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Science, Innovation and Electronic Information Division

Knowledge sharing succeeds: how selected service industries rated the importance of using knowledge management practices to their success

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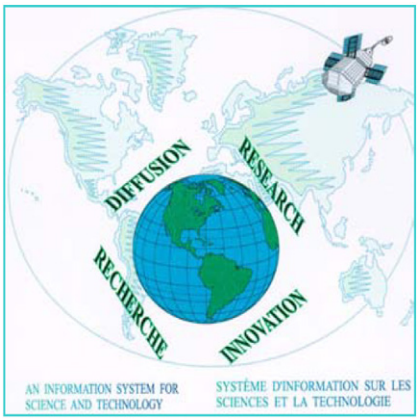

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Symbols

The following standard symbols are used in Statistics Canada publications:

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

NOTE: Due to rounding, components may not add to totals

The science and innovation information program

The purpose of this program is to develop **useful indicators of science and technology activity** in Canada based on a framework that ties them together into a coherent picture. To achieve the purpose, statistical indicators are being developed in five key entities:

- **Actors**: are persons and institutions engaged in S&T activities. Measures include distinguishing R&D performers, identifying universities that license their technologies, and determining the field of study of graduates.
- **Activities**: include the creation, transmission or use of S&T knowledge including research and development, innovation, and use of technologies.
- **Linkages**: are the means by which S&T knowledge is transferred among actors. Measures include the flow of graduates to industries, the licensing of a university's technology to a company, co-authorship of scientific papers, the source of ideas for innovation in industry.
- **Outcomes**: are the medium-term consequences of activities. An outcome of an innovation in a firm may be more highly skilled jobs. An outcome of a firm adopting a new technology may be a greater market share for that firm.
- **Impacts**: are the longer-term consequences of activities, linkages and outcomes. Wireless telephony is the result of many activities, linkages and outcomes. It has wide-ranging economic and social impacts such as increased connectedness.

The development of these indicators and their further elaboration is being done at Statistics Canada, in collaboration with other government departments and agencies, and a network of contractors.

Prior to the start of this work, the ongoing measurements of S&T activities were limited to the investment of money and human resources in research and development (R&D). For governments, there were also measures of related scientific activity (RSA) such as surveys and routine testing. These measures presented a limited picture of science and technology in Canada. More measures were needed to improve the picture.

Innovation makes firms competitive and we are continuing with our efforts to understand the characteristics of innovative and non-innovative firms, especially in the service sector that dominates the Canadian Economy. The capacity to innovate resides in people and measures are being developed of the characteristics of people in those industries that lead science and technology activity. In these same industries, measures are being made of the creation and the loss of jobs as part of understanding the impact of technological change.

The federal government is a principal player in science and technology in which it invests over five billion dollars each year. In the past, it has been possible to say only *how much* the federal government spends and *where* it spends it. Our report **Federal Scientific Activities, 1998 (Cat. No. 88-204)** first published socio-economic objectives indicators to show *what* the S&T money is spent on. As well as offering a basis for a public debate on the priorities of government spending, all of this information has been used to provide a context for performance reports of individual departments and agencies.

As of April 1999, the Program has been established as a part of Statistics Canada's Science, Innovation and Electronic Information Division.

The final version of the framework that guides the future elaboration of indicators was published in December, 1998 (**Science and Technology Activities and Impacts: A Framework for a Statistical Information System,** Cat. No. 88-522). The framework has given rise to **A Five-Year Strategic Plan for the Development of an Information System for Science and Technology** (Cat. No. 88-523).

It is now possible to report on the Canadian system on science and technology and show the role of the federal government in that system.

Our working papers and research papers are available at no cost on the Statistics Canada Internet site at http://www.statcan.ca/cgi-bin/downpub/research.cgi?subject=193.

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Acknowledgements

This report provides new Statistics Canada estimates on the importance of knowledge management practices to the success of business units in selected services industries. The results are based on information from the Survey of Innovation in Selected Services Industries, 2003. Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued co-operation and goodwill.

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Preface

Innovation and the adoption and dissemination of technologies and practices are vital to economic growth and development. It is through innovation that new products are introduced to the market, new production processes are developed and introduced, and organisational changes are made. Through the adoption of newer, more advanced, technologies and practices, industries can increase their production capabilities, improve their productivity, and expand their lines of new goods and services.

In 1993, the first survey of innovation and the adoption of advanced technologies in the Canadian manufacturing sector was carried out. It was followed in 1996 by a survey of innovation in the communications, financial services and technical business services industries. The Survey of Innovation, 1999 surveyed manufacturing and was the first innovation survey of selected natural resource industries. The Survey of Innovation, 2003 concentrated on innovation activities in selected service industries including all of the service industries in information communication technology.

Biotechnology surveys carried out in 1996, 1997, 1999, 2001 and 2003 have examined both the development of new biotechnology products and processes and the use and planned use of biotechnologies. The 2003 Bioproducts Development survey was also conducted. The 1999 Survey of Innovation, Advanced Technologies and Practices in the Construction and Related Industries is the first survey of the innovation and advanced technologies and practices in the construction sector. A number of surveys have focused on the use and planned use of advanced technologies and practices: surveys of advanced manufacturing technologies were carried out in 1987, 1989, 1993 and 1998; and surveys of the use and planned use of information and communication technologies have been carried out annually since 1999.

In 2001, SIEID piloted the Knowledge Management Practices Survey that gathered information on the use and planned use of a series of business management practices as well as the reasons for implementing these practices and their perceived results. Interest in business practices continued with the addition of a question on how private sector enterprises and public sector organisations use electronic networks to share business information within their organisations and with other organisations to the 2001 Survey of Electronic Commerce and Technology. This study extends the exploration of the importance of business practices to innovative firms in selected services in 2003.

This study is one in a series of studies that the Science, Innovation and Electronic Information Division (SIEID) is undertaking to examine the role of innovation in the service sector in 2003.

Knowledge sharing succeeds: How selected services industries rated the importance of using knowledge management practices to their success

Introduction

Management practices employed to harness the power of knowledge have been at the forefront of business literature for over a decade (Davenport and Prusak 1998; Quinn 1999; and Zack 1999). Knowledge transfer, knowledge sharing, knowledge retention, knowledge codification and even knowledge management have been hotly debated and promoted by business gurus and academics alike (OECD 2000; Lesser, Fontaine and Slusher 2000; Cross and Israelit 2000; and Dutrénit 2000). Some firms have established the role of chief knowledge officer and have introduced a series of management practices specifically to improve how knowledge is managed. The Survey of Innovation, 2003, for selected service industries allowed respondents to rate the level of importance to their success of a series of twelve knowledge management practices. These practices, or groupings of them, and the characteristics of business units that rated them, are highlighted in this paper.

In selected service industries, it appears that knowledge sharing is a road to success. Over half of the business units considered a knowledge sharing culture to be important to their success. A knowledge sharing culture includes having a "value system or culture promoting knowledge sharing"; "encouraging experienced workers to transfer their knowledge to new or less experienced workers"; and "using teams which bring together people with different skills". The responses for the three practices were aggregated to create the knowledge sharing culture category. Four other groupings of knowledge management practices were created and will be presented in this paper.

The first group is knowledge codification which consists of preparing written documentation and updating databases. The second is knowledge development which includes encouraging workers to continue their education by reimbursing tuition fees and offering off-site training to workers to keep skills current. Knowledge management policies/strategies is comprised of one management practice: a written knowledge management policy/strategy or a knowledge management officer. The final grouping, knowledge acquisition and retention, consists of hiring skilled workers; the use of partnerships, strategic alliances or joint ventures to acquire knowledge; the use of financial incentives to attract and retain employees; and encouraging risk taking initiatives by employees. Individually the most highly rated practices were hiring skilled workers and encouraging experienced workers to transfer their knowledge to new or less experienced workers as success factors for business units (see Table 1).

Table 1. Business units in selected service industries showing value of knowledge management success factors

	Not Relevant	Unimportant	Neither unimportant nor important	Important
Knowledge codification	**7% B**	**22% B**	**26% B**	**45% B**
Regularly updating databases of good work practices, lessons learned or listing of experts	11% B	23% B	24% B	42% B
Preparing written documentation such as lessons learned, training manuals, good work practices, articles for publication	11% B	25% B	25% B	38% B
Knowledge sharing culture	**4% B**	**15% B**	**27% B**	**54% B**
A value system or culture promoting knowledge sharing	10% B	15% B	22% B	54% B
Encouraging experienced workers to transfer their knowledge to new or less experienced workers	6% B	5% B	14% B	75% B
Using teams which bring together people with different skills	15% B	17% B	22% B	46% B
Knowledge development	**8% B**	**25% B**	**23%**	**44% B**
Encouraging workers to continue their education by reimbursing tuition fees for successfully completed work-related courses	14% B	24% B	24% B	38% B
Offering off-site training to workers in order to keep skills current	10% B	21% B	25% B	44% B
Knowledge management policies/strategies	**20% B**	**36% B**	**19%**	**25% B**
A written knowledge management policy/strategy or a knowledge management officer	20% B	36% B	19% B	25% B
Knowledge acquisition and retention	**3% B**	**17% B**	**34% B**	**45% B**
Use of partnerships, strategic alliances or joint ventures to acquire knowledge	16% B	23% B	23% B	38% B
Hiring skilled workers	5% B	5% B	13% B	76% B
Use of financial incentives to attract and retain employees	10% B	18% B	25% B	47% B
Encouraging risk taking initiatives by employees	15% B	26% B	26% B	32% B

Note: See Appendix 1 for an explanation of the alphabetic data quality indicators.
Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Perception of the importance of management practices to a business unit's success is to some extent predicated by characteristics of the business unit. For instance, business units in these selected service industries can be characterised by their smaller relative size as measured by employment compared with those in manufacturers or other goods producing industries. Also, the rates of adoption of formal management practices is considered to be correlated with the number of business units within a firm, the overall employment size of the firm and whether the business unit is foreign controlled (Earl and Gault 2003; Kremp and Mairesse 2003; Schuetze 2001; and Edler 2003). There are also differences in management styles across the service industries particularly for those services which rely on highly qualified personnel and research and development (Kremp and Mairesse 2003; Edler 2003; and Rosa and Gault 2003). These characteristics of business units will be briefly highlighted in this paper. However, the main thrust of the paper is an exploration of whether or not innovators, business units which have either introduced a new or significantly improved product (good or service) or process within the three-year period of 2001-2003, found the twelve knowledge management practices to be important to their success. The characteristics of innovators, including type of innovator and the quality of innovation will be presented.

Knowledge management practices were widely used in selected service industries

On average, business units in the selected services indicated that 10.6 knowledge management practices had some level of importance to their success suggesting that the practice was in use. The levels of importance range from low to high and this is being used as an indicator of use of knowledge management practices. If the business unit indicated that the knowledge management practice was not relevant, then this practice is considered not to have been in use. This measure should not be considered a perfect indicator of use of knowledge management practices as respondents may have answered low importance to practices not in use.[1]

1. Knowledge management pilot surveys conducted in Canada and Germany both indicated that selected service industries showed a higher propensity to use more knowledge management practices (see Edler 2003; and Earl 2003).

Table 2. Average number of knowledge management practices in use by selected characteristics

	Business Units	Non-Innovators	Innovators
Total selected service industries	**10.6 B**	**9.7 B**	**11.3 B**
Information Communication Technology Services	11.2 B	10.4 B	11.5 B
Professional Services	10.6 B	9.8 B	11.3 B
Other Services	9.9 B	9.4 B	10.9 B
Employment Thirds (business units)			
Low	10.4 B	9.7 B	11.1 B
Medium	10.3 B	9.2 B	11.3 B
High	10.9 B	10.1 B	11.5 B
Revenue Thirds (business units)			
Low	9.6 B	8.6 B	11.0 B
Medium	10.8 B	10.2 B	11.3 B
High	11.2 B	10.7 B	11.5 B
Highly qualified personnel			
< 5% of full-time employees with university degrees	9.3 B	8.6 B	10.9 B
5%-49.9 of full-time employees with university degrees	11.1 B	10.6 B	11.4 B
50% or more full-time employees with university degrees	11.1 B	10.5 B	11.4 B
Research and development full-time employees			
None	10.0 B	9.4 B	11.0 B
< 20% of full-time employees in R&D	11.3 B	10.5 B	11.6 B
20% or more full-time employees in R&D	11.3 B	10.8 B	11.4 B
Country of Control			
Canada	10.5 B	9.6 B	11.3 B
Foreign	11.5 B	10.8 B	11.7 B
Type of Establishment			
Single establishment business unit	10.3 B	9.4 B	11.2 B
Part of a larger firm	11.0 B	10.3 B	11.5 B
Type of innovator			
Product and process innovator	N/A	N/A	11.6 B
Product innovator	N/A	N/A	11.1 B
Process innovator	N/A	N/A	10.9 B

Note: N/A means not applicable.
Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Less than one-half of the knowledge management practices were important success factors

Another measure is the average number of knowledge management practices that the business units found to be important to their successes. The selected service industries on average found 5.5 out of a possible 12 knowledge management practices of importance to their success.

Table 3. Average number of important knowledge management practices to a business unit's success showing selected characteristics

	Business Units	Non-Innovators	Innovators
Total selected service industries	**5.5 B**	**4.7 B**	**6.2 B**
Information Communication Technology Services	6.0 B	5.0 E	6.3 B
Professional Services	6.3 B	5.7 B	6.8 B
Other Services	4.4 B	3.9 E	5.3 E
Employment Thirds (business units)			
Low	5.3 B	4.6 B	6.0 B
Medium	5.3 B	4.5 E	6.0 B
High	6.0 B	5.0 B	6.6 B
Revenue Thirds (business units)			
Low	5.0 B	4.3 E	5.9 B
Medium	5.5 B	4.7 B	6.2 B
High	6.1 B	5.4 B	6.5 B
Highly qualified personnel			
< 5% of full-time employees with university degrees	4.2 B	3.8 E	5.2 E
5%-49.9 of full-time employees with university degrees	5.7 B	5.1 B	6.1 B
50% or more full-time employees with university degrees	6.4 B	5.9 B	6.7 B
Research and development full-time employees			
None	5.0 B	4.5 B	6.0 B
< 20% of full-time employees in R&D	6.0 B	4.9 E	6.4 B
20% or more full-time employees in R&D	6.3 B	5.8 E	6.4 B
Country of Control			
Canada	5.5 B	4.6 B	6.2 B
Foreign	6.8 E	6.4 E	6.9 E
Type of Establishment			
Single establishment business unit	5.4 B	4.7 B	6.0 B
Part of a larger firm	5.9 B	4.7 B	6.6 B
Type of innovator			
Product and process innovator	N/A	N/A	6.8 B
Product innovator	N/A	N/A	5.6 B
Process innovator	N/A	N/A	6.1 B

Note: N/A means not applicable.
Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Size matters

For selected services, business units with the highest third of revenue rated using knowledge management practices of greater importance to their success than their smaller counterparts except for having a written knowledge management policy/strategy or a knowledge management officer. This supports the theory that formalisation and relevance of management practices may also increase with revenue size. However, only in two cases did the business units in the largest employment third for the selected services indicate that the groupings of knowledge management practices were significantly more important to their success than did their smaller counterparts. These two cases were knowledge development and knowledge acquisition and retention. Table 4a below highlights a striking similarity between small and

medium-sized business units based on employment size and their perceptions of the importance of knowledge management practices to their success.[2]

Table 4a. Total business units in selected service industries by employment thirds showing groupings of knowledge management practices important to success

Important	Small[1]	Medium[1]	Large[1]
Knowledge codification	41% B	44% E	49% E
Knowledge sharing culture	51% B	49% E	61% E
Knowledge development	40% B	40% B	53% E
Knowledge management policies/strategies	23% B	25% B	26% B
Knowledge acquisition and retention	41% B	42% E	53% E

Note: [1]The employment thirds for business units were created by industry groups; see tables 4b-d for employment sizes.
Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Table 4b. Total business units in information and communication technology services by employment thirds showing groupings of knowledge management practices important to success

Important	Small (< 22)	Medium (22-50)	Large (51 or more)
Knowledge codification	45% E	49% E	53% E
Knowledge sharing culture	64% E	57% E	68% E
Knowledge development	41% E	51% E	56% E
Knowledge management policies/strategies	25% E	27% E	29% E
Knowledge acquisition and retention	49% E	51% E	63% E

Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Table 4c. Total business units in selected professional, scientific and technical services by employment thirds showing groupings of knowledge management practices important to success

Important	Small (< 22)	Medium (22-45)	Large (46 or more)
Knowledge codification	46% E	51% E	56% E
Knowledge sharing culture	63% E	65% E	71% E
Knowledge development	51% E	48% E	60% E
Knowledge management policies/strategies	23% E	25% E	23% E
Knowledge acquisition and retention	48% E	49% E	59% E

Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

2. When employment thirds by enterprise for the industries were created, it became clearer that the large firms found the groupings of knowledge management practices more important to their success. However, the average numbers of knowledge management practices in use or that were important to firms by employment size differed little from comparable averages for business units. It is important to note that the employment thirds were developed to evenly distribute the units across three employment size groups. The size groups, therefore, may not differentiate well between small, medium and large business units (see Hamdani (2001) for a discussion of firm sizes in engineering services).

Table 4d. Total business units in selected other services industries by employment thirds showing groupings of knowledge management practices important to success

Important	Small (< 21)	Medium (21-37)	Large (38 or more)
Knowledge codification	33% E	33% E	40% E
Knowledge sharing culture	27% E	26% E	45% E
Knowledge development	29% E	22% E	43% E
Knowledge management policies/strategies	19% E	24% E	26% E
Knowledge acquisition and retention	25% E	27% E	38% E

Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

For purposes of this analysis, the selected services have been sub-divided into three groups which are detailed in Appendix 2. The first industry group matches the standard industrial sub-grouping for information and communication technology services. The second industrial sub-grouping comprises a selection of professional, scientific and technical services, while the third grouping combines services related to natural resources and transportation. The tables above show the relative levels of importance of groupings of knowledge management practices to business units of different employment sizes. When comparing between the industrial groupings by employment size group there were few significant differences in their perception of knowledge management practices as being important to success.

Business units with high revenue found knowledge management important

When revenue thirds by business units are compared, a clear pattern of increasing importance of knowledge management practices appears, with the exception of knowledge management policies or strategies.[3] This pattern holds across the industry sub-groupings quite well, with exception in the information communication technologies services in two cases where no significant differences are seen in the level of importance ascribed to knowledge codification or having a knowledge sharing culture. This might be explained by the nature of work done by ICT services in which creating users' manuals and other documentation are more likely to be standard operating procedures.

3. When revenue thirds were created for enterprises by industry sub-grouping, the same patterns appeared. Similar to employment thirds for enterprises, the average number of knowledge management practices in use or important by revenue thirds differed little between business units and firms.

Table 5a. Total business units in selected service industries by business unit revenue thirds showing groupings of knowledge management practices important to success

Important	Low[1]	Medium[1]	High[1]
Knowledge codification	37% E	45% E	52% E
Knowledge sharing culture	43% E	55% E	62% E
Training and mentoring (knowledge development)	32% B	46% E	54% E
Knowledge management policies/strategies	23% B	25% B	26% B
Knowledge acquisition and retention	38% E	43% E	55% E

Note: [1]The revenue thirds for business units were created by industry groups, see tables below for the cut-offs.
Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Table 5b. Total business units in information communication technology services by business unit revenue thirds showing groupings of knowledge management practices important to success

Important	Low <$2,448,069	Medium $2,448,069-$6,165,000	High $6,165,001 or more
Knowledge codification	42% E	49% E	56% E
Knowledge sharing culture	59% E	70% E	60% E
Knowledge development	39% E	47% E	62% E
Knowledge management policies/strategies	29% E	28% E	25% E
Knowledge acquisition and retention	47% E	60% E	56% E

Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Table 5c. Total business units in professional, scientific and technical services by business unit revenue thirds showing groupings of knowledge management practices important to success

Important	Low <$1,394,434	Medium $1,394,434-$3,217,172	High $3,217,173 or more
Knowledge codification	38% E	53% E	62% E
Knowledge sharing culture	51% E	69% E	78% E
Knowledge development	40% E	57% E	62% E
Knowledge management policies/strategies	20% E	24% E	27% E
Knowledge acquisition and retention	45% E	45% E	65% E

Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Table 5d. Total business units in selected other services by business unit revenue thirds showing groupings of knowledge management practices important to success

Important	Low <$2,079,001	Medium $2,079,001-$5,073,000	High $5,073,001 or more
Knowledge codification	30% E	35% E	41% E
Knowledge sharing culture	20% E	28% E	50% E
Knowledge development	19% E	35% E	40% E
Knowledge management policies/strategies	21% E	23% E	26% E
Knowledge acquisition and retention	22% E	25% E	44% E

Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Presence of highly qualified personnel made knowledge management practices count

The proportion of full-time employees with university education appears to impact the perception of importance of knowledge management practices to business units. In almost 30% of business units less than 5% of full-time employees were university graduates. These business units were the least likely to find knowledge management practices of value to them. About 38% of business units had at least one-half of their employees with university degrees. At least half of these business units intensely employing highly qualified personnel found the knowledge management practices of importance to their success with the usual exception of having knowledge management policies or strategies. The remaining third of business units had between 5% and 49.9% of their full-time employees with university education. In the case of knowledge management practices, this group more strongly resembled the group with at least half of their employees with university degrees.

Of interest are the high rates of perceived importance of knowledge sharing cultures and knowledge acquisition and retention practices to business units with at least one-half of their full-time employees with university education. It would appear that hiring skilled employees, encouraging risk taking initiatives and using partnerships or strategic alliances to acquire knowledge are very important to business units in which at least one-half of their full-time employees are considered highly qualified personnel. Promoting teamwork and a value system to nurture knowledge sharing are knowledge management practices important to this type of business unit also. This strongly suggests that how firms are managed reflects the educational profile of their employees. Of course, the workforce skills found within industries also reflects the nature of work performed.

Table 6. Total business units in selected service industries by percentage of full-time employees in 2003 who were university graduates rating knowledge management practices important

Important	Percentage of full-time employees in 2003 who were university graduates		
	Less than 5%	5% to 49.9%	50% or more
Knowledge codification	**32% E**	**50% B**	**51% B**
Regularly updating databases of good work practices, lessons learned or listing of experts	30% E	47% B	47% B
Preparing written documentation such as lessons learned, training manuals, good work practices, articles for publication	28% E	42% B	43% B
Knowledge sharing culture	**31% E**	**54% B**	**70% B**
A value system or culture promoting knowledge sharing	34% E	54% B	69% B
Encouraging experienced workers to transfer their knowledge to new or less experienced workers	70% E	78% B	77% B
Using teams which bring together people with different skills	22% B	47% B	63% B
Knowledge development	**29% E**	**49% B**	**52% B**
Encouraging workers to continue their education by reimbursing tuition fees for successfully completed work-related courses	23% B	44% B	45% B
Offering off-site training to workers in order to keep skills current	37% E	46%B	47% B
Knowledge management policies/strategies	**24% E**	**28% B**	**22% B**
A written knowledge management policy/strategy or a knowledge management officer	24% E	28% B	22% B
Knowledge acquisition and retention	**27% E**	**42% B**	**62% B**
Use of partnerships, strategic alliances or joint ventures to acquire knowledge	25% E	35% B	50% B
Hiring skilled workers	68% E	74% B	84% B
Use of financial incentives to attract and retain employees	44% E	45% B	50% B
Encouraging risk taking initiatives by employees	17% B	31% B	45% B

Note: 29.6% of business units reported less than 5% of their full-time employees were university graduates; 32.7% had between 5% and 49.9% of their full-time employees with university degrees; and 37.7% had 50% or more.
Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Undertaking research and development makes a difference

Business units in which research and development (R&D) activities are performed by full-time employees differ from those which do not perform R&D in how they perceive the importance of knowledge management practices to their success[4]. Almost 55% of business units did not perform R&D activities and these units found that nurturing a knowledge

4. Kremp and Mairesse (2003) also found that doing R&D doubled a firm's propensity to use knowledge management practices. These findings were also true when innovative firms were compared to non-innovative firms (p.149).

sharing culture of less importance to their success than those business units which did perform R&D. Non-R&D performers were also less likely to find preparing written documentation important to their success than did the R&D intensive firms. R&D intensive firms were twice as likely to find encouraging risk taking initiatives by employees as important to their success than non-R&D performers. This again suggests that the types of management practices of importance to a business unit reflect the type of work performed.

R&D intensive business units also placed more emphasis on using joint ventures, strategic alliances and partnerships to acquire knowledge again suggesting that the nature of R&D activities may impact the perceived importance of the knowledge management practices used. This is emphasized by the high rating given to having a knowledge sharing culture by R&D intensive business units.

Table 7. Total business units in selected service industries by percentage of full-time employees in 2003 performing research and development activities rating knowledge management practices important

Important	Percentage of full-time employees in 2003 performing R&D activities		
	None	**Less than 20%**	**20% or more**
Knowledge codification	**42% B**	**45% E**	**52% E**
Regularly updating databases of good work practices, lessons learned or listing of experts	41% B	42% E	44% E
Preparing written documentation such as lessons learned, training manuals, good work practices, articles for publication	34% B	38% E	49% E
Knowledge sharing culture	**44% B**	**62% E**	**70% E**
A value system or culture promoting knowledge sharing	44% B	59% E	72% E
Encouraging experienced workers to transfer their knowledge to new or less experienced workers	73% B	84% B	72% E
Using teams which bring together people with different skills	36% B	56% E	60% E
Knowledge development	**40% B**	**50% E**	**48% E**
Encouraging workers to continue their education by reimbursing tuition fees for successfully completed work-related courses	34% B	44% E	43% E
Offering off-site training to workers in order to keep skills current	43% B	44% E	45% E
Knowledge management policies/strategies	**25% B**	**25% E**	**22% E**
A written knowledge management policy/strategy or a knowledge management officer	25% B	25% E	22% E
Knowledge acquisition and retention	**35% B**	**54% E**	**61% E**
Use of partnerships, strategic alliances or joint ventures to acquire knowledge	30% B	41% E	54% E
Hiring skilled workers	73% B	82% B	78% E
Use of financial incentives to attract and retain employees	47% B	48% E	44% E
Encouraging risk taking initiatives by employees	24% B	35% E	48% E

Note: 54.8% of business units reported that none of their full-time employees did R&D; 23.5% had between 0.1% and 19.9% of their full-time employees in R&D activities; and 21.7% had 20% or more.
Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Influence of country of control and complexity of organisational structure

The vast majority (94%) of the business units in the selected service industries were Canadian-controlled. For three of the knowledge management practices groupings the foreign-controlled business units were more likely to have rated them as being important to their success. The two exceptions were knowledge codification and of course knowledge management policies. One-half of the foreign-controlled business units were in the top third of employment and three-quarters also indicated that they were part of a larger firm suggesting that firm size may also play a role in how the business units were managed.

Just over one-third (35%) of the business units reported that they were part of larger firms. However, the more complex organisational structures within which the business unit operated did not show any significant differences to simpler organisational structures in the importance of knowledge management practices to success. This seems to be contradictory as it has already been shown that larger firms are more likely to use more knowledge management practices possibly due to the increased difficulties of communications and other knowledge sharing activities in these firms. It would therefore follow that firms with multiple locations would face similar issues however, the evidence does not support this thought.

Table 8. Total business units in selected service industries by country of control showing groupings of knowledge management practices important to their success

Important	**Canadian-controlled**	**Foreign-controlled**
Knowledge codification	44% B	58% E
Knowledge sharing culture	52% B	74% E
Knowledge development	43% B	64% E
Knowledge management policies/strategies	25% B	18% E
Knowledge acquisition and retention	44% B	67% E

Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Table 9. Total business units in selected service industries by type of business unit showing groupings of knowledge management practices important to their success

Important	**Single Establishment Business Unit**	**Part of larger firm-Business Unit**
Knowledge codification	43% B	48% E
Knowledge sharing culture	52% B	57% E
Knowledge development	43% B	47% E
Knowledge management policies/strategies	23% B	27% E
Knowledge acquisition and retention	44% B	47% E

Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

There are some differences based on industry

The business units were distributed evenly across the following industrial sub-sectors: information communication technology (ICT) services; professional services and other services, of which transportation services were the vast majority (90%) with natural resource services and other services making up the remainder. The ICT and the professional services behaved similarly towards the importance of knowledge management practices to their successes with, on the most part, professional services leading. On the other hand, the behaviour of other services towards the impact of knowledge management practices on their successes stood in stark contrast. On the most part, business units from the other services grouping were generally much less likely to have rated any of the groupings of knowledge management practices as important to their success.

Table 10. Total business units by industrial grouping showing groupings of knowledge management practices important to their success

Important	Information Communication Technology Services	Professional Services	Other Services
Knowledge codification	49% E	51% B	35% E
Knowledge sharing culture	63% E	66% B	33% E
Knowledge development	49% E	53% B	32% E
Knowledge management policies/strategies	27% B	24% B	23% E
Knowledge acquisition and retention	55% E	52% B	30% E

Note: Other services groups transportation services and natural resource services.
See Appendix 2 for more information.
Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Innovators found knowledge management practices more important to success than non-innovators

According to the Survey of Innovation 2003, 55% of the business units in the selected service industries were innovators. Innovators rated all of the knowledge management practices as having a greater impact on their success than did non-innovators.

After the top two knowledge management practices - knowledge transfer between workers and hiring skilled workers - the degree of importance to non-innovators of the remaining practices to business units' successes fell off. Also there was a shift in the order of importance of the knowledge management practices to non-innovators as compared to innovators.

It is important to note the distribution of innovators and non-innovators across the employment size and revenue groups. Looking at innovators by employment thirds of the business units, four out of ten were in the top third employment size group compared to three out of ten non-innovators with the reverse happening for the bottom third of employment. When innovators and non-innovators are distributed by business unit revenue thirds, just one-quarter of non-innovators fell into the highest third of revenue while four out of ten innovators were in this revenue group.

Four out of ten innovators indicated that they were part of larger firms whereas just three out of ten non-innovators declared that they had ties to larger firms. Finally, of the foreign-controlled business units, eight out of ten were innovators. Taken together these indicators suggest that size and complexity of organisational structures could play roles in how business units perceived the importance of knowledge management practices to their success, especially since innovators generally rated these practices more highly.

Innovators on average used more knowledge management practices

Of a possible twelve knowledge management practices that could be used, innovators on average used 11.3 whereas non-innovators employed 9.7. Foreign-controlled innovators employed on average almost every one of the knowledge management practices, suggesting that distance may indeed affect management style as foreign-controlled non-innovators also had a higher number of knowledge management practices in use at 10.8. Complexity of organisational structure has an effect on the average number of knowledge management practices used as shown by the higher averages for both innovators and non-innovators which were part of larger firms. This may also be the case for innovators and non-innovators with the highest revenues and in the largest employment size groups. Finally, innovators that did research and development as well as those that employed higher proportions of university graduates had higher rates of using knowledge management practices. This suggests that the type of work as well as the educational skills of the employees may influence how business units manage their knowledge.

Innovators rated an average of 6.2 knowledge management practices as important to their success. Showing the value of these management practices to more complex organisational structures, foreign-controlled innovators rated an average of 6.9 knowledge management practices of great importance to their success. This average for innovators that were part of larger firms stood at 6.6 which was also the average for the highest thirds of innovators by revenue and employment size. Again, perhaps indicating that highly qualified personnel require different management styles, innovators with at least half of their full-time employees holding university degrees on average found 6.7 knowledge management practices important to their success. The average ratings of knowledge management practices as important to their success for non-innovators, on the other hand, in all cases were lower to their innovative counterparts. The lower average number of knowledge management practices important to the success of non-innovators is reflected in their lower tendency to find any of the knowledge management practices important with the usual exception of knowledge management policies/strategies.

Table 11. All business units, non-innovators and innovators showing proportion of knowledge management practices important to their success

	Important		
	Total	**Non-Innovators**	**Innovators**
Knowledge codification	**45% B**	**35% B**	**53% B**
Regularly updating databases of good work practices, lessons learned or listing of experts	42% B	35% B	48% B
Preparing written documentation such as lessons learned, training manuals, good work practices, articles for publication	38% B	29% B	46% B
Knowledge sharing culture	**54% B**	**40% B**	**65% B**
A value system or culture promoting knowledge sharing	54% B	40% B	65% B
Encouraging experienced workers to transfer their knowledge to new or less experienced workers	75% B	72% B	78% B
Using teams which bring together people with different skills	46% B	34% B	56% B
Knowledge development	**44% B**	**36% B**	**51% B**
Encouraging workers to continue their education by reimbursing tuition fees for successfully completed work-related courses	38% B	31% B	44% B
Offering off-site training to workers in order to keep skills current	44% B	40% B	46% B
Knowledge management policies/strategies	**25% B**	**23% B**	**26% B**
A written knowledge management policy/strategy or a knowledge management officer	25% B	23% B	26% B
Knowledge acquisition and retention	**45% B**	**33% B**	**55% B**
Use of partnerships, strategic alliances or joint ventures to acquire knowledge	38% B	30% B	44% B
Hiring skilled workers	76% B	71% B	80% B
Use of financial incentives to attract and retain employees	47% B	41% B	51% B
Encouraging risk taking initiatives by employees	32% B	23% B	39% B

Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Set of knowledge management practices important to success differed by type of innovation

The importance of knowledge management practices to innovators nominally depended upon the type of innovation undertaken within the business. Product-only innovators are business units which only introduced new or significantly improved products (goods or services) and they comprised 37.2% of innovators. Innovators that only introduced new or significantly improved processes (including improved ways of delivering goods or services) are known as process-only innovators. Process-only innovators represented 17.6% of the innovators. The remaining innovators (45.2%) are product and process innovators. How these three types of innovators rated the use of knowledge management practices to their success showed some variation.

Table 12. The proportion of product-only, process-only, and product and process innovators rating knowledge management practices important to their success

	Important		
	Product-only Innovators	**Process-only Innovators**	**Product and Process Innovators**
Knowledge codification	**40% E**	**59% E**	**61% E**
Regularly updating databases of good work practices, lessons learned or listing of experts	35% E	53% E	57% E
Preparing written documentation such as lessons learned, training manuals, good work practices, articles for publication	35% E	50% E	54% E
Knowledge sharing culture	**58% E**	**59% E**	**73% E**
A value system or culture promoting knowledge sharing	63% E	59% E	70% E
Encouraging experienced workers to transfer their knowledge to new or less experienced workers	77% E	76% E	79% B
Using teams which bring together people with different skills	51% E	43% E	65% E
Knowledge development	**44% E**	**54% E**	**57% E**
Encouraging workers to continue their education by reimbursing tuition fees for successfully completed work-related courses	37% E	43% E	51% E
Offering off-site training to workers in order to keep skills current	41% E	49% E	50% E
Knowledge management policies/strategies	**19% E**	**26% E**	**32% E**
A written knowledge management policy/strategy or a knowledge management officer	19% E	26% E	32% E
Knowledge acquisition and retention	**48% E**	**46% E**	**64% E**
Use of partnerships, strategic alliances or joint ventures to acquire knowledge	37% E	37% E	54% E
Hiring skilled workers	77% E	86% E	81% B
Use of financial incentives to attract and retain employees	52% E	61% E	46% E
Encouraging risk taking initiatives by employees	37% E	25% E	47% E

Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Six out of ten innovators that had only introduced or significantly changed processes credited knowledge codification for their success whereas just four out of ten product only innovators indicated that these practices were important to them. In fact, product only innovators more closely resembled non-innovators in their rating of knowledge codification. It may be a case of product innovators not perceiving a great need for written documentation.

While there was no difference between the product-only innovators and process-only innovators concerning knowledge sharing cultures, this type of culture was of the most importance to product and process innovators. It would appear that product and process innovators found using teams which bring together people with different skills of greater importance to their business units than either product-only innovators or process-only innovators. Process and product innovators also placed more emphasis on the use of partnerships, strategic alliances or joint ventures to acquire knowledge than did either of the other two types of innovators.

Industry makes little difference for innovators

Unlike for all the business units, innovators were not evenly spread across the three industry groupings. Innovators in information communication technology services comprised 47% of all innovators, followed by professional services at 31% and other services at 22%. On the other hand, business units in other professional services composed half of the non-innovators (51%) with other services at one-third following and information communication technologies services comprising just 16%.

Across the groupings of knowledge management practices by industry groupings, there were few significant differences in the level of importance given by innovators and non-innovators to the importance of using these practices to success. Innovators in information communication technology services and professional, scientific and technical services found having a knowledge sharing culture equally important to their success and of greater importance to innovators in other services. Innovators in professional services also found knowledge acquisition and retention practices of more importance than their counterparts in other services. However, between innovators and non-innovators for some of the knowledge management groupings by industry there were some significant differences.

Within professional services innovators were significantly more likely to find a knowledge sharing culture, knowledge codification and knowledge acquisition and retention practices of greater importance than did their non-innovative counterparts. Only for knowledge acquisition and retention practices did a significant difference occur between innovators and non-innovators in information communication technology services. Whereas innovators in other services found two knowledge management groupings, knowledge codification and knowledge acquisition and retention, of more importance than their non-innovative counterparts. This suggests that innovation and service sector may both play a role in the perception of value of knowledge management practices.

Table 13. Proportion of innovators and non-innovators by industry rating groupings of knowledge management practices important to their success

	Important		
	All Business Units	**Innovators**	**Non-innovators**
Knowledge codification	**45% B**	**53% B**	**35% B**
Information Communication Technology Services	49% E	53% E	36% E
Professional Services	51% B	59% E	42% E
Other Services	35% E	45% E	30% E
Knowledge sharing culture	**54% B**	**65% B**	**40% B**
Information Communication Technology Services	63% E	66% E	51% E
Professional Services	66% B	74% E	56% E
Other Services	33% E	48% E	25% E
Knowledge development	**44% B**	**51% B**	**36% B**
Information Communication Technology Services	49% E	51% E	42% E
Professional Services	53% B	59% E	47% E
Other Services	32% E	41% E	27% E
Knowledge management policies/strategies	**25% B**	**26% B**	**23% B**
Information Communication Technology Services	27% B	28% E	23% E
Professional Services	24% B	23% E	24% E
Other Services	23% E	24% E	23% E
Knowledge acquisition and retention	**45% B**	**55% B**	**33% B**
Information Communication Technology Services	55% E	58% E	41% E
Professional Services	52% B	60% E	43% E
Other Services	30% E	42% E	24% E

Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Market first innovations

Product and process innovators were asked to identify if any of their innovations were a first in Canada or the world. If an innovator had neither a world-first nor a Canada-first innovation they were considered to have made a firm-first innovation. Innovators which had either a Canada-first or a world-first innovation or both can be viewed as market-first innovators. This measure was developed for product innovators in the manufacturing sector for reasons of international comparability (Mohnen and Therrien 2003, p.317). Product innovators with market-first innovations can be viewed as more creative or original than product innovators with firm-first innovations which most likely were copied from other companies (Hamdani 2001).

It appears that the success of launching a new or significantly improved product onto the national or global market depends more highly upon a knowledge sharing culture. And this holds true for product and process innovators with market-first products. The stewardship of knowledge was more important to product and process innovators with firm-first products than it was for their product-only innovators suggesting that written knowledge management policies are more relevant for process innovations. Knowledge acquisition and retention practices were also more important to product innovators with market-first innovations than for their counterparts with firm-first innovations. The real distinction comes in the usage of partnerships, strategic alliances or joint ventures to acquire knowledge showing that placing products onto the national or global market requires a greater reliance on networks. Again, product and process innovators with market-first products mimicked this management behaviour, suggesting that undertaking market product innovation requires not only creativity but also a specific set of management practices.

Table 14. Proportions product innovation and product and process innovators with market-first or firm-first products that rated knowledge management practices important to their success

	Important			
	Product innovators[1]		Product and process innovators	
	Firm-first product	Market-first product	Firm-first product	Market-first product
Knowledge codification	**48% E**	**57% E**	**59% E**	**64% E**
Regularly updating databases of good work practices, lessons learned or listing of experts	44% E	51% E	53% E	61% E
Preparing written documentation such as lessons learned, training manuals, good work practices, articles for publication	41% E	51% E	50% E	58% E
Knowledge sharing culture	**57% E**	**78% E**	**64% E**	**81% E**
A value system or culture promoting knowledge sharing	58% E	78% E	63% E	76% E
Encouraging experienced workers to transfer their knowledge to new or less experienced workers	76% E	82% E	77% E	81% E
Using teams which bring together people with different skills	55% E	64% E	60%E	70% E
Knowledge development	**52% E**	**49% E**	**56% E**	**58% E**
Encouraging workers to continue their education by reimbursing tuition fees for successfully completed work-related courses	44% E	46% E	48% E	54% E
Offering off-site training to workers in order to keep skills current	48% E	43% E	51% E	49% E
Knowledge management policies/strategies	**28% E**	**24% E**	**35% E**	**27% E**
A written knowledge management policy/strategy or a knowledge management officer	28% E	24% E	35% E	27% E
Knowledge acquisition and retention	**51% E**	**66% E**	**56% E**	**73% E**
Use of partnerships, strategic alliances or joint ventures to acquire knowledge	40% E	54% E	46% E	61% E
Hiring skilled workers	77% E	82% E	79% E	83% E
Use of financial incentives to attract and retain employees	46% E	53% E	44% E	49% E
Encouraging risk taking initiatives by employees	38% E	48% E	39% E	54% E

1. Product innovators does not equal product-only innovators discussed above. Product innovators also can include product innovators which had process innovators. Product and process innovators had to have both types of innovations. Information for product-only innovators is available and shows similar patterns although the data quality is not as good.
Source: Statistics Canada. Survey of Innovation in Selected Service Industries, 2003.

Summary

This paper has profiled the perceived importance of knowledge management practices to the success of business units in selected services. It has shown that innovators, business units which introduced new or significantly improved products or processes between 2001 and 2003, indicated that they found knowledge management practices to be of greater importance to their successes than non-innovators. Process-only innovators, those innovators that introduced new or significantly improved processes, depended on knowledge codification and knowledge sharing practices for their successes. On the other hand, product innovators who only introduced new or significantly improved products looked to their knowledge sharing culture as being important to their success.

Organisational structure also plays a role in defining knowledge management practices as important to success. Business units which were foreign-controlled or part of a larger firm were slightly more likely to have indicated that how their knowledge was managed was important to their success. This was emphasised if the business units were also innovators. Similar results were also seen for the business units in the highest employment and revenue thirds. The type of work activity being managed as well as the educational composition of the full-time employees also played important roles. The level of importance of knowledge management practices and the average number of these practices in use increased with greater presence of highly qualified personnel, full-time employees with university degrees. Research and development activities performed by full-time employees also increased the importance of knowledge management practices.

A review of market-first product innovations for product innovators and product and process innovators underlined the broader reliance on a number of knowledge management practices required to be successful. The fact that product and process innovators emphasised different sets of knowledge management practices is itself an important finding.

There were some differences noted between the industrial groupings and by whether or not they were innovators. Two industrial groupings, information communication technology services and professional services acted very similarly in indicating the importance of selected knowledge management practices to their successes. Other services composed mainly of transportation services and natural resource services indicated a lower level of importance in how they managed their knowledge to their success than the other industrial sub-groupings.

It appears that on the most part innovators believe that how they manage their knowledge contributes to their success. This suggests that the adoption of management practices by business units plays a role in the innovation process. It also appears that understanding how business units are managed and their perception of the value of management practices may provide an indicator of whether or not a business unit will be innovative and, to some extent, the type of innovation.

Appendix 1: Survey Methodology and Data Quality Indicators

1. Introduction

The Survey of Innovation 2003 is based on the Oslo Manual (OECD/Eurostat 1997)[5] 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;

5. OECD/Eurostat, *Proposed Guidelines for Collecting and Interpreting Innovation Data (Oslo Manual)*, Paris, 1997

- impact;
- 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

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

	Imputation Rate			
CV	**< 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

	Imputation Rate			
Standard Error	**< 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 2: Selected services industrial groupings

North American Industry Classification System (NAICS) Code 2002	Name
Information communication technology services[1]	
4173	Computer and communications equipment and supplies 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
51811	Internet service providers, Web search portals
5182	Data processing, hosting and related services
53242	Office machinery and equipment rental and leasing
54151	Computer systems design and related services
8112	Electronic and precision equipment repair and maintenance
Professional services	
54133	Engineering services
54136	Geophysical surveying and mapping services
54137	Surveying and mapping (except geophysical) services
54138	Testing laboratories
54142	Industrial design services
54161	Management consulting services
54162	Environmental consulting services
54169	Other scientific and technical consulting services
54171	Research and development in the physical, engineering and life sciences
54172	Research and development in the social sciences and humanities
Other services	
1153	Support activities for forestry
21311	Support activities for mining and oil and gas extraction
4179 (excluding 41791)	Other machinery, equipment and supplies wholesaler-distributors (excluding Office and store machinery and equipment wholesaler-distributors)
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

1. The Information Communication Technology Services industries correspond to the standard available from Statistics Canada for this sector. For more information go to www.statcan.ca and view reference documents.

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