Survey of Innovation 2003

Methodology Note

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1. Introduction

The Survey of Innovation 2003 is based on the Oslo Manual (OECD/Eurostat 1997)[1] which outlines proposed guidelines for collecting and interpreting innovation data at the level of the firm. The purpose of the manual is to "provide a framework within which existing surveys can evolve towards comparability; and to assist newcomers to this important field" (p.13). It allows for the production of internationally comparable, meaningful indicators of innovation.

The manual identifies two types of technological innovation — product and process. In the case of product innovation, the new or significantly improved product must have been introduced to the market. The term "product" includes both goods and services as innovation outputs. A new or significantly improved process innovation must have been used within the production process. An innovative firm is one that has offered a new or significantly improved product or introduced a new or significantly improved process during the previous three years.

Statistics Canada has conducted several surveys of innovation since 1993 to gain a better understanding of innovation in Canada.

- The Survey of Innovation and Advanced Technology 1993 surveyed manufacturing firms.
- The Survey of Innovation 1996 surveyed the communications, financial services and technical business services industries.
- The Survey of Innovation, Advanced Technologies and Practices in the Construction and Related Industries 1999 was the first survey of advanced technologies and practices in the construction sector.
- The Survey of Innovation 1999 surveyed manufacturing firms and was the first innovation survey of selected natural resource industries.
- The Survey of Innovation 2003 surveyed selected service industries.

The questionnaire designed for the Survey of Innovation 2003 consisted of 13 sections. The following topics were covered:

- general information on business units' operations;
- factors for firm success;
- new or significantly improved products and processes;
- not yet completed or abandoned innovation activities;
- innovation activities;
- sources of information;
- co-operative and collaborative arrangements;
- problems and obstacles;
- impact;

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[1] OECD/Eurostat, *Proposed Guidelines for Collecting and Interpreting Innovation Data (Oslo Manual)*, Paris, 1997

- protection of intellectual property;
- business unit clients;
- geomatics activities; and
- government support programs.

2. Target Population

The target population for the Survey of Innovation 2003 is establishments with 15 employees and $250,000 in revenues in selected service industries including: selected Transportation Industries (Table 1); all ICT industries (Table 2); selected Professional, Scientific and Technical Services Industries (Table 3); and selected Natural Resource Support Services Industries (Table 4). The industry Other Machinery, Equipment and Supplies Wholesaler-Distributors (NAICS 4179) was also sampled.

Table 1. Transportation Industries	
NAICS 2002	**Description**
481	Air Transportation
482	Rail Transportation
483	Water Transportation
484	Truck Transportation
4852	Interurban and Rural Bus Transportation
48811	Airport Operations
48831	Port and Harbour Operations

Table 2. Information and Communication Technology (ICT) industries	
NAICS 2002	**Description**
4173	Computer and Communications Equipment and Supplier Wholesaler-Distributors
41791	Office and Store Machinery and Equipment Wholesaler-Distributors
5112	Software Publishers
5171	Wired Telecommunications Carriers
5172	Wireless Telecommunications Carriers (except Satellite)
5173	Telecommunications Resellers
5174	Satellite Telecommunications
5175	Cable and Other Program Distribution
5179	Other Telecommunications
518111	Internet Service Providers
518112	Web Search Portals
5182	Data Processing, Hosting, and Related Services
53242	Office Machinery and Equipment Rental and Leasing
5415*	Computer Systems Design and Related Services*
8112	Electronic and Precision Equipment Repair and Maintenance

*Industries included in more than one category.

Table 3. Selected Professional, Scientific and Technical Services	
NAICS 2002	**Description**
54133	Engineering Services
54136	Geophysical Surveying and Mapping*
54137	Surveying and Mapping (except Geophysical)*
54138	Testing Laboratories
54142	Industrial Design Services
54151	Computer System Design*
54161	Management Consulting Services
54162	Environmental Consultants
54169	Other Scientific and Technical Consulting Services
54171	R&D in Physical, Engineering and Life Sciences
54172	R&D in the Social Sciences and Humanities

*Industries included in more than one category.

Table 4. Natural Resource Support Services	
NAICS 2002	**Description**
1153	Support Activities for Forestry
213117	Contract Drilling (except Oil and Gas)
213119	Other Support Activities for Mining
54136	Geophysical Surveying and Mapping*
54137	Surveying and Mapping (except Geophysical)*

*Industries included in more than one category.

3. Stratification

All industries, with the exception of the Transportation Industries and Mining services were sampled with the following criterion:
- A census for Newfoundland, PEI, Nova Scotia, New Brunswick, Manitoba, Saskatchewan, the Yukon, Northwest Territories and Nunavut;
- Random sample for Ontario, Alberta, Quebec and BC.

For the Transportation Industries
- Random sample at national level.

For Mining Services (NAICS 213117 and 213119)
- Census

The population and the sample by NAICS and by province are presented in Appendix 1 and Appendix 2.

4. Questionnaire Design

The questionnaire was designed by the Science, Innovation and Electronic Information Division of Statistics Canada in collaboration with Industry Canada, Transport Canada and Natural Resources Canada. A small sample of individual establishments was interviewed to test the questionnaire and ensure that the questions were well understood. Feedback from these establishments was incorporated into the questionnaire.

5. Data Collection

Data was collected through respondent completed questionnaires in paper format (mail or fax). All establishments were contacted ahead of time commencing in July 2003 to determine the name and correct mailing address for the respondent. Questionnaires were then mailed out commencing September 15, 2003. Mail, telephone and fax follow-ups were carried out to elicit a response from non-respondents. In some cases, respondents completed the questionnaire over the phone with the assistance of a Statistics Canada interviewer. Responses were entered on a paper questionnaire by the interviewer. All responses for completed questionnaires were entered into computer in a data capture phase creating a database of all completed questionnaires. Data capture ended on January 30, 2004.

6. Response Rate

The response rate for the Survey of Innovation 2003 was calculated as the total number of completed questionnaires as a percentage of the total active, in-scope survey sample. The total number of completed questionnaires was 2,123 and the overall response rate was 70.4%.

Given the relatively low rate of non-response to the survey, it is reasonable to assume that the characteristics of the non-respondent population were the same as those of the respondent population. Accordingly, the contribution of non-responses to the estimates was accounted for by adjusting the sample weights of the respondent population.

Estimates based on the responses to survey questions are population estimates — that is, they represent the percentage of businesses in the population that exhibit a particular characteristic. Population estimates are generated through the accumulation of the product of the response variable and the sample weight for the defined tabulation cells.

7. Sampling Error and Non-Sampling Error

As the sample drawn for this survey was only one of many possible samples that could have been drawn, a sampling error was attributed to it. The difference between an estimate that is based on sample data and a value obtained through a census (survey of the entire population) is called the sampling error. Generally, a larger sample will have a smaller sampling error. The sampling error is measured by the standard deviation or standard error, which indicates the expected variability of the estimate that will be

produced if the given characteristic is sampled repeatedly. The actual value of this standard deviation is unknown but can be estimated from the sample. Standard errors will be used to provide a guide as to the reliability of the results where estimates are expressed as a percentage.

The coefficient of variation (CV) is used to measure the precision of estimates. The CV is simply the standard deviation or standard error expressed as a percentage of the estimate. It is a relative measure of estimate precision. The smaller the CV the more reliable the estimate. The CV will be used where estimates are an average of responses.

Another kind of error that can occur with estimates is non-sampling error. These kinds of errors are not taken into account in computing the CV or standard error nor can CV or standard errors be used to measure them. Survey response rate, coverage rate and imputation rate can be used as indicators of the possible extent of non-sampling errors. Response rate by question for non-mandatory questions was evaluated for completed questionnaires.

The reliability of the data is reported using the following symbol convention (Table 5) for quality indicator interpretation. This convention combines the effect of sampling (since we did not do a census) and the imputation rate.

Table 5: Quality Indicators

CV	Imputation Rate			
	< 15%	≥ 15% and < 35%	≥ 35% and < 50%	≥ 50%
≤ 5.0%	A	B	E	F
> 5.0% and ≤ 15%	B	E	F	F
> 15.0% and ≤ 30.0%	E	F	F	F
> 30.0%	F	F	F	F
A: Very reliable B: Reliable				
E: Use with caution F: Too unreliable to be published				

Standard Error	Imputation Rate			
	< 15%	≥ 15% and < 35%	≥ 35% and < 50%	≥ 50%
≤ 2.5%	A	B	E	F
> 2.5% and ≤ 7.5%	B	E	F	F
> 7.5 and ≤ 15%	E	F	F	F
> 15%	F	F	F	F
A: Very reliable B: Reliable				
E: Use with caution F: Too unreliable to be published				

Estimates with very poor reliability (F) were suppressed.

8.   Coverage rate

Not all industries operate in all provinces. Consequently, it was impossible to produce estimates for all industries in all geographic areas (provinces, CMA/CA or ER). However, these small populations contribute to estimates at the aggregate level. Similarly, where the number of records contributing to an estimate brought the quality of representation of the data into question, the estimate was suppressed.

9.   Edits

Validity and flow edits were built into the data capture system and were applied during data collection and data entry. Validity edits ensured that responses to particular questions fell within a limited range of possible values. Post-collection consistency edits were applied to complete questionnaires.

10.   Imputation Strategy

Imputation was employed for missing responses to non-mandatory questions. The Generalized Edit and Imputation System (GEIS) software was used to select donors. There were several cases where the relevance of a set of questions relied on a response to a preceding question. The ability to proceed along a path of questioning was reliant on the nature of the response, and the subsequent responses were influenced by the firm behaviour indicated by the response to the preceding question. Block imputation (one donor) was used for these correlated questions as a means to avoid edit failures.

Appendix 1: Population by NAICS and Province, Survey of Innovation 2003

NAICS	Description	NF	PE	NS	NB	QC	ON	MB	SK	AB	BC	YT	NT	NV	Total
1153	Support Activities for Forestry	4	3	4	25	60	18	1	4	19	111	0	6	0	**255**
213117	Contract Drilling (except oil and gas)	0	0	2	5	13	6	5	1	3	8	3	3	0	**49**
213119	Other Support Activities for Mining	5	0	1	2	13	19	2	5	22	19	1	5	0	**94**
4173	Computer and Communications Equipment and Supplier Wholesaler-Distributors	4	0	17	4	144	348	17	10	72	83	0	2	0	**701**
4179	Other Machinery, Equipment and Supplies Wholesaler-Distributors	10	1	34	11	251	536	32	12	113	124	0	1	0	**1,125**
41791	Office and Store Machinery and Equipment Wholesalers-Distributors	3	1	10	5	88	169	17	9	36	43	0	0	0	**381**
481	Air Transportation	7	1	5	1	39	66	15	8	27	65	4	11	4	**253**
482	Rail Transportation	0	0	3	1	16	9	1	2	6	4	0	0	0	**42**
483	Water Transportation	12	4	10	5	25	13	1	0	0	37	0	2	1	**110**
484	Truck Transportation	32	12	77	107	535	935	134	146	474	287	4	10	1	**2,754**
4852	Interurban and Rural Bus Transportation	1	1	1	1	11	10	5	3	5	10	0	0	0	**48**
48811	Airport Operations	2	1	2	3	11	26	4	3	5	12	1	1	1	**72**
48831	Port and Harbour Operations	2	1	2	2	9	3	0	0	1	12	0	0	0	**32**
5112	Software Publishers	0	1	7	4	91	152	6	3	37	56	0	0	0	**357**
5171	Wired Telecommunications Carriers	1	0	3	0	59	44	4	1	10	12	1	1	0	**136**
5172	Wireless Telecommunications Carriers (except Satellite)	0	0	2	0	15	31	5	1	13	15	0	0	0	**82**
5173	Telecommunications Resellers	0	0	1	0	9	21	2	0	7	8	0	0	0	**48**
5174	Satellite Telecommunications	2	0	1	0	1	7	0	0	3	3	1	0	0	**18**
5175	Cable and Other Program Distribution	2	1	3	6	50	45	3	7	18	22	0	0	0	**157**
5179	Other Telecommunications	0	0	0	0	1	2	0	0	0	1	0	0	0	**4**
518111	Internet Service Providers	0	1	1	1	21	56	4	0	6	42	0	0	0	**132**
518112	Web Search Portals	0	0	1	0	1	6	0	0	1	0	0	0	0	**9**
5182	Data Processing, Hosting, and Related Services	0	0	2	1	13	58	5	1	21	12	0	0	0	**113**
53242	Office Machinery and Equipment Rental and Leasing	0	0	0	1	4	20	0	1	0	1	0	0	0	**27**
54133	Engineering Services	35	3	39	30	240	486	29	36	260	191	3	4	0	**1,356**
54136	Geophysical Surveying and Mapping Services	1	0	2	0	4	10	0	0	91	5	0	2	0	**115**
54137	Surveying and Mapping (except Geophysical) Services	1	2	6	3	15	38	2	5	43	11	0	3	0	**129**
54138	Testing Laboratories	0	0	5	2	35	61	4	3	52	26	0	0	0	**188**
54142	Industrial Design Services	0	0	0	0	23	22	2	0	3	1	0	0	0	**51**
54151	Computer System Design	13	3	42	30	469	1,061	45	25	216	270	0	3	1	**2,178**
54161	Management Consulting Services	8	5	22	11	258	796	28	14	228	190	0	5	3	**1,568**
54162	Environmental Consulting Services	3	1	8	8	9	33	0	1	32	25	0	0	0	**120**
54169	Other Scientific and Consulting Services	2	0	8	7	45	100	4	6	46	26	0	0	1	**245**
54171	Research and Development in Physical, Engineering and Life Sciences	3	4	7	6	153	168	15	10	34	80	0	0	0	**480**
54172	Research and Development in the Social Sciences and Humanities	1	0	7	0	25	41	3	5	7	14	1	0	0	**104**
8112	Electronic and Precision Equipment Repair and Maintenance	2	0	2	2	39	74	3	3	24	11	1	0	0	**161**
Total		**153**	**45**	**327**	**279**	**2,707**	**5,321**	**381**	**316**	**1,899**	**1,794**	**20**	**59**	**12**	**13,313**

Appendix 2: Sample by NAICS and Province, Survey of Innovation 2003

NAICS	Description	NF	PE	NS	NB	QC	ON	MB	SK	AB	BC	YT	NT	NV	Total
1153	Support Activities for Forestry	4	3	4	25	28	14	1	4	14	35	0	6	0	**138**
213117	Contract Drilling (except oil and gas)	0	0	2	5	13	6	5	1	3	8	3	3	0	**49**
213119	Other Support Activities for Mining	5	0	1	2	13	19	2	5	22	19	1	5	0	**94**
4173	Computer and Communications Equipment and Supplier Wholesaler-Distributors	4	0	17	4	37	44	17	10	30	32	0	2	0	**197**
4179	Other Machinery, Equipment and Supplies Wholesaler-Distributors	10	1	34	11	42	46	32	12	35	36	0	1	0	**260**
41791	Office and Store Machinery and Equipment Wholesalers-Distributors	3	1	10	5	16	15	17	9	10	13	0	0	0	**99**
481	Air Transportation	3	0	3	0	14	35	7	2	12	30	2	5	1	**114**
482	Rail Transportation	0	0	3	1	15	9	1	2	6	4	0	0	0	**41**
483	Water Transportation	7	3	6	4	21	10	1	0	0	26	0	0	0	**78**
484	Truck Transportation	1	1	3	9	32	55	6	8	34	18	0	1	0	**168**
4852	Interurban and Rural Bus Transportation	1	1	1	1	10	9	5	3	4	10	0	0	0	**45**
48811	Airport Operations	1	1	1	2	9	25	3	2	5	8	1	1	1	**60**
48831	Port and Harbour Operations	2	1	2	2	9	3	0	0	1	12	0	0	0	**32**
5112	Software Publishers	0	1	7	4	33	38	6	3	22	27	0	0	0	**141**
5171	Wired Telecommunications Carriers	1	0	3	0	28	24	4	1	9	10	1	1	0	**82**
5172	Wireless Telecommunications Carriers (except Satellite)	0	0	2	0	12	20	5	1	11	12	0	0	0	**63**
5173	Telecommunications Resellers	0	0	1	0	8	15	2	0	7	8	0	0	0	**41**
5174	Satellite Telecommunications	2	0	1	0	1	7	0	0	3	3	1	0	0	**18**
5175	Cable and Other Program Distribution	2	1	3	6	26	24	3	7	14	16	0	0	0	**102**
5179	Other Telecommunications	0	0	0	0	1	2	0	0	0	1	0	0	0	**4**
518111	Internet Service Providers	0	1	1	1	15	27	4	0	6	23	0	0	0	**78**
518112	Web Search Portals	0	0	1	0	1	6	0	0	1	0	0	0	0	**9**
5182	Data Processing, Hosting, and Related Services	0	0	2	1	11	27	5	1	15	10	0	0	0	**72**
53242	Office Machinery and Equipment Rental and Leasing	0	0	0	1	4	15	0	1	0	1	0	0	0	**22**
54133	Engineering Services	35	3	39	30	42	45	29	36	42	40	3	4	0	**348**
54136	Geophysical Surveying and Mapping Services	1	0	2	0	4	9	0	0	33	5	0	2	0	**56**
54137	Surveying and Mapping (except Geophysical) Services	1	2	6	3	12	22	2	5	24	10	0	3	0	**90**
54138	Testing Laboratories	0	0	5	2	21	28	4	3	26	18	0	0	0	**107**
54142	Industrial Design Services	0	0	0	0	16	16	2	0	3	1	0	0	0	**38**
54151	Computer System Design	13	3	42	30	45	48	45	25	41	42	0	3	1	**338**
54161	Management Consulting Services	8	5	22	11	42	47	28	14	41	40	0	5	3	**266**
54162	Environmental Consulting Services	3	1	8	8	8	21	0	1	20	17	0	0	0	**87**
54169	Other Scientific and Consulting Services	2	0	8	7	24	34	4	6	25	18	0	0	1	**129**
54171	Research and Development in Physical, Engineering and Life Sciences	3	4	7	6	38	39	15	10	21	31	0	0	0	**174**
54172	Research and Development in the Social Sciences and Humanities	1	0	7	0	17	23	3	5	7	12	1	0	0	**76**
8112	Electronic and Precision Equipment Repair and Maintenance	2	0	2	2	23	30	3	3	17	10	1	0	0	**93**
Total		**112**	**32**	**246**	**178**	**675**	**842**	**244**	**171**	**554**	**593**	**14**	**42**	**7**	**3,710**