China	144	2.8	China	282	5.5
Czech Republic	17	0.3	Czech Republic	12	0.2
Denmark	70	1.4	Denmark	51	1.0
Egypt	2	0.0	Egypt	1	0.0
Finland	63	1.2	Finland	46	0.9
France	238	4.6	France	212	4.1
Germany	281	5.5	Germany	318	6.2
Greece	42	0.8	Greece	31	0.6
Hong Kong	14	0.3	Hong Kong	10	0.2
Hungary	14	0.3	Hungary	10	0.2
Iceland	2	0.0	Iceland	1	0.0
India	44	0.9	India	32	0.6
Ireland	21	0.4	Ireland	15	0.3
Israel	61	1.2	Israel	45	0.9
Italy	223	4.3	Italy	149	2.9
Japan	97	1.9	Japan	153	3.0
Korea	43	0.8	Korea	31	0.6
Mexico	14	0.3	Mexico	10	0.2
Netherlands	149	2.9	Netherlands	145	2.8
New Zealand	23	0.4	New Zealand	17	0.3
Norway	50	1.0	Norway	36	0.7
Poland	11	0.2	Poland	8	0.2
Portugal	27	0.5	Portugal	20	0.4
Russia	13	0.3	Russia	9	0.2
Singapore	34	0.7	Singapore	25	0.5
South Africa	7	0.1	South Africa	5	0.1

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(Unweighted)			(Weighted)		
Country	Frequency	Percent	Country	Frequency	Percent
Spain	180	3.5	Spain	131	2.5
Sweden	89	1.7	Sweden	65	1.3
Switzerland	118	2.3	Switzerland	118	2.3
Taiwan	33	0.6	Taiwan	24	0.5
Turkey	38	0.7	Turkey	28	0.5
United Kingdom	489	9.5	United Kingdom	455	8.8
United States	1,721	33.4	United States	2,117	41.1
Other	115	2.2	Other	84	1.6
No response	13	0.3	No response	13	0.3
Total*	5,154	100.0	Total*	5,155	100.0

* Totals differ due to rounding in weighted sample.

Table A5.3

Distribution of Respondents by Field of Expertise (weighted)

Field of Expertise	Frequency	Percent
Agriculture, Fisheries & Forestry	168	3.3
Biology	285	5.5
Biomedical Research	677	13.1
Built Environment & Design	51	1.0
Chemistry	430	8.3
Clinical Medicine	404	7.8
Communication & Textual Studies	54	1.1
Earth & Environmental Sciences	428	8.3
Economics & Business	93	1.8
Enabling & Strategic Technologies	201	3.9
Engineering	756	14.7
Historical Studies (includes anthropology and archaeology)	61	1.2
Information & Communication Technologies	364	7.1
Mathematics & Statistics	204	3.9
Philosophy & Theology	51	1.0
Physics & Astronomy	401	7.8
Psychology & Cognitive Sciences	190	3.7
Public Health & Health Services	170	3.3
Social Sciences	156	3.0
Visual & Performing Arts	12	0.2
Total	5,154	100.0

Table A5.4

Age Distribution of Respondents

Age	Frequency	Percent
Under 35 years	251	4.9
35-44 years	1,213	23.5
45-54 years	1,720	33.4
55-64 years	1,221	23.7
65 years or older	721	14.0
No response	30	0.6
Total	5,155	100.0

Table A5.5

Response to the question "In your research career, have you visited, worked or studied at a Canadian university or research institution, or collaborated with Canadian researchers?"

Answer	Frequency	Percent
No, never	1,446	28.0
Yes, I have visited	2,231	43.3
Yes, I have worked as a researcher in a Canadian university	403	7.8
Yes, I have worked as a researcher in a Canadian business	5	0.1
Yes, I have studied in Canada	56	1.1
Yes, I have collaborated with Canadian researchers	994	19.3
Don't know/No response	20	0.4
Total	5,155	100.0

Table A5.6

Countries Identified as in the Top Five for Each of the Broad Areas of Research (Actual Number of Responses)

	Agriculture, Fisheries & Forestry	Biology	Biomedical Research	Built Environment & Design	Chemistry	Clinical Medicine	Communication & Textual Studies	Earth & Environmental Sciences	Economics & Business	Enabling & Strategic Technologies	Engineering	Historical Studies	Information & Communication Technologies	Mathematics & Statistics	Philosophy & Theology	Physics & Astronomy	Psychology & Cognitive Sciences	Public Health & Health Services	Social Sciences	Visual & Performing Arts	Total
Number of respondents in the field	168	285	677	51	430	404	54	428	93	201	756	61	364	204	51	401	189	170	156	12	5,154
Argentina	3	4	0	0	1	2	0	1	0	0	4	0	0	0	0	0	0	2	3	0	20
Austria	0	3	1	0	1	5	0	2	1	2	4	0	0	1	0	10	0	0	1	0	31
Australia	68	107	101	14	36	97	19	137	27	21	77	12	46	20	36	28	44	71	59	5	1,023
Belgium	3	1	5	0	2	4	0	0	1	0	14	0	4	2	0	3	5	1	1	0	46
Brazil	9	6	13	2	5	8	0	6	1	1	15	1	1	1	2	1	0	5	1	1	80
Canada	96	105	253	15	87	172	31	175	59	34	204	21	151	55	41	76	131	99	84	7	1,896
Chile	0	3	1	0	0	0	0	3	1	0	1	0	0	1	0	3	0	0	0	0	13
China	27	37	54	14	158	21	1	57	7	70	231	2	92	49	0	54	2	3	2	0	880
Denmark	23	14	45	11	5	36	6	14	5	6	26	0	12	8	4	4	5	24	9	0	255
Egypt	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	3
Finland	17	7	13	4	5	13	6	19	1	5	15	0	20	4	2	5	9	23	11	2	182
France	60	105	237	14	143	132	7	166	32	58	260	41	137	127	11	235	28	21	23	5	1,843

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	Agriculture, Fisheries & Forestry	Biology	Biomedical Research	Built Environment & Design	Chemistry	Clinical Medicine	Communication & Textual Studies	Earth & Environmental Sciences	Economics & Business	Enabling & Strategic Technologies	Engineering	Historical Studies	Information & Communication Technologies	Mathematics & Statistics	Philosophy & Theology	Physics & Astronomy	Psychology & Cognitive Sciences	Public Health & Health Services	Social Sciences	Visual & Performing Arts	Total
Number of respondents in the field	**168**	**285**	**677**	**51**	**430**	**404**	**54**	**428**	**93**	**201**	**756**	**61**	**364**	**204**	**51**	**401**	**189**	**170**	**156**	**12**	**5,154**
Germany	58	185	454	22	351	199	31	296	36	168	481	46	225	112	27	335	120	30	63	10	3,247
Greece	0	0	1	0	1	0	0	0	0	0	2	0	2	1	0	0	0	0	0	0	7
Iceland	1	1	4	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	8
India	6	2	5	3	14	2	2	10	1	3	21	0	19	9	0	6	0	2	0	1	105
Ireland	5	0	2	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	9
Israel	7	7	52	1	17	17	8	8	12	19	48	3	61	20	4	21	19	8	18	0	349
Italy	7	6	60	3	31	70	2	15	4	10	88	10	44	53	1	82	8	9	3	3	509
Japan	32	78	303	17	272	90	3	104	9	126	379	2	113	35	0	206	13	8	8	0	1,798
Korea	1	3	17	1	26	11	6	7	1	25	104	0	29	7	0	14	0	0	2	1	254
Mexico	2	3	2	0	0	1	0	1	1	0	3	1	0	0	0	0	0	0	0	0	15
Netherlands	58	58	148	9	63	119	18	93	32	29	98	13	51	21	9	67	104	81	68	1	1,140
New Zealand	25	11	7	0	1	4	3	15	0	0	3	2	2	0	7	1	9	9	6	0	106
Norway	12	16	10	3	2	14	1	32	3	5	11	1	3	5	1	1	5	7	8	0	142
Other	2	2	9	2	8	2	2	7	4	2	4	8	6	9	0	5	6	1	5	1	84

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	Agriculture, Fisheries & Forestry	Biology	Biomedical Research	Built Environment & Design	Chemistry	Clinical Medicine	Communication & Textual Studies	Earth & Environmental Sciences	Economics & Business	Enabling & Strategic Technologies	Engineering	Historical Studies	Information & Communication Technologies	Mathematics & Statistics	Philosophy & Theology	Physics & Astronomy	Psychology & Cognitive Sciences	Public Health & Health Services	Social Sciences	Visual & Performing Arts	Total
Number of respondents in the field	**168**	**285**	**677**	**51**	**430**	**404**	**54**	**428**	**93**	**201**	**756**	**61**	**364**	**204**	**51**	**401**	**189**	**170**	**156**	**12**	**5,154**
Poland	0	0	0	0	0	0	0	0	0	0	1	0	1	3	0	3	0	0	0	0	8
Russia	0	2	5	0	24	1	2	5	0	6	51	1	7	37	0	32	0	0	1	0	174
Singapore	0	1	11	7	9	2	2	1	4	6	29	0	18	1	0	5	0	0	7	0	103
South Africa	0	5	1	0	0	1	0	4	0	0	6	6	0	0	0	1	0	7	3	0	34
Spain	10	26	22	1	19	23	1	12	6	10	35	7	21	16	1	15	5	5	1	1	239
Sweden	16	40	109	8	25	82	8	47	12	7	61	4	33	6	2	10	15	49	32	1	567
Switzerland	9	31	66	3	74	33	3	69	10	44	99	0	72	24	6	73	7	9	7	0	641
Taiwan	0	0	2	0	0	2	0	1	0	2	11	0	6	1	0	0	1	0	1	0	26
Turkey	0	0	1	0	2	1	0	1	1	1	7	0	3	3	0	0	0	0	0	0	19
United Kingdom	95	238	571	38	269	284	41	338	86	122	401	55	203	135	49	264	160	140	136	12	3,638
United States	153	271	649	45	394	362	54	408	89	195	692	60	346	188	51	385	187	158	150	10	4,849

Note: Each cell in the table indicates the number of respondents in the field that identified the country as one of the leading five countries in the world in terms of research originality, impact, and rigour. (Each survey respondent selected up to five countries. Therefore, the total in each column adds up to more than the total number of respondents in that field).

Table A5.7

Respondents' Opinions of the Strength of Research Fields in Canada Compared to Other Advanced Countries (Actual Number of Responses)

	Very Weak 1	2	3	About The Same 4	5	6	Very Strong 7	Don't Know	Total
Agriculture, Fisheries & Forestry	0	0	5	24	43	58	36	2	168
Biology	0	2	15	57	77	84	48	2	285
Biomedical Research	4	4	33	164	181	188	95	8	677
Built Environment & Design	1	3	2	16	15	10	3	2	51
Chemistry	3	6	30	126	109	109	36	9	430
Clinical Medicine	5	6	25	86	88	122	66	5	404
Communication & Textual Studies	0	0	6	14	11	13	8	2	54
Earth & Environmental Sciences	1	3	15	93	101	136	73	7	428
Economics & Business	0	1	3	16	34	30	7	1	93
Enabling & Strategic Technologies	1	0	17	57	67	42	12	6	201
Engineering	5	17	63	196	204	190	51	29	756
Historical Studies (includes anthropology and archaeology)	0	1	3	9	17	24	4	2	61
Information & Communication Technologies	1	6	25	71	108	97	50	5	364
Mathematics & Statistics	1	2	4	46	53	64	28	5	204
Philosophy & Theology	0	1	1	1	9	29	9	1	51
Physics & Astronomy	4	3	28	100	90	120	51	5	401
Psychology & Cognitive Sciences	0	0	10	32	43	59	44	1	189
Public Health & Health Services	2	1	5	30	53	50	26	2	170
Social Sciences	2	5	6	40	35	42	20	6	156
Visual & Performing Arts	0	0	1	1	4	4	3	0	12
TOTAL	30	61	296	1180	1343	1473	671	101	5154

Table A5.8

Responses to the Question, "Does Canada have world-leading research programs or infrastructure?"

	% Yes	% No	% Don't know
Agriculture, Fisheries & Forestry	63	6	31
Biology	55	7	38
Biomedical Research	59	9	32
Built Environment & Design	37	14	49
Chemistry	51	9	40
Clinical Medicine	59	8	33
Communication & Textual Studies	33	2	65
Earth & Environmental Sciences	61	7	32
Economics & Business	51	13	37
Enabling & Strategic Technologies	51	10	39
Engineering	51	7	42
Historical Studies (includes anthropology and archaeology)	55	10	35
Information & Communication Technologies	44	10	46
Mathematics & Statistics	64	3	32
Philosophy & Theology	50	8	42
Physics & Astronomy	64	6	30
Psychology & Cognitive Sciences	64	6	30
Public Health & Health Services	64	8	27
Social Sciences	51	10	38
Visual & Performing Arts	75	8	17
Total	**56**	**8**	**36**

Appendix 6
Survey of Canadian S&T Experts

Appendix 6 Survey of Canadian S&T Experts

This appendix provides a transcript of the questions asked in the survey of Canadian S&T experts, as well as key data. The full database in SPSS format is available on request from the Council of Canadian Academies by contacting **info@scienceadvice.ca**.

A6.1 SURVEY QUESTIONS

The Council of Canadian Academies (**www.scienceadvice.ca**) is approaching a select number of individuals knowledgeable in the area of Canadian science and technology. We would appreciate your completion of the following questionnaire.

The Council of Canadian Academies is a not-for-profit corporation that supports independent, evidence-based, expert assessments that inform public policy development in Canada. The Council has been asked by the Minister of Industry to assess the state of science and technology (S&T) in Canada. This assessment on S&T will build on the Council's inaugural report, *The State of Science and Technology in Canada*, released in 2006. The Council's 2006 report highlighted the strengths and weaknesses of the Canadian science and technology environment. This 2011 assessment will be comparable to the 2006 report, while introducing new methodologies and improving on existing ones.

Please note the following:

- The questionnaire is to be completed on-line, and should take approximately 20 minutes.
- Data in the final report will be aggregated in order to preserve anonymity of individual respondents.
- The Council's report will be made publically available in both official languages.
- Please complete your questionnaire by September 15.

We apologize in advance if you receive this questionnaire more than once, please only complete it once and do not forward to colleagues, this questionnaire is intended for you.

This survey is intended to record your personal opinion of Canada's standing — relative to our peer group of advanced countries — in a broad range of S&T fields and components of infrastructure. We do not expect you to do any research to respond. Rather, we are seeking your informed judgment.

To facilitate analysis, we have adopted a taxonomy of major fields and sub-fields that corresponds with the bibliometric taxonomy being used. This seeks an adequate degree of granularity but inevitably involves compromises. Please comment on those areas where you are able to offer an informed opinion.

Responses to the survey will be combined with other data and analysis to draw a multi-faceted picture of Canada's S&T capabilities in an international context. We thank you for taking the time to share your experience and wisdom to help develop an authoritative and up-to-date picture of Canada's S&T assets.

For more information on this assessment or the Council of Canadian Academies please visit: **www.scienceadvice.ca** or contact, Eleanor Fast, Program Director, at **eleanor.fast@scienceadvice.ca**.

To report technical problems with this questionnaire please contact: Derek Jansen at **djansen@ekos.com**.

Question 1

What are the areas of particular scientific or technological strength for Canada?

Below are listed broad research disciplines and areas of technological application. Think of these as "gateways" to the various fields with which you have some familiarity. Choose as many as you wish. For each "gateway box" selected you will be presented with a menu of relevant sub-areas that cover the broad area. You should then rate Canada's standing in all those sub-areas where you are comfortable expressing a view.

Please note you will also be provided with an opportunity to return to this "gateways" menu at the end of the sub sections you have selected.

Broad areas ("gateways") menu
(Select the broad areas you wish to assess by clicking the relevant boxes, then press the "Continue" button and rate the sub-areas that pop up.)

❒	Agriculture, Fisheries & Forestry	❒	General Science & Technology
❒	Built Environment & Design	❒	General Arts, Humanities & Social Sciences
❒	Enabling & Strategic Technologies	❒	Biomedical Research
❒	Engineering	❒	Clinical Medicine
❒	Information & Communication Technologies	❒	Psychology & Cognitive Sciences

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❒	Communication & Textual Studies	❒	Public Health & Health Services
❒	Historical Studies (includes anthropology and archaeology)	❒	Biology
❒	Philosophy & Theology	❒	Chemistry
❒	Visual & Performing Arts	❒	Earth & Environmental Sciences
❒	Economics & Business	❒	Mathematics & Statistics
❒	Social Sciences	❒	Physics & Astronomy

Agriculture, Fisheries & Forestry

1. For each of the following sub-areas for which you are comfortable expressing a view, please first provide your opinion of Canada's current overall strength relative to other advanced countries (i.e., roughly the OECD group.) Please consider both the quality and the extent of the work carried out in Canada. Please use the following scale when rating Canada's relative strength in each of these sub-areas:

7	Research that is widely acknowledged to be world-leading within its field in terms of originality, impact and rigour. (Very Strong)
6	Research that is internationally acknowledged to be above world standards in its field in terms of originality, impact and rigour but which falls short of the highest standards of excellence.
5	Research that is recognized to be generally above world standards in its field in terms or originality, impact and rigour.
4	Research that is recognized to be at the level of world standards in its field in terms of originality, impact and rigour. (About The Same)
3	Research that may be regarded as below world standards in its field with respect to originality, impact and rigour.
2	Research that is generally acknowledged as below world standards with respect to originality, impact and rigour.
1	Research is that is widely acknowledged to be below world standards with respect to originality, impact and rigour. (Very Weak)

2. Second, please rate your opinion of the overall trend in Canada's relative strength over roughly the past five years — are we gaining ground, falling behind, or remaining stable?

3. Third, please indicate which three provinces/territories have greatest strength in this sub-area in terms of research quality and impact? In answering this question please do not focus on volume, but on quality and impact.

Please note, if you do not feel sufficiently knowledgeable to express an opinion about a sub area, please leave it blank.

Sub-Areas	1. Canada's Overall Strength Relative to Other Advanced Countries							2. Recent Trend		
	Very Strong 7	6	5	About The Same 4	3	2	Very Weak 1	Gaining Ground	Stable	Falling Behind
Agronomy & Agriculture	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒
Dairy & Animal Science	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒
Fisheries	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒
Food Science	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒
Forestry	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒
Horticulture	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒
Veterinary Sciences	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒

Sub-Areas	3. Geographic strength										
	Alberta	British Columbia	Manitoba	New Brumswick	Newfoundland and Labrador	Northern Territories	Nova Scotia	Ontario	Prince Edward Island	Quebec	Saskatchewan
Agronomy & Agriculture	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒
Dairy & Animal Science	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒
Fisheries	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒
Food Science	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒
Forestry	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒
Horticulture	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒
Veterinary Sciences	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Agriculture, Fisheries & Forestry?

❒ Yes (please name)	❒ No	❒ Don't know/No response

The above depicts a question for Agriculture, Fisheries & Forestry. This is repeated for all fields selected.

Would you like to return to the Broad Areas ("GATEWAYS") to select other areas to assess?

❒ Yes	❒ No

Please note that interdisciplinary researchers may also find relevant topics under the general field of Enabling and Strategic Technologies which includes the sub-fields: *Bioinformatics*, *Biotechnology*, *Energy*, *Materials*, *Nanoscience & Nanotechnology*, *Optoelectronics & Photonics*, *Strategic Defence and Security Studies*.

Question 2

Which elements of Canada's S&T infrastructure confer significant advantages?

The following list includes both "soft" infrastructure (e.g., networks; government programs) and "hard" infrastructure (e.g. major research facilities).

For those elements where you are comfortable expressing a view, please rate your opinion of the degree of advantage they provide for Canadian research and/or technological application relative to other advanced countries (i.e., roughly the OECD group).

You should consider in combination: (a) how close the specific infrastructure is to global best practice (i.e. the quality element); and, where applicable, (b) the extent of deployment of the infrastructure in Canada relative to deployment in other advanced countries (i.e. the "extent of use" element).

Please note, if you do not feel sufficiently knowledgeable to express an opinion about a particular element, please leave it blank.

Degree of Advantage for Canada Relative to Other Advanced Countries

Knowledge Production and Support	Significant Advantage 7	6	5	Neither 4	3	2	Significant Disadvantage 1
Canada's Universities	❒	❒	❒	❒	❒	❒	❒
Canada's Polytechnics	❒	❒	❒	❒	❒	❒	❒
Canada's Community Colleges	❒	❒	❒	❒	❒	❒	❒
Canada's Research Hospitals	❒	❒	❒	❒	❒	❒	❒
National Research Council Institutes	❒	❒	❒	❒	❒	❒	❒
Natural Sciences and Engineering Research Council (NSERC)	❒	❒	❒	❒	❒	❒	❒
Social Sciences and Humanities Research Council (SSHRC)	❒	❒	❒	❒	❒	❒	❒
Canadian Institutes of Health Research (CIHR)	❒	❒	❒	❒	❒	❒	❒
Canada Council for the Arts	❒	❒	❒	❒	❒	❒	❒
Provincial/ Territorial Research Funding Programs	❒	❒	❒	❒	❒	❒	❒
Charitable Support for Research	❒	❒	❒	❒	❒	❒	❒
Canada Foundation for Innovation (CFI)	❒	❒	❒	❒	❒	❒	❒
Canada Research Chairs (CRCs)	❒	❒	❒	❒	❒	❒	❒
Canada Excellence Research Chairs (CERCs)	❒	❒	❒	❒	❒	❒	❒
Canadian Institute for Advanced Research (CIFAR)	❒	❒	❒	❒	❒	❒	❒
Council of Canadian Academies (CCA)	❒	❒	❒	❒	❒	❒	❒
Library and Archives Canada (LAC)	❒	❒	❒	❒	❒	❒	❒
CANARIE High-Speed Network	❒	❒	❒	❒	❒	❒	❒
High Performing Computing Networks	❒	❒	❒	❒	❒	❒	❒
Canadian Research Knowledge Network (CRKN)	❒	❒	❒	❒	❒	❒	❒
SSHRC Research Data Centres	❒	❒	❒	❒	❒	❒	❒
Statistics Canada	❒	❒	❒	❒	❒	❒	❒
Federal Laboratories and Facilities	❒	❒	❒	❒	❒	❒	❒
Provincial Laboratories and Facilities	❒	❒	❒	❒	❒	❒	❒
Infectious Diseases Laboratories	❒	❒	❒	❒	❒	❒	❒

Which elements of Canada's S&T infrastructure confer significant advantages?

For the following elements where you are comfortable expressing a view, please rate your opinion of the degree of advantage they provide for Canadian research and/or technological application relative to other advanced countries (i.e., roughly the OECD group).

Please note, if you do not feel sufficiently knowledgeable to express an opinion about a particular element, please leave it blank.

Degree of Advantage for Canada Relative to Other Advanced Countries

"Big Science" Facilities	Significant Advantage 7	6	5	Neither 4	3	2	Significant Disadvantage 1
TRIUMF (UBC)	❒	❒	❒	❒	❒	❒	❒
Sudbury Neutrino Observatory (SNO)	❒	❒	❒	❒	❒	❒	❒
Canadian Light Source Synchotron	❒	❒	❒	❒	❒	❒	❒
Canadian Resarch Icebreaker (Amundsen)	❒	❒	❒	❒	❒	❒	❒
NEPTUNE Canada	❒	❒	❒	❒	❒	❒	❒
VENUS Canada	❒	❒	❒	❒	❒	❒	❒
NRU Reactor (AECL)	❒	❒	❒	❒	❒	❒	❒
Astronomical Observatories	❒	❒	❒	❒	❒	❒	❒
Genome Sequencing Centres	❒	❒	❒	❒	❒	❒	❒
Perimeter Institute	❒	❒	❒	❒	❒	❒	❒

Which elements of Canada's S&T infrastructure confer significant advantages?

For the following elements where you are comfortable expressing a view, please rate your opinion of the degree of advantage they provide for Canadian research and/or technological application relative to other advanced countries (i.e., roughly the OECD group).

Please note, if you do not feel sufficiently knowledgeable to express an opinion about a particular element, please leave it blank.

Degree of Advantage for Canada Relative to Other Advanced Countries

S&T Commercialization/Translation and Support	Significant Advantage 7	6	5	Neither 4	3	2	Significant Disadvantage 1
SR&ED Tax Credit	❒	❒	❒	❒	❒	❒	❒
University Technology Transfer	❒	❒	❒	❒	❒	❒	❒
College/Polytechnic Technology Transfer	❒	❒	❒	❒	❒	❒	❒
Venture Capital Providers	❒	❒	❒	❒	❒	❒	❒
Canada's Banking System	❒	❒	❒	❒	❒	❒	❒
Business Development Bank of Canada	❒	❒	❒	❒	❒	❒	❒
Export Development Canada (EDC)	❒	❒	❒	❒	❒	❒	❒
Canadian Commercial Corporation (CCC)	❒	❒	❒	❒	❒	❒	❒
S&T Counselors (Foreign Affairs and International Trade Canada)	❒	❒	❒	❒	❒	❒	❒
NRC's Industrial Research Assistance Program (IRAP)	❒	❒	❒	❒	❒	❒	❒
Federal Support Programs for Technology-intensive Business (e.g., Regional Agencies)	❒	❒	❒	❒	❒	❒	❒
Provincial Government Support Programs for Technology-intensive Business	❒	❒	❒	❒	❒	❒	❒
Provincial Research Councils	❒	❒	❒	❒	❒	❒	❒
Genome Canada and Regional Centres	❒	❒	❒	❒	❒	❒	❒
Sustainable Development Technology Canada	❒	❒	❒	❒	❒	❒	❒
International Development Research Centre (IDRC)	❒	❒	❒	❒	❒	❒	❒
Networks of Centres of Excellence	❒	❒	❒	❒	❒	❒	❒
Business-Led NCEs	❒	❒	❒	❒	❒	❒	❒
Centres of Excellence for Commercialization and Research (CECR)	❒	❒	❒	❒	❒	❒	❒

Which elements of Canada's S&T infrastructure confer significant advantages?

For the following elements where you are comfortable expressing a view, please rate your opinion of the degree of advantage they provide for Canadian research and/or technological application relative to other advanced countries (i.e., roughly the OECD group).

Please note, if you do not feel sufficiently knowledgeable to express an opinion about a particular element, please leave it blank.

Degree of Advantage for Canada Relative to Other Advanced Countries

Regulatory System	Significant Advantage 7	6	5	Neither 4	3	2	Significant Disadvantage 1
Intellectual Property Protection (e.g. patents, trademarks)	❒	❒	❒	❒	❒	❒	❒
Copyright Regulation	❒	❒	❒	❒	❒	❒	❒
Environmental Regulation	❒	❒	❒	❒	❒	❒	❒
Health and Safety Regulation	❒	❒	❒	❒	❒	❒	❒
Business Framework Regulations (e.g. start-ups, bankruptcy)	❒	❒	❒	❒	❒	❒	❒

Which elements of Canada's S&T infrastructure confer significant advantages?

Are there any other areas where Canadian S&T infrastructure confers significant advantages or disadvantages?

Degree of Advantage for Canada Relative to Other Advanced Countries

Others	Significant Advantage 7	6	5	Neither 4	3	2	Significant Disadvantage 1
< Other 1 >	❒	❒	❒	❒	❒	❒	❒
< Other 2 >	❒	❒	❒	❒	❒	❒	❒
< Other 3 >	❒	❒	❒	❒	❒	❒	❒
< Other 4 >	❒	❒	❒	❒	❒	❒	❒
< Other 5 >	❒	❒	❒	❒	❒	❒	❒

The following often have been identified as areas of research or technological application that are likely to be of increasing significance over the next 10–15 years. Please choose from the list below (augmented by any you may wish to add) the TOP FIVE areas where you believe Canada is best-placed to be among the global leaders in development and/or application.

❒	Advanced bio-based materials
❒	Aging in place
❒	Aquaculture
❒	Clean fossil fuel technologies; CO2 sequestration; etc.
❒	Clean renewable energy wind, biofuels, etc.
❒	Digital humanities
❒	Digital media (gaming, social media)
❒	Energy recovery technologies e.g. oil sands; gas hydrates
❒	Food and food systems
❒	Genetically modified organisms
❒	Green manufacturing
❒	High performance computing
❒	Improved diagnostic and surgical methods
❒	Mobile technology and applications
❒	Personalized medicine and health care
❒	Probiotics
❒	Public and personal security technologies
❒	Quantum computing
❒	Quantum cryptography for secure information transfer
❒	Robotics
❒	Smart materials
❒	Targetted drug delivery
❒	Tissue engineering (including stem cells, etc.)
❒	Other? (Please list, but do not identify more than five items in total, including those you have checked from the list above)
❒	Don't know/No response

Taking into account all aspects of S&T — knowledge generation and application; supporting infrastructure; and positioning for the future — what is your opinion of Canada's current overall strength in S&T relative to other advanced countries? Please also rate your opinion of the overall trend in Canada's relative strength over roughly the past five years - are we gaining ground, falling behind, or remaining stable? Please use the following scale when rating Canada's relative strength:

7	Research that is widely acknowledged to be world-leading within its field in terms of originality, impact and rigour. (Very Strong)
6	Research that is internationally acknowledged to be above world standards in its field in terms of originality, impact and rigour but which falls short of the highest standards of excellence.
5	Research that is recognized to be generally above world standards in its field in terms or originality, impact and rigour.
4	Research that is recognized to be at the level of world standards in its field in terms of originality, impact and rigour. (About The Same)
3	Research that may be regarded as below world standards in its field with respect to originality, impact and rigour.
2	Research that is generally acknowledged as below world standards with respect to originality, impact, and rigour.
1	Research is that is widely acknowledged to be below world standards with respect to originality, impact and rigour. (Very Weak)

	Canada's Overall Strength Relative to Other Advanced Countries							Recent Trend		
	Very Strong 7	6	5	About The Same 4	3	2	Very Weak 1	Gaining Ground	Stable	Falling Behind
Overall	❒	❒	❒	❒	❒	❒	❒	❒	❒	❒

Please use this space, if you wish, to comment on any aspects of Canada's S&T capabilities — existing or prospective — and particularly on matters that may not have been reflected adequately in the questionnaire.

For example, you may wish to identify emerging areas of interdisciplinary work that are particularly important for Canada. Or, you may wish to comment on Canada's strengths (or weaknesses) in translating research into commercial application. Or, you may wish to comment on particular regional strengths and specific clusters of S&T capabilities.

(Your comments will not be attributed to you, but anonymous excerpts might be included in our report.)

❒ Comments	❒ No comments

Which of the following general fields most closely matches your area of expertise?

❒	Agriculture, Fisheries & Forestry	❒	Social Sciences
❒	Built Environment & Design	❒	Biomedical Research
❒	Enabling & Strategic Technologies	❒	Clinical Medicine
❒	Engineering	❒	Psychology & Cognitive Sciences
❒	Information & Communication Technologies	❒	Public Health & Health Services
❒	Communication & Textual Studies	❒	Biology
❒	Historical Studies (includes anthropology and archaeology)	❒	Chemistry
❒	Philosophy & Theology	❒	Earth & Environmental Sciences
❒	Visual & Performing Arts	❒	Mathematics & Statistics
❒	Economics & Business	❒	Physics & Astronomy

Your affiliation(s)

(Please check as many boxes as apply.)

❒	Fellow of the Royal Society of Canada
❒	Academy of Arts and Humanities
❒	Academy of Social Sciences
❒	Academy of Science
❒	Fellow of the Canadian Academy of Engineering
❒	Fellow of the Canadian Academy of Health Sciences
❒	University or College Administrator (President, VP Research or equivalent, University-Industry Liaison)
❒	Canada Research Chair
❒	Networks of Centres of Excellence
❒	Canadian Institute for Advanced Research Program Member
❒	Other Faculty from a University or College
❒	Senior Employee of a Business Corporation (including commercial Crown Corporations)
❒	Small business (under 20 full-time employees)
❒	Medium business (20–99 employees)
❒	Medium-Large business (100–500 employees)
❒	Large business (over 500 employees)
❒	Senior Representative of an Industry Association

continued on next page

❒	Recipient of technology development funding (e.g., Industry Research Chair; Collaborative Research Development Grant)
❒	Officer of IRAP or Technology Partnerships Canada
❒	Senior Executive in Federal Government or Government-Sponsored Entity (ADM, Chief Scientist, Director General, Foundation Executive)
❒	Representative of a Provincial Government (or Affiliated Entity)
❒	Other Federal Government (or Affiliate) Employee
❒	Current Member of a Federal or Provincial (S&T-Related) External Advisory Body or Board
❒	Senior Representative of a "Think Tank" (i.e., Policy-Advisory NGO)
❒	Member of the International Development Community (S&T-related)
❒	Member of another S&T-related Non-Governmental Organization
❒	Shad Valley Alumnus
❒	Other (Please specify)
❒	No response

Please indicate where you normally work.

❒	British Columbia	❒	New Brunswick
❒	Alberta	❒	Prince Edward Island
❒	Saskatchewan	❒	Newfoundland & Labrador
❒	Manitoba	❒	Yukon
❒	Ontario	❒	Northwest Territories
❒	Quebec	❒	Nunavut
❒	Nova Scotia		
❒	Other: (Please specify)		
❒	No response		

What is your current age? (Please specify range)

❒	Under 35 years
❒	35–44 years
❒	45–54 years
❒	55–64 years
❒	65 years or older
❒	No response

Table A6.2

Self-Identified Fields of Expertise of Respondents

Field	Frequency	Percent
Agriculture, Fisheries & Forestry	20	2.9
Biology	17	2.5
Biomedical Research	156	23.0
Built Environment & Design	12	1.8
Chemistry	23	3.4
Clinical Medicine	15	2.2
Communication & Textual Studies	19	2.8
Earth & Environmental Sciences	28	4.1
Economics & Business	24	3.5
Enabling & Strategic Technologies	20	2.9
Engineering	83	12.2
Historical Studies (includes anthropology and archaeology)	28	4.1
Information & Communication Technologies	45	6.6
Mathematics & Statistics	20	2.9
Philosophy & Theology	12	1.8
Physics & Astronomy	15	2.2
Psychology & Cognitive Sciences	25	3.7
Public Health & Health Services	47	6.9
Social Sciences	62	9.1
Visual & Performing Arts	4	0.6
Missing	4	0.6
Total	679	100.0

Table A6.3

Self-Identified Affiliations of Respondents

Affiliation	Frequency	Percent
Academy of Arts and Humanities	9	0.7
Academy of Science	31	2.3
Academy of Social Sciences	13	1.0
Canada Research Chair	234	17.2
Canadian Institute for Advanced Research Program Member	8	0.6
Current Member of a Federal or Provincial (S&T-Related) External Advisory Body or Board	42	3.1
Fellow of the Canadian Academy of Engineering	86	6.3
Fellow of the Canadian Academy of Health Sciences	62	4.6
Fellow of the Royal Society of Canada	78	5.7
Large business (over 500 employees)	12	0.9
Medium business (20–99 employees)	6	0.4
Medium to Large business (100–500 employees)	4	0.3
Member of another S&T-related Non-Governmental Organization	16	1.2
Member of the International Development Community (S&T-related)	15	1.1
Networks of Centres of Excellence	78	5.7
Other Faculty from a University or College	397	29.2
Other Federal Government (or Affiliate) Employee	3	0.2
Recipient of technology development funding (e.g., Industry)	50	3.7
Representative of a Provincial Government (or Affiliated Entity)	3	0.2
Senior Employee of a Business Corporation (including commercial Crown Corporations)	14	1.0
Senior Executive in Federal Government or Government-Sponsor	11	0.8
Senior Representative of an Industry Association	2	0.1
Senior Representative of a "Think Tank" (i.e., Policy- Advisory NGO)	13	1.0
Shad Valley Alumnus	2	0.1
Small business (under 20 full-time employees)	41	3.0
University or College Administrator (President, VP Research)	47	3.5
Other	74	5.4
No response	9	0.7

*Note: Survey respondents could list multiple affiliations therefore total exceeds the total number of respondents.

Table A6.4

Working Location of Respondents

Province	Frequency	Percent
Alberta	76	11.2
British Columbia	96	14.1
Manitoba	10	1.5
New Brunswick	12	1.8
Newfoundland & Labrador	8	1.2
Nova Scotia	32	4.7
Ontario	234	34.5
Prince Edward Island	1	0.1
Quebec	170	25.0
Saskatchewan	10	1.5
Outside Canada	25	3.7
No response	5	0.7
Total	679	100.0

Table A6.5

Age of Respondents

Age	Frequency	Per cent
Under 35 years	9	1.3
35–44 years	156	23.0
45–54 years	222	32.7
55–64 years	173	25.5
65 years or older	106	15.6
No response	13	1.9

Table A6.6

Opinions of Canadians on the Strength of Each Field Compared with other Advanced Countries and Whether it is Gaining Ground, Stable, or Falling Behind

Field	N	OVERALL					
		Weak (1–3) (%)	About the Same (4) (%)	Strong (5–7) (%)	Gaining Ground (%)	Stable (%)	Falling Behind (%)
Agriculture, Fisheries & Forestry	75	3	19	78	7	75	19
Biology	75	10	33	57	5	79	16
Biomedical Research	210	3	35	62	8	74	18
Built Environment & Design	41	14	36	50	10	83	7
Chemistry	47	2	45	53	6	66	29
Clinical Medicine	68	6	39	55	7	78	16
Communication & Textual Studies	34	13	32	55	21	66	14
Earth & Environmental Sciences	95	7	22	71	10	64	26
Economics & Business	47	5	30	66	14	80	6
Enabling & Strategic Technologies	75	4	34	62	13	66	21
Engineering	122	3	27	70	8	74	17
General Arts, Humanities & Social Sciences	81	11	33	56	22	48	29
General Science & Technology	102	14	35	51	16	39	45
Historical Studies (includes anthropology and archaeology)	47	12	35	53	9	76	15
Information & Communication Technologies	95	7	29	64	5	82	12
Mathematics & Statistics	47	4	20	76	24	62	15
Philosophy & Theology	20	5	30	65	12	82	6
Physics & Astronomy	47	4	40	56	8	83	10
Psychology & Cognitive Sciences	54	6	27	67	15	81	4
Public Health & Health Services	115	5	31	65	26	64	10
Social Sciences	108	6	34	60	12	77	11
Visual & Performing Arts	20	14	18	68	22	72	6

Table A6.7

Opinions of Canadians on the Strength of Each Field and Sub-Field Compared with Other Advanced Countries, Whether it is Gaining Ground, Stable, or Falling Behind, Which Provinces are Leading, and Whether it has World-Leading Infrastructure

Agriculture, Fisheries & Forestry

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
	Per cent (%)																
Agronomy & Agriculture	5	18	77	13	67	21	56	20	20	2	–	2	63	2	24	50	–
Dairy & Animal Science	2	30	68	10	74	17	39	12	8	–	–	2	71	2	43	24	2
Fisheries	4	16	80	18	62	20	–	67	2	22	49	51	10	12	12	–	–
Food Science	11	30	59	18	67	15	33	26	14	–	2	–	72	–	44	9	–
Forestry	12	12	76	15	55	30	9	89	–	13	2	–	36	–	49	–	6
Horticulture	7	52	40	11	77	11	3	42	3	–	–	6	84	6	42	3	–
Veterinary Sciences	9	31	60	8	84	8	25	9	7	–	–	2	73	20	39	43	2

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Agriculture, Fisheries and Forestry?

Yes	No	Don't know/No response
48%	19%	33%

Biology

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength									
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK
	Per cent (%)															
Ecology	13	28	60	20	69	11	35	77	10	–	3	6	61	–	48	6
Entomology	23	48	29	7	67	26	50	50	11	11	–	11	72	–	33	–
Evolutionary Biology	7	36	57	31	53	17	19	56	–	–	–	26	89	–	37	4
Marine Biology & Hydrobiology	9	24	68	24	55	21	3	85	–	15	27	64	27	–	15	–
Ornithology	16	60	24	4	78	17	21	64	14	7	–	7	71	–	36	14
Plant Biology & Botany	17	17	67	9	73	18	19	50	23	–	–	–	73	4	35	27
Zoology	14	43	43	3	81	16	29	67	4	4	8	–	75	–	50	4

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Biology?

Yes	No	Don't know/No response
41%	17%	43%

Biomedical Research

Sub-Fields	Strength: Weak (1–3)	Strength: About the Same (4)	Strength: Strong (5–7)	Trend: Gaining Ground	Trend: Stable	Trend: Falling Behind	Geographic Distribution of Strength: AB	BC	MB	NB	NF	NS	ON	PE	QC	SK
	Per cent (%)															
Anatomy & Morphology	16	64	20	2	74	24	32	55	3	1	–	4	82	–	63	1
Biochemistry & Molecular Biology	5	21	74	21	56	22	38	70	2	–	–	2	93	–	65	–
Biophysics	19	37	44	14	66	21	40	53	2	–	–	2	86	–	50	4
Developmental Biology	10	28	62	20	61	19	26	51	1	–	–	3	94	–	64	1
Genetics & Heredity	4	16	80	31	50	18	17	66	3	–	2	3	89	–	75	2
Microbiology	9	30	61	11	68	21	28	58	14	–	–	2	78	1	56	5
Microscopy	20	48	32	11	69	20	32	49	–	–	1	4	86	–	54	–
Mycology & Parasitology	29	43	28	1	71	27	18	47	10	–	–	2	77	–	65	6
Nutrition & Dietetics	15	46	39	11	70	19	28	49	5	–	–	1	88	1	59	2
Physiology	17	39	44	4	65	32	38	44	5	–	1	5	89	–	56	–
Toxicology	24	48	28	7	76	17	16	43	5	–	–	5	79	1	61	9
Virology	13	24	63	21	61	17	32	39	23	–	–	5	72	1	51	9

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Biomedical Research?

Yes	No	Don't know/No response
70%	9%	21%

Built Environment & Design

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
	Per cent (%)																
Architecture	21	38	41	17	63	21	27	69	8	–	–	–	77	–	50	–	–
Building & Construction	15	26	59	11	74	15	70	44	11	–	–	–	78	–	33	4	4
Design Practice & Management	16	39	45	24	64	12	46	46	8	–	–	–	85	–	42	–	–
Urban & Regional Planning	31	28	41	22	67	11	31	65	4	–	–	4	73	4	46	–	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Built Environment & Design?

Yes	No	Don't know/No response
39%	27%	33%

Chemistry

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength									
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK
	Per cent (%)															
Analytical Chemistry	3	57	40	7	63	30	79	41	–	–	–	–	83	–	38	3
General Chemistry	3	58	39	4	74	22	48	52	–	–	–	7	89	–	56	–
Inorganic & Nuclear Chemistry	9	33	58	13	63	25	41	59	–	–	–	4	89	–	41	–
Medicinal & Biomolecular Chemistry	15	33	51	21	38	41	42	55	–	–	–	–	82	3	52	–
Organic Chemistry	6	31	63	11	48	41	47	57	–	–	–	–	97	–	60	–
Physical Chemistry	10	33	58	13	57	30	52	35	–	–	–	6	90	–	55	3
Polymers	16	41	44	19	50	31	29	33	–	–	–	–	92	4	63	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Chemistry?

Yes	No	Don't know/No response
61%	14%	25%

Clinical Medicine

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
	Per cent (%)																
Allergy	14	43	43	14	66	21	29	17	17	–	–	–	88	–	54	4	–
Anesthesiology	18	59	24	4	81	15	5	23	14	–	–	–	86	–	41	–	–
Arthritis & Rheumatology	5	42	53	23	77	–	18	48	–	–	–	–	86	–	46	–	–
Cardiovascular System & Hematology	2	6	91	61	37	3	43	30	5	–	–	–	97	3	65	–	–
Complementary & Alternative Medicine	42	39	18	19	56	26	16	37	11	–	–	16	53	–	16	5	5
Dentistry	26	59	15	10	67	24	11	26	–	–	–	–	95	–	47	–	–
Dermatology & Venereal Diseases	40	43	17	8	64	28	5	42	11	–	–	5	84	–	42	–	–
Emergency & Critical Care Medicine	14	28	58	32	61	7	31	42	4	4	–	4	96	–	31	–	–
Endocrinology & Metabolism	6	18	76	58	42	–	17	21	13	–	–	–	92	–	67	–	–
Environmental & Occupational Health	16	52	32	16	60	24	6	47	–	–	–	–	82	–	71	6	–
Gastroenterology & Hepatology	3	53	44	4	81	15	60	12	–	–	–	–	96	–	68	–	–
General & Internal Medicine	8	38	54	19	65	16	48	30	–	–	–	–	85	4	56	–	–
General Clinical Medicine	13	35	52	16	68	16	16	37	–	–	–	5	95	5	63	–	–
Geriatrics	7	31	62	23	59	18	18	53	–	6	–	12	76	–	71	–	–
Immunology	6	25	69	34	52	14	34	28	7	–	–	–	90	–	62	–	–
Legal & Forensic Medicine	50	42	8	5	59	36	14	21	–	–	–	–	86	–	36	–	–

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Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
	Per cent (%)																
Neurology & Neurosurgery	3	18	79	60	33	7	43	25	–	–	–	–	86	4	75	–	–
Nuclear Medicine & Medical Imaging	6	35	58	35	57	9	19	43	–	–	–	–	90	5	62	5	–
Obstetrics & Reproductive Medicine	7	40	53	25	63	13	14	59	5	–	–	5	77	–	59	–	–
Oncology & Carcinogenesis	–	17	83	70	27	3	36	57	–	–	–	–	93	7	64	–	–
Ophthalmology & Optometry	21	45	34	9	77	14	–	38	–	–	–	–	56	–	6	–	–
Orthopedics	7	50	43	29	67	5	33	6	–	–	–	6	50	–	6	–	–
Otorhinolaryngology	38	46	17	11	67	22	–	7	–	7	–	7	86	–	50	–	–
Pathology	34	34	31	9	50	41	19	56	–	–	–	6	88	–	56	–	–
Pediatrics	10	26	64	38	59	3	19	48	–	–	–	–	96	4	48	–	–
Pharmacology & Pharmacy	16	41	44	15	52	33	35	35	–	–	–	–	90	5	60	–	–
Psychiatry	19	56	26	29	52	19	6	38	–	–	–	6	94	–	69	–	–
Respiratory System	3	23	74	31	62	8	32	41	5	–	–	–	86	–	50	–	–
Sport Sciences	7	57	36	13	83	4	56	25	–	–	–	6	75	–	31	–	–
Surgery	13	42	45	22	70	9	16	32	–	–	–	11	95	–	47	–	–
Tropical Medicine	57	36	7	–	74	26	–	19	19	–	–	6	75	–	56	–	–
Urology & Nephrology	14	50	36	18	68	14	31	38	–	–	–	–	100	6	56	–	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Clinical Medicine?

Yes	No	Don't know/No response
62%	17%	22%

Communication & Textual Studies

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
	Per cent (%)						AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
Communication & Media Studies	18	25	57	38	46	17	22	70	–	4	–	–	87	–	78	–	–
Languages & Linguistics	11	43	46	12	65	23	17	39	–	17	4	–	91	–	83	–	4
Literary Studies	7	41	52	20	64	16	36	45	5	5	–	–	86	–	68	5	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Communication & Textual Studies?

Yes	No	Don't know/No response
34%	21%	45%

Earth & Environmental Sciences

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
	Per cent (%)																
Environmental Sciences	10	23	67	25	48	27	47	66	5	2	–	5	81	–	39	3	2
Geochemistry & Geophysics	2	30	68	17	58	25	74	58	–	2	5	2	67	–	26	7	–
Geology	2	28	71	10	73	16	64	59	2	–	9	2	66	2	27	2	5
Meteorology & Atmospheric Sciences	15	25	61	8	63	29	14	55	2	–	7	2	86	2	50	7	–
Oceanography	15	28	57	12	61	27	–	85	–	2	43	64	6	–	19	–	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Earth & Environmental Sciences?

Yes	No	Don't know/No response
44%	18%	38%

Economics & Business

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength									
	Per cent (%)						AB	BC	MB	NB	NF	NS	ON	PE	QC	SK
Accounting	17	30	52	13	75	13	45	55	–	–	5	–	90	–	40	–
Agricultural Economics & Policy	14	27	59	7	73	20	41	24	29	–	–	–	76	–	12	47
Business & Management	14	23	63	21	54	25	25	57	–	–	–	4	100	–	75	–
Development Studies	25	25	50	19	75	6	6	50	6	6	–	11	83	11	50	6
Econometrics	18	25	57	5	90	5	9	55	–	–	–	–	86	–	64	–
Economic Theory	22	33	44	15	80	5	14	76	–	–	–	–	90	–	52	–
Economics	14	21	64	18	77	5	9	78	–	–	–	–	100	4	52	–
Finance	7	17	76	30	61	9	32	50	–	–	–	–	96	–	50	–
Industrial Relations	27	18	55	6	69	25	26	37	5	–	–	–	84	–	42	–
Logistics & Transportation	15	25	60	21	57	21	24	35	6	–	–	–	76	–	71	–
Marketing	24	38	38	14	64	21	22	39	–	–	–	–	83	–	44	6
Sport, Leisure & Tourism	37	32	32	15	69	15	29	35	–	–	–	–	29	–	–	6

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Economics & Business?

Yes	No	Don't know/No response
43%	27%	30%

Enabling & Strategic Technologies

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength									
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK
	Per cent (%)															
Bioinformatics	18	43	40	26	42	32	34	71	–	–	–	–	89	–	51	3
Biotechnology	18	29	53	18	47	35	21	76	5	–	–	–	82	–	68	11
Energy	13	21	66	31	46	23	85	28	2	–	4	2	66	–	36	11
Materials	14	27	59	16	73	11	50	47	–	–	–	3	91	–	50	6
Nanoscience & Nanotechnology	12	27	61	29	41	29	74	37	–	–	–	–	81	–	58	2
Optoelectronics & Photonics	20	13	67	21	50	29	21	31	–	–	–	–	87	–	72	5
Strategic, Defence & Security Studies	43	43	15	6	56	38	26	33	–	–	4	7	100	4	48	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Enabling & Strategic Technologies?

Yes	No	Don't know/No response
46%	22%	32%

Engineering

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
	Per cent (%)																
Aerospace & Aeronautics	12	15	73	19	62	19	3	15	8	–	–	3	65	–	90	1	–
Automobile Design & Engineering	27	33	40	15	57	28	–	4	–	1	–	1	100	–	22	–	–
Biomedical Engineering	10	23	67	39	45	16	32	41	1	1	–	–	89	–	57	3	–
Chemical Engineering	2	35	64	17	69	15	70	20	–	–	–	2	78	–	33	7	–
Civil Engineering	7	30	63	14	67	19	43	41	5	–	–	–	80	2	52	3	–
Electrical & Electronic Engineering	8	29	63	17	52	31	26	52	1	–	–	–	97	–	55	1	–
Environmental Engineering	8	27	65	23	53	24	29	57	4	–	2	2	80	–	45	5	–
Geological & Geomatics Engineering	–	21	79	20	73	7	71	37	2	6	6	4	46	2	35	6	2
Industrial Engineering & Automation	17	48	35	8	63	29	17	30	2	–	2	–	89	2	49	–	–
Mechanical Engineering & Transports	14	32	54	23	58	19	23	32	2	2	–	4	91	4	58	–	–
Mining & Metallurgy	5	16	78	20	58	22	37	59	2	–	3	–	68	2	49	12	2
Operations Research	16	45	38	9	74	17	25	20	–	3	–	–	85	5	50	–	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Engineering?

Yes	No	Don't know/No response
54%	12%	34%

General Arts, Humanities & Social Sciences

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength									
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK
	Per cent (%)															
General Arts, Humanities & Social Sciences	11	33	56	22	48	29	30	71	5	2	–	6	90	2	65	2

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of General Arts, Humanities & Social Sciences?

Yes	No	Don't know/No response
51%	12%	36%

General Science & Technology

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength									
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK
	Per cent (%)															
General Science & Technology	14	35	51	16	39	45	41	67	–	–	1	–	100	1	73	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of General Science & Technology?

Yes	No	Don't know/No response
49%	22%	29%

Historical Studies

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
	Per cent (%)																
Anthropology	14	42	44	14	75	11	17	77	3	–	3	–	83	–	63	–	3
Archaeology	20	33	47	16	64	20	45	50	5	–	–	–	85	–	40	–	5
Classics	26	44	30	14	50	36	32	53	–	–	–	11	95	–	53	–	–
History	17	33	50	17	66	17	19	55	–	–	3	6	94	–	68	10	–
History of Science, Technology & Medicine	14	31	55	33	58	8	25	20	–	–	–	10	85	5	45	10	–
History of Social Sciences	25	36	39	14	64	23	10	60	–	–	–	5	80	–	50	–	–
Paleontology	11	32	58	13	75	13	40	20	–	–	–	7	67	7	13	13	7

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Historical Studies?

Yes	No	Don't know/No response
60%	19%	21%

Information & Communication Technologies

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
	Per cent (%)																
Artificial Intelligence & Image Processing	13	30	57	23	66	11	21	52	–	–	–	1	90	–	46	3	–
Computation Theory & Mathematics	14	29	57	12	71	17	22	50	2	–	–	2	90	–	45	–	–
Computer Hardware & Architecture	32	32	35	9	58	32	22	22	–	2	–	–	93	–	30	–	–
Distributed Computing	27	42	31	10	73	17	23	32	–	–	–	–	89	–	30	9	–
Information Systems	11	38	52	11	80	9	19	31	4	–	2	2	93	–	50	2	2
Medical Informatics	26	24	50	33	40	26	35	37	2	–	2	4	81	2	44	2	–
Networking & Telecommunications	8	11	81	19	48	33	26	33	1	1	1	1	89	–	40	6	1
Software Engineering	7	34	59	16	61	23	25	46	2	–	2	2	86	–	43	2	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Information & Communication Technologies?

Yes	No	Don't know/No response
49%	11%	40%

Mathematics & Statistics

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength									
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK
	Per cent (%)															
Applied Mathematics	8	25	67	38	54	8	30	73	–	–	–	–	90	–	37	–
General Mathematics	8	21	71	19	70	11	26	74	3	–	–	–	97	–	61	–
Numerical & Computational Mathematics	9	26	65	33	52	14	28	45	–	–	–	–	28	–	–	–
Statistics & Probability	2	26	71	15	67	19	17	69	–	–	–	–	97	–	53	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Mathematics & Statistics?

Yes	No	Don't know/No response
80%	7%	13%

Philosophy & Theology

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength									
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK
	Per cent (%)															
Applied Ethics	5	35	60	12	88	–	14	57	–	–	–	14	86	–	71	–
Philosophy	11	26	63	13	75	13	47	41	6	–	–	6	88	–	65	–
Religions & Theology	13	40	47	31	54	15	20	27	20	–	–	13	87	–	87	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Philosophy & Theology?

Yes	No	Don't know/No response
80%	0%	20%

Physics & Astronomy

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength									
	Per cent (%)						AB	BC	MB	NB	NF	NS	ON	PE	QC	SK
Acoustics	15	75	10	–	94	6	38	44	–	–	6	13	81	–	31	–
Applied Physics	10	48	42	29	64	7	18	68	5	–	–	–	95	–	64	14
Astronomy & Astrophysics	8	14	78	22	59	19	22	69	–	–	–	–	97	–	53	3
Chemical Physics	15	50	35	9	74	17	38	52	–	–	–	5	100	–	52	10
Fluids & Plasmas	42	31	27	5	59	36	47	37	–	–	–	5	79	–	53	5
General Physics	10	62	28	8	83	8	38	57	–	–	–	–	95	–	43	10
Mathematical Physics	10	39	52	17	75	8	21	46	–	–	–	–	92	–	50	–
Nuclear & Particles Physics	19	22	59	10	65	26	19	69	3	–	–	3	100	3	31	13
Optics	3	32	65	42	54	4	20	44	4	–	–	–	92	–	80	8

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Physics & Astronomy?

Yes	No	Don't know/No response
80%	7%	14%

Psychology & Cognitive Sciences

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
	Per cent (%)																
Behavioural Science & Comparative Psychology	3	37	61	25	67	8	28	53	3	–	–	9	84	–	66	–	3
Clinical Psychology	6	15	79	23	73	3	12	50	4	4	–	8	92	–	69	8	–
Developmental & Child Psychology	8	8	85	21	71	8	13	81	–	–	–	9	100	3	53	–	–
Experimental Psychology	5	24	70	15	61	24	20	60	–	–	3	10	90	3	57	–	–
General Psychology & Cognitive Sciences	8	18	75	23	71	6	24	52	–	–	–	6	97	–	64	–	–
Human Factors	15	52	33	20	68	12	26	58	–	–	–	–	89	–	37	–	–
Psychoanalysis	56	40	4	10	65	25	–	60	–	–	–	–	80	–	90	–	–
Social Psychology	13	26	62	21	74	6	21	79	3	3	–	3	93	–	41	3	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Psychology & Cognitive Sciences?

Yes	No	Don't know/No response
44%	18%	38%

Public Health & Health Services

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
	Per cent (%)																
Epidemiology	10	30	60	35	54	11	10	61	17	–	–	1	88	1	53	1	–
Gerontology	15	33	52	30	56	14	17	39	7	–	–	2	66	–	44	10	–
Health Policy & Services	9	20	71	41	40	19	11	58	36	1	–	1	78	1	37	7	1
Nursing	10	39	51	29	56	15	37	47	11	3	–	5	74	–	39	11	–
Public Health	11	25	64	36	45	19	18	49	21	–	–	3	79	4	58	3	–
Rehabilitation	8	37	55	31	60	9	28	33	3	3	3	3	89	–	36	3	–
Speech-Language Pathology & Audiology	16	59	24	9	78	13	5	35	5	–	–	5	50	–	–	–	–
Substance Abuse	9	37	54	23	60	17	14	67	5	–	–	–	74	–	33	5	2

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Public Health & Health Services?

Yes	No	Don't know/No response
52%	17%	31%

Social Sciences

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
	Per cent (%)						AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
Criminology	5	33	62	22	68	11	3	61	3	3	–	–	89	–	44	–	–
Cultural Studies	10	29	62	28	67	4	18	47	3	–	11	5	68	–	58	–	–
Demography	13	36	51	10	63	27	20	17	–	–	–	6	89	–	54	–	–
Education	12	28	60	12	72	16	18	50	3	5	3	–	88	–	45	–	–
Family Studies	19	37	44	20	63	18	20	17	10	3	3	7	90	7	50	3	–
Gender Studies	9	34	57	25	57	18	8	50	5	8	–	10	88	3	48	3	–
Geography	5	27	67	26	68	6	12	70	2	–	2	5	72	–	40	2	2
Information & Library Sciences	3	47	50	27	57	17	10	19	–	5	5	5	95	–	33	–	–
International Relations	18	38	44	16	63	21	–	59	3	–	–	3	94	–	50	–	–
Law	5	38	57	18	76	5	12	39	3	3	3	9	97	3	61	–	–
Political Science & Public Administration	10	29	61	21	71	7	15	32	–	3	3	–	94	3	50	9	–
Science Studies	15	40	46	19	65	16	10	28	3	7	–	–	90	3	41	3	–
Social Sciences Methods	17	38	44	11	70	19	14	39	5	7	2	7	86	–	43	–	–
Social Work	19	33	49	19	68	14	13	25	4	8	–	–	75	–	50	8	–
Sociology	22	43	35	5	72	23	19	41	5	–	–	5	84	–	54	–	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Social Sciences?

Yes	No	Don't know/No response
54%	15%	31%

Visual & Performing Arts

Sub-Fields	Weak (1–3)	About the Same (4)	Strong (5–7)	Gaining Ground	Stable	Falling Behind	Geographic Distribution of Strength										
							AB	BC	MB	NB	NF	NS	ON	PE	QC	SK	Terr.
	Per cent (%)																
Art Practice, History & Theory	11	33	56	33	53	13	19	50	–	–	–	19	94	–	69	–	–
Drama & Theatre	15	15	70	36	57	7	22	44	6	–	–	–	94	–	61	–	–
Folklore	17	33	50	25	56	19	12	12	–	6	59	18	29	–	41	6	12
Music	15	25	60	33	60	7	25	35	5	–	5	10	80	–	75	–	–

In your opinion, does Canada have infrastructure or research programs that are of worldwide importance within the broad area of Visual & Performing Arts?

Yes	No	Don't know/No response
30%	10%	60%

Table A6.8

Answers to the Question, "The following often have been identified as areas of research or technological application that are likely to be of increasing significance over the next 10–15 years. Please choose from the list below (augmented by any you may wish to add) the TOP FIVE areas where you believe Canada is best-placed to be among the global leaders in development and/or application."

Research Area	Percentage
Personalized medicine and health care	35
Clean renewable energy wind, biofuels, etc.	34
Energy recovery technologies e.g., oil sands; gas hydrates	27
Clean fossil fuel technologies; CO_2 sequestration; etc.	21
Tissue engineering (including stem cells, etc.)	21
Digital media (gaming, social media)	18
Improved diagnostic and surgical methods	18
Food and food systems	17
Aging in place	16
Mobile technology and applications	15
Green manufacturing	14
Aquaculture	13
Advanced bio-based materials	13
Digital humanities	13
Targeted drug delivery	12
High performance computing	11
Smart materials	9
Genetically modified organisms	9
Quantum computing	7
Robotics	7
Quantum cryptography for secure information transfer	5
Probiotics	4
Public and personal security technologies	2
Don't know/No response	8
Total:	678

Table A6.9

Answers to the Question "Taking into account all aspects of S&T — knowledge generation and application; supporting infrastructure; and positioning for the future, what is your opinion of Canada's current overall strength in S&T relative to other advanced countries?"

OVERALL	
Total:	*n = 655*
Weak (1-3)	14%
About the Same (4)	29%
Strong (5-7)	57%
Total:	*n = 438*
Gaining ground	15%
Stable	34%
Falling behind	50%

Table A6.10

Answers in 2006 and 2011 for the Following Question: "For the following elements where you are comfortable expressing a view, please rate your opinion of the degree of advantage they provide for Canadian research and/or technological application relative to other advanced countries (i.e., roughly the OECD group)." Those items labeled with a dash (–) were not part of the 2006 survey.

	2011			2006		
	A Disadvantage (1–3) (%)	Neither (4) (%)	An Advantage (5–7) (%)	A Disadvantage (1–3) (%)	Neither (4) (%)	An Advantage (5–7) (%)
Canada Research Chairs (CRCs)	5	7	88	6	12	82
Canada's Universities	4	8	87	7	13	80
Canada Foundation for Innovation (CFI)	6	7	87	6	12	82
Canada's Research Hospitals	6	8	86	7	13	80
Canadian Institutes of Health Research (CIHR)	7	8	85	8	13	78
Canadian Light Source Synchotron	3	14	83	5	21	73
Natural Sciences and Engineering Research Council (NSERC)	9	11	81	9	13	78
Sudbury Neutrino Observatory (SNO)	3	17	80	6	20	74

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	2011			2006		
	A Disadvantage (1–3) (%)	Neither (4) (%)	An Advantage (5–7) (%)	A Disadvantage (1–3) (%)	Neither (4) (%)	An Advantage (5–7) (%)
Genome Sequencing Centres	6	17	77	–	–	–
Canadian Research Icebreaker (Amundsen)	2	21	77	6	25	69
Networks of Centres of Excellence	11	12	77	12	16	73
TRIUMF (UBC)	6	21	73	9	27	64
High Performing Computing Networks	9	18	73	9	28	64
Social Sciences and Humanities Research Council (SSHRC)	11	18	72	13	25	62
Canada Excellence Research Chairs (CERCs)	11	17	71	–	–	–
Statistics Canada	11	18	71	–	–	–
Perimeter Institute	6	23	71	–	–	–
National Research Council Institutes	13	18	68	11*	16*	72*
Genome Canada and Regional Centres	13	20	67	14	18	68-
Provincial/Territorial Research Funding Programs	15	19	66	27	19	54
Infectious Diseases Laboratories	7	27	65	5	17	78
NRC's Industrial Research Assistance Program (IRAP)	15	21	64	8	16	76
Provincial Research Councils	18	18	64	26	27	47
SR&ED Tax Credit	15	22	63	8	19	73
CANARIE High-Speed Network	9	27	63	7	28	65
NRU Reactor (AECL)	10	28	62	10	35	55
SSHRC Research Data Centres	12	30	58	11	33	56
Astronomical Observatories	10	32	58	9	34	57
Canada Council for the Arts	11	33	57	–	–	–
Federal Laboratories and Facilities	18	26	56	11*	16*	72*
University Technology Transfer	21	23	56	24	28	48
NEPTUNE Canada	5	39	56	–	–	–
Canadian Institute for Advanced Research (CIFAR)	11	34	55	13	32	56
International Development Research Centre (IDRC)	15	30	55	20	32	48

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	2011			2006		
	A Disadvantage (1–3) (%)	Neither (4) (%)	An Advantage (5–7) (%)	A Disadvantage (1–3) (%)	Neither (4) (%)	An Advantage (5–7) (%)
Centres of Excellence for Commercialization and Research (CECR)	21	26	53	–	–	–
Library and Archives Canada (LAC)	11	36	53	12	36	52
Intellectual Property Protection	12	36	51	18	39	43
Federal Support Programs for Technology-intensive Business	22	27	51	17	27	56
Canada's Polytechnics	10	40	50	–	–	–
Health and Safety Regulation	11	38	50	17	38	45
Provincial Government Support Programs for Technology-intensive Business	24	27	49	25	24	51
Charitable Support for Research	30	22	48	38	26	36
VENUS Canada	6	46	48	–	–	–
Canadian Research Knowledge Network (CRKN)	13	40	47	13	46	41
Sustainable Development Technology Canada	16	36	47	15	37	47
Council of Canadian Academies (CCA)	13	41	46	–	–	–
Environmental Regulation	18	36	46	21	39	40
Provincial Laboratories and Facilities	28	27	46	–	–	–
Business-led NCEs	22	34	44	–	–	–
Canada's Banking System	33	30	37	48	36	16
Copyright Regulation	20	43	37	–	–	–
Business Framework Regulations	16	47	37	23	46	32
Export Development Canada (EDC)	24	41	36	20	41	39
College/Polytechnic Technology transfer	25	38	36	–	–	–
Canada's Community Colleges	22	44	34	16	44	40
Business Development Bank of Canada (BDC)	30	38	32	29	39	31
S&T Counselors (Foreign Affairs and International Trade Canada)	31	40	29	20	41	39
Venture Capital Providers	46	27	27	46	25	29
Canadian Commercial Corporation (CCC)	31	46	23	21	53	25

* In 2006, NRC institutes and federal laboratories were together in one question. These were separated for the 2011 survey. Those items with a dash (–) were not part of the 2006 survey.

Appendix 7
Description of Technometric Variables

Appendix 7 Description of Technometric Variables

This appendix provides a description of the technometric indicators used in the analysis of patent data from the United States Patent and Trademark Office (USPTO) in Chapter 7. The following indicators were produced for Canada, its provinces and leading countries by field, sub-field, and over time (1999–2004, 2005–2010, and 1997–2010 aggregated; 1997–2010 by year) unless otherwise indicated. These data were produced only where applicable, recognizing the appropriate lower thresholds whereby data would become unreliable or uninformative.

Data Source for Technometric Analysis

This Panel employed data from USPTO for the analysis of Canadian patent ownership (this was the same database used for the 2006 assessment). The USPTO database is commonly used to measure invention. Since the U.S. is the largest market in the world, the most important inventions tend to be patented there, and it is consequently one of the largest registers of patented inventions in the world. Although the USPTO database is biased towards the U.S. market, it is still a useful tool for country-level comparisons. In addition, since the focus in this report is on the analysis of Canada's technological strengths, the USPTO database is highly appropriate. Canada now has more patented inventions in the USPTO database — nearly 18,000 patents in the 2005–2010 period) — than it does in the Canadian Intellectual Property Office (CIPO) database (about 12,000 for the same period). This choice of data source also aids comparability with the analysis in the 2006 assessment.

Number of Patents

Unlike scientific publications, patents possess two fields that contain information relevant to the calculation of where a patent originates: the inventor field and the assignee field. These fields can be used to compute statistics on two different indicators — namely, invention and intellectual property (IP). The majority of patents are owned by corporations, and their addresses, which appear in the assignee field, are used to compute the geographic location of the ownership of IP. In some cases, where an individual owns the IP, the address of this owner is used to compute the location of the IP. For the sake of simplicity, this report presents data on IP (i.e., ownership of intellectual property) only. However, the notion of where the invention was produced is taken into account in the analysis of the flow of IP.

Specialization Index (SI)

This is an indicator of the concentration of IP of a given geographic or organizational entity in a given field relative to a reference entity in the same field. If, for example, the percentage of Canadian patents (i.e., the geographic entity) in the field of genomics is greater than the percentage of patents in this field at the world level (i.e., the reference), then Canada is said to be specializing in this field. This is computed in the same manner as the SI for scientific output (see Appendix 1).

Average Relative Citations (ARC)

The number of citations received for each patent was counted for the year in which they were granted and the two years that followed. For patents granted in 2000, for example, citations received in 2000, 2001, and 2002 were counted. Consequently, no scores were calculated for 2008 and 2009. Those scores were then normalized per year and sub-field to take into account citation discrepancies between sub-fields and over time, which resulted in a relative citations score for each patent. The average of relative citations was then computed for Canada, its provinces, and leading countries by field and sub-field for the different periods between 1997 and 2010.

Flow of Intellectual Property

To expand on the analysis done for the 2006 assessment, this Panel also studied patterns in the net flow of intellectual property (IP) of Canada and its provinces by field and sub-field (2005–2010 aggregated). Using this indicator allows evaluators to determine whether an entity's inventors are making a larger contribution than what the entity actually owns. The location of inventors provides a proxy for the creativity of regions, whereas the location of IP ownership provides an indicator of the potential economic impact of inventions. The net flow of IP ([IP – Invention]/Invention) was calculated on the basis of fractions of invention by region and the fraction of IP owned by each region. In the calculation of provincial net flow of IP, the part of invention and IP whose origin is unknown was redistributed at the pro rata of invention and IP known for each province. When the flow of IP is negative, an entity owns the commercial rights on fewer inventions than it actually created (i.e., there is a net loss of IP). Conversely, when the flow of IP is positive, an entity owns the commercial rights on more inventions than it actually created (i.e., there is a net gain of IP).

Appendix 8
Highly Qualified and Skilled Personnel

Appendix 8 Highly Qualified and Skilled Personnel

A8.1 DATA SOURCES IN CHAPTER 8

Organisation for Economic Co-operation and Development's (OECD) Online Education Database

The database on education statistics is compiled by UNESCO/OECD/Eurostat (UOE) as reported by national education authorities or statistical agencies according to international standards, classifications, and definitions. In addition to graduates, the database also covers: student enrollment; foreign and international/mobile students enrolled; new entrants by sex and age; education personnel; expenditure by funding source and transaction type; expenditure by nature and resource category; students aligned to finance and personnel data; and total population by sex and age. This data provides evidence for the *Education at a Glance* publication.

Statistics Canada's Postsecondary Student Information System (PSIS)

The Postsecondary Student Information System (PSIS) is a national survey that enables Statistics Canada to provide detailed information on enrolments and graduates of Canadian postsecondary education institutions in order to meet policy and planning needs in postsecondary education. In support of the assessment, data was requested for college and university degrees, diplomas and certificates awarded by year (2000–2010), province, program level, field of study (CIP codes), and immigration status.

Statistics Canada's University and College Academic Staff System (UCASS)

This is an annual survey that collects national comparable data on selected socio-economic characteristics of full-time teaching staff at Canadian degree-granting institutions (universities and colleges). Information for each individual staff member employed by the institution as of October 1st of the academic year is collected. In support of the assessment, data were requested on university and college staff (teachers and researchers) by year (2000–2010), province; subject taught; age; highest earned degree; and immigration status.

Table A8.2

Conversion of Statistics Canada's Classification of Instructional Programs to Science-Metrix's Ontology

CIP Code (Statistics Canada — PSIS)	Science-Metrix Ontology
Agricultural and Domestic Animal Services	Agriculture, Fisheries & Forestry
Agricultural and Food Products Processing	Agriculture, Fisheries & Forestry
Agricultural Mechanization	Agriculture, Fisheries & Forestry
Agricultural Production Operations	Agriculture, Fisheries & Forestry
Agricultural Public Services	Agriculture, Fisheries & Forestry
Agriculture, Agriculture Operations and Related Sciences, Other	Agriculture, Fisheries & Forestry
Agriculture, General	Agriculture, Fisheries & Forestry
Animal Sciences	Agriculture, Fisheries & Forestry
Applied Horticulture/Horticultural Business Services	Agriculture, Fisheries & Forestry
Fishing and Fisheries Sciences and Management	Agriculture, Fisheries & Forestry
Food Science and Technology	Agriculture, Fisheries & Forestry
Forestry	Agriculture, Fisheries & Forestry
International Agriculture	Agriculture, Fisheries & Forestry
Plant Sciences	Agriculture, Fisheries & Forestry
Soil Sciences	Agriculture, Fisheries & Forestry
Veterinary Biomedical and Clinical Sciences (Cert., M.Sc., PhD)	Agriculture, Fisheries & Forestry
Veterinary Medicine (DVM)	Agriculture, Fisheries & Forestry
Veterinary Residency Programs	Agriculture, Fisheries & Forestry
Biology, General	Biology
Botany/Plant Biology	Biology
Ecology, Evolution, Systematics and Population Biology	Biology
Natural Resources and Conservation, Other	Biology
Wildlife and Wildlands Science and Management	Biology
Zoology/Animal Biology	Biology
Biochemistry/Biophysics and Molecular Biology	Biomedical Research
Biological and Biomedical Sciences, Other	Biomedical Research
Cell/Cellular Biology and Anatomical Sciences	Biomedical Research
Foods, Nutrition and Related Services	Biomedical Research
Genetics	Biomedical Research
Microbiological Sciences and Immunology	Biomedical Research
Nutrition Sciences	Biomedical Research
Pharmacology and Toxicology	Biomedical Research

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CIP Code (Statistics Canada — PSIS)	Science-Metrix Ontology
Physiology, Pathology and Related Sciences	Biomedical Research
Architectural Engineering Technology/Technician	Built Environment & Design
Architectural History and Criticism	Built Environment & Design
Architectural Technology/Technician	Built Environment & Design
Architecture (B.Arch., BA/B.Sc., M.Arch., MA/M.Sc., PhD)	Built Environment & Design
Area Studies	Built Environment & Design
City/Urban, Community and Regional Planning	Built Environment & Design
Engineering-related Technologies	Built Environment & Design
Environmental Design/Architecture	Built Environment & Design
Landscape Architecture (B.Sc., BSLA, BLA, MSLA, MLA, PhD)	Built Environment & Design
Chemistry	Chemistry
Advanced/Graduate Dentistry and Oral Sciences (Cert., M.Sc., PhD)	Clinical Medicine
Allied Health Diagnostic, Intervention and Treatment Professions	Clinical Medicine
Alternative and Complementary Medical Support Services	Clinical Medicine
Chiropractic (DC)	Clinical Medicine
Clinical/Medical Laboratory Science and Allied Professions	Clinical Medicine
Dental Residency Programs	Clinical Medicine
Dental Support Services and Allied Professions	Clinical Medicine
Dentistry (DDS, DMD)	Clinical Medicine
Dietetics and Clinical Nutrition Services	Clinical Medicine
Gerontology	Clinical Medicine
Health Professions and Related Clinical Sciences, Other	Clinical Medicine
Health/Medical Preparatory Programs	Clinical Medicine
Medical Residency Programs	Clinical Medicine
Medical Scientist (M.Sc., PhD)	Clinical Medicine
Medicine (MD)	Clinical Medicine
Neuroscience	Clinical Medicine
Ophthalmic and Optometric Support Services and Allied Professions	Clinical Medicine
Optometry (OD)	Clinical Medicine
Pharmacy, Pharmaceutical Sciences and Administration	Clinical Medicine
Podiatric Medicine/Podiatry (DPM)	Clinical Medicine

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CIP Code (Statistics Canada—PSIS)	Science-Metrix Ontology
Aboriginal and Foreign Languages, Literatures and Linguistics, Other	Communication & Textual Studies
Aboriginal Languages, Literatures and Linguistics	Communication & Textual Studies
African Languages, Literatures and Linguistics	Communication & Textual Studies
Classics and Classical Languages, Literatures and Linguistics	Communication & Textual Studies
Communication and Media Studies	Communication & Textual Studies
Communication, Journalism and Related Programs, Other	Communication & Textual Studies
Communications Technology/Technician	Communication & Textual Studies
East Asian Languages, Literatures and Linguistics	Communication & Textual Studies
English Creative Writing	Communication & Textual Studies
English Language and Literature, General	Communication & Textual Studies
English Speech and Rhetorical Studies	Communication & Textual Studies
English Technical and Business Writing	Communication & Textual Studies
French Canadian Literature	Communication & Textual Studies
French Composition	Communication & Textual Studies
French Creative Writing	Communication & Textual Studies
French Language and Literature, General	Communication & Textual Studies
French Language and Literature/Letters, Other	Communication & Textual Studies
French Technical and Business Writing	Communication & Textual Studies
Germanic Languages, Literatures and Linguistics	Communication & Textual Studies
Graphic Communications	Communication & Textual Studies
Journalism	Communication & Textual Studies
Linguistic, Comparative and Related Language Studies and Services	Communication & Textual Studies
Linguistic, Comparative and Related Language Studies and Services	Communication & Textual Studies
Middle/Near Eastern and Semitic Languages, Literatures and Linguistics	Communication & Textual Studies
Modern Greek Language and Literature	Communication & Textual Studies
Public Relations, Advertising and Applied Communication	Communication & Textual Studies
Publishing	Communication & Textual Studies
Radio, Television and Digital Communication	Communication & Textual Studies
Romance Languages, Literatures and Linguistics	Communication & Textual Studies
Second Language Learning	Communication & Textual Studies
Sign Language	Communication & Textual Studies

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CIP Code (Statistics Canada — PSIS)	Science-Metrix Ontology
Slavic, Baltic and Albanian Languages, Literatures and Linguistics	Communication & Textual Studies
South Asian Languages, Literatures and Linguistics	Communication & Textual Studies
Atmospheric Sciences and Meteorology	Earth & Environmental Sciences
Geological and Earth Sciences/Geosciences	Earth & Environmental Sciences
Natural Resources Conservation and Research	Earth & Environmental Sciences
Natural Resources Management and Policy	Earth & Environmental Sciences
Accounting and Computer Science	Economics & Business
Accounting and Related Services	Economics & Business
Agricultural Business and Management	Economics & Business
Air Transportation	Economics & Business
Business Administration, Management and Operations	Economics & Business
Business Operations Support and Assistant Services	Economics & Business
Business, Management, Marketing and Related Support Services, Other	Economics & Business
Business/Commerce, General	Economics & Business
Business/Corporate Communications	Economics & Business
Business/Managerial Economics	Economics & Business
Construction Management	Economics & Business
Economics	Economics & Business
Entrepreneurial and Small Business Operations	Economics & Business
Finance and Financial Management Services	Economics & Business
General Sales, Merchandising and Related Marketing Operations	Economics & Business
Ground Transportation	Economics & Business
Health and Physical Education/Fitness	Economics & Business
Hospitality Administration/Management	Economics & Business
Human Resources Management and Services	Economics & Business
Insurance	Economics & Business
International Business/Trade/Commerce	Economics & Business
Leisure and Recreational Activities	Economics & Business
Leisure and Recreational Activities	Economics & Business
Management Information Systems and Services	Economics & Business
Management Sciences and Quantitative Methods	Economics & Business
Marine Transportation	Economics & Business
Marketing	Economics & Business
Parks, Recreation and Leisure Facilities Management	Economics & Business

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CIP Code (Statistics Canada — PSIS)	Science-Metrix Ontology
Parks, Recreation and Leisure Studies	Economics & Business
Parks, Recreation, Leisure and Fitness Studies, Other	Economics & Business
Real Estate	Economics & Business
Specialized Sales, Merchandising and Marketing Operations	Economics & Business
Taxation	Economics & Business
Transportation and Materials Moving, Other	Economics & Business
Apparel and Textiles	Enabling & Strategic Technologies
Biology Technician/Biotechnology Laboratory Technician	Enabling & Strategic Technologies
Biomathematics and Bioinformatics	Enabling & Strategic Technologies
Biotechnology	Enabling & Strategic Technologies
Military Technologies	Enabling & Strategic Technologies
Aerospace, Aeronautical and Astronautical Engineering	Engineering
Agricultural/Biological Engineering and Bioengineering	Engineering
Biomedical/Medical Engineering	Engineering
Chemical Engineering	Engineering
Civil Engineering	Engineering
Civil Engineering Technology/Technician	Engineering
Construction Engineering	Engineering
Construction Engineering Technology/Technician	Engineering
Drafting/Design Engineering Technologies/Technicians	Engineering
Electrical and Electronic Engineering Technologies/Technicians	Engineering
Electrical, Electronics and Communications Engineering	Engineering
Electromechanical and Instrumentation and Maintenance Technologies/Technicians	Engineering
Engineering Science	Engineering
Engineering Technologies/Technicians, Other	Engineering
Engineering Technology, General	Engineering
Engineering, General	Engineering
Engineering, Other	Engineering
Engineering/Industrial Management	Engineering
Environmental Control Technologies/Technicians	Engineering
Environmental/Environmental Health Engineering	Engineering
Forest Engineering	Engineering
Geological/Geophysical Engineering	Engineering

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CIP Code (Statistics Canada — PSIS)	Science-Metrix Ontology
Industrial Engineering	Engineering
Industrial Production Technologies/Technicians	Engineering
Manufacturing Engineering	Engineering
Materials Engineering	Engineering
Mechanical Engineering	Engineering
Mechanical Engineering Related Technologies/Technicians	Engineering
Metallurgical Engineering	Engineering
Mining and Mineral Engineering	Engineering
Mining and Petroleum Technologies/Technicians	Engineering
Naval Architecture and Marine Engineering	Engineering
Ocean Engineering	Engineering
Operations Research	Engineering
Petroleum Engineering	Engineering
Polymer/Plastics Engineering	Engineering
Quality Control and Safety Technologies/Technicians	Engineering
Surveying Engineering	Engineering
Systems Engineering	Engineering
Systems Science and Theory	Engineering
Liberal Arts and Sciences, General Studies and Humanities	General Arts, Humanities & Social Sciences
Multidisciplinary/Interdisciplinary Studies, Other	General Arts, Humanities & Social Sciences
Biological and Physical Sciences	General Science & Technology
Natural Sciences	General Science & Technology
Science Technologies/Technicians	General Science & Technology
Anthropology	Historical Studies
Archeology	Historical Studies
Classical and Ancient Studies	Historical Studies
Historic Preservation and Conservation	Historical Studies
History	Historical Studies
Medieval and Renaissance Studies	Historical Studies
Science, Technology and Society	Historical Studies
Computer and Information Sciences and Support Services, General	Information & Communication Technologies
Computer and Information Sciences and Support Services, Other	Information & Communication Technologies
Computer Engineering	Information & Communication Technologies
Computer Engineering Technologies/Technicians	Information & Communication Technologies

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CIP Code (Statistics Canada—PSIS)	Science-Metrix Ontology
Computer Programming	Information & Communication Technologies
Computer Science	Information & Communication Technologies
Computer Software and Media Applications	Information & Communication Technologies
Computer Systems Analysis/Analyst	Information & Communication Technologies
Computer Systems Networking and Telecommunications	Information & Communication Technologies
Computer/Information Technology Administration and Management	Information & Communication Technologies
Data Entry/Microcomputer Applications	Information & Communication Technologies
Data Processing and Data Processing Technology/Technician	Information & Communication Technologies
Information Science/Studies	Information & Communication Technologies
Applied Mathematics	Mathematics & Statistics
Mathematics	Mathematics & Statistics
Mathematics and Computer Science	Mathematics & Statistics
Mathematics and Statistics, Other	Mathematics & Statistics
Statistics	Mathematics & Statistics
Bible/Biblical Studies	Philosophy & Theology
Bioethics/Medical Ethics	Philosophy & Theology
Pastoral Counselling and Specialized Ministries	Philosophy & Theology
Philosophy and Religious Studies, Other	Philosophy & Theology
Philosophy, Logic and Ethics	Philosophy & Theology
Religion/Religious Studies	Philosophy & Theology
Religious Education	Philosophy & Theology
Religious/Sacred Music	Philosophy & Theology
Theological and Ministerial Studies	Philosophy & Theology
Theology and Religious Vocations, Other	Philosophy & Theology
Astronomy and Astrophysics	Physics & Astronomy
Engineering Physics	Physics & Astronomy
Nuclear and Industrial Radiologic Technologies/Technicians	Physics & Astronomy
Nuclear Engineering	Physics & Astronomy
Physical Science Technologies/Technicians	Physics & Astronomy
Physical Sciences, General	Physics & Astronomy
Physical Sciences, Other	Physics & Astronomy
Physics	Physics & Astronomy
Behavioural Sciences	Psychology & Cognitive Sciences
Biopsychology	Psychology & Cognitive Sciences

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CIP Code (Statistics Canada — PSIS)	Science-Metrix Ontology
Clinical Child Psychology	Psychology & Cognitive Sciences
Clinical Psychology	Psychology & Cognitive Sciences
Cognitive Psychology and Psycholinguistics	Psychology & Cognitive Sciences
Cognitive Science	Psychology & Cognitive Sciences
Counselling Psychology	Psychology & Cognitive Sciences
Developmental and Child Psychology	Psychology & Cognitive Sciences
Educational Psychology	Psychology & Cognitive Sciences
Experimental Psychology	Psychology & Cognitive Sciences
Family Psychology	Psychology & Cognitive Sciences
Forensic Psychology	Psychology & Cognitive Sciences
Health/Medical Psychology	Psychology & Cognitive Sciences
Industrial and Organizational Psychology	Psychology & Cognitive Sciences
Physiological Psychology/Psychobiology	Psychology & Cognitive Sciences
Psychology, General	Psychology & Cognitive Sciences
School Psychology	Psychology & Cognitive Sciences
Social Psychology	Psychology & Cognitive Sciences
Allied Health and Medical Assisting Services	Public Health & Health Services
Communication Disorders Sciences and Services	Public Health & Health Services
Health Aides/Attendants/Orderlies	Public Health & Health Services
Health and Medical Administrative Services	Public Health & Health Services
Health Services/Allied Health/Health Sciences, General	Public Health & Health Services
Medical Illustration and Informatics	Public Health & Health Services
Mental and Social Health Services and Allied Professions	Public Health & Health Services
Nursing	Public Health & Health Services
Public Health	Public Health & Health Services
Rehabilitation and Therapeutic Professions	Public Health & Health Services
Area, Ethnic, Cultural and Gender Studies, Other	Social Sciences
Bilingual, Multilingual and Multicultural Education	Social Sciences
Criminal Justice and Corrections	Social Sciences
Criminology	Social Sciences
Curriculum and Instruction	Social Sciences
Demography and Population Studies	Social Sciences
Education, General	Social Sciences
Education, Other	Social Sciences
Educational Administration and Supervision	Social Sciences
Educational Assessment, Evaluation and Research	Social Sciences

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CIP Code (Statistics Canada — PSIS)	Science-Metrix Ontology
Educational/Instructional Media Design	Social Sciences
Ethnic, Cultural Minority and Gender Studies	Social Sciences
Family and Consumer Economics and Related Services	Social Sciences
Family and Consumer Sciences/Human Sciences Business Services	Social Sciences
Family and Consumer Sciences/ Human Sciences, General	Social Sciences
Family and Consumer Sciences/Human Sciences, Other	Social Sciences
Geography and Cartography	Social Sciences
Housing and Human Environments	Social Sciences
Human Development, Family Studies and Related Services	Social Sciences
Intercultural/Multicultural and Diversity Studies	Social Sciences
International and Comparative Education	Social Sciences
International Relations and Affairs	Social Sciences
International/Global Studies	Social Sciences
Law (LLB, JD, BCL)	Social Sciences
Legal Professions and Studies, Other	Social Sciences
Legal Research and Advanced Professional Studies (Post-LLB/JD)	Social Sciences
Legal Support Services	Social Sciences
Library Assistant/Technician	Social Sciences
Library Science, Other	Social Sciences
Library Science/Librarianship	Social Sciences
Museology/Museum Studies	Social Sciences
Non-professional General Legal Studies (Undergraduate)	Social Sciences
Peace Studies and Conflict Resolution	Social Sciences
Political Science and Government	Social Sciences
Public Administration	Social Sciences
Public Administration and Social Service Professions, Other	Social Sciences
Public Policy Analysis	Social Sciences
Social and Philosophical Foundations of Education	Social Sciences
Social Sciences, General	Social Sciences
Social Sciences, Other	Social Sciences
Social Work	Social Sciences
Sociology	Social Sciences

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CIP Code (Statistics Canada — PSIS)	Science-Metrix Ontology
Special Education and Teaching	Social Sciences
Student Counselling and Personnel Services	Social Sciences
Teacher Education and Professional Development, Specific Levels and Methods	Social Sciences
Teacher Education and Professional Development, Specific Subject Areas	Social Sciences
Teaching Assistants/Aides	Social Sciences
Teaching English or French as a Second or Foreign Language	Social Sciences
Urban Studies/Affairs	Social Sciences
Work and Family Studies	Social Sciences
Crafts/Craft Design, Folk Art and Artisanry	Visual & Performing Arts
Dance	Visual & Performing Arts
Design and Applied Arts	Visual & Performing Arts
Drama/Theatre Arts and Stagecraft	Visual & Performing Arts
Film/Video and Photographic Arts	Visual & Performing Arts
Fine Arts and Art Studies	Visual & Performing Arts
Music	Visual & Performing Arts
Visual and Performing Arts, General	Visual & Performing Arts
Visual and Performing Arts, Other	Visual & Performing Arts

Table A8.3

Number of College and Doctoral Graduates per Thousand Populations, 2009

Country	Population (millions)	Doctoral graduates/ thousand population	College graduates/ thousand population
Australia	21.2	0.3	2.9
Brazil	193.7	0.1	2.4
Canada	33.4	0.2	4.5
France	62.1	0.2	3.5
Germany	82.8	0.3	1.6
Japan	127.4	0.1	2.7
Korea	48.7	0.2	4.1
Norway	4.7	0.2	0.1
Sweden	9.2	0.4	9.3
United Kingdom	61.9	0.3	0.1
United States	307.2	0.2	0.4

Data source: *Education at a Glance* (OECD, 2011) and *OECD Factbook 2010* (OECD, 2010)

Table A8.4

Number of College and University Graduates in Canada by Program Type, 2000–2009

Year	College	Undergraduate	Master's	Doctorate
2000	116,301	128,568	24,228	3,861
2001	120,084	127,341	24,915	3,708
2002	127,599	131,820	26,316	3,726
2003	133,572	138,807	29,007	3,864
2004	135,966	146,202	32,496	4,251
2005	132,600	149,766	32,730	4,194
2006	132,693	159,384	33,927	4,443
2007	136,332	173,592	34,812	5,007
2008	132,750	169,905	36,246	5,424
2009	155,442	170,106	38,304	5,673

Note: Numbers are students who successfully complete an educational program during the reference year of the data collection. Data from the college sector represent career, technical or professional training programs and exclude post-career, technical or professional training programs or pre-university programs (e.g., CEGEP and associate degree programs).

Data source: Special Tabulation (Statistics Canada, 2011c)

Table A8.5

Distribution of Graduates by Field and Program Type, 2009

Field	College	Undergraduate	Master's	Doctorate
Agriculture, Fisheries & Forestry	1,560	933	408	153
Biology	366	7,038	792	294
Biomedical Research	135	4,437	1,077	579
Built Environment & Design	1,269	3,138	1,056	60
Chemistry	54	1,014	282	231
Clinical Medicine	7,437	4,680	576	264
Communication & Textual Studies	5,286	12,405	1,737	273
Earth & Environmental Sciences	1,086	1,926	963	177
Economics & Business	37,764	35,037	9,831	315
Enabling & Strategic Technologies	600	159	111	3
Engineering	14,850	10,419	3,723	1,032
General Arts, Humanities & Social Sciences	3,864	5,529	207	48
General Science & Technology	543	1,140	21	3
Historical Studies	93	5,781	747	138

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Field	College	Undergraduate	Master's	Doctorate
Information & Communication Technologies	6,315	3,438	921	234
Mathematics & Statistics	N/A	1,920	546	159
Philosophy & Theology	39	1,986	573	117
Physics & Astronomy	426	804	297	192
Psychology & Cognitive Sciences	201	10,080	1,080	435
Public Health & Health Services	17,700	10,254	3,252	138
Social Sciences	22,179	40,869	8,874	705
Visual & Performing Arts	6,042	7,092	915	93
Other	432	162	66	N/A

Note: Numbers are students who successfully complete an educational program during the reference year of the data collection. Data from the college sector represent career, technical or professional training programs and exclude post-career, technical or professional training programs or pre-university programs (e.g., CEGEP and associate degree programs).

Data source: Special Tabulation (Statistics Canada, 2011c)

Table A8.6

Researchers Engaged in R&D by Sector of Performance, 2006–2008

Sector	2006	2007	2008
Federal government	6,750	7,100	7,320
Provincial governments	1,260	1,470	1,420
Provincial research organization	180	150	150
Business enterprise	84,410	92,760	90,300
Higher education	43,420	47,310	49,300
Private not-for-profit organizations	520	520	490
Total	140,660	149,300	148,980

Data source: *Science Statistics* (Statistics Canada, 2011a)

Table A8.7

Number of Faculty by Field, 2008

Field	Faculty
Social Sciences	7,236
Economics & Business	4,980
Clinical Medicine	4,221
Communication & Textual Studies	3,528
Engineering	3,471
Public Health & Health Services	1,845
Visual & Performing Arts	1,824
Psychology & Cognitive Sciences	1,770
Biomedical Research	1,686
Historical Studies	1,602
Mathematics & Statistics	1,500
Philosophy & Theology	1,245
Information & Communication Technologies	1,203
General Science & Technology	1,038
Chemistry	939
Physics & Astronomy	882
Agriculture, Fisheries & Forestry	792
Earth & Environmental Sciences	720
Biology	516
Built Environment & Design	477
Not reported	303
General Arts, Humanities & Social Sciences	144
Enabling & Strategic Technologies	3

Data source: Special Tabulation (Statistics Canada, 2011b)

Table A8.8

Percentage of International Graduating Students per Degree Level, 2000–2009

Year	College	Undergraduate	Master's	Doctoral
2000	3.5	2.2	6.7	8.6
2001	3.0	3.0	11.5	12.9
2002	3.2	3.2	12.3	13.0
2003	3.5	3.9	12.6	12.7
2004	3.1	4.5	14.8	13.2
2005	3.5	5.2	14.1	13.9
2006	4.1	5.6	15.3	13.7
2007	4.6	5.6	15.8	13.3
2008	4.4	5.9	15.3	12.9
2009	4.5	5.8	14.6	12.8

Note: International graduates are defined as individuals who at the time of the granting of their degree were students on a valid student visa.

Data source: Special Tabulation (Statistics Canada, 2011c)

Table A8.9

Distribution of Academic Faculty by Field Level and Immigration Status, 2005–2008

Field	Visa Holder	Canadian	Permanent resident	Unknown	Total
Agriculture, Fisheries & Forestry	237	2,376	375	60	3,048
Biology	141	1,770	285	24	2,220
Biomedical Research	357	5,235	894	102	6,588
Built Environment & Design	162	1,503	168	54	1,887
Chemistry	246	2,859	546	69	3,720
Clinical Medicine	780	13,749	1,650	309	16,488
Communication & Textual Studies	912	11,256	1320	441	13,929
Earth & Environmental Sciences	222	2,139	396	24	2,781
Economics & Business	1,422	15,162	2,121	594	19,299
Enabling & Strategic Technologies		12			12
Engineering	846	10,779	1,659	186	13,470
General Arts, Humanities & Social Sciences	36	405	66	6	513
General Science & Technology	186	3,189	375	63	3,813
Historical Studies	552	4,983	534	198	6,267
Information & Communication Technologies	381	3,471	879	159	4,890
Mathematics & Statistics	456	4,395	909	168	5,928
Philosophy & Theology	339	4,029	480	84	4,932
Physics & Astronomy	312	2,583	450	69	3,414
Psychology & Cognitive Sciences	369	5,871	561	174	6,975
Public Health & Health Services	243	6,123	426	180	6,972
Social Sciences	1,266	23,961	2,061	573	27,861
Visual & Performing Arts	327	5,835	546	372	7,080
Not applicable — Researchers		3	0		3
Not reported	66	690	30	501	1,287

Data source: Special Tabulation (Statistics Canada, 2011b)

Table A8.10

Number and Growth Rate of University/College Degrees, Diplomas and Certificates Granted by Sub-fields, 2005–2009

Sub-Fields	Program Type											
	College			Undergraduate			Master's			Doctorate		
	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change
Accounting	4,821	6,402	32.8	1,848	2,793	51.1	120	153	27.5	N/A	N/A	N/A
Aerospace & Aeronautics	N/A	N/A	N/A	165	144	-12.7	87	120	37.9	9	15	66.7
Agricultural Economics & Policy	102	120	17.6	69	102	47.8	27	69	155.6	3	6	100.0
Agronomy & Agriculture	573	483	-15.7	12	21	75.0	3	3	0.0	N/A	N/A	N/A
Anatomy & Morphology	3	0	-100.0	36	126	250.0	78	45	-42.3	45	39	-13.3
Anthropology	6	12	100.0	1,233	1,158	-6.1	186	186	0.0	39	42	7.7
Applied Ethics	N/A	N/A	N/A	N/A	N/A	N/A	9	6	-33.3	6	0	-100.0
Applied Mathematics	N/A	N/A	N/A	105	69	-34.3	27	15	-44.4	N/A	N/A	N/A
Applied Physics	N/A	N/A	N/A	141	129	-8.5	12	12	0.0	3	3	0.0
Archaeology	3	18	500.0	156	189	21.2	27	39	44.4	12	3	-75.0
Architecture	702	1,197	70.5	768	807	5.1	495	459	-7.3	3	9	200.0
Art Practice, History & Theory	5,457	4,605	-15.6	4,200	4,944	17.7	375	462	23.2	30	36	20.0
Astronomy & Astrophysics	N/A	N/A	N/A	36	51	41.7	3	24	700.0	6	27	350.0
Behavioural Science & Comparative Psychology	15	96	540.0	18	15	-16.7	252	315	25.0	N/A	0	N/A
Biochemistry & Molecular Biology	N/A	N/A	N/A	1,443	1,710	18.5	252	315	25.0	159	207	30.2
Bioinformatics	N/A	N/A	N/A	18	18	0.0	N/A	N/A	N/A	3	3	0.0

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Sub-Fields	Program Type											
	College			Undergraduate			Master's			Doctorate		
	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change
Biology	6	3	-50.0	5,268	6,519	23.7	468	636	35.9	150	228	52.0
Biomedical Engineering	N/A	N/A	N/A	60	105	75.0	78	81	3.8	15	48	220.0
Biotechnology	474	477	0.6	27	69	155.6	N/A	33	N/A	N/A	N/A	N/A
Business & Management	15,906	16,830	5.8	16,713	19,323	15.6	7,092	7,899	11.4	114	159	39.5
Chemical Engineering	N/A	N/A	N/A	747	1,017	36.1	258	261	1.2	75	78	4.0
Civil Engineering	2,178	2,544	16.8	1,098	1,707	55.5	558	648	16.1	102	147	44.1
Classics	3	3	0.0	36	30	-16.7	3	9	200.0	0	N/A	N/A
Clinical Psychology	N/A	N/A	N/A	N/A	3	N/A	12	15	25.0	24	27	12.5
Communication & Media Studies	4,326	4,524	4.6	3,105	3,795	22.2	315	501	59.0	15	33	120.0
Complementary & Alternative Medicine	N/A	N/A	N/A	42	60	42.9	N/A	N/A	N/A	N/A	N/A	N/A
Criminology	5,580	5,976	7.1	1,554	2,172	39.8	93	123	32.3	9	12	33.3
Cultural Studies	99	48	-51.5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dairy & Animal Science	60	57	-5.0	189	210	11.1	51	63	23.5	21	27	28.6
Demography	N/A	N/A	N/A	N/A	6	N/A	3	15	400.0	3	6	100.0
Dentistry	1,626	2,325	43.0	462	495	7.1	60	75	25.0	9	15	66.7
Developmental & Child Psychology	N/A	N/A	N/A	336	372	10.7	234	309	32.1	27	33	22.2

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Sub-Fields	Program Type											
	College			Undergraduate			Master's			Doctorate		
	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change
Drama & Theater	1,206	948	-21.4	702	873	24.4	54	60	11.1	N/A	N/A	N/A
Ecology	351	363	3.4	174	201	15.5	39	81	107.7	15	24	60.0
Economics	18	24	33.3	4,134	3,963	-4.1	774	696	-10.1	54	81	50.0
Education	3,966	3,393	-14.4	16,293	18,570	14.0	3,507	4,164	18.7	372	333	-10.5
Electrical & Electronic Engineering	2,463	3,114	26.4	2,421	2,010	-17.0	1,182	975	-17.5	171	312	82.5
Emergency Services (Police, Fire, Community Organization & Advocacy)	1,221	1,440	17.9	90	96	6.7	6	30	400.0	N/A	N/A	N/A
Engineering (General)	N/A	N/A	N/A	1,644	1,389	-15.5	447	489	9.4	63	117	85.7
Environmental Engineering	834	3,309	296.8	36	N/A	N/A	24	30	25.0	0	12	N/A
Environmental Sciences	753	1,020	35.5	918	120	-86.9	504	654	29.8	24	48	100.0
Experimental Psychology	N/A	15	N/A	N/A	1,323	N/A	0	9	N/A	0	0	N/A
Family Studies	354	171	-51.7	180	372	106.7	24	15	-37.5	3	3	0.0
Finance	2,598	2,184	-15.9	1,443	1,758	21.8	525	444	-15.4	N/A	N/A	N/A
Fisheries	6	N/A	N/A	3	3	0.0	3	3	0.0	N/A	N/A	N/A
Food Science	120	153	27.5	42	81	92.9	27	60	122.2	12	12	0.0
Forestry	600	426	-29.0	219	177	-19.2	105	114	8.6	27	45	66.7
Gender Studies	33	12	-63.6	636	1,098	72.6	42	102	142.9	3	9	200.0

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Sub-Fields	Program Type											
	College			Undergraduate			Master's			Doctorate		
	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change
General Arts, Humanities & Social Sciences	5,814	3,864	-33.5	5,283	5,529	4.7	78	207	165.4	30	48	60.0
General Chemistry	24	54	125.0	867	1,014	17.0	216	282	30.6	186	231	24.2
General Clinical Medicine	3,975	4,422	11.2	2,082	2,763	32.7	237	240	1.3	102	138	35.3
General Mathematics	N/A	N/A	N/A	1,890	1,746	-7.6	399	465	16.5	96	141	46.9
General Physics	585	426	-27.2	579	624	7.8	234	252	7.7	111	162	45.9
General Psychology & Cognitive Sciences	141	90	-36.2	8,145	9,636	18.3	345	489	41.7	279	345	23.7
General Science & Technology	471	543	15.3	1,218	1,140	-6.4	12	21	75.0	3	3	0.0
Genetics & Heredity	N/A	N/A	N/A	225	222	-1.3	45	51	13.3	30	51	70.0
Geochemistry & Geophysics	102	66	-35.3	480	585	21.9	255	285	11.8	72	123	70.8
Geography	273	264	-3.3	2,217	2,202	-0.7	249	300	20.5	69	90	30.4
Geological & Geomatics Engineering	N/A	N/A	N/A	63	96	52.4	3	3	0.0	N/A	0	N/A
Health Policy & Services	7,389	9,141	23.7	219	315	43.8	198	393	98.5	15	9	-40.0
History	87	60	-31.0	4,020	4,398	9.4	423	513	21.3	81	93	14.8
History of Science, Technology & Medicine	N/A	N/A	N/A	9	6	-33.3	N/A	N/A	N/A	N/A	N/A	N/A
Horticulture	528	441	-16.5	93	195	109.7	87	78	-10.3	24	36	50.0

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Sub-Fields	Program Type											
	College			Undergraduate			Master's			Doctorate		
	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change
Immunology	276	291	5.4	51	30	-41.2	12	12	0.0	N/A	3	N/A
Industrial Engineering & Automation	945	3,672	288.6	693	663	-4.3	192	267	39.1	33	63	90.9
Information & Library Sciences	321	306	-4.7	6	3	-50.0	498	537	7.8	6	18	200.0
Information Systems	4,431	3,075	-30.6	2,370	1,479	-37.6	564	432	-23.4	51	126	147.1
International Relations	N/A	N/A	N/A	330	621	88.2	93	135	45.2	N/A	0	N/A
Languages & Linguistics	252	504	100.0	3,036	3,273	7.8	570	660	15.8	132	150	13.6
Law	1,887	2,127	12.7	2,691	3,090	14.8	207	255	23.2	18	18	0.0
Literary Studies	273	258	-5.5	4,896	5,337	9.0	486	576	18.5	84	90	7.1
Logistics & Transportation	807	3,168	292.6	27	12	-55.6	6	6	0.0	3	6	100.0
Marketing	4,761	4,332	-9.0	1,197	1,359	13.5	120	99	-17.5	N/A	N/A	N/A
Materials	141	99	-29.8	15	30	100.0	N/A	N/A	N/A	N/A	N/A	N/A
Mechanical Engineering & Transports	1,161	1,284	10.6	2,523	2,907	15.2	777	732	-5.8	126	213	69.0
Meteorology & Atmospheric Sciences	N/A	N/A	N/A	21	18	-14.3	12	24	100.0	3	6	100.0
Microbiology	N/A	N/A	N/A	492	456	-7.3	144	135	-6.3	72	84	16.7
Mining & Metallurgy	378	927	145.2	129	255	97.7	81	108	33.3	21	27	28.6
Music	441	489	10.9	1,203	1,275	6.0	300	393	31.0	36	57	58.3

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Sub-Fields	Program Type											
	College			Undergraduate			Master's			Doctorate		
	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change
Networking & Telecommunications	1,737	1,764	1.6	2,547	1,356	-46.8	543	426	-21.5	63	99	57.1
Neurology & Neurosurgery	N/A	N/A	N/A	93	96	3.2	57	63	10.5	30	54	80.0
Nuclear & Particles Physics	N/A	N/A	N/A	N/A	N/A	N/A	3	9	200.0	N/A	N/A	N/A
Nursing	8,376	7,611	-9.1	6,474	8,760	35.3	519	810	56.1	30	48	60.0
Nutrition & Dietetics	156	135	-13.5	546	837	53.3	117	180	53.8	24	36	50.0
Operations Research	N/A	N/A	N/A	3	6	100.0	9	9	0.0	N/A	N/A	N/A
Ophthalmology & Optometry	270	294	8.9	105	120	14.3	9	3	-66.7	0	9	N/A
Pharmacology & Pharmacy	42	105	150.0	957	1,116	16.6	165	183	10.9	39	45	15.4
Philosophy	N/A	3	N/A	1,062	1,185	11.6	192	252	31.3	57	54	-5.3
Physiology	N/A	N/A	N/A	99	189	90.9	159	156	-1.9	63	66	4.8
Plant Biology & Botany	N/A	N/A	N/A	27	18	-33.3	36	27	-25.0	12	18	50.0
Political Science & Public Administration	84	114	35.7	3,687	4,878	32.3	1,179	1,476	25.2	78	90	15.4
Psychoanalysis	N/A	N/A	N/A	N/A	N/A	N/A	264	252	-4.5	24	30	25.0
Public Health	96	36	-62.5	318	504	58.5	402	588	46.3	33	57	72.7
Rehabilitation	882	798	-9.5	900	612	-32.0	513	1,161	126.3	6	18	200.0
Religions & Theology	36	36	0.0	1,053	801	-23.9	534	315	-41.0	57	63	10.5

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Sub-Fields	Program Type											
	College			Undergraduate			Master's			Doctorate		
	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change	2005	2009	% Change
Social Psychology	204	90	-55.8	6	54	800.0	9	6	-33.3	3	N/A	N/A
Social Sciences	N/A	N/A	N/A	87	108		36	51	41.7	12	9	-25.0
Social Work	9,462	9,660	2.1	2,637	3,258	23.5	837	1,236	47.7	21	39	85.7
Sociology	6	18	200.0	4,074	4,491	10.2	294	465	58.2	66	78	18.2
Software Engineering	1,962	1,476	-24.8	885	603	-31.9	87	63	-27.6	3	9	200.0
Speech-Language Pathology & Audiology	144	114	-20.8	63	63	0.0	261	300	14.9	3	6	100.0
Sport, Leisure & Tourism	4,374	4,704	7.5	5,025	5,727	14.0	384	465	21.1	42	63	50.0
Statistics & Probability	N/A	N/A	N/A	96	105	9.4	48	66	37.5	6	18	200.0
Strategic, Defence & Security Studies	9	24	166.7	57	42	-26.3	30	63	110.0	3	0	-100.0
Toxicology	N/A	N/A	N/A	597	897	50.3	177	195	10.2	105	96	-8.6
Urban & Regional Planning	111	57	-48.6	729	804	10.3	348	411	18.1	21	30	42.9
Veterinary Sciences	N/A	N/A	N/A	318	246	-22.6	51	87	70.6	39	33	-15.4
Zoology	N/A	N/A	N/A	234	300	28.2	84	48	-42.9	39	24	-38.5
Other	420	432	2.9	66	162	145.5	N/A	66	N/A	N/A	N/A	N/A

Data source: Special Tabulation (Statistics Canada, 2011c)

Table A8.11

Distribution of Academic Faculty by Subject Taught and Province, 2008

Field	AB	BC	MB	NB	NF	NS	ON	PE	QC	SK
Agriculture, Fisheries & Forestry	126	36	48	0	0	27	198	72	156	129
Biology	57	69	36	3	6	15	78	N/A	243	6
Biomedical Research	246	171	96	21	57	102	522	6	393	78
Built Environment & Design	30	66	30	3	0	21	177	N/A	135	9
Chemistry	90	126	30	39	27	54	351	6	189	27
Clinical Medicine	504	519	135	N/A	174	246	1,182	N/A	1,263	195
Communication & Textual Studies	318	414	114	141	69	210	1,509	12	606	117
Earth & Environmental Sciences	75	96	27	15	30	54	276	N/A	117	27
Economics & Business	453	444	120	159	81	264	2,076	21	1,200	171
Enabling & Strategic Technologies	N/A	N/A	N/A	6	N/A	N/A	N/A	N/A	N/A	N/A
Engineering	324	357	78	138	48	102	1,383	6	897	144
General Arts, Humanities & Social Sciences	18	6	N/A	3	3	6	69	N/A	36	3
General Science & Technology	93	123	21	60	21	75	387	12	219	27
Historical Studies	165	174	72	54	36	84	690	9	261	57
Information & Communication Technologies	117	165	42	36	27	51	462	3	252	48
Mathematics & Mathematics & Statistics	147	189	60	51	36	75	600	12	285	45
Philosophy & Theology	108	72	51	33	21	84	585	6	222	51
Physics & Astronomy	93	123	33	33	21	42	336	3	168	27
Psychology & Cognitive Sciences	135	144	78	66	42	87	705	9	453	48
Public Health & Health Services	240	177	72	90	42	147	675	9	321	78
Social Sciences	645	855	273	204	135	303	2,919	24	1,605	249
Visual & Performing Arts	192	198	84	39	39	75	729	9	399	57

Data source: Special Tabulation (Statistics Canada, 2011b)

REFERENCES

OECD (Organisation for Economic Co-operation and Development) (2011). *Education at a Glance 2011: OECD Indicators*. Paris (FR): Organisation for Economic Co-operation and Development.

OECD (Organisation for Economic Co-operation and Development) (2010). *OECD Factbook 2010: Economic, Environmental and Social Statistics*. Paris (FR): Organisation for Economic Co-operation and Development

Statistics Canada (2011a). *Science Statistics: Research and Development Personnel 1999–2008*. Ottawa (ON): Statistics Canada.

Statistics Canada (2011b). Special Tabulation, based on University and College Academic Staff System (UCASS). Ottawa (ON): Statistics Canada.

Statistics Canada (2011c). Special Tabulation, based on Postsecondary Student Information System (PSIS). Ottawa (ON): Statistics Canada.

Appendix 9
International and Provincial Research Strategies

Appendix 9 International and Provincial Research Strategies

As background research for the assessment, the Panel conducted a comparative analysis of the research strategies of 11 advanced economies, several key emerging economies and the research strategies of Canada's provinces and territories.

Table 9.1

Research Priorities of a Selection of Advanced and Emerging Economies

Countries / S&T Priorities	Natural Resources	Information & Communication Technologies	Health & Related Life Sciences	Energy & Environment	Manufacturing, Construction & Transportation Technologies	Security & Defence	Other	GERD/ GDP (2008)[a]	Forecast (2011)[c]
Canada http://www.stic-csti.ca/eic/site/stic-csti.nsf/vwapj/08-141_IC_SOTN_EN_Final_no_trans2.pdf/$FILE/08-141_IC_SOTN_EN_Final_no_trans2.pdf	Oil sands, artic resource production	Telecom., broad-band, animation, new media	Regenerative medicine, biomedical engineering, technologies	Biofuels, fuel cell, nuclear energy				1.8%	1.8%
United States http://whitehouse.gov/innovation/strategy	Fossil Energy R&D	Broadband, e-learning, cyberspace security	E-health, medical therapeutics, nanotechnologies, bioinformatics	Smart grid, renewable technologies, biofuels, ecosystems-based management	Advanced vehicles technologies, high speed rail, advanced combustion	Chem/bio sensors, moving target defence strategies	Earth observation, geopositioning	2.8%	2.7%
United Kingdom http://www.bis.gov.uk/assets/biscore/sciencedocs/i/11-p123-international-comparative-performance-uk-research-base-2011 http://news.bbc.co.uk/nol/shared/bsp/hi/pdfs/science_innovation_120704.pdf	Alloy production, agricultural processing	Electronics, photonics	Early diagnosis, medical imaging, photodynamic therapy	Photovoltanics, hydrogen cells, biofuels	Sustainable trans-portation materials	Biotags, sensing and imaging technologies	Sustainable production, waste manage-ment, design engineering, advanced manufacturing	1.8%	1.7%
France http://media.enseignementsup-recherche.gouv.fr/file/S.N.R.I/28/7/SNRI_rapport_general_GBdef_158287.pdf		IT software, mobile technologies, e-health, IT hardware	Healthcare, biotechnology, aging, nutrition	Nuclear, second gen biofuels, photovoltanics, ecotechnology, energy storage	Hybrid vehicles, aircraft development, vehicle engine improvement			2%	1.9%

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Countries / S&T Priorities	Natural Resources	Information & Communication Technologies	Health & Related Life Sciences	Energy & Environment	Manufacturing, Construction & Transportation Technologies	Security & Defence	Other	GERD/ GDP (2008)[a]	Forecast (2011)[c]
Germany http://www.bmbf.de/pub/forschung_und_innovation_fuer_deutschland_en.pdf		E-health, satellite based systems, ICT systems, optical technologies	Health research, medical technology, nutrition	Environmental monitoring, renewable energy technologies	Aeronautical, maritime and automobile technologies	Air transport security, protection against terrorism, chemical and biological attacks		1.9%	2.3%
Japan http://www8.cao.go.jp/cstp/english/basic/3rd-BasicPolicies_2006-2010.html	Geothermal & Hydroelectric	Mobile phone services, visual communications, online affiliate marketing, gaming	Health products, biotechnology, nanotechnology	Renewable energy, nuclear	Nanotechnologies, material science			2.7%	3.3% 4% (2020)
Brazil http://www.mct.gov.br/upd_blob/0203/203404.pdf	Oil, natural gas, coal exploration, production and transport, biodiversity, agribusiness	Telecommunications, wireless, e-security, digital TV	Biotechnology, nanotechnology, health supplies	Biofuels, nuclear, hydrogen, electrical power, climate monitoring		Space Science and National Defense	Weather and climate	1.1%	0.9%
China http://www.gov.cn/jrzg/2006-02/09/content_183787.htm	Oil, gas exploration, integrated resource planning, hydrate and deep sea operation, agriculture	Laser, computers, hi-def flat screen, network technologies	Biotechnology, biomed materials, disease prevention, contraception and birth defects prevention	Waste management, energy distribution, hydrogen and fuel cell technology	Air, marine and land transportation technologies, metal recycling, advanced manufacturing technology	Food safety, biosecurity, emergency/ natural disaster preparedness		1.5%	1.4% 2.5% (2020)
Australia http://www.innovation.gov.au/AboutUs/KeyPublications/PortfolioFactSheets/Documents/POWERING-IDEAS.pdf http://www.innovation.gov.au/Science/Documents/StrategicRoadmap.pdf	Deep sea resources, minerals, oil and gas extraction	Photonics, data management, communication	Medical science preventative healthcare, aging	Sustainable technologies, water, soil chemistry and emission capture	Alternative transport technologies and clean combustion	Invasive species prevention, military and terrorism surveillance	Advanced materials, astronomy, oceanography	2.21%	1.7%

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Countries / S&T Priorities	Natural Resources	Information & Communication Technologies	Health & Related Life Sciences	Energy & Environment	Manufacturing, Construction & Transportation Technologies	Security & Defence	Other	GERD/ GDP (2008)[a]	Forecast (2011)[c]
India http://www.dst.gov.in/about_us/11th-plan/rep-s-t.pdf	Metallurgical industries, natural gas, ocean exploration	Cyber security, telecommunications, mobile security, networking, integrated systems	Pharmaceuticals, diagnostics, health research	Biotechnology, protection of coastal waters, atomic energy	Transportation development, car combustion process	Surveillance technologies		0.88%[b]	0.9%
Republic of Korea http://english.mest.go.kr/web/1714/en/board/enview.do?bbsId=263&boardSeq=1321&mode=view	Agriculture, resource exploration and development	4G technology, communications, internet and broadcasting technology	Diagnostics, pharma, stem cell, biosensors	Renewable energy, nuclear, hydrogen cells, environmental conservation and management	Transportation, nanotechnology, semiconductors	Military, weapons, infectious disease monitoring, food safety		3.4%	3.0% 5% (2012)
Denmark http://en.fi.dk/publications/publications-2008/research2015-a-basis-for-prioritisation-of-strategic-res/research2015-net.pdf	Exploitation of resources	IT, communications technology, sensor technology, bioinformatics, robots, cryptology, data mining	Food research, industrial bioproduction, animal welfare, nutrition, production technology, disease bio, mol cell bio, genetic epidemiology, pathophysiology, bioinformatics, pre/clinical research, pharmaceuticals, diagnostics and monitoring, behavioural research, health economics, sociology and policy, IP, bio ethics	Materials, physics, chemistry, nanotech, geology, hydrology, bioenergy, aerodynamics, energy systems, geothermal, carbon capture, energy statistics, climatology	Materials research, manufacturing technology, process tech, sustainable transport infrastructure, propulsion systems, energy systems, surface treatment, ICT for transport		Cultural understanding (welfare research, anthropology, minority studies, media studies, cultural history) sociology, intercultural communication, applied SSH, political science, law, economics	2.7%	2.4%

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Countries / S&T Priorities	Natural Resources	Information & Communication Technologies	Health & Related Life Sciences	Energy & Environment	Manufacturing, Construction & Transportation Technologies	Security & Defence	Other	GERD/ GDP (2008)[a]	Forecast (2011)[c]
Finland http://www.aka.fi Tiedostot/Tiedostot/Julkaisut/tutkimusohjelmastrategia09_210x280_ENG.pdf	Metals forestry, nanocellulose, wood production	Information and communications	Food, health and well being (obesity, brain disorders)	Carbon neutral energy production, distributed energy systems, sustainable fuels, smart grids, energy efficiency, resource efficient production, waste management, asessment of environmental efficiency	Production technology, light constructions		Design engineering	3.7%	3.1%
Norway http://www.forskningsradet.no/en/Article/Main_strategy_of_the_Research_Council/1193731376993	Oceans, marine research	ICT	Food safety, health and welfare, biotechnology	Energy and the environment, climate and eco-systems, energy solutions	New materials and nanotechnology, maritime transport		Tourism	1.6%	1.6%
Sweden http://www.sweden.gov.se/content/1/c6/11/49/96/f9f1df5d.pdf	Arctic	ICT, broadband, IT	Medicine, Alzheimer's, cancer	Climate and environment, carbon dioxide emissions			Humanities, social sciences, education	3.75%	3.3%

a) Except for Australia, the GERD/GDP ratios shown for OECD countries are sourced from *Main Science and Technology Indicators, 2010/11*, OECD. Ratios for Australia have been obtained from Australian Bureau of Statistics, b) Indian GERD/GDP from 2007, c) Source: Battelle Institute, 2010.

Table 9.2

Research Priorities of Canadian Provinces and Territories

Province or Territory / S&T Priorities	Natural Resources	Information & Communication Technologies	Health & Related Life Sciences	Energy & Environment	Manufacturing, Construction & Transportation Technologies	Security & Defence	Other	GERD/ GDP (2008)
Alberta http://www.albertainnovates.ca/ http://eae.alberta.ca/media/277640/ahris_report_aug2010_web.pdf	Fibre conversion technologies, unconventional natural gas and light oil recovery, biorefining		Child, maternal, mental, addictions, environmental health, infectious and chronic, diseases, injury prevention, service delivery	Bitumen upgrading, clean carbon/coal, improved recovery, renewable and alternate energy, CO_2 and emissions, and water/resource management			Nanotechnology, quantitative imaging	0.99%
British Columbia http://www.tted.gov.bc.ca/TRI/research/Documents/strategy.pdf	Forestry, agriculture, fishing, mining, oil, gas	New media, wireless, emerging technologies	Health and biotechnology	Alternative technologies, biomass, fuel cells, hydrogen, renewable energies	Low-energy transportation and green buildings			1.42%
Manitoba http://www.gov.mb.ca/stem/innovation/files/lo_framework.pdf	Agricultural, Hydro energy	Telecommunications equipment, electronic components, cable television software developers, internet	Health, environmental biotechnology, pharmaceuticals, nutraceuticals	Clean, renewable water energy, ethanol, hydrogen and biomass	Engines, commercial aircrafts		Advanced manufacturing (biomedical equipment, electronics, chemicals and plastics)	1.11%
New Brunswick http://www.gnb.ca/cnb/Promos/Innovation/Innovation-e.pdf	Value-added natural resources-agriculture, wood composites, mining exploration, fish, shellfish	E-health, e-learning, new media, wireless applications, software dev., hydrographic, ocean and mineral mapping	Biomed engineering, pharmaceuticals, informatics, bio-pesticides, aquaculture, forest protection	Renewable energy (wind, solar, hydro/marine, bio-fuel and geothermal), energy storage, energy infrastructure, environmental monitoring	Transportation equipment		Plastic, metal fabrications, smart materials, sensors	1.10%

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Province or Territory / S&T Priorities	Natural Resources	Information & Communication Technologies	Health & Related Life Sciences	Energy & Environment	Manufacturing, Construction & Transportation Technologies	Security & Defence	Other	GERD/ GDP (2008)
Newfoundland and Labrador http://www.intrd.gov.nl.ca/intrd/innovation/FullReport.pdf	Value-added natural resource industries (aqua-culture, mineral processing and others), offshore petroleum engineering	Maritime surveillance, digital nautical charts, electronic marine navigation	Health and life sciences	Energy, ocean technology	Aerospace	Defence	Advanced manufacturing	0.88%
Northwest Territories http://www.enr.gov.nt.ca/_live/documents/content/GNWT_Science_Agenda%20_November_2009.pdf	Oil, gas, minerals, timber extraction and processing, unconventional gas, geothermal, land use strategies		Aboriginal health concerns	Remote sensing, biodiversity management, environmental monitoring and systems				
Nova Scotia http://ttns.gov.ns.ca/en/home/doingbusiness/gettingtoknowus/sectorsnapshots/default.aspx	Nutraceuticals, natural gas, coal bed methane, shale gas exploration, tidal energy, fisheries, forestry, mining	Telecommunications, wireless, e-security, digital TV	Biotechnology, nanotechnology, health supplies	Biofuels, nuclear, hydrogen, electrical power, climate monitoring		Space Science and National Defense	Weather and climate	1.1%
Nunavut http://www.nri.nu.ca/pdf/researchagenda.pdf	Commercial fisheries, mining technology and aquaponics		Medical and Health related research (dietary studies, mental illness, healthcare delivery)	Environmental monitoring, polar studies, climate change, biodiversity lost/recovery, arctic pollution, photovoltaic arrays				

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Province or Territory / S&T Priorities	Natural Resources	Information & Communication Technologies	Health & Related Life Sciences	Energy & Environment	Manufacturing, Construction & Transportation Technologies	Security & Defence	Other	GERD/ GDP (2008)
Ontario http://www.mri.gov.on.ca/english/programs/oia/documents/Ontario%20Innovation%20Agenda.pdf	Mineral processing, forestry and agriculture technologies	Digital media, advanced communications, interactive gaming	Regenerative medicine, genomics, medical devices and infectious disease control	Wind, solar and energy-management, waste-water treatment	Pharmaceutical manufacturing			2.37%
Prince Edward Island http://www.gov.pe.ca/photos/original/IPS.pdf	Agriculture and fisheries, natural product development	Interactive media, e-health, rural broadband strategy	Personal care and cosmetics, treatment of diseases of aging and obesity, infection and immunity specialty oils, animal and human health products, nutrition, diagnostics	Wind energy	Active pharmaceutical ingredients, aerospace			1.38%
Quebec http://www.frsq.gouv.qc.ca/en/publications/pdf/sqri_summary.pdf	Forestry, hydroelectricity	Optics and photonics, digital industry, wireless communications, geomatics	Genomics, biotechnology, nanotechnologies, biopharmaceutical	Green technology	Electric bus, electric motors, intelligent transportation systems, aircraft manufacturing		Fashion and clothing technology	2.61%
Saskatchewan http://www.src.sk.ca/html/research_technology/index.cfm	Agriculture bioprocessing, petroleum technology, mining, minerals (potash), forestry, remote sensing		Biotechnology, genomics, health, aquatic ecology	Energy conservation, climatology, remediation, water/soil toxicity	Manufacturing, ethanol vehicles, energy efficient buildings			0.81%
Yukon http://www.eco.gov.yk.ca/pdf/northern_strategy_yukon_chapter.pdf	Agriculture, forestry, oil and gas resources, geological sensing		Health and social services (child care, health delivery services)	Wildlife and diversity, air, soil and water monitoring, conservation				

REFERENCES

Academy of Finland (2009). *Academy of Finland Research Programme Strategy*. Helsinki (Finland): Academy of Finland.

Battelle Institute (2010). 2011 *Global R&D Funding Forecast*. *R&D* Magazine.

Government of Alberta (2010). *Alberta's Health Research and Innovation Strategy*. Edmonton (AB): Ministry of Advanced Education and Technology.

Government of Australia (2008). *Strategic Roadmap for Australian Research Infrastructure*. Canberra (NSW): Australia, Department of Innovation, Industry, Science and Research.

Government of Australia (2009). *Powering Ideas: An Innovation Agenda for the 21st Century*. Canberra (NSW): Australia, Ministry of Innovation, Industry, Science and Research.

Government of Brazil (2007). *Science, Technology, and Innovation for National Development Action Plan 2007–2010*. Brasilia (BRI): Ministry of Science and Technology.

Government of British Columbia (2007). *Local Excellence, Global Impact: B.C. Research and Innovation Strategy*. Victoria (BC): Ministry of Advanced Education and Ministry Responsible for Research and Technology.

Government of China (2006). Medium- and Long-term Science and Technology Development Plan (2006–2020). Beijing (CN): Ministry of Science and Technology.

Government of Denmark (2008). *Research 2015: A Basis for Prioritization of Strategic Research*. Copenhagen (DK): Ministry of Science, Technology and Innovation.

Government of France (2009). *National Research and Innovation Strategy*. Paris (FR): Ministry for Higher Education and Research.

Government of Germany (2009). *Research and Innovation for Germany*. Berlin (DE): Federal Ministry of Education and Research (BMBF).

Government of India (2006). *Report of the Steering Committee on Science and Technology for Eleventh Five Year Plan (2007–12)*. New Delhi (IN): Government of India Planning Commission.

Government of Japan (2006). *Science and Technology Basic Plan*. Tokyo (JP): Government of Japan.

Government of Japan (2009). *On the New Growth Strategy (Basic Policies): Toward a Radiant Japan*. Tokyo (JP) : Government of Japan.

Government of Korea (2008). *Becoming a S&T Power Nation through the 577 Initiative*. Seoul (KR): Ministry of Education, Science, and Technology; Korea Institute of S&T Evaluation and Planning.

Government of Manitoba (2003). *Manitoba at the Forefront of Innovation*. Winnipeg (MB): Manitoba Innovation, Energy and Mines.

Government of New Brunswick (2002). *Embracing Innovation: An Innovation Agenda for New Brunswick*. Fredericton (NB): Government of New Brunswick.

Government of Newfoundland and Labrador (2006). *Innovation Newfoundland and Labrador: A Blueprint for Prosperity*. St. John's (NL): Department of Innovation, Trade and Rural Development.

Government of Northwest Territories (2009). *Building a Path for Northern Science*. Inuvik (NT): Department of Education, Culture, and Employment.

Government of Norway (2009). In the Vanguard of Research. Oslo (NO): The Research Council of Norway.

Government of Ontario (2008). Seizing Global Opportunities: Ontario's Innovation Agenda. Toronto (ON): Ministry of Research and Innovation.

Government of Prince Edward Island (2010). *Island Prosperity — A Focus for Change*. Charlottetown (PE): Office of Biosciences and Economic Innovation, Michael Mayne.

Government of Quebec (2010). *Mobilize, Innovate, Prosper: The 2010–2013 Québec Research and Innovation Strategy*. Québec City (QC): Ministry of Economic Development, Innovation, and Export Trade.

Government of Sweden (2008). *A Boost to Research and Innovation*. Stockholm (SE): Ministry of Education and Research.

Government of United Kingdom (2009a). *International Comparative Performance of the UK Research Base*. Leeds (UK): Department for Business Innovation and Skills.

Government of United Kingdom (2009b). *Science and Innovation Investment Framework 2004–2014*. London (U K): Department for Business Innovation and Skills.

Government of United Kingdom (2010). *The 2010 R&D Scoreboard*. London (UK): Department for Business, Innovation and Skills.

Government of Yukon (2005). Northern Strategy Yukon Chapter. Whitehorse (YK): Northern Strategy Trust Secretariat. Executive Council Office.

National Economic Council (2009). A Strategy for American Innovation: Driving Towards Sustainable Growth and Quality Jobs. Retrieved Feb. 2011, from http://whitehouse.gov/innovation/strategy.

Nunavut Research Institute (1997). *Nunavut Research Agenda: Research Policy and Needs for Nunavut*. Iqaluit (NU): Nunavut Research Institute, Nunavut Research Council.

OECD (Organisation for Economic Co-operation and Development) (2010). *Main Science and Technology Indicators 2010/11*. Paris (FR): Organisation for Economic Co-operation and Development.

Saskatchewan Research Council (2012). *Research and Technology*. Retrieved June 2012, from http://www.src.sk.ca/html/research_technology/index.cfm.

STIC (Science, Technology and Innovation Council) (2009). *State of the Nation 2008: Canada's Science, Technology and Innovation System*. Ottawa (ON): Science, Technology and Innovation Council.

Trade Team Nova Scotia (2012). *Highlights of Nova Scotia's Economy*. Retrieved June 2012, from http://www.ttns.gov.ns.ca.