Cat. No. 88F0006XIE02006

Are we Managing our Knowledge?: Results from the Pilot Knowledge Management Practices Survey, 2001

Statistics Canada Statistique Canada

Canada

ARE WE MANAGING OUR KNOWLEDGE?

Results from the Pilot Knowledge Management Practices Survey, 2001

Louise Earl

Science, Innovation and Electronic Information Division

April 2002

88F0006XIE No. 06

CONTACTS FOR MORE INFORMATION

Science, Innovation and Electronic Information Division

Director Dr. F.D. Gault (613-951-2198)

Assistant Director Brian Nemes (613-951-2530)
Assistant Director Paul McPhie (613-951-9038)

The Science and Innovation Information Program

Chief, Indicators Development
Dr. Frances Anderson (613-951-6307)

Chief, Knowledge Indicators
Michael Bordt (613-951-8585)

Chief, Innovation
Daood Hamdani (613-951-3490)

Chief, Life Science Unit
Antoine Rose (613-951-9919)

Science and Innovation Surveys Section

Chief
Bert Plaus (613-951-6347)

FAX: (613-951-9920)

Working Papers

The Working Papers publish research related to science and technology issues. All papers are subject to internal review. The views expressed in the articles are those of the authors and do not necessarily reflect the views of Statistics Canada.

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.

Table of Contents


ELECTRONIC PUBLICATIONS AVAILABLE AT
www.statcan.ca

Preface

Innovation and the adoption and dissemination of technologies and management 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 management practices, industries can increase their production capabilities, improve their productivity, and expand their lines of new products and services.

This study is one in a series of studies that the Science, Innovation and Electronic Information Division (SIEID) has undertaken that have examined technological and organisational change in the Canadian economy. In 1993, a first survey of innovation and the adoption of advanced technologies in the 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.

Biotechnology surveys carried out in 1996, 19997 and 1999 have examined both the development of new biotechnology products and processes and the use and planned use of biotechnologies. The 1999 Survey of Innovation, Advanced Technologies and Practices in the Construction and Related Industries is the first survey of 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 survey of the use and planned use of information communication technologies were carried out in 1999, 2000, and 2001. And finally, the Survey of Electronic Commerce and Technology, 2000 contained two questions on organisational and technological improvements and provided the first cross-economy data on the issue, covering both firms in the private sector and organisations in the public sector.

The pilot Knowledge Management Practices Survey is the latest addition to this series of surveys on the adoption of new organisational practices. This working paper provides an overview of the results of the survey that includes the use and planned use of a set of knowledge management practices, the reasons that firms employ these management practices and the results attained from their use. This working paper is the first of several that are planned using data from the Knowledge Management Practices Survey, 2001.

Acknowledgements

This report provides data from the first release of the pilot Knowledge Management Practices Survey, 2001. Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

The publication of this report was made possible through the contribution of many people, first and foremost amongst whom are our respondents. The members of the working group on Knowledge Management Surveys in the Private Sector, especially the Centre for Educational Research and Innovation at the Organisation for Economic Cooperation and Development, Wenche Stromses, Center for Ledelse (Copenhagen), Jakob Edler, Fraunhofer Institute for Systems and Innovation Research (Karlsruhe), and Larry Prusak, Institute for Knowledge Management (Boston) all made immeasurable contributions to the development of the survey questionnaire. The following people at Statistics Canada freely gave their time and expertise to the success of the survey: Fred Gault, Michael Bordt, Iain McKellar, Yves Morin, Brian Nemes, Claude Beaudoin, Joel D'aoust, Linda Gorman, and Mary-Ann Clarke-Wilkinson. This report would not have been possible without the assistance of Guy Sabourin, Adele St.Pierre, Al Short, Nicholas Lavigne, John Flanders and Claire Racine-Lebel. Finally, the constant assistance and encouragement of Dominique Foray and Fred Gault made working on this project a pleasure.

Highlights

The pilot Survey on Knowledge Management Practices was conducted in the fall of 2001 as part of an international initiative headed by the Organization for Economic Co-operation and Development. The pilot survey accomplished two objectives. It demonstrated that the use of knowledge management practices in firms could be identified and it provided the findings described in this paper.

This survey sampled firms in five sub-sectors of the North American Industrial Classification System: forestry and logging; chemical manufacturing; transportation equipment manufacturing; machinery, equipment and supplies wholesaler-distributors; and management, scientific and technical consulting services. The questionnaire was mailed to 407 firms of which 348, or 86%, responded. These firms represent an estimated 5,245 enterprises in these five sub-sectors.

According to the data, a majority of firms in these five sub-sectors were managing some aspect of their knowledge. Nine out of 10 used at least one of 23 business practices related to knowledge management, which involves any systematic activity related to the capture and sharing of knowledge by the organisation.

Not surprisingly, service industries had the highest average number of practices in use. These industries depend to a great extent upon marketing the application of the knowledge of their workers.

On average, firms in all five sub-sectors used 11 knowledge management practices. This ranged from a high of 14 used by firms in management, technical and scientific consulting services, to 10 used by firms in machinery and equipment supplies wholesaler-distributors.

Findings suggest that firms are employing knowledge management practices strategically to improve their competitive performance and productivity. Half the firms in the five sub-sectors reported that the critical reason they used knowledge management practices was to improve the competitive advantage of the firm. About 30% of firms said they used such practices to increase efficiency by using knowledge to improve production processes. About 23% reported that their aim was to train workers to meet strategic objectives of the firm, and another 23%, to integrate knowledge within the firm.

Knowledge sharing, creation, generation and maintenance are perceived as important to a firm's productivity. Almost nine out of 10 firms reported that the most effective result of using knowledge management practices was improving worker skills and knowledge. The second most effective result was increased worker efficiency and/or productivity.

Firms viewed the loss of key personnel as the main trigger for implementing more knowledge management practices, followed by the loss of market share.


ELECTRONIC PUBLICATIONS AVAILABLE AT
www.statcan.ca

1. Introduction

Today more than ever, knowledge matters.[1] New terms related to knowledge, often not clearly defined, are creeping into everyday vocabulary. There is the idea of the knowledge-based economy and knowledge-based industries (OECD, 1999).[2] We have knowledge workers. Academics study knowledge-based enterprises.[3] Firms and organisations are concerned about knowledge loss (Cross and Baird, 2000; and Brown and Duguid, 2000). And business strategists advise of the need to leverage knowledge resources (Bartlett and Ghoshal, 2002; Zack, 1999; and Quinn, 1999). Knowledge has long been recognised as "power" and pundits are persuaded that this "power" intensifies when it is shared (Stehr, 2001; and de la Mothe and Foray, 2001). Understanding how and whether Canadian firms and organisations are actively applying management practices to their knowledge was a primary objective of the pilot Knowledge Management Practices Survey, 2001 (KMPS).

2. Survey Background/Overview

The pilot Knowledge Management Practices Survey was conducted in the fall of 2001 with a sample of five sub-sectors of the North American Industrial Classification System (NAICS)(Statistics Canada, 1997): forestry and logging (NAICS 113); chemical manufacturing (NAICS 325); transportation equipment manufacturing (NAICS 336); machinery, equipment and supplies wholesaler-distributors (NAICS 417) and management, scientific and technical consulting services (NAICS 5416). The questionnaire was mailed to 407 firms of which 348 or 86% responded. Taken together these firms represent an estimated 5,245 enterprises in these five sub-sectors. (For more information on the survey, see Annex 3 – Methodological Notes)

---

[1] **Canada's Innovation Strategy, 2002**, has two major texts: *Knowledge Matters: Skills and Learning for Canadians* and *Achieving Excellence: Investing in People, Knowledge and Opportunity*. The latter "recognises the need to consider knowledge as a strategic national asset. It focuses on how to strengthen our science and research capacity and on how to ensure that this knowledge contributes to building an innovative economy that benefits all Canadians." The former "recognises that people are a country's greatest resource in today's global knowledge-based economy." (abstracts)

[2] One direction that the Working Party on Statistics of the Committee on Industry and Business Environment, Organisation for Economic Co-operation and Development is taking is to study knowledge-based industries.

[3] For example: the Queen's School for Business has a Centre for studying Knowledge-Based Enterprises. The Conference Board of Canada has annual conferences on knowledge management. Recently Federated Press announced its three-day conference on knowledge management in government. And the fifth World Congress on Intellectual Capital was hosted by McMaster Business School and the Centre for Management of Innovation and New Technology Research in Hamilton in January 2002. At this conference topics such as intellectual capital, knowledge management, innovation, organisational learning, and knowledge assets were discussed.

Table 1. Distribution of Weighted Sample by Sub-sector and by Firm Size – Knowledge Management Practices Survey, 2001.

Five Sub-sectors and Firm Size	Distribution %
Sub-sectors	100%
Forestry and Logging	11% A*
Chemical Manufacturing	9% A
Transportation Equipment Manufacturing	10% A
Machinery, Equipment and Supplies Wholesaler-Distributors	52% B
Management, Scientific and Technical Consulting Services	18% B
Workers in Canada	100%
Less than 50 workers	82% A
50 – 249 workers	13% A
250 - 499 workers	2% A
500 - 1,999 workers	2% A
2,000 and more workers	1% A

*Data quality indicators are described in Annex 3 – Methodological Notes.

3. Definition of Knowledge Management

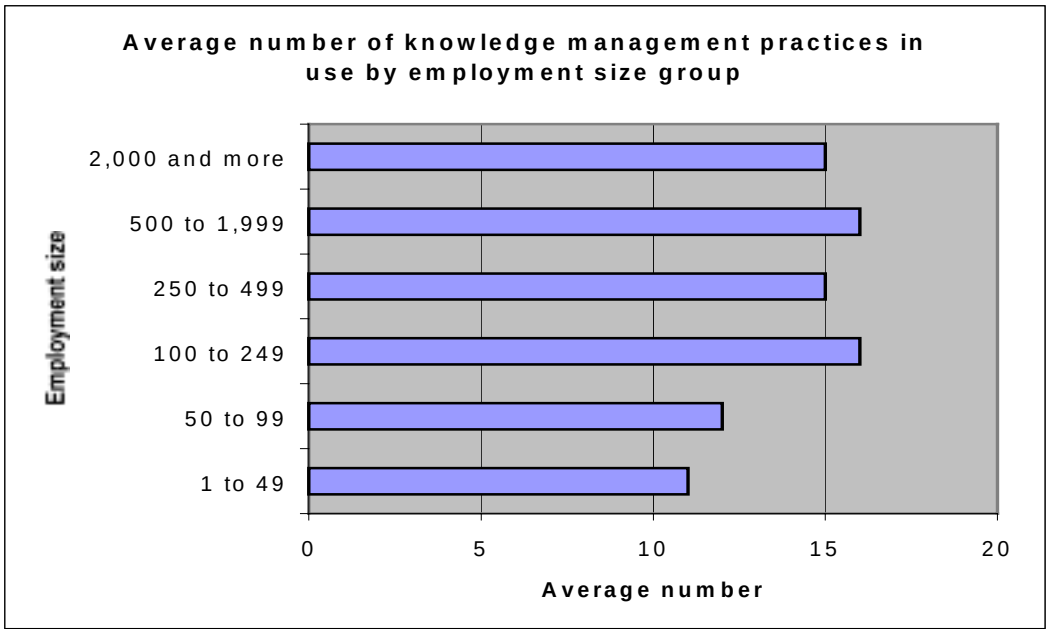
Many experts from different disciplines have defined knowledge management in many ways (Earl and Scott, 1999). For the purpose of the pilot Knowledge Management Practices Survey, "knowledge management involves any systematic activity related to the capture and sharing of knowledge by the organisation." Respondents indicated whether they used or planned to use 23 business practices related to knowledge management. And the vast majority (93%) of firms or organisations is using at least one of the knowledge management practices listed.

4. Non-Users of Knowledge Management Practices

Non-users of the knowledge management practices comprised a very small but important component of the five sub-sectors at 7% (See Annex 1 for more information on non-users). Firms or organisations of less than 50 workers represented the majority (88% and 59% for firms with less than 20 workers) of non-users of knowledge management practices. This result is in keeping with Larry Prusak's work on knowledge management (Prusak, 2001; Cohen and Prusak, 2001; Davenport and Prusak, 1998; and Lesser and Prusak, 2000). Prusak commented that the need for knowledge management practices rose with firm size and that those firms with less than 250 employees were less likely to employ these business practices.[4] The Knowledge Management Practices Survey's results suggest that for Canada, firms begin to employ more knowledge management practices when they attain at least 100 workers.

[4] Notes taken from conversations with Larry Prusak, February 2001.

Chart 1. Average number or knowledge management practices in use by employment size group



5. Knowledge Management Practices in Use

For the purposes of this paper, users of knowledge management are defined as those firms that indicated they used at least one knowledge management practice from the list shown in Table 2. The sub-sector that had the highest average number of practices in use was not surprisingly in the services sector. (See Annex 2 - Definitions) Firms in services depend to a great extent upon marketing the application of the knowledge of their workers. On average, management, technical and scientific consulting services firms used 14 of the knowledge management practices. Machinery and equipment supplies wholesaler-distributors had the lowest average number of practices in place at 10. Overall the average number of knowledge management practices in use was 11 for the five sub-sectors.

Table 2. Knowledge Management Practices in Use and the Proportion of them that were Recently Adopted – Users of Knowledge Management Practices

Knowledge Management Practices	In Use	Percent of the Practices in Use Since 1999
	%	%
Leadership		
Knowledge management practices were a responsibility of managers and executives	94 A	13 B
Knowledge management practices were explicit criteria for assessing worker performance	35 B	27 C
Knowledge management practices were a responsibility of non-management workers	34 B	21 C
Knowledge management practices were a responsibility of the knowledge officer or knowledge management unit	22 B	25 C
Knowledge Capture and Acquisition		
Firm captured and used knowledge obtained from other industry sources such as industrial associations, competitors, clients and suppliers	92 A	9 B
Firm captured and used knowledge obtained from public research institutions including universities and government laboratories	43 C	13 C
Firm dedicated resources to detecting and obtaining external knowledge and communicating it within the firm	43 C	18 C
Firm encouraged workers to participate in project teams with external experts	41 B	25 C
Training and Mentoring		
Firm encouraged experienced workers to transfer their knowledge to new or less experienced workers	82 C	9 B
Firm provided informal training related to knowledge management	81 B	17 B
Firm encouraged workers to continue their education by reimbursing tuition fees for successfully completed work-related courses	63 C	4 B
Firm offered off-site training to workers in order to keep skills current	51 C	20 B
Firm provided formal training related to knowledge management practices	32 B	16 B
Firm used formal mentoring practices, including apprenticeships	28 B	43 C
Policies and Strategies		
Used partnerships or strategic alliances to acquire knowledge	68 B	20 C
Policies or programs intended to improve worker retention	66 B	24 C
Values system or culture intended to promote knowledge sharing	59 C	31 C
Written knowledge management policy or strategy	36 C	39 C
Communications		
Workers shared knowledge by preparing written documentation such as lessons learned, training manuals, good work practices, articles for publication, etc. (organisational memory)	44 B	24 C
Workers shared knowledge by regularly updating databases of good work practices, lessons learned or listings of experts	41 B	34 C
Workers shared knowledge in collaborative work by project teams that are physically separated (“virtual teams”)	17 B	26 C
Incentives		
Knowledge sharing was rewarded with monetary incentives	32 B	35 C
Knowledge sharing was rewarded with non-monetary incentives	36 B	30 C

Note: Users are defined as having used at least one of the knowledge management practices listed. The percentage of adopted since 1999 is calculated by dividing the total of in use since 1999 by total in use.

5a. The Most Popular Knowledge Management Practices

The users of knowledge management practices in the five sub-sectors indicated that almost every firm (94% A) looked to its managers and executives to be responsible for providing knowledge management leadership (see Table 2). For just 13% (B) of managers and executives this was a recently adopted practice. Firms also showed their marked inclination towards capturing and using knowledge obtained from other industrial sources.[5] Again this popular practice that could include business environment scanning and market research was only recently adopted by 9% (B) of firms using the practice.

Table 3. Percentage of Firms by Sub-sector that were Capturing and Using Knowledge Obtained from Other Industry Sources – Users of Knowledge Management Practices

Sub-sector	In Use %
Management, Scientific and Technical Consulting Services	100 A
Machinery, Equipment and Supplies Wholesaler-Distributors	96 A
Chemical Manufacturing	89 A
Forestry and Logging	81 A
Transportation Equipment Manufacturing	73 A

Note: Users are defined as having used at least one knowledge management practice.

Every firm in management, scientific and technical consulting services using at least one knowledge management practice actively captured and used knowledge obtained from other industry sources such as industrial associations, competitors, clients and suppliers.[6] Transportation equipment manufacturing firms were the least likely to employ this knowledge management practice at 73% (A).

The two next most popular knowledge management practices in use fell under training and mentoring. This section of practices indicates how firms develop, transfer and retain the knowledge of their workers.[7] Training and mentoring practices included formal and informal training that encouraged the development of new knowledge or skills in workers

[5] W. Cohen and R. Levinthal (2000) argued that "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends is critical to its innovative capabilities." This ability they labelled its absorptive capacity. (p. 39) There is an entire body of work on organisational learning and absorptive capacity that relates directly to acquiring, capturing and using knowledge from sources outside of firms.

[6] R. Miller (2001) in "Bringing Tradeshow Knowledge to the Desktop" provided a case study about integrating customer queries and concerns from trade shows into work processes at Uniqema. He concluded that this process was applying "business intelligence in real time" (p.33).

[7] S. Brelade and C. Harman (2001) discussed in depth the role of human resource departments in knowledge management. They stated "it's only through the acquisition of knowledge by individuals and their willingness to apply it for the benefit of the organization that competitive advantage and service excellence can be achieved." (p.30) For them, human resources needed to play an active role in implementing rewards and recognition strategies for knowledge sharing, designing employee retention, recruitment and succession plans, developing training programs oriented towards knowledge management and in general understanding the role of knowledge in the organisational culture.

as well as the transfer of work experiences between new and experienced workers (Dixon, 2000; Cross and Israelit, 2000; and Baird, Deacon and Holland, 2000). While some of these practices, such as apprenticeships, have been used for hundreds of years, their continued use emphasises the importance of transferring and sharing knowledge in the workplace. Not all workplace skills can be put down in writing (codified) and distributed through documentation (Denning, 2001). Some skills and knowledge are shared and transferred through practical application or "doing". Four-fifths of firms encouraged experienced workers to transfer their knowledge to new or less experienced workers. This is clearly a long-standing practice since only 9% (B) of firms adopted it after 1999. Providing informal training on knowledge management practices was also widespread - four-fifths of firms reported using it. The higher proportion of recent adopters of this practice (17% B) perhaps indicates a recent rising awareness of knowledge management practices by firms in the five sub-sectors. Machinery, equipment and supplies wholesaler-distributors firms were the least likely to employ this knowledge management practice at 72% (C).

Table 4. Percentage of Firms by Sub-sector that Encouraged Experienced Workers to Transfer Their Knowledge to New or Less Experienced Workers- Users of Knowledge Management Practices

Sub-sector	In Use %
Forestry and Logging	98 A
Management, Scientific and Technical Consulting Services	96 B
Transportation Equipment Manufacturing	92 A
Chemical Manufacturing	88 A
Machinery, Equipment and Supplies Wholesaler-Distributors	72 C

Note: Users are defined as having used at least one knowledge management practice.

5b. The Least Used Knowledge Management Practices

Interestingly, collaborative work on project teams that were physically separated ("virtual teams") was the least popular knowledge management practice with under one fifth of firms using this practice to share knowledge. For about one quarter of the firms using virtual teams, this was a recent practice.

The second least popular practice for knowledge sharing and transfer were formal mentoring programs including apprenticeships. The low popularity of this practice is striking due to the long-standing practice of using apprenticeships in some industries and trades and perhaps in this instance reflects the sub-sectors sampled. For instance, one half of forestry and logging firms used this practice as opposed to one out of five firms in the machinery and equipment supplies wholesaler-distributors sub-sector. Also, mentoring has become much more noticeable in the business press recently and this may

have influenced the higher recent adoption rate for mentoring practices – 43% (C).[8] (Stone, 1999; Shea, 1999; and Bell, 1996, have all written manuals on mentoring.).

5c. Firms Are Turning to Communications Practices

Having and requiring good documentation and making these materials available is recognised as being vital to maintaining high quality work standards (Field, 2001). Accessing the lessons learned by others as well as good work practices helps to prevent firms from repeating errors while allowing new project teams to build on the work of their predecessors (Dixon, 2000; and Baird, Deacon and Holland, 2000). As the results indicate, in 44% (B) of firms workers prepared written documentation such as lessons learned, training manuals, and good work practices. These activities taken together assist firms in developing their organisational memory. For almost one quarter of firms that are developing their organisational memories through documentation (or codification of knowledge) this was a new practice. And one-tenth of users not already codifying their knowledge indicated that they intended to put the practice in place in the next 24 months.

Updating databases of good work practices, lessons learned or listings of experts is another method of creating organisational memory, usually electronically. Over 40% of users indicated their use of updating databases. Suggesting a growing interest in this type of practice, for over one third of the firms that updated databases of good work practices recently introduced this practice.

5d. Knowledge Acquisition – Always Vital

Sharing knowledge and information generated from work within the firm is one method that firms use to manage their knowledge. Another important aspect of managing knowledge is acquiring it from outside of the firm. This can be done through hiring of new employees, an aspect of knowledge management that was not covered by the Knowledge Management Practices Survey as well as by capturing knowledge generated elsewhere. Obtaining knowledge from public research institutions, dedicating resources to obtaining external knowledge and encouraging workers to participate in project teams with external experts were less frequently used methods of knowledge acquisition. As opposed to the nine tenths (using at least one knowledge management practice) of firms that regularly captured knowledge from other industry sources, about four tenths obtained knowledge from public research institutions. And this was a new practice for 13% (C) of firms looking to public research institutions for knowledge. The findings are quite similar for firms that dedicated resources to obtaining external knowledge with 43% (C)

[8] Victor Newman (2002) discussed the role that retired employees played in Pfizer's knowledge transfer and retention plans. Retired employees are invited to return to share their experiences and knowledge with current incumbents thus ensuring that less knowledge is let "walk out the door" (p.17). Knowledge transfer mechanisms in place at Pfizer are intended to "help someone become competent in the shortest period of time by concentrating on the most relevant areas of knowledge." (p.15)

participating and 18% (C) of the firms participating indicating that they recently introduced the practice.

5e. Culture Backed by Policies Important to Knowledge Management

Firms in the five sub-sectors generally believed that their corporate cultures or value systems encouraged knowledge sharing and two-thirds had policies or programs in place that were intended to improve worker retention. Churn rates for firms – employee turnover – are topics of many investigations (Sunter, 2001; Bowlby, 2001; Picot and Dupuy, 1996; and Picot, Heisz and Nakamura, 2001). Retirement and a seasonal business cycle are some of the natural causes of employee turnover. And for the most part, firms know and plan for their business cycles and employee retirement (Hamdani, 1996). In a hot market in which workers with specialised skills are in high demand, churn rates can sky rocket (Catt and Scudamore, 1997; and Kaye and Jordon-Evans, 1999).[9] The results of the Knowledge Management Practices Survey indicate that firms in the five sub-sectors are anticipating the need to formally plan the retention of employees. Worker retention policies could in part reflect the costs to firms associated with new hires ranging from providing basic orientation programs to the time and productivity lost while employees learn how to do their new tasks efficiently.

Using partnerships or strategic alliances specifically to acquire knowledge was a fairly common knowledge management practice for firms with almost 70% participating. Of interest, this high rate may reflect the importance that this strategy played with small firms of less than 50 employees.

5f. Leadership from Management and Executives and by Not Incentives

As already stated, in most firms, knowledge management practices were a responsibility of managers and executives. However, a small percentage of firms had a knowledge management unit or knowledge officer with responsibility for knowledge management practices. About one third of the firms explicitly assessed worker participation in knowledge management as part of their performance reviews.

The firms in the five sub-sectors also very rarely gave monetary or non-monetary incentives as rewards for knowledge sharing. The lack of rewards combined with the low level of assessment as part of performance reviews could perhaps indicate that knowledge management practices including knowledge sharing are expected work

[9] The Knowledge Management Review Vol. 4 Issue 6 addresses the question of knowledge retention from many angles. Charles Seeley's (2002) "Knowledge Preservation in Turbulent Times" as well as the section "Briefings: Facing the Reality of Knowledge Attrition" discuss knowledge retention techniques firms are using. These techniques include: "alumni" programs, "exit interviews", and retention plans for the highly mobile younger workers sometimes known as "free agents" with their "my way perspective" and the middle-aged "balance careerists" for whom work-life balance is a priority. Understanding these human resource issues are all important to ensuring the competitive well being of firms as knowledge leakage is costly.

behaviours and therefore do not require formal recognition. Finally, a low proportion of the firms had adopted written knowledge management policies or strategies.

6. Reasons Knowledge Management Practices Were Adopted

The following section looks at the importance users of at least one knowledge management practice attribute to reasons for using knowledge management practices.

Table 5. Reasons for Using Knowledge Management Practices

Reasons Knowledge Management Practices Were Used	Critical	Important	Critical or Important Sub-total	Somewhat or not at all Important Sub-total
	%	%	%	%
Improve competitive advantage of firm	50 C	43 C	**93 A**	7 A
Train workers to meet strategic objectives of the firm	23 B	58 C	**81 C**	19 C
Improve worker retention	13 B	61 B	**74 B**	26 B
Help integrate knowledge within the firm	23 B	49 C	**72 C**	28 C
Increase worker acceptance of innovations	10 B	61 C	**71 C**	29 C
Increase efficiency by using knowledge to improve production processes	30 B	39 C	**69 C**	31 C
Identify and/or protect strategic knowledge present in firm	18 B	47 C	**65 C**	35 C
Promote sharing or transferring knowledge with clients or customers	20 B	41 C	**61 C**	39 C
Improve sharing or transferring of knowledge with partners in strategic alliances, joint ventures or consortia	13 B	45 C	**57 C**	43 C
Protect the firm from loss of knowledge due to workers' departures	17 B	36 C	**53 C**	47 C
Improve the capture and use of knowledge from sources outside the firm	14 B	37 B	**51 B**	49 B
Ease collaborative work of projects or teams that are physically separated (i.e. different work sites)	7 B	20 B	**27 B**	73 B

Percentage is calculated for knowledge management practitioners (used at least one knowledge management practice).

6a. Improving Competitive Advantage Critical to Half of the Firms

As expected, half of the firms asserted that improving the competitive advantage of the firm to be a critical reason to use knowledge management practices; in fact less than 10% of the firms found this reason of little importance. Increasing efficiency by using knowledge to improve production processes placed second as a critical reason to use knowledge management practices at 30% (B). It was followed closely by training workers to meet strategic objectives of the firm (23% B) and integrating knowledge within the firm (23% B). These findings suggest that firms are employing knowledge

management practices strategically to improve their competitive performance and productivity.[10]

6b. Firms Did Not Employ Knowledge Management Practices to Ease Work of Virtual Teams

The high proportion of firms that viewed easing collaborative work of projects or teams that are physically separated as unimportant is striking in relation to the other reasons listed. However, this latter finding is in keeping with the low proportions of firms that encouraged workers to participate in virtual teams or on project teams with external experts. Large firms with more than 2,000 workers in Canada were more likely (72% B) to find this reason of importance than small firms of less than 50 workers (21% B) showing the importance of firm size to working in virtual teams.

What is interesting is that although almost every firm captured and used knowledge obtained from other industry sources and about four tenths captured knowledge obtained from other external sources, only half felt that it was important to improve their ability to capture and use of knowledge from external sources. This may suggest that some of the knowledge capturing and acquisition practices are quite entrenched in the firms and as such not viewed as candidates for improvement. This is probably true for firms that indicated they regularly captured and used knowledge obtained from other industry sources such as industrial associations, competitors, clients and suppliers. About half of these firms indicated that improving knowledge capture and use was important or critical.

For firms capturing and using knowledge obtained from public research institutions, however, the improvement of the capture and use of knowledge from sources outside the organisation was critical to 29% (C) and important to 39% (C). And those firms that dedicated resources to knowledge acquisition most found improving external knowledge capture and use to be of importance; in fact for 29% (C) it was critical and 51% (C) important.

6c. Firms of at least 50 Workers Found Increasing Efficiency Most Important to using Knowledge Management Practices

Firms with at least 50 workers in Canada rated increasing efficiency by using knowledge to improve production processes as the most important or critical reason for using their sets of knowledge management practices. Small firms of less than 50 workers, however, rated improving their competitive advantage as the most important or critical reason for using their sets of knowledge management practices (93% A) with increasing efficiency rating seventh at 64 % (C). Of interest, three of the five sub-sectors rated increasing

[10] The Survey of Innovation 1999 gave firms the opportunity of rating objectives of their innovations. Four of these objectives related to productivity. Of the four objectives, 63 % (C) logging firms found increasing production capacity of moderately or high importance; for reducing labour costs it was 55% (B); and reducing production time for 51% (C) and finally 47% (B) for improving production flexibility.

efficiency as their most important reason for employing their sets of knowledge management practices. For machinery equipment and supplies wholesaler distributors rated improving the competitive advantage of their firms as the most important or critical reason to use knowledge management practices (97% A) with just half finding that improving efficiency was important. On the other hand, firms in management, scientific and technical consulting services found that integrating knowledge within the firm was the most important or critical reason to use knowledge management practices (99% A) with increasing efficiency tying with three other practices for third at 93% (B).[11]

7. Knowledge Management Practices Most Effective for Improving Workers' Skills and Knowledge

Knowledge management practices were considered most effective for two human resources-oriented results. The most effective result of using knowledge management practices was improving worker skills and knowledge – 88% (A). The second most effective result was increased worker efficiency and / or productivity. These results suggest that knowledge sharing, creation, generation and maintenance are perceived as important to firm productivity.

Knowledge management practices were also very effective or effective at creating a client-oriented firm. Almost four out of five firms indicated that the knowledge management practices they used were very effective or effective at increasing the adaptation of products or services to client requirements as well as improving client relations.

[11] For management, scientific and technical consulting services firms the order of reasons using knowledge management practices was: 1. Integrating knowledge within the firm or organisation (99%B); 2. Improving the competitive advantage of the firm (96% B); 3. Improving the capture and use of knowledge from sources outside the firm or organisation (93% B); Training workers to meet strategic objectives of the firm (93% C); and Increasing efficiency by using knowledge to improve production processes (93% B).

Table 6. Effectiveness of Results of Using Knowledge Management Practices

Using knowledge management practices:	Very Effective and Effective – Sub-total %	Somewhat Effective and Not at all Effective – Sub-total %
Improved skills and knowledge of workers	88 A	12 A
Improved worker efficiency and / or productivity	80 B	20 B
Increased the adaptation of products or services to client requirements	78 B	22 B
Improved client or customer relations	76 B	24 B
Increased knowledge sharing horizontally (across departments, function or business units)	65 C	35 C
Helped add new products or services	64 B	37 B
Improved the involvement of workers in the workplace activities	63 C	36 C
Increased knowledge sharing vertically (up the organisational hierarchy)	52 C	48 C
Improved corporate or organisational memory	51 C	48 C
Increased the ability to capture knowledge from other business enterprises, industrial associations, technical literature, etc.	49 C	50 C
Increased flexibility in production and innovation	44 B	55 B
Prevented duplicate research and development	34 C	65 C
Increased the number of markets (more geographic locations)	33 C	68 C
Increased the ability to capture knowledge from public research institutions including universities and government laboratories	22 B	77 B

Percentage is calculated for knowledge management practitioners (used at least one knowledge management practice).

7a. Knowledge Management Practices Not Very Effective for Increasing Capture of Knowledge from Public Research Institutions

Overall, almost four out of five firms indicated that knowledge management practices were not very effective at increasing the capture of knowledge from public research institutions. This result, however, indicates the low propensity of the firms to capture and use knowledge from public research institutions. When the results are viewed for firms actually capturing knowledge from public research institutions, then the picture changes with 46% (C) of these firms finding the practice either very effective or effective. This indicates that firms could answer these questions for their own set of practices. This could also hold true for the low level of effectiveness for preventing duplicate research and development. Some firms may have responded "not at all effective" due to the fact that they do not undertake research and development.

Finally, while knowledge management practices were considered effective for client-orientation, they were not considered effective for increasing markets by adding more

geographic locations. Again this may reflect the nature of the sub-sectors sampled, that firms served local markets or that the firms had not expanded their number of markets.

7b. Large Firms Found that Knowledge Management Practices Led to Increased Horizontal Knowledge Sharing, Improved Worker Efficiency and Skills

In Canada, firms in the five sub-sectors with more than 2000 workers using knowledge management practices found that these practices were effective or very effective at increasing horizontal knowledge sharing, improving worker efficiency and improving workers' skills and knowledge (all rated first at 87% A). Adding new products and services and increasing flexibility in production and innovation ranked second for large firms of more than 2000 workers (both at 81% B). The high ranking for horizontal sharing may indicate the perceived need for this type of practice in large firms as opposed to small firms (less than 50 workers) – 63 % (C) that indicated they found their set of knowledge management practices were effective or very effective at increasing knowledge sharing horizontally. Small firms on the other hand rated improved skills and knowledge of workers as the most effective result at 92 % (B). And across the sub-sectors improving workers' skills and knowledge rated first, ranging from a high of 96% (C) for firms in management, scientific and technical consulting to a low of 71% (A) in the logging and forestry sub-sector finding this practice effective or very effective.

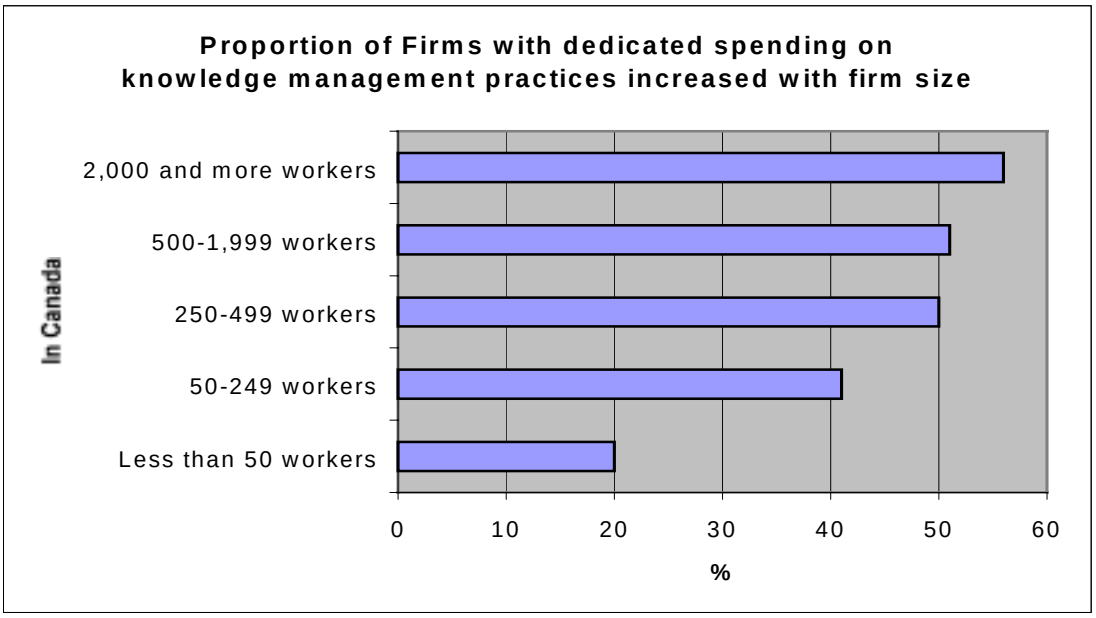
8. Executive Management Teams Responsible for Knowledge Management in Firms

As already noted almost every firm in the five sub-sectors looked to its managers and executives for knowledge management leadership (see Table 2). And, just over two-thirds of the firms also ascribed the overall direct responsibility for knowledge management practices in place in the firm to their executive management teams. While the executive management team had the responsibility for knowledge management, a very low proportion of firms indicated that they measured the effectiveness of the their firm's knowledge management practices. Management (95% A) was also almost always a source that triggered the introduction of the set of knowledge management practices in place in the firms. Other important sources for the knowledge management practices in place were suppliers (50% B) and customers or clients (42% B). One third of firms used strategic partners (33% C) and competitors (34% C) as sources of knowledge management practices. These findings are in keeping with the low usage rate of capturing and acquiring knowledge from external sources such as public research institutions.

9. One Quarter of Firms Had Dedicated Budgets for Knowledge Management

Just one quarter of firms using knowledge management practices had dedicated budgets or spending for these practices. Firms that did not have budgets indicated that they did not expect to have dedicated budgets or spending within the next 24 months. These findings are in keeping with low proportion of firms that indicated they had knowledge management units or officers and the high proportion of firms that looked to management and executives for leadership and for the ultimate responsibility for the knowledge management practices in place. Obviously the practices in place in the firms had to be funded from other budgets that could include human resources, marketing and information communications technology. This could help explain why dedicated spending on knowledge management practices increased with firm size (Chart 2).

Chart 2. Proportion of Firms with Dedicated Spending or Budgets for Knowledge Management Practices by Worker Size Group – Users of Knowledge Management Practices



10. Almost No Resistance Recorded to the Implementation of Knowledge Management

Again, the firms indicated that they encountered very little resistance to the implementation of their sets of knowledge management practices. This result could in part indicate that resistance to implementation of knowledge management practices was not an issue for the firms in the five sub-sectors. In the very few firms that experienced

resistance, the group most likely to resist were non-management workers and department was production.

11. Loss of Key Personnel Would Trigger Firms to Use More Knowledge Management Practices

Firms viewed the loss of key personnel as the main trigger for implementing or implementing more knowledge management practices. This is not surprising given the fact that three-quarters of the firms indicated that the reason they had implemented knowledge management practices was to improve worker retention. However, just one-half indicated that the reason they used knowledge management was to protect the firm from loss of knowledge due to workers' departures. This seeming contradiction could indicate that the firms surveyed had not experienced loss of workers but were prepared to plan for such a contingency. Losing market share placed second followed by difficulties in capturing workers' undocumented knowledge (know-how) as triggers for implementing more knowledge management practices. The importance given to these triggers may indicate that firms were prepared to put into place mechanisms to control knowledge loss and therefore to protect themselves competitively.

Table 7. Incentives to Implement Knowledge Management Practices

Incentives to Implement Knowledge Management Practices	**Total Response**	**Users of Knowledge Management Practices**
	%	**%**
Loss of key personnel and their knowledge	77 B	79 B
Loss of market share	57 B	61 B
Difficulty in capturing workers' undocumented knowledge (know-how)	38 B	40 B
Information overload problems with the firm or organisation	32 B	34 B
Use of knowledge management tools or practices by competitors	27 B	29 B
Difficulties in incorporating external knowledge	13 B	13 B

Of interest, firms of different sizes that used at least one knowledge management practice rated the incentives to use knowledge management practices differently. For firms of less than 250 workers, loss of key personnel was stated as a reason to introduce new or more knowledge management practices by four-fifths of firms. And this reason in terms of popularity by far out-stripped the other reasons. However, for firms of 250 and more workers, loss of key personnel while still rating as a most important reason for introducing new or more knowledge management practices, clustered much more closely to two other reasons: loss of market share and difficulty in capturing workers' undocumented knowledge (know-how).

Table 8. Selected Reasons to Use More or to Implement Knowledge Management Practices by Firm Size – Users of Knowledge Management Practices

Users of knowledge management practices	Loss of key personnel and their knowledge	Loss of Market Share	Difficulty in Capturing Workers' Undocumented Knowledge (know-how)
Worker Size Group	**%**	**%**	**%**
Less than 50 workers	79 B	64 C	35 C
50-249 workers	83 B	44 C	56 C
250-499 workers	57 A	59 A	59 A
500-1,999 workers	72 A	43 A	72 A
2,000 and more workers	59 B	49 B	42 B
(all size groups reflect workers in Canada only)			

The ordering of reasons to introduce new or more knowledge management practices was similar across the five sub-sectors. However, firms in the machinery, equipment and supplies wholesaler-distributor sub-sector showed a higher tendency to cite loss of key personnel and loss of market share as reasons to introduce knowledge management practices than firms in the other sub-sectors. While some firms in forestry and logging expressed concern over the economic viability of their sector, loss of market share was considered by less than one-third a reason to introduce knowledge management. This suggests that these firms may have decided to look to other devices to protect their market shares.

Table 9. Selected Reasons to Use More or to Implement Knowledge Management Practices by Sub-sector – Users of Knowledge Management Practices

Users of knowledge management practices	Loss of key personnel and their knowledge	Loss of Market Share	Difficulty in Capturing Workers' Undocumented Knowledge (know-how)
Sub-Sector	**%**	**%**	**%**
Machinery, Equipment and Supplies Wholesaler-Distributors	88 C	77 C	29 C
Forestry and Logging	69 A	29 A	44 A
Transportation Equipment Manufacturing	68 A	52 A	46 A
Chemical Manufacturing	64 A	54 A	57 A

12. Knowledge Management – Important Business Practices

The results of this pilot Knowledge Management Practices Survey indicate that most firms are managing some aspect of their knowledge. At present it appears that firms are more actively managing the transfer and sharing of knowledge within the firm and external knowledge that could directly bear on their markets. Knowledge management practices are seen as important tools in improving firms' competitive advantage and as a manner to unite workers in the goals of firms' strategic objectives. In fact, the majority of reasons found to be most important to the firms show a slant towards internalising knowledge and protecting the knowledge in place. Very few of the practices in use or the reasons or results of using the knowledge management practices indicated a strong willingness on the part of firms to share their knowledge with competitors or between work-sites. It must be taken into account that not all firms surveyed would have multiple work-sites so creating virtual teams or easing collaborative work between projects that were physically separated may not have been applicable. However, horizontal sharing of knowledge ranked within the top four results of using knowledge management practices for firms.

Firms are adopting knowledge management practices. Knowledge obviously matters to these firms. Firms' strengths appear to be internalising their knowledge and their weakness may be not looking outside for sources of knowledge and expertise. The results of the Knowledge Management Practices Survey indicate that firms in different industries and of different employment size groups manage their knowledge resources in differently. Twenty years ago, similar results were shown for the adoption of advanced technologies. Now it is important to know more about how those technologies are being used, especially the information communication technologies (ICTs). Knowledge management practices are a significant application with policy implications and both economic and social impacts. This is a step towards understanding better how and why firms are using selected management practices to do better what they do.

Annex 1 - Non-Users of Knowledge Management Practices

Non-users – forestry and logging comprised one-third

The forestry and logging sub-sector had by far the largest proportion of non-users of knowledge management practices at one-fifth of the firms in the industry. In fact these firms comprised over one-third of all of the non-users. In the fall of 2001 the softwood logging industry was pre-occupied with the softwood lumber dispute with the United States. In fact, one respondent noted: "We are in the forest industry. Does not apply to us. Get us back to work."

According to the Survey of Innovation 1999, about four out of ten logging firms were innovators.[12] Innovators were defined as firms that introduced new or significantly improved products or processes from 1997 to 1999. (See Annex 2 - Definitions) Just over one third of logging firms introduced new processes. While these rates are in keeping with the results from the five-selected natural resource sub-sectors, they lag those of the manufacturing sub-sectors. In fact, four out of five manufacturing firms were innovators with two thirds of manufacturers introducing new or significantly improved processes. The lower process innovation rate of the logging industry suggests that this industry might also be less likely to introduce new management practices.

Annex 1, Table 1. Percent of Innovative Firms During the Period 1997-1999, Survey of Innovation 1999

Selected Sub-sectors	Innovators	Product Innovators	Process Innovators
	%	%	%
Logging	41 B	22 B	35 B
Coal Mining	50 A	33 B	33 B
Metal Ore Mining	47 B	21 A	47 B
Non-Metallic Mineral Mining	42 B	32 B	33 B
Electric Power Generation, Transmission and Distribution	31 B	23 B	19 B
Manufacturing (Total)	80 A	68 A	66 A

Firms in forestry, fishing and hunting sector also recorded lower than average rates of organisational and technological change between 1998 and 2000. (See Annex 2 - Definitions) The average rate of organisational change for the private sector was 38% and 44% for technological change. Firms in the other sectors recorded higher rates of change for both organisational and technological change. The lower than average introduction of organisational change rate for the forestry, fishing and hunting sector

[12] For more information from the Survey of Innovation 1999 results see "Innovation in Canadian Manufacturing: National Estimates", June 2001 by Susan Schaan and Frances Anderson (catalogue no. 88F006XIE No. 10).

together with the low innovation rate for logging to some extent confirms the suggestion that the forestry and logging sub-sector may not introduce new management practices.

Annex 1, Table 2. Percentage of Firms Introducing Organisational and Technological Change, Selected Sectors, 1998-2000 (Survey of Electronic Commerce and Technology, 2000)

Sectors	Organisational Change		Technological Change	
	% of Firms	Reliability*	% of Firms	Reliability*
Private Sector	38%	B	44%	B
Forestry, Fishing and Hunting	23%	C	27%	C
Manufacturing	50%	B	51%	B
Wholesale Trade	46%	C	45%	C
Professional, Scientific and Technical Services	40%	B	59%	B

* For an explanation of the reliability codes see: Annex 1 in Earl *"Innovation and Change in the Public Sector: A Seeming Oxymoron"* Statistics Canada, Catalogue No. 88F0006XIE02001

Comments about the survey from small firms

Comments from some small firms indicated that the Knowledge Management Practices Survey was not pertinent to them. These examples are all from firms of less than 50 employees: "We are a very small with 6 office staff. All scalers (a job in the forestry) work on their own." "Sending this survey to a company of our size is a waste of everyone's time" (20-49 workers). "Better off to leave surveys to bigger companies" (1-19 workers). And "Nous sommes juste une petite enterprise avec cinq personnes au bureau et vingt personnes dans le niveau du production: Ce n'applique pas à notre enterprise on est trop petite" (20-49 workers). Finally, "We are a very small family-owned and operated business. Formal policies and procedures do not apply" (1-19 workers).[13]

[13] Schuetze (2001) commented that knowledge management in small firms, while important, these firms may not understand the term and concepts. He suggested that "for these firms knowledge management presents problems of another kind, in particular finding relevant information and know-how from outside the firm, and absorbing and applying it to the firm's business" (p.98). The Knowledge Management Practices Survey specifically addressed some of these issues by including formal and informal practices as well as targeting firms with at least 10 employees.

Annex 2 - Definitions

Industrial Sub-sectors

Chemical Manufacturing (NAICS 325): This subsector comprises establishments primarily engaged in manufacturing chemicals and chemical preparations, from organic or inorganic raw materials.

Exclusion(s): Establishments primarily engaged in:

- ∂ field processing of crude petroleum and natural gas (211, Oil and Gas Extraction)
- ∂ Beneficiating mineral ores (212, Mining (except Oil and Gas))
- ∂ Processing crude petroleum and coal (Petroleum and Coal Products Manufacturing)
- ∂ Smelting and refining ores and concentrates (331, Primary Metal Manufacturing)

Forestry and Logging (NAICS 113): This subsector comprises establishments primarily engaged in growing and harvesting timber on a long production cycle (of ten or more years). Long production cycles use different production processes than short production cycles, which require more horticultural interventions prior to harvest, resulting in processes more similar to those found in the Crop Production subsector. Consequently, Christmas tree production and other production involving production cycles of less than ten years, are classified to the Crop Production subsector.

Industries in Forestry and Logging specialize in different stages of the production cycle. Reforestration requires production of seedlings in specialized nurseries. Timber production requires natural forests or suitable ares of land that are available for a long duration. The maturation time for timber depends upon the species of tree, the climatic conditions of the region, and the intended purpose of the timber. The harvesting of timber, except when done on an extremely small scale, requires specialized machinery unique to the industry. The gathering of forest products, such as gums, barks, balsam needles and Spanish moss, are also included in this subsector.

Machinery, Equipment and Supplies Wholesaler-Distributors (NAICS 417): This subsector comprises establishments primarily engaged in wholesaling farm, lawn and garden machinery and equipment; construction, forestry, mining and industrial machinery, equipment and supplies; computers and communication equipment and supplies; and other machinery, equipment and supplies.

Management, Scientific and Technical Consulting Services (NAICS 5416): This industry group comprises establishments primarily engaged in providing expert advice and assistance to other organisation on management, environmental, scientific and technical issues.

Exclusion(s): Establishments primarily engaged in:

- providing expert advice and assistance to other organisations on architectural and engineering issues (5413, architectural, Engineering and Related Services);
- providing expert advice and assistance to other organisations on interior, industrial and graphic design issues (5414), Specialised Design Services); and
- Providing expert advice and assistance to other organisations on information technology issues (5415, Computer Systems Design and Related Services).

Transportation Equipment Manufacturing (NAICS 336): This subsector comprises establishments primarily engaged in manufacturing equipment for transporting people and goods. The industry goods are based on the various modes of transportation – road, rail, air and water. Three industry groups are based on road transportation equipment – for complete vehicles, for body and trailer manufacture and for parts.

Establishments primarily engaged in rebuilding equipment and parts are included in the same industry as establishments manufacturing new products.

Exclusion(s): Establishment primarily engaged in:

- manufacturing equipment designed for moving materials and goods on industrial sites, construction sites, in logging camps and other off-highway locations (333, Machinery Manufacturing)

Innovation Related Terms

Innovators: Includes both product innovators and process innovators (defined elsewhere) either in combination or uniquely.

Product Innovators: Offered a new product (good or service) that was new to the firm whose characteristics or intended uses differed significantly from product's previously offered by the firm. And / Or offered a significantly improved product (good or service) is an existing product whose performance has been significantly enhanced or upgraded. A complex product which consists of a number of components or integrated subsystems may be improved by partial changes to one of the components or subsystems. Changes to your firm's existing products which are purely aesthetic or which only involve minor modifications are not to be included.

Process Innovators: Introduced new production/manufacturing methods, procedures, systems, machinery or equipment that differed significantly from the firm's previous production/manufacturing processes. And / Or introduced significantly improved

production/manufacturing processes that involved significant changes to existing processes that may be intended to produce new or significantly improved products (goods or services) or production/manufacturing processes.

Knowledge Management Related Terms

Knowledge management: Knowledge management involves any systematic activity related to the capture and sharing of knowledge by the organisation.

Knowledge Management Users: Firms that indicated they are using at least one of the knowledge management practices listed in question 1 of the Knowledge Management Practices Survey and in Table 2.

Knowledge Management Non-Users: Firms that indicated that they are not using at least one of the knowledge management practices listed in question 1 of the Knowledge Management Practices Survey and in Table 2.

Number of full-time equivalents: "Full-time equivalents" represents the number of person-years.

Recently Adopted: Indicates the proportion of practice in use that was adopted since 1999.

Workers: The term "workers" includes regular workers (employees) as well as managers, executives, partners, directors, and persons employed under contract.

Organisational Change Related Terms

Organisational change is defined by a positive response to this question from the Survey of Electronic Commerce and Technology, 2000: "During the last three years, 1998 to 2000, did your organisation introduce significantly improved organisational structures or implement improved management techniques?"

Technological change is defined by a positive response to this question from the Survey of Electronic Commerce and Technology, 2000: "During the last three years, 1998 to 2000, did your organisation introduce significantly improved technologies?"

Annex 3 - Methodological Notes

Questionnaire Development

Statistics Canada conducted this pilot survey on Knowledge Management Practices as part of an international initiative headed by the Organisation for Economic Co-operation and Development. Canada was the lead country piloting this survey. Other countries that in 2001 undertook pilot surveys based on the contents of the Knowledge Management Practices' questionnaire were Denmark and Germany.

The questionnaire for the Knowledge Management Practices Survey was designed by the Science, Innovation and Electronic Information Division of Statistics Canada in collaboration with: the Centre for Educational Research and Innovation (Organisation for Economic Co-operation and Development); the Ministry of Trade and Industry and the Center for Ledelse (Denmark); the Fraunhofer Institute for Systems and Innovation Research (Germany); Service des études et des statistiques industrielles and Institut national de la statistique et des études économiques (France); the Office of National Statistics (the United Kingdom); Innovazione tecnologica e ricerca scientifica (Italy); Statistics Netherlands (The Netherlands); Statistics Sweden (Sweden); and the Institute for Knowledge Management (United States of America).

Statistics Canada undertook cognitive testing of the questionnaire through extensive interviews with individual firms in both official languages to ensure that the questions were well understood. Feedback from respondents was incorporated into the questionnaire design.

Survey Content

Statistics Canada between September and December 2001 conducted the pilot survey. The survey is based on in-use / planned-use identification of a series of business practices related to knowledge management. These practices are grouped/categorised as follows: policies and strategies; leadership; incentives; knowledge capture and acquisition; training and mentoring; and communications. Respondents that indicated that any practice listed in the first question was "In Use" (In Use Before 1999 or Used Since 1999) continued to the next section. Respondents not using any of the practices moved (skipped) to question 10 – "Incentives to Use".

Questions 3-9 captured the reasons, results, effectiveness and responsibility for using knowledge management practices. Also included in this section were questions on the sources of knowledge management practices, spending dedicated to knowledge management and resistance to using knowledge management practices.

All respondents answered questions 10-14. Question 10 related to incentives to use knowledge management practices. Question 11 provided employment structure information for the firm. Questions 12-14 were administrative questions for response burden issues, improvements to the questionnaire and to determine if the results were of interest to the respondents.

Data reliability

The reliability of the data has been assessed using the following convention:

Code	Rating	Standard Error
A	Very good	$\leq$ 2.5%
B	Good	> 2.5% and $\leq$ 7.5%
C	Good to poor – use with caution	> 7.5% and $\leq$ 15.0%
D	Very poor – may not be acceptable	> 15.0%

Success of the Survey

The Knowledge Management Practices Survey was a pilot survey. It's first objective was to confirm that the questionnaire, which had undergone extensive cognitive testing with potential respondents and revisions based upon feedback, worked. That is, it was able to distinguish between firms on the basis of their use of knowledge management practices. The overall response rate and the response rates for individual questions suggest that the questionnaire made sense to respondents. The analysis demonstrated that firms could be distinguished on the basis of their use of knowledge management practices. For these reasons, the survey was deemed to have satisfied the criteria to determine its success.

Collection Methodology

The primary objective of this survey was to determine which practices Canadian businesses used to support the sharing, transfer, acquisition and retention of knowledge and if they found these practices to be effective. The KMPS used samples from the Annual Survey of Manufacturers (ASM) and the Unified Enterprise Survey (UES).

Preliminary contacts took place around September 12, 2001 and the mail-out started on September 24, 2001. Follow-ups were carried out starting on October 14, 2001.

Since it was a pilot survey, the coverage of Canadian enterprises is limited to the following activity sectors:

Forestry and Logging (113)
Chemical Manufacturing (325)
Transportation Equipment Manufacturing (336)

Machinery, Equipment and Supplies Wholesaler-Distributors (417)
Management, Scientific and Technical Consulting Services (5416)

Survey Frame

In order to reduce the response burden of the questionnaire, existing surveys were used as a survey frame. Thus, the 1999 Annual Survey of Manufacturers (ASM) was considered for sectors 113, 325 and 336 while the 1999 Unified Enterprise Survey (UES) was used for sectors 417 and 5416. Financial and production data are available from these surveys.

Sampling

Given that existing samples were used, a two-stage survey was developed. For the first stage level, you must refer to the documentation in the ASM and UES to understand the sample stratification, allocation and selection process. It should be noted that the statistical unit of these surveys is the establishment.

The KMPS information was collected from enterprises with at least 10 employees and revenue of $250,000 or more. A mailing of about 400 questionnaires was desirable. Based on the combined rate of 21% for non-respondents, out-of-scope units and inactive units, the size of the sample was set at 510 enterprises.

At the second stage, the units of interest were responding enterprises from the ASM and UES with at least 10 employees and revenue of $250,000 or more. The establishments in these two surveys were grouped at the enterprise level. The activity sectors (5) and the size of the enterprises (10-49, 50-199, 200 and more employees) were used for the purposes of stratification. The distribution of these 510 enterprises was done in such a way that the Coefficients of Variation (CVs) are similar for all strata. A simple random sampling was carried out for each of them.

Verification and imputation

All questionnaires confirmed as completed passed through a verification and imputation system. As one of the objectives was to evaluate the questionnaire, minimal imputation took place. In general, verification was limited to ensuring that the responding values were valid and that the question skips were respected. In cases identified as incorrect, the following actions were carried out:

- ∂ imputation of a value from a donor for questions identified as mandatory,
- ∂ imputation of a non-response code for questions identified as non-mandatory.

Donors were selected randomly according to certain characteristics (hot deck) and independently for each of the questions. Groups of donors were assembled based on their characteristics:

- ∂ Group I: same province, same activity sector and same category - number of employees (question 11),
- ∂ Group II: same activity sector and same category - number of employees (question 11),
- ∂ Group III: same activity sector and category grouping - number of employees (question 11).

For each value to be imputed, an attempt was made to find a donor in the Group I's. If no donor was found there, donors from Group II's were used, and so on.

Response Rate

After preliminary contact, the distribution of the response codes for the 510 enterprises was as follows:

- ∂ 407 enterprises suitable to receive a questionnaire,
- ∂ 48 non-respondent enterprises (refusal, no contact, ...),
- ∂ 51 out-of-scope enterprises
- ∂ 4 inactive enterprises.

Of the 407 questionnaires sent out, the distribution of the response codes is as follows:

- ∂ 348 enterprises with a complete questionnaire,
- ∂ 58 enterprises with an incomplete questionnaire or non-respondents,
- ∂ 1 out-of-scope enterprise.

The response rate for the survey is about 76.5% (348/455).

Estimation

As mentioned earlier, the statistical units of the first stage are for enterprises whereas the second stage are for establishments. To produce estimates at the enterprise level, the weight share method was used. All the estimates were produced using Statistics Canada's Generalized Estimation System (GES). For the formulas used in variance calculations, please refer to the GES documentation.

Annex 4 - Questionnaire

Science, Innovation and Electronic Information Division

Knowledge Management Practices, 2001

Confidential when completed

Collected under the Authority of the Statistics Act, Revised Statutes of Canada, 1985, Chapter S19.

Completion of this questionnaire is a legal requirement under the Statistics Act.

Si vous préférez ce questionnaire en français, veuillez cocher ○

Contact Information

Correct pre-printed label information if necessary using the corresponding boxes below:

0001 Legal Name

0002 Name of business

0003 Contact Name

0004 Title

0005 City

0006 Province 0007 Postal Code

0008 Telephone Number 0009 Fax Number

0010 E-mail 0011 Web address

Purpose

Statistics Canada is conducting a survey to measure the extent to which knowledge management practices are used or will be used by Canadian businesses. A highly mobile and aging workforce has increased the need for a better set of knowledge retention, acquisition, sharing and transfer practices.

Data collected in this survey will result in a greater understanding of knowledge management practices to support enhanced learning and performance by organisations.

Although completion of this questionnaire is a legal requirement under the *Statistics Act*, your cooperation is essential for the results of the survey to be valid and reliable.

Statistics Canada will create a data base combining individual survey responses with existing Statistics Canada data records. These data will be released in aggregate form so as to protect the confidentiality of individual business records.

Confidentiality

Law prohibits Statistics Canada from publishing any statistics, which would divulge information obtained from this survey that relates to any identifiable business, institution, or individual. The *Access to Information Act* or any other legislation does not affect the confidentiality provisions of the *Statistics Act.*

Questions?

If you require assistance in the completion of this questionnaire or have any questions regarding the survey, please contact:

Science, Innovation and Electronic Information Division
Statistics Canada, Tunney's Pasture,
Ottawa, Ontario
K1A 0T6

Telephone: 1 613 951-0719 or 1-866-726-8879
Fax: 1 613 951-7601 or 1-866-822-9703
E-mail: SIEID@statcan.ca

Definition

Knowledge Management

Knowledge management involves any systematic activity related to the capture and sharing of knowledge by the organisation.

Please complete and return this questionnaire within 10 days of receipt using the envelope provided.

5-4900-506.1: 2001-07-26 STC/SAT-465-75220

Knowledge Management Practices

This section measures the use of formal, informal and everyday knowledge management practices.

1. Using the tables below please indicate the use your firm or organisation makes of each of the knowledge management practices listed.

Use the following response categories in your answers:

- **In Use Before 1999** ➢ Firm or organisation began regularly using this practice before 1999
- **Used Since 1999** ➢ Firm or organisation has regularly used this practice since 1999
- **Plan to Use in the Next 24 months** ➢ Firm or organisation intends to regularly use this practice in the next 24 months
- **Don't know / Not Applicable**

For the purposes of this survey, the term **workers** includes your regular workers (employees) as well as managers, executives, partners, directors, and persons employed under contract.

✓ **Check ONE response for each item.**

	Knowledge Management Practices Within your Firm or Organisation	In Use Before 1999	Used Since 1999	Plan to Use in the Next 24 Months	Don't Know / Not Applicable
1.1	**Policies and Strategies**				
	Your firm or organisation:				
1001	A. has a written knowledge management policy or strategy	1○	2○	3○	9○
1002	B. has a values system or culture intended to promote knowledge sharing	1○	2○	3○	9○
1003	C. has policies or programs intended to improve worker retention	1○	2○	3○	9○
1004	D. uses partnerships or strategic alliances to acquire knowledge	1○	2○	3○	9○
1.2	**Leadership**				
	In your firm or organisation knowledge management practices are:				
1005	A. a responsibility of managers and executives	1○	2○	3○	9○
1006	B. a responsibility of non-management workers	1○	2○	3○	9○
1007	C. a responsibility of the knowledge officer or knowledge management unit	1○	2○	3○	9○
1008	D. explicit criteria for assessing worker performance	1○	2○	3○	9○
1.3	**Incentives**				
	Your firm or organisation specifically rewards knowledge sharing with:				
1009	A. monetary incentives	1○	2○	3○	9○
1010	B. non-monetary incentives	1○	2○	3○	9○

Knowledge Management Practices Within your Firm or Organisation	In Use Before 1999	Used Since 1999	Plan to Use in the Next 24 Months	Don't Know / Not Applicable
1.4 Knowledge capture and acquisition Your firm or organisation regularly:				
1011 A. captures and uses knowledge obtained from other industry sources such as industrial associations, competitors, clients and suppliers	1 ◯	2 ◯	3 ◯	9 ◯
1012 B. captures and uses knowledge obtained from public research institutions including universities and government laboratories	1 ◯	2 ◯	3 ◯	9 ◯
1013 C. dedicates resources to detecting and obtaining external knowledge and communicating it within your firm or organisation	1 ◯	2 ◯	3 ◯	9 ◯
1014 D. encourages workers to participate in project teams with external experts	1 ◯	2 ◯	3 ◯	9 ◯
1.5 Training and Mentoring Your firm or organisation:				
1015 A. provides formal training related to knowledge management practices	1 ◯	2 ◯	3 ◯	9 ◯
1016 B. provides informal training related to knowledge management	1 ◯	2 ◯	3 ◯	9 ◯
1017 C. uses formal mentoring practices, including apprenticeships	1 ◯	2 ◯	3 ◯	9 ◯
1018 D. encourages experienced workers to transfer their knowledge to new or less experienced workers	1 ◯	2 ◯	3 ◯	9 ◯
1019 E. encourages workers to continue their education by reimbursing tuition fees for successfully completed work-related courses	1 ◯	2 ◯	3 ◯	9 ◯
1020 F. offers off-site training to workers in order to keep skills current	1 ◯	2 ◯	3 ◯	9 ◯
1.6 Communications In your firm or organisation workers share knowledge or information by:				
1021 A. regularly updating databases of good work practices, lessons learned or listings of experts	1 ◯	2 ◯	3 ◯	9 ◯
1022 B. preparing written documentation such as lessons learned, training manuals, good work practices, articles for publication, etc. (organisational memory)	1 ◯	2 ◯	3 ◯	9 ◯
1023 C. facilitating collaborative work by projects teams that are physically separated ("virtual teams")	1 ◯	2 ◯	3 ◯	9 ◯

2. 1101 **Are there any knowledge management practices that your firm or organisation uses that we have not included in this survey?**

2 ◯ No

1 ◯ Yes, please specify 1102 _____

_____

_____

If you checked **at least** one response in either the **In Use Before 1999 or Used Since 1999** columns in any of **Questions 1.1 - 1.6**, please **continue**. Otherwise please **go to Question 10**.

If you checked **at least** one response in either the **In Use Before 1999 or Used Since 1999** columns in any of **Questions 1.1 - 1.6**, please **continue**. Otherwise please **go to Question 10**.

Reasons for Using Knowledge Management Practices

This section measures the reasons for using knowledge management practices.

3. Please indicate the level of importance you attribute to each reason for using the knowledge management practices currently in use in your firm or organisation.

✓ **Check ONE response for each item.**

		Reasons knowledge management practices are used in your firm or organisation	Critical	Important	Somewhat Important	Not at all Important
2001	A.	To improve the competitive advantage of your firm or organisation	1 ○	2 ○	3 ○	4 ○
2002	B.	To help integrate knowledge within your firm or organisation	1 ○	2 ○	3 ○	4 ○
2003	C.	To improve the capture and use of knowledge from sources outside your firm or organisation	1 ○	2 ○	3 ○	4 ○
2004	D.	To improve sharing or transferring of knowledge with partners in strategic alliances, joint ventures or consortia	1 ○	2 ○	3 ○	4 ○
2005	E.	To increase efficiency by using knowledge to improve production processes	1 ○	2 ○	3 ○	4 ○
2006	F.	To protect your firm or organisation from loss of knowledge due to workers' departures	1 ○	2 ○	3 ○	4 ○
2007	G.	To train workers to meet strategic objectives of your firm or organisation	1 ○	2 ○	3 ○	4 ○
2008	H.	To increase worker acceptance of innovations	1 ○	2 ○	3 ○	4 ○
2009	I.	To improve worker retention	1 ○	2 ○	3 ○	4 ○
2010	J.	To identify and/or to protect strategic knowledge present in your firm or organisation	1 ○	2 ○	3 ○	4 ○
2011	K.	To ease collaborative work of projects or teams that are physically separated (i.e. different work sites)	1 ○	2 ○	3 ○	4 ○
2012	L.	To promote sharing or transferring knowledge with clients or customers	1 ○	2 ○	3 ○	4 ○

Results of Using Knowledge Management Practices

This section measures the results of using knowledge management practices.

4. In the table below, please indicate the level of effectiveness you attribute to these results for the knowledge management practices currently in use in your firm or organisation.

✓ **Check ONE response for each item.**

	Effectiveness of Results of Using Knowledge Management Practices	Very Effective	Effective	Somewhat Effective	Not at all Effective
	Using Knowledge Management Practices				
2101	A. increased our knowledge sharing horizontally (across departments, functions or business units)	1 ◯	2 ◯	3 ◯	4 ◯
2102	B. increased our knowledge sharing vertically (up the organisational hierarchy)	1 ◯	2 ◯	3 ◯	4 ◯
2103	C. improved worker efficiency and / or productivity	1 ◯	2 ◯	3 ◯	4 ◯
2104	D. improved skills and knowledge of workers	1 ◯	2 ◯	3 ◯	4 ◯
2105	E. increased our number of markets (more geographic locations)	1 ◯	2 ◯	3 ◯	4 ◯
2106	F. improved client or customer relations	1 ◯	2 ◯	3 ◯	4 ◯
2107	G. helped us add new products or services	1 ◯	2 ◯	3 ◯	4 ◯
2108	H. increased our adaptation of products or services to client requirements	1 ◯	2 ◯	3 ◯	4 ◯
2109	I. increased flexibility in production and innovation	1 ◯	2 ◯	3 ◯	4 ◯
2110	J. prevented duplicate research and development	1 ◯	2 ◯	3 ◯	4 ◯
2111	K. improved our corporate or organisational memory	1 ◯	2 ◯	3 ◯	4 ◯
2112	L. increased our ability to capture knowledge from public research institutions including universities and government laboratories	1 ◯	2 ◯	3 ◯	4 ◯
2113	M. increased our ability to capture knowledge from other business enterprises, industrial associations, technical literature, etc.	1 ◯	2 ◯	3 ◯	4 ◯
2114	N. improved involvement of workers in the workplace activities	1 ◯	2 ◯	3 ◯	4 ◯

Responsibility for Knowledge Management Practices

5. 2201 **Which of the following groups is responsible for the knowledge management practices currently in use in your firm or organisation?**

✓ **Check ONE response only.**

1 ◯ Human Resources
2 ◯ Information Technology
3 ◯ Knowledge Management Unit
4 ◯ Library / Documentation Centre
5 ◯ Executive Management Team (direct responsibility)
6 ◯ Other, please specify

2202 _____

9 ◯ Don't Know

Effectiveness of Knowledge Management Practices

6. 2301 **Do you measure the effectiveness of your firm's or organisation's knowledge management practices?**

2 ◯ No
1 ◯ Yes, please specify

2302 _____

Sources of Knowledge Management Practices

7. 2401 **Please indicate which source(s) triggered your firm or organisation to put into effect the knowledge management practices that you currently use.**

✓ **Check ALL that apply.**

Internal

01 ◯ A. Management

02 ◯ B. Non-management workers

03 ◯ C. Union(s) active in the workplace(s)

External

04 ◯ D. Firm or organisation with which you have a strategic alliance, joint venture or consortium

05 ◯ E. Competitors

06 ◯ F. Suppliers

07 ◯ G. Professional, trade or industrial associations or federations

08 ◯ H. Universities, technical colleges, public laboratories or business schools

09 ◯ I. Consultants

10 ◯ J. Regulatory agencies dealing with environmental, health and safety, financial and other requirements

11 ◯ K. Customers or clients

12 ◯ L. Other, please specify 2402 _____

_____

_____

_____

_____

Spending on Knowledge Management Practices

8. 2501 **Do the knowledge management practices currently in use in your firm or organisation have dedicated budgets or spending?**

1 ◯ Yes → In the next 24 months, do you anticipate the knowledge management practices' share of the budget to:

2502 1 ◯ Increase

2 ◯ Decrease

3 ◯ Stay the same

9 ◯ Don't know

2 ◯ No → In the next 24 months, do you expect knowledge management practices to have dedicated budgets or spending:

2503 1 ◯ Yes

2 ◯ No

9 ◯ Don't know

Resistance to Knowledge Management Practices

9. 2601 **Did your firm or organisation experience significant resistance to implementing any of the knowledge management practices currently in use?**

2 ◯ No

1 ◯ Yes → What groups resisted the implementation of knowledge management practices currently in use?

2602 ✓ **Check ALL that apply.**

Officers and Workers

01 ◯ Management
02 ◯ Non-management workers
03 ◯ Union(s) active in the workplace(s)

Functions, Departments or Business Units

04 ◯ Information technology, computer group
05 ◯ Marketing, sales
06 ◯ Distribution, purchasing, communications (corporate library)
07 ◯ Research and development
08 ◯ Engineering
09 ◯ Administration, accounting, human resources
10 ◯ Production

Incentives to Implement Knowledge Management Practices

10. 2701 **What would motivate your firm or organisation to implement or to increase knowledge management practices?**

✓ **Check ALL that apply.**

01 ◯ Information overload problems within your firm or organisation
02 ◯ Difficulty in capturing workers' undocumented knowledge (know-how)
03 ◯ Use of knowledge management tools or practices by competitors
04 ◯ Loss of key personnel and their knowledge
05 ◯ Loss of market share
06 ◯ Difficulties in incorporating external knowledge
07 ◯ Other, please specify

2702 _____

_____

_____

Employment Structure

11. For each category listed below, please indicate the range that best represents the current number of workers in your firm or organisation.

Please include your regular workers employees as well as managers, executives, partners, directors, and persons employed under contract.

Employment in CANADA

Number of full-time equivalent workers in Canada ("Full-time equivalents" represents the number of person-years.)

3001 ✓ **Check ONE response only.**

01 ◯ 0
02 ◯ 1-19
03 ◯ 20-49
04 ◯ 50-99
05 ◯ 100-249
06 ◯ 250-499
07 ◯ 500-1,999
08 ◯ 2,000+

Employment Outside of CANADA

Number of full-time equivalent workers outside of Canada (exclude Canada-based workers).

3002 ✓ **Check ONE response only.**

01 ◯ 0
02 ◯ 1-19
03 ◯ 20-49
04 ◯ 50-99
05 ◯ 100-249
06 ◯ 250-499
07 ◯ 500-1,999
08 ◯ 2,000+

12. 4001 **Please indicate how long it took you to complete this questionnaire.**

|_|_|_| minutes

13. 4002 **If you would like to receive summary results from this survey please check.**

1 ◯ Yes

2 ◯ No

Comments

14. **Your comments are important to us. Please let us know how we may improve this survey.**

6001 _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

6002 |_|_|_|_| |_|_|_|_| |_|_|_|_| |_|_|_|_| |_|_|_|_| |_|_|_|_|

Your response is very much appreciated.
Thank you for participating.

Please complete and return this questionnaire within 10 days of receipt using the envelope provided.

References

Baird, R. S. Deacon and P. Holland. (2000). "From Action Learning to Learning from Action: Implementing the After Action Review" in Cross, R. and S. Israelit (eds). **Strategic Learning in a Knowledge Economy: Individual, Collective and Organizational Learning Process**. (Resources for the Knowledge-Based Economy Series). Woburn: Butterworth-Heinnemann. pp. 185-202.

Bartlett, C.A. and S. Ghoshal. (2002). "Building Competitive Advantage Through People". **MIT Sloan Management Review**. (Cambridge, MA) Vol. 43, No. 2. pp. 34-41.

Bell, C. R. (1996). **Managers as Mentors: Building Partnerships for Learning**. San Francisco: Berrett-Koehler Publishers.

Bowlby, G. (2001). "The Labour Market: Year-end Review". **Perspectives on Labour and Income.** (Statistics Canada, Cat. No. 75-001XPE) Vol. 13, No. 1. pp. 9-19.

Brelade, S. and C. Harman. (2001). "How Human Resources Can Influence Knowledge Management". **Strategic HR Review** (London: Melcrum Publishing). Vol 1, Issue 1. pp. 30-33.

Brown, J.S. and Duguid, P. (2000). "Balancing Act: How to Capture Knowledge Without Killing It". **Harvard Business Review** (Boston, MA) May-June 2000, pp. 73-80.

Catt, H. and P. Scudamore. (1997). **Solving Skills Shortages: How to Recruit and Retain Skilled People**. London: Kogan Page Limited.

Cohen, D. and L. Prusak. (2001). **In Good Company: How Social Capital Makes Organizations Work**. Boston: Harvard Business School Press.

Cohen, W. M. and D.A. Levinthal. (2000). "Absorptive Capacity: A New Perspective on Learning and Innovation" (reprint of 1990 article) in Cross, R. and S. Israelit (eds). **Strategic Learning in a Knowledge Economy: Individual, Collective and Organizational Learning Process**. (Resources for the Knowledge-Based Economy Series). Woburn: Butterworth-Heinnemann. pp. 39-67.

Cross, R. and L. Baird. (2000). "Technology is Not Enough: Improving Performance by Building Organizational Memory". **MIT Sloan Management Review**. (Cambridge, MA) Vol 41 No. 3. pp. 69-78.

Cross, R. and S. Israelit (eds). (2000). "Introduction: Strategic Learning in a Knowledge Economy: Individual, Collective and Organizational Learning Process" in Cross, R. and S. Israelit (eds). **Strategic Learning in a Knowledge Economy:**

Individual, Collective and Organizational Learning Process. (Resources for the Knowledge-Based Economy Series). Woburn: Butterworth-Heinnemann. pp. vii-xvii.

Denning, S. (2001). **The Springboard: How Storytelling Ignites Action in Knowledge-Era Organizations**. Boston: Butterworth-Heinemann.

Dixon, N. M. (2000) **Common Knowledge: How Companies Thrive by Sharing What They Know**. Boston: Harvard Business School Press.

Davenport, T. H. and L. Prusak. (1998). **Working Knowledge: How Organizations Manage What They Know**. Boston: Harvard Business School Press.

de la Mothe, J. and D. Foray. (2001). "Conclusion" in de la Mothe, J. and D. Foray (eds) **Knowledge Management in the Innovation Process**, Boston: Kluwer Academic Press. pp. 217-225.

Earl, L. (2002). "Innovation and Change in the Public Sector: A Seeming Oxymoron", Statistics Canada, Cat. No. 88F0006XIE02001. Working Papers Series No. 1, Science, Innovation and Electronic Information Division, Ottawa.

Earl, M. J. and I. A. Scott. (1999). "Opinion: What is a Chief Knowledge Officer". **MIT Sloan Management Review**. (Cambridge, MA) Vol 40 No. 2. pp. 29-38.

Field, D. (2001). "Sharing on the London Underground". **Knowledge Management Review**. (London: Melcrum Publishing) Vol 4, Issue 6. pp. 12-13.

Hamdani, D. (1996). "The Temporary Help Service Industry: Its Role, Structure and Growth". **Services Indicators**. (Statistics Canada: Catalogue No. 63-016-XPB), pp. 1-19.

Human Resources and Development Canada. (2002). **Knowledge Matters: Skills and Learning for Canadians**. (Catalogue No. SP-482-02-02).

Industry Canada. (2002) **Achieving Excellence: Investing in People, Knowledge and Opportunity**. (Catalogue No. C2-596/2001).

Kaye, B. and S. Jordan-Evans. (1999). **Love'em or Lose'em: Getting Good People to Stay**. San Francisco: Berrett-Koehler Publishers.

Knowledge Management Review. (2002). "Briefings – Facing the Reality of Knowledge Attrition". **Knowledge Management Review**. (London: Melcrum Publishing) Vol 4, Issue 6. pp. 8-9.

Lesser, E. and L. Prusak (2000). "Communities of Practice, Social Capital and Organisational Knowledge" in Lesser, E. L., M.A. Fontaine and J.A. Slusher (eds)

Knowledge and Communities (Resources for the Knowledge-Based Economy Series). Woburn: Butterworth-Heinnemann. pp. 123-131.

Miller, R. (2001). "Bringing Tradeshow Knowledge to the Desktop: Sharing Conference Knowledge with your Workforce". **Knowledge Management Review**. (London: Melcrum Publishing) Vol 4, Issue 4. pp. 30-33.

Newman, V. (2002 Interview). (2002). "Transferring High-value Knowledge at Pfizer: Retaining Knowledge to Improve Decision-Making". **Knowledge Management Review**. (London: Melcrum Publishing) Vol 4, Issue 6. pp. 14-17.

OECD (Organisation for Economic Co-operation and Development) (1999). **Science, Technology and Industry Scoreboard 1999: Benchmarking Knowledge-based Economies**. Paris.

Picot, G. and R. Dupuy. (1996). "Job Creation by Company Size Class: Concentration and Persistence of Job Gains and Losses in Canadian Companies". (Analytical Studies Branch, Statistics Canada: Cat. No. 11F0019MPE) Research Paper No. 93.

Picot, G., A. Heisz and A. Nakamura. (2001). "Job Tenure, Worker Mobility and the Youth Labour Market During the 1990s". (Analytical Studies Branch, Statistics Canada: Cat. No. 11F0019MPE) Research Paper No. 155.

Prusak, L. (2001). "Practices and Knowledge Management" in de la Mothe, J. and D. Foray (eds) **Knowledge Management in the Innovation Process**, Boston: Kluwer Academic Press. pp. 153-158.

Quinn, J.B. (1999). "Strategic Outsourcing: Leveraging Knowledge Capabilities" **MIT Sloan Management Review**. (Cambridge, MA) Vol 40 No. 4. pp. 9-21.

Schaan, S. and F. Anderson. (2001). "Innovation in Canadian Manufacturing: National Estimates", Statistics Canada, Cat. No. 88F0006XIE No.10. Working Papers Series No. 10, Science, Innovation and Electronic Information Division, Ottawa.

Schuetze, H. G. (2001). "Knowledge Management in Small Firms: Theoretical Perspectives and Evidence" in de la Mothe, J. and D. Foray (eds) **Knowledge Management in the Innovation Process**, Boston: Kluwer Academic Press. pp. 97-122.

Seeley, C. P. (2002). "Knowledge Preservation in Turbulent Times". **Knowledge Management Review**. (London: Melcrum Publishing) Vol 4, Issue 6. p. 5.

Shea, G.F. (1999). Making the Most of Being Mentored. Menlo Park, CA: Crisp Publications.

Statistics Canada. (1998). **North American Industry Classification System, Canada, 1997**. (Statistics Canada: Catalogue No. 12-501-XPE).

Stehr, N. (2001). "The Grammar of Productive Knowledge" in de la Mothe, J. and D. Foray (eds) **Knowledge Management in the Innovation Process**, Boston: Kluwer Academic Press. pp. 193-203.

Stone, F.A. (1999). **Coaching, Counselling and Mentoring.** New York: American Management Association.

Sunter, D. (2001). "Demography and the Labour Market". **Perspectives on Labour and Income.** (Statistics Canada, Cat. No. 75-001XPE) Vol. 13, No. 1. pp. 28-39.

Zack, M.H. (1999). "Managing Codified Knowledge". **MIT Sloan Management Review**. (Cambridge, MA) Vol 40 No. 4. pp. 45-58.

How to Order Catalogued Publications

These and other Statistics Canada publications may be purchased from local authorized agents and other community bookstores, through the local Statistics Canada offices, or by mail order to:

Statistics Canada
Dissemination Division
Circulation Management
120 Parkdale Avenue
Ottawa, Ontario
K1A 0T6

Telephone: 1(613)951-7277
National toll free order line: 1-800-700-1033
Fax number: 1-(613)951-1584 or 1-800-889-9734
Toronto Credit Card only (416)973-8018
Internet: order@statcan.ca

CATALOGUED PUBLICATIONS

Statistical Publication

88-202-XPB Industrial Research and Development, 2001 Intentions (with 2000 preliminary estimates and 1999 actual expenditures)

88-204-XIB Federal Scientific Activities, 2000-2001[e] (annual)

88-001-XIB Science Statistics (monthly)

Volume 25

No. 1 Distribution of Federal Expenditures on Science and Technology, by Province and Territories, 1998-99

No. 2 Estimates of Total Spending on Research and Development in the Health Field in Canada, 1988 to 2000[e]

No. 3 Biotechnology Scientific Activities in Selected Federal Government Departments and Agencies, 1999-2000

No. 4 Biotechnology Research and Development (R&D) in Canadian Industry, 1998

No. 5 Research and Development (R&D) Personnel in Canada, 1990 to 1999[e]

No. 6 Industrial Research and Development, 1997 to 2001

No. 7 Estimation of Research and Development Expenditures in the Higher Education Sector, 1999-2000

No. 8 Total Spending on Research and Development in Canada, 1990 to 2001[e], and provinces, 1990 to 1999

No. 9 Federal Government Expenditures on Scientific Activities, 2001-2002[e]

No. 10 Research and Development (R&D) Expenditures of Private Non-Profit (PNP) Organizations, 2000

No. 11 Scientific and Technological (S&T) Activities of Provincial Governments, 1992-93 to 2000-2001[e]

No. 12 Distribution of Federal Expenditures on Science and Technology, by Province and Territories, 1999-2000

Volume 26

No. 1 The Provincial Research Organizations, 1999

WORKING PAPERS - 1998

These working papers are available from the Science and Innovation Surveys Section of Statistics Canada, please contact:

Science and Innovation Surveys Section
Science, Innovation and Electronic Information Division
Statistics Canada
Ottawa, Ontario
K1A 0T6
Internet: http://www.statcan.ca/english/research/scilist.htm
Tel: (613) 951-6309

ST-98-01 A Compendium of Science and Technology Statistics, February 1998

ST-98-02 Exports and Related Employment in Canadian Industries, February 1998

ST-98-03 Job Creation, Job Destruction and Job Reallocation in the Canadian Economy, February 1998

ST-98-04 A Dynamic Analysis of the Flows of Canadian Science and Technology Graduates into the Labour Market, February 1998

ST-98-05 Biotechnology Use by Canadian Industry – 1996, March 1998

ST-98-06 An Overview of Statistical Indicators of Regional Innovation in Canada: A Provincial Comparison, March 1998

ST-98-07 Federal Government Payments to Industry 1992-93, 1994-95 and 1995-96, September 1998

ST-98-08 Bibliometric Analysis of Scientific and Technological Research: A User's Guide to the Methodology, September 1998

ST-98-09 Federal Government Expenditures and Personnel on Activities in the Natural and Social Sciences, 1989-90 to 1998-99[e], September 1998

ST-98-10 Knowledge Flows in Canada as Measured by Bibliometrics, October 1998

ST-98-11 Estimates of Canadian Research and Development Expenditures (GERD), Canada, 1987 to 1998[e], and by Province 1987 to 1996, October 1998

ST-98-12 Estimation of Research and Development Expenditures in the Higher Education Sector, 1996-97, November 1998

WORKING PAPERS - 1999

ST-99-01 Survey of Intellectual Property Commercialization in the Higher Education Sector, 1998, February 1999

ST-99-02 Provincial Distribution of Federal Expenditures and Personnel on Science and Technology, 1988-89 to 1996-97, June 1999

ST-99-03 An Analysis of Science and Technology Workers: Deployment in the Canadian Economy, June 1999

ST-99-04 Estimates of Gross Expenditures on Research and Development in the Health Field in Canada, 1970 to 1998[e] , July 1999

ST-99-05 Technology Adoption in Canadian Manufacturing, 1998, August 1999

ST-99-06 A Reality Check to Defining E-Commerce, 1999, August 1999

ST-99-07 Scientific and Technological Activities of Provincial Governments, 1990-1991 to 1998-1999[e], August 1999

ST-99-08 Estimates of Canadian Research and Development Expenditures (GERD), Canada, 1988 to 1999[e], and by Province, 1988 to 1997, November 1999

ST-99-09 Estimation of Research and Development Expenditures in the Higher Education Sector, 1997-98

ST-99-10 Measuring the Attractiveness of R&D Tax Incentives: Canada and Major Industrial Countries, December 1999

WORKING PAPERS - 2000

ST-00-01 Survey of Intellectual Property Commercialization in the Higher Education Sector, 1999, April 2000

ST-00-02 Federal Government Expenditures and Personnel in the Natural and Social Sciences, 1990-91 to 1999-2000[e], July 2000

ST-00-03 A Framework for Enhanced Estimations of Higher Education and Health R&D Expenditures, by Mireille Brochu, July 2000

ST-00-04 Information and Communications Technologies and Electronic Commerce in Canadian Industry, 1999, November 2000

WORKING PAPERS - 2001

ST-01-01 Estimates of Canadian Research and Development Expenditures (GERD), Canada, 1989 to 2000[e], and by Province 1989 to 1998, January 2001

ST-01-02 Estimation of Research and Development Expenditures in the Higher Education Sector, 1998-99, January 2001

ST-01-03 Innovation, Advanced Technologies and Practices in the Construction and Related Industries: Provincial Estimates, 1999, January 2001

ST-01-04 Innovation, Advanced Technologies and Practices in the Construction and Related Industries: National Estimates, 1999, February 2001

ST-01-05 Provincial Distribution of Federal Expenditures and Personnel on Science and Technology 1990-91 to 1998-99, February 2001

ST-01-06 Estimates of Total Expenditures on Research and Development in the Health Field in Canada, 1988 to 2000[e], March 2001

ST-01-07 Biotechnology Use and Development, 1999, March 2001

ST-01-08 Federal Government Expenditures and Personnel in the Natural and Social Sciences, 1991-92 to 2000-2001[e], April 2001

ST-01-09 Estimates of Research and Development Personnel in Canada, 1979 to 1999[e], June 2001

ST-01-10 Innovation in Canadian Manufacturing: National Estimates, 1999, June 2001

ST-01-11 Practices and Activities of Canadian Biotechnology Firms: Results from the Biotechnology Use & Development Survey -- 1999, August 2001

ST-01-12 Canadian Biotechnology Industrial Activities: Features from the 1997 Biotechnology Survey, September 2001

ST-01-13 Innovation in Canadian Manufacturing: Provincial Estimates, 1999, September 2001

ST-01-14 Estimates of Canadian Research and Development Expenditures (GERD), Canada, 1990 to 2001[e], and by Province, 1990 to 1999, November 2001

ST-01-15 Estimation of Research and Development Expenditures in the Higher Education Sector, 1999-2000, December 2001

WORKING PAPERS - 2002

ST-02-01 Innovation and Change in the Public Sector: A Seeming Oxymoron, January 2002

ST-02-02 Measuring the Networked Economy, March 2002

ST-02-03 Use of Biotechnologies in the Canadian Industrial Sector: Results from the Biotechnology Use & Development Survey - 1999, March 2002

ST-02-04 Profile of Spin-off Firms in the Biotechnology Sector: Results from the Biotechnology Use and Development Survey - 1999, March 2002

ST-02-05 Scientific and Technological Activities of Provincial Governments 1992-1993 to 2000-2001[e], April 2002

RESEARCH PAPERS – 1996-2001

No. 1 The State of Science and Technology Indicators in the OECD Countries, by Benoit Godin, August 1996

No. 2 Knowledge as a Capacity for Action, by Nico Stehr, June 1996

No. 3 Linking Outcomes for Workers to Changes in Workplace Practices: An Experimental Canadian Workplace and Employee Survey, by Garnett Picot and Ted Wannell, June 1996

No. 4 Are the Costs and Benefits of Health Research Measurable?, by M.B. Wilk, February 1997

No. 5 Technology and Economic Growth: A Survey, by Petr Hanel and Jorge Niosi, April 1998

No. 6 Diffusion of Biotechnologies in Canada, by Anthony Arundel, February 1999

No. 7 Barriers to Innovation in Services Industries in Canada, by Pierre Mohnen and Julio Rosa, November 1999

No. 8 Explaining Rapid Growth in Canadian Biotechnology Firms, by Jorge Niosi, August 2000

No. 9 Internationally Comparable Indicators on Biotechnology: A Stocktaking, a Proposal for Work and Supporting Material, by W. Pattinson, B. Van Beuzekom and A. Wyckoff, January 2001

No. 10 Analysis of the Survey on Innovation, Advanced Technologies and Practices in the Construction and Related Industries, 1999, by George Seaden, Michael Guolla, Jérôme Doutriaux and John Nash, January 2001

No. 11 Capacity to Innovate, Innovation and Impact: The Canadian Engineering Services Industry, by Daood Hamdani, March 2001

No. 12 Patterns of Advanced Manufacturing Technology (AMT) Use in Canadian Manufacturing: 1998 AMT Survey Results, by Anthony Arundel and Viki Sonntag, November 2001