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Are Small Businesses Positioning Themselves for Growth? A Comparative Look at the Use of Selected Management Practices by Firm Size

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Statistics Canada
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Note of appreciation

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

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

Highlights 6
Introduction 7
Structural differences between the private and public sectors 8
Organizational structures most commonly used management practice 10
Changing management practices 11
Small firms are managed differently 12
Larger firms had similar change rates for the selected management practices 14
Conclusion 16
References 17
Appendix 1: Methodology of the Survey of Electronic Commerce and Technology 2004 (SECT) 18

Highlights

In 2004, the Survey of Electronic Commerce and Technology provided a list of eight management practices that according to interviews with small and medium-sized firms indicated potential firm growth. The management practices listed were organisational structures; employee feedback surveys; mentoring or coaching programs; and written strategies for marketing; managing growth; commercialisation of intellectual property; succession management; and risk management.

Managers often look to their management practices to help them improve their efficiency and productivity as well as to position their firms for growth. Managers also employ management practices strategically based on industry needs and according to the number of employees. In 2004 on average medium-sized (3.1 practices) and large firms (4.9 practices) employed more of the management practices than small firms (1.2 practices).

When the public sector organisations and private sector firms are compared by size, they have similar usage rates for the management practices with the usage rate increasing with employment size group. Using organizational structures was the most often used management practice for both the public sector and the private sector. Organizational structures include how organizations divide their work, allocate responsibility and exercise control.

Not surprisingly, large firms were more likely to have written marketing strategies, important to firms' primary purpose of generating profit but were less likely to conduct employee surveys than public sector organisations.

Across the major industrial sectors of the private sector, the usage rates of each of the management practices were very similar. Consistently, the least used of the management practices was a formal plan for commercialisation of intellectual property. Small firms in a few specific industries, such as utilities and finance and insurance, two industries which are risk averse had higher propensities to use written policies, strategies or plans for risk management. This is one of the few examples of industry-specific use of the selected management practices.

Less than half of the small firms and small public sector organisations which used the selected management practices indicated that they had recently introduced or modified these management practices.

Technological innovation has been shown as important to firms' survival. Organisational innovation may also be important to firms' survival and potential for growth. It is interesting to note that there was very little difference in the levels of change rates across the selected management practices by firm size which suggests firms of all sizes using these management practices were similarly inclined toward organisational innovation. This also suggests that small firms implementing or changing these selected management practices may be positioning themselves towards growth or emulating how larger firms manage.

Introduction

Managers often look to their management practices to help them improve their efficiency and productivity as well as to position their firms for growth. In the private sector, some management practices are considered important to a firm's competitiveness and profitability. For instance, knowledge sharing management practices are perceived as important success factors for selected service industries (Earl 2005). Generally, the private sector and public sector have differing adoption rates of new organisational practices. However these rates converge when organisation employment size is held constant (Earl 2002). It is well-known that small firms are managed differently from large firms, and this paper provides further evidence in support of this idea while suggesting that some small firms are adopting management behaviours of larger firms. Could these small firms be positioning themselves for growth or using organisational innovation as a tool for survival or adopting some formal organization practices early?

The Survey of Electronic Commerce and Technology 2004 fills this data gap by providing information on the use, recent introduction or modification of eight selected management practices by both the private and public sectors. This provides an indication of the rate of organisational innovation based on organisational change in management practices taking place in the Canadian economy. More importantly for small businesses, these practices were identified as growth factors in a series of interviews with small and medium-sized firms conducted in 2003 and 2004 (Bordt et al., 2006). Below is the survey question as it appeared on the Survey of Electronic Commerce and Technology questionnaire for 2004:

During the last three years, 2002-2004, did your organization introduce or significantly modify any of the following: (For each response, please check all that apply)

	During the last three years, 2002-2004			
Management Practices	Introduced in last 3 years	Modified in last 3 years	Already in place (unmodified)	Do not use / Not applicable
Organizational structures	☐	☐	☐	☐
Employee feedback surveys	☐	☐	☐	☐
Mentoring or coaching programs	☐	☐	☐	☐
A written marketing strategy or plan	☐	☐	☐	☐
A written policy, strategy or plan for managing growth	☐	☐	☐	☐
A written policy, strategy or plan for the commercialisation of intellectual property	☐	☐	☐	☐
A written policy, strategy or plan for succession management	☐	☐	☐	☐
A written policy, strategy or plan for risk management	☐	☐	☐	☐

For information only

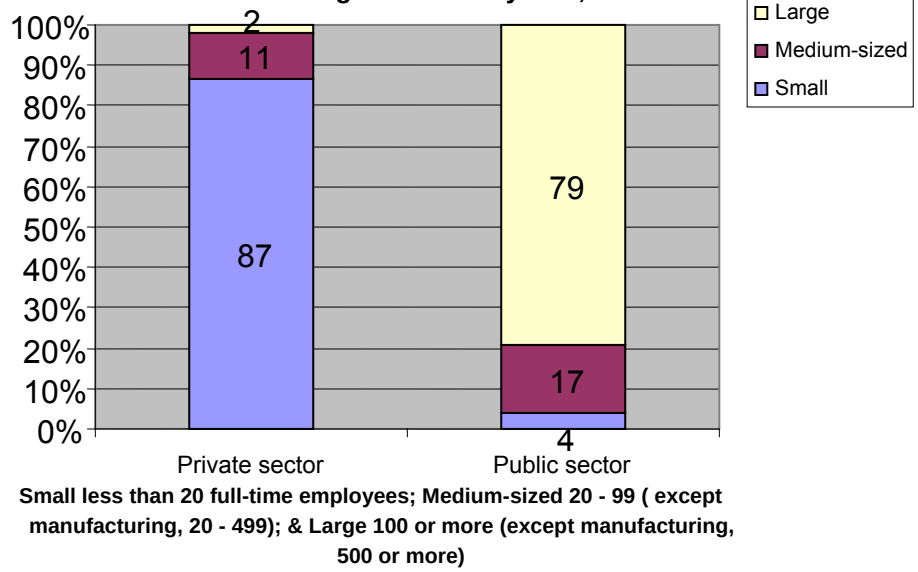
Source: Statistics Canada. Survey of Electronic Commerce and Technology, 2004.

Structural differences between the private and public sectors

Private sector firms and public sector organisations have two quite different objectives and reasons for operation. Private sector firms are managed in order to maximize profits whereas public sector organisations serve the public good and they are not profit centres. However, both private sector firms and public sector organisations must manage their human resources, operations and budgets. Effective management is intended to reduce overheads and increase efficiency which in turn should decrease the costs of the production of goods and services. Managers are always looking for ways to improve and grow their operations. Introducing new management practices or modifying existing practices are two methods used to prompt organisational change, or organisational innovation which in turn help firms to thrive and, in some cases, to grow. However, it appears firms and public sector organisations are managed differently depending on size more than on industry.

The majority of firms in the private sector have less than 20 full-time employees whereas for the public sector the majority of organisations have more than 300 full-time employees (Chart 1). The small, medium-sized and large employment size groups used in this paper are comparable to the standard employment size groups already published from this survey. For the private sector, firms in manufacturing are distributed slightly differently based on their employment size. All small firms have less than 20 full-time employees. Medium-sized firms have between 20 - 99 full-time employees (except manufacturing, 20 - 499 full-time employees) and large firms have 100 or more full-time employees (except manufacturing, 500 or more full-time employees)[1]. The small, medium-sized and large public sector organisations are distributed according to the private sector employment size groups with no exceptions.

Chart 1 Distribution of private sector firms and public sector organizations by size, 2004



Small less than 20 full-time employees; Medium-sized 20 - 99 (except manufacturing, 20 - 499); & Large 100 or more (except manufacturing, 500 or more)

Source: Statistics Canada. Survey of Electronic Commerce and Technology, 2004.

The private sector is often further sub-divided into the goods-producing sector and the services-producing sector, which in turn is composed of good-related services and intangible services. As Table 1 below indicates, the services producing sector and in particular intangible services have the highest concentration of small firms.

1. A review that classified manufacturing firms to the same firm size groups as used by the rest of the public and private sector industries only made very slight differences to the proportion of practices in use for medium-sized and large firms. Therefore, it was determined that the standard classification would be used for reasons of data comparability.

Table 1 Distribution of private sector firms by firm size, 2004			
	Small (1 to 19 full-time employees)	**Medium-sized** (20 to 99 full-time employees except manufacturing – 20 to 499)	**Large** (100 and more full-time employees except manufacturing – 500 and more)
	percentage		
Total private sector	87	11	2
Goods producing sector	75	23	1
Services producing sector	88	10	2
Goods-related services	85	13	2
Intangible services	89	8	2

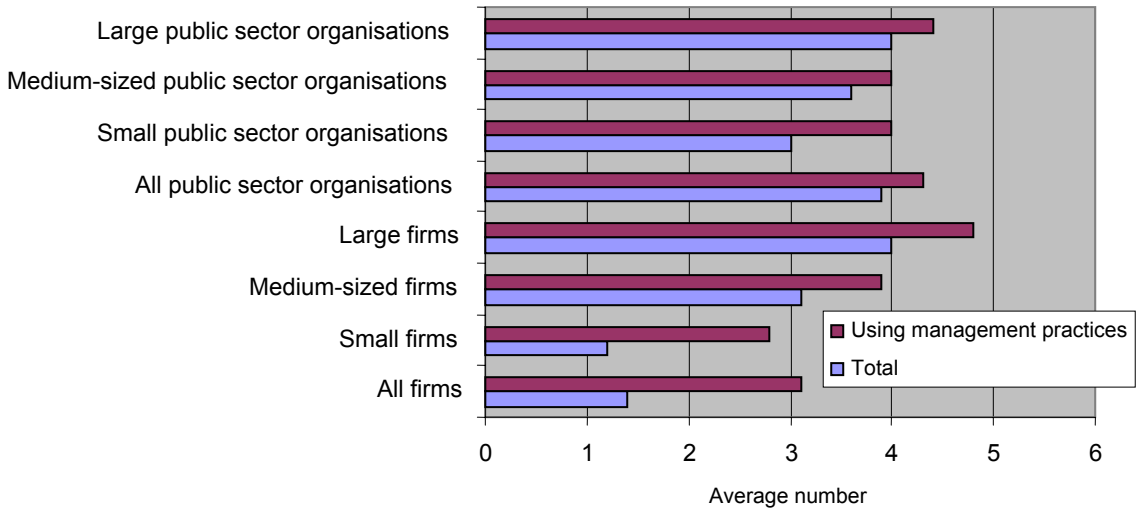
Note: Rows may not add to 100% due to rounding.
Source: Statistics Canada. Survey of Electronic Commerce and Technology, 2004.

The usage rates[2] of each of the management practices actually increases across the firm or organisation size. The same pattern holds true for the average number of practices in use by firm or organisation size (see Chart 2).

There were also significant differences in the rates of usage of the individual management practices between public sector organisations and private sector firms according to firm size. Small firms on average employed 1.2 of these management practices whereas small public sector organisations used on average 3. It appears that small public sector organisations are managed differently from small firms since those small firms that actually use any of the management practices employed on average 2.8 practices as compared to 4 practices in place in small public sector organisations.

On average, medium-sized sized firms employed 3.1 management practices slightly less than the average of 3.6 used by medium-sized public sector organisations. However, when medium-sized firms and public organisations that used the management practices are compared, the averages are much more similar at 3.9 and 4.0. On the other hand, large firms that used the management practices on average employed 4.9 slightly more than their public sector counterparts at 4.4.

Chart 2 Average number of management practices in use, 2004



Source: Statistics Canada. Survey of Electronic Commerce and Technology, 2004.

2. Usage rates were calculated by summing the responses that indicated that the practice was in use (introduced in the last 3 years, modified in last 3 years and already in place) and dividing by the total response.

Organizational structures most commonly used management practice

For both the public sector and the private sector, using organizational structures, which could include how organizations divide their work, allocate responsibility and exercise control (Trent and Monczka 2005, p. 29), is the most often used management practice. The impact of the high proportion of small firms in the private sector is immediately noticeable when the usage rates for the total private and public sectors is shown (see Table 2).

Table 2 Percentage of firms and public sector organisations using the selected management practices, 2004

	Private sector	Public sector
	percentage	
Organizational structures	40[A]	81[A]
Employee feedback surveys	15[A]	61[A]
Mentoring or coaching programs	18[A]	48[A]
A written marketing strategy or plan	21[A]	40[A]
Written policy, strategy or plan for managing growth	18[A]	45[A]
Written policy, strategy or plan for the commercialisation of intellectual property	8[A]	20[A]
Written policy, strategy or plan for succession management	12[A]	38[A]
Written policy, strategy or plan for risk management	13[A]	60[A]

Note: See Appendix 1 for an explanation of the alphabetic data quality indicator.
Source: Statistics Canada. Survey of Electronic Commerce and Technology, 2004.

The usage rates by large firms and large public sector organisations were similar except for two practices. Not surprisingly large firms were more likely to have written marketing strategies, important to firms' primary purpose of generating profit but were less likely to conduct employee surveys than public sector organisations.

Table 3 Percentage of firms and public sector organisation using the selected management practices by size, 2004

	Private sector			Public Sector		
	Small	Medium	Large	Small	Medium	Large
	percentage					
Organizational structures	35.3[A]	67.8[A]	75.6[B]	67.7[C]	77.8[A]	81.8[A]
Employee feedback surveys	11.4[A]	34.7[A]	50.3[B]	40.1[C]	52.2[B]	63.3[A]
Mentoring or coaching programs	14.5[A]	36.6[A]	41.8[B]	…	34.8[B]	50.8[A]
A written marketing strategy or plan	17.0[A]	45.7[A]	57.0[B]	…	34.7[B]	41.4[A]
Written policy, strategy or plan for managing growth	14.7[A]	40.6[A]	48.9[B]	…	41.6[B]	46.2[A]
Written policy, strategy or plan for the commercialisation of intellectual property	5.9[A]	19.9[A]	30.7[B]	…	…	22.4[A]
Written policy, strategy or plan for succession management	9.1[A]	28.4[A]	42.8[B]	…	44.0[B]	37.1[A]
Written policy, strategy or plan for risk management	9.8[A]	31.7[A]	49.0[B]	46.0[C]	62.4[B]	59.7[A]

Note: See Appendix 1 for an explanation of the alphabetic data quality indicator.
Source: Statistics Canada. Survey of Electronic Commerce and Technology, 2004.

When usage rates for the management practices are compared across firm size, medium-sized firms have significantly higher usage rates for all of the management practices than small firms. For large firms, as compared to medium-sized firms, the three management practices which have significantly different usage rates are the use of employment feedback surveys, and written succession management and risk management strategies or policies, all of which large firms employ more frequently. These findings indicate that management practices in use are probably employed in manners that are appropriate to the firm size and strategies. More sophisticated management styles generally come into place as the firm size increases. However, firms on a growth trajectory may be adopting management practices used by larger firms in order to facilitate their growth. How long the practices have been in use provides an indication of organisational change or innovation.

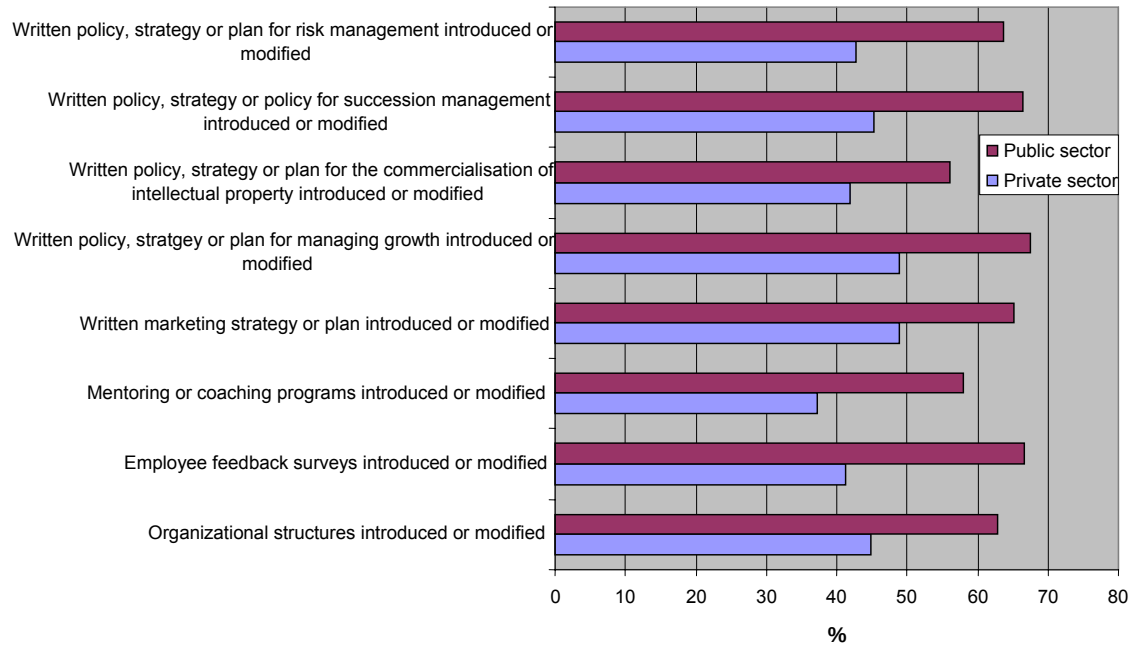
Changing management practices

Public sector organisations with the selected management practices in place had significantly higher rates of changing these practices during the three years period of 2002-2004[3]. In fact, over half of the public sector organisations using the management practices changed each of these practices within the three-year period. The changes included either introduction of a new practice or modifying an existing practice within the three-year period. For the public sector, the least popular management practices to change were written policies, strategies or plans for the commercialisation of intellectual property and mentoring or coaching programs. The change rate for these two practices did not differ significantly from each other or from the change rate for organizational structures. The rate of change for commercialisation of intellectual property practices was significantly lower than the rates posted for the remaining practices. A similar pattern developed for the change rate for mentoring or coaching programs except that there was no significant difference between its change rate and that of risk management practices.

Changing management practices was less popular generally with the private sector. Less than half of the firms using the management practices changed them. For the private sector the least popular form of organisational change was the introduction or modification of mentoring or coaching programs. This human resource development practice was significantly less popular than four other forms of changing management techniques which were modifying or introducing organizational structures; marketing, growth or success management strategies or plans.

3. Change is calculated as the sum of responses to introduced in last 3 years and modified in last 3 years divided by total in use.

Chart 3 Change rates for selected management practices, 2002-2004



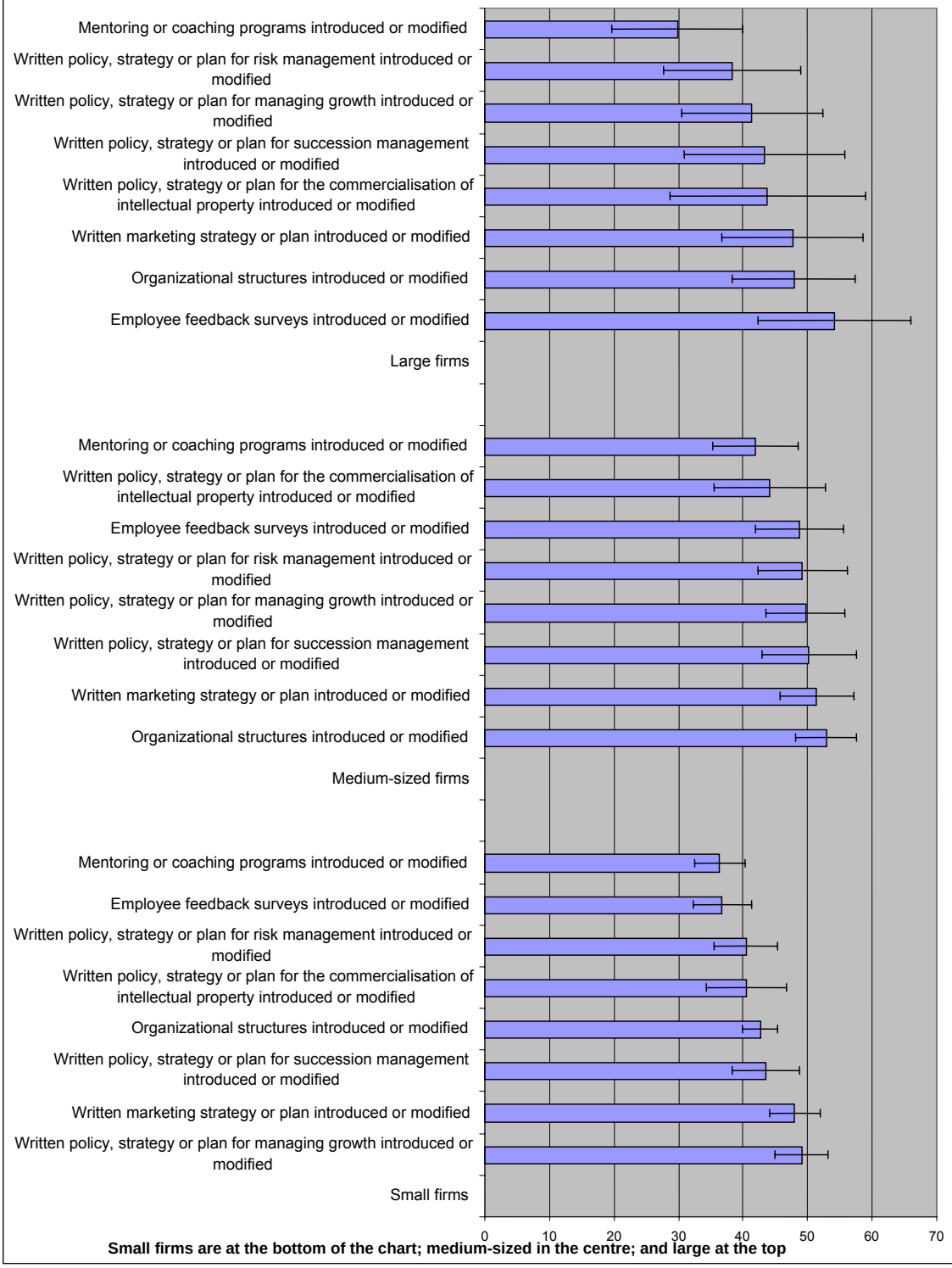
Source: Statistics Canada. Survey of Electronic Commerce and Technology, 2004.

Small firms are managed differently

Less than half of the small firms and small public sector organisations which used the selected management practices indicated that they had recently introduced or modified these practices. Only one third of small firms indicated that they introduced or modified employee feedback surveys or mentoring or coaching programs and this could be a function of size and perceived need. Also, these firms were significantly less likely to have introduced or modified these two management practices than they were to have introduced or modified strategies pertaining to marketing or managing growth. The fact that almost one-half of the small firms that used marketing and growth strategies either modified or introduced these strategies between 2002 and 2004 indicated their managements' desires to increase market presence. However, these small firms represented less than 10% of all small firms in 2004.

The fact that many small firms are family-owned and operated may lessen the need for employee mentoring programs and feedback surveys. There are also cost constraints to be considered in the introduction of any management practice that can inhibit businesses from adopting the practice. Chart 4 below shows the change rates, percentage of management practices modified or introduced between 2002 and 2004, for small firms and small public sector organisations.

Chart 4 Change rates (%) for small, medium-sized and large firms showing confidence intervals, 2002-2004



Small firms are at the bottom of the chart; medium-sized in the centre; and large at the top

Source: Statistics Canada. Survey of Electronic Commerce and Technology, 2004.

Larger firms had similar change rates for the selected management practices

Small firms when compared to medium-sized firms only differed significantly in their lower rates for the introduction or modification of two management practices: employment feedback surveys and organisational structures. There were no significant differences between the change rates for the selected management practices between the medium-sized and large firms, although the ranked order differed (Chart 4).

Within the private sector, industry had little impact on the usage rates of the selected management practices

Table 4 Percentage of firms using the selected management practices by industrial sector, 2004

	Goods producing sector	Services producing sector		
	Total goods producing sector	Total services producing sector	Goods-related services	Intangible services
	percentage			
Organizational structures	41.9[A]	39.5[A]	40.8[A]	39.0[A]
Employee feedback surveys	14.9[A]	14.9[A]	16.9[A]	14.2[A]
Mentoring or coaching programs	17.0[A]	17.7[A]	17.3[A]	17.8[A]
A written marketing strategy or plan	22.6[A]	20.8[A]	20.0[A]	21.1[A]
A written policy, strategy or plan for managing growth	20.7[A]	18.0[A]	18.4[A]	17.8[A]
A written policy, strategy or plan for the commercialization of intellectual property	11.4[A]	7.5[A]	6.8[A]	7.8[A]
A written policy, strategy or plan for succession management	15.2[A]	11.6[A]	13.6[A]	10.9[A]
A written policy, strategy or plan for risk management	16.3[A]	12.6[A]	13.0[A]	12.5[A]

Note: See Appendix 1 for an explanation of the alphabetic data quality indicator.
Source: Statistics Canada. Survey of Electronic Commerce and Technology, 2004.

Firms in the goods producing sector, although still unlikely to have in place written policies for commercialization of intellectual property, succession management or risk management had significantly higher usage rates, albeit only marginally, of these three management practices than the services producing sector overall. This could reflect in part the purposes of the management practices as well as how they may be employed across industries. For instance, utilities, a component of the goods-producing sector have by far the highest usage rate for written risk management strategies, policies or plans (64% D) which could indicate how important risk such as plants going off-line, and natural and unnatural disasters are to these organizations. While in the services producing sector, the finance and insurance industry, another industry where risk might be considered important, had the highest usage rate for risk policies at 29% B, far below the rate recorded for utilities.

Table 5 Percentage of firms using the selected management practices by industrial sector and by small (S), medium-sized (M) and large (L) firm sizes, 2004

	Goods producing sector			Services producing sector								
	Total goods producing sector			Total services producing sector			Goods-related services			Intangible services		
	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
	percentage											
Organizational structures	33.3[A]	67.2[B]	82.5[D]	35.5[A]	67.9[A]	74.9[B]	35.9[A]	68.1[B]	72.2[C]	35.4[A]	67.8[B]	75.9[B]
Employee feedback surveys	9.8[A]	29.3[B]	46.0[D]	11.6[A]	36.6[A]	50.7[B]	13.1[A]	37.8[B]	42.1[D]	11.1[A]	35.9[B]	53.7[C]
Mentoring or coaching programs	11.7[A]	32.9[B]	39.7[D]	14.9[A]	37.9[A]	42.0[B]	14.3[A]	33.9[B]	37.9[C]	15.1[A]	40.1[B]	43.5[C]
A written marketing strategy or plan	15.2[A]	45.0[B]	52.4[D]	17.2[A]	45.9[A]	57.4[B]	17.1[A]	33.6[B]	51.5[D]	17.2[A]	52.7[B]	59.5[C]
A written policy, strategy or plan for managing growth	14.4[A]	39.2[B]	51.9[D]	14.7[A]	41.0[A]	48.7[B]	15.2[A]	34.4[B]	50.0[D]	14.5[A]	44.7[B]	48.2[C]
A written policy, strategy or plan for the commercialization of intellectual property	7.6[A]	22.6[B]	29.2[D]	5.7[A]	19.0[A]	30.8[B]	5.6[A]	11.8[B]	24.1[C]	5.7[A]	23.0[A]	33.2[C]
A written policy, strategy or plan for succession management	9.6[A]	30.8[B]	[E]	9.1[A]	27.5[A]	41.8[B]	10.9[A]	27.6[B]	35.7[C]	8.5[A]	27.5[B]	44.0[C]
A written policy, strategy or plan for risk management	10.5[A]	33.2[B]	[E]	9.7[A]	31.2[A]	49.0[B]	9.8[A]	27.8[B]	49.9[D]	9.7[A]	33.1[B]	48.7[C]

Note: See Appendix 1 for an explanation of the alphabetic data quality indicator.
Source: Statistics Canada. Survey of Electronic Commerce and Technology, 2004.

Small firms generally are less likely to employ the selected management practices and there is little variation in their usage rates of these practices across industrial sectors (Table 5). The pattern of increased usage by firm size across industrial sectors is very consistent suggesting that firms use management practices on an as-needed basis. It appears therefore that firms are strategically selecting their management practices to suit their needs, and business plans.

Conclusion

Firms and organisations of all sizes appear to employ management practices strategically. Not surprisingly, as management practices are often directed towards human resources, the selection of management practices in use in a firm is more dependent upon the size of the organisation than the industry. What is interesting is that the management practices studied were selected as indicators for firms intending to grow. Usage rates for each of the eight selected management practices increased with firm size in the private sector and organization size in the public sector. This is in keeping with the hypothesis that larger firms and organisations need more management tools to manage.

Since the purpose of public sector organisations is to serve the public good whereas private sector firms direct their efforts towards maximising profits, it was not surprising to discover that formal marketing plans were less used in the public sector to the private sector. Also, as public sector organisations are bureaucracies that must follow government-wide management directives, it was again not surprising that more of the management practices were in use on average, particularly in the small organisations.

Across the major industrial sectors of the private sector, the usage rates of each of the management practices were very similar. Consistently, the least used of the management practices was a formal plan for commercialisation of intellectual property. Small firms in a few specific industries such as utilities and finance and insurance two industries which are risk adverse had higher propensities to use written policies, strategies or plans for risk management. This is one of the few examples of industry-specific use of the selected management practices.

The introduction or modification of management practices is a form of organisational innovation. About four out of ten private sector firms that used the management practices had either introduced or modified these practices between 2002 and 2004, for the public sector it was about six out of ten. Technological innovation has been shown as important to firms' survival (Cefis and Marsili, 2006). Organisational innovation may also be important to firms' survival and potential for growth. It is interesting to note that there was very little difference in the levels of change rates across the selected management practices by firm size which suggests firms of all sizes using these management practices were similarly inclined toward organisational innovation. This also suggests that small firms implementing or changing these selected management practices may be positioning themselves towards growth or emulating how larger firms manage.

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Appendix 1: Methodology of the Survey of Electronic Commerce and Technology 2004 (SECT)

1. Introduction

The Survey of Electronic Commerce and Technology 2004 (SECT) is an annual survey in its sixth year. It collects information on communication and technology such as the use of computers, Internet and web sites, as well as the use of Internet to do electronic commerce from a sample of Canadian enterprises.

The collection began in November 2004 and data for the reference year 2004 was published in April 2005. The data are collected for the 12 month fiscal period for which the final day occurs on or between January 1, 2004, and December 31, 2004.

2. Coverage

The sample used for this survey covers most industrial sectors. These are described using the North American Industrial Classification System (NAICS). Some sectors are excluded such as:

A) **Sector 11 Sub-sector 111, 112, 114, 1151 and 1152** (Crop and Animal Production Industries, Fishing, hunting and Trapping industries, Support Activities for Crop and Animal Production industries),
B) **Sector 23 Sub-sector 238** (Construction –Specialist contractors),
C) **Sector 91 Sub-sector 913** (Local Governments),
D) **Sector 55 Sub-sector 551114** (Head office),
E) **Sector 81 Sub-sector 814** (Private households).

3. Survey Frame and Target Universe

The frame consists primarily of the Business Register (**BR**) developed by Statistics Canada. The sampling unit is the enterprise. For more information on the Business Register and the sampling unit, refer to Cuthill (1998).

An administrative list is also used to cover the public sector. This list is provided and maintained for the needs of the survey by the Science, Innovation and Electronic Information Division (SIEID) at Statistics Canada. These units are sampled with certainty.

Because of the dynamic nature of businesses and/or units missed by the frame used, some units may be added once the sample has been selected to obtain a better coverage for the desired reference year. These units are sampled with certainty.

The initial sampling frame contains approximately 1,924,000 enterprises.

Exclusions

Once the new universe is constructed, all units with income less than a certain limit are eliminated from the frame. We consider these units to have a negligible impact on electronic commerce. The exclusion allows us to reduce the response burden of small units.

The limit that delineates the out-of-scope units is determined as a function of industrial sector (NAICS), following the industrial level for publication. The limit is calculated in such a way that a maximum of 5% of the total revenue in the industrial sector becomes out-of-scope with a maximum exclusion threshold of $250,000.

After exclusion, the sampling frame contains approximately 709,000 enterprises. This frame is our target population.

4. Sampling

The sampling consists of stratification, allocation and sample selection that are described in the following text.

Stratification and Allocation

First, some units for which we expect very large sales over the Internet were identified. These predetermined units were to be selected with certainty and thus were removed from the stratification and allocation process described below.

The remaining units on the frame were first stratified by NAICS at the level required for estimation. Then, within each industrial level, we built three strata by size: large units which are sampled with certainty, and medium and small units, in which the sampling is conducted using a probability of selection. The size variable is the Gross Business Income for the private enterprises and the Number of Employees for the public enterprises.

The method used is the Lavallée-Hidirouglou algorithm (1988) which does the stratification and the sample allocation to strata by minimizing the sampling size while attaining the target CV based on the size variable (see section 8 for more details on CVs).

A sample of around 17,000 enterprises allows us to obtain a target CV of 6% in all industries except for the manufacturing, wholesale trade, retail trade, and transportation and warehousing sectors where a CV of less than 2.3% was targeted, these sectors being more favourable to electronic commerce.

Once the stratification and the allocation were done, we increased the sample size in some strata when necessary in order to obtain a minimum sampling fraction of 1% and a minimum of five units by stratum when possible. The next step is to select the sample of enterprises.

Selection

All predetermined units and all units in the take-all strata were selected with certainty, while a random sample was selected in the take-some strata under the constraint of maximizing the overlap with the previous year's sample. The Kish and Scott method (1971) was used and a global overlap of almost 72% with the last sample was obtained.

5. Collection and Data Editing

A questionnaire was mailed to enterprises and respondents were encouraged to complete and return it.

At data collection, some edits were applied to each questionnaire such as rules of consistency and historical edits. For more details on the edit rules, see Uhrbach (2004).

Units that had not responded or had answered incorrectly were subject to mail and fax follow-up to ensure the data was obtained. Also, some follow-ups were done by phone in order to increase the response rate and improve the representativity of the sample.

Follow-ups were done on questionnaires received to get data not reported, to correct inconsistencies in the data or to validate/correct data significantly different with historical data.

Finally, we prioritized the follow-ups by taking into account the response rate by industrial sector, the size of the enterprise, the importance of the missing variables and the kind of inconsistencies on the questionnaire.

The definition of response rate varies depending on the needs. We will give here the response rate based on responding units among units where a questionnaire was sent.

Units sampled: 16,983 enterprises
Units sent out for data collection: 15,843 enterprises
Responding units: 10,765 enterprises
Response rate: 68%

Some units selected are not sent for data collection. These are units where their status changed since the frame was created and/or are errors on the frame such as duplicates, out-of-business or out-of-scope. There is no interest to send these units for collection.

6. Outlier Detection

Outlier detection was done on the variable “Sales over the Internet” as collected in the 2004 survey. We also did outlier detection on the year over year difference between sales over the Internet in 2004 and in 2003. In both cases, the detection was made within groups formed according to the private/public sector and the industrial sector (NAICS-2 level) if there were at least 10 units in the group. Otherwise, the detection was done by private/public sector only. A method using the distance between observations was used (Nobrega, 1998).

For outlier detection on sales over the Internet for 2004, more than 50 units were detected as outliers. These units were analyzed and corrected as necessary. About 10 units were corrected. The units that are outliers and correct were promoted to a take-all stratum in order to represent only themselves. We consider that these units are misclassified during the sampling and do not correctly represent other units in the stratum. The selection probability for residual units was then recomputed.

For outlier detection on the year over year difference between sales over the Internet in 2004 and in 2003, about 20 units were detected as outliers. Most of these units had already been detected as outliers because of the value of their sales over the Internet. Those units had already been treated (see above paragraph). For remaining units, no treatment has been done: those units had a weight close to 1 and represented almost only themselves.

7. Edit and Imputation

Once the survey collection was closed, some records remained incomplete and/or inconsistent. The missing and/or inconsistent fields on these records were imputed. Globally, 4% of the fields were imputed due to missing data while 0.2% of the fields were imputed due to inconsistencies. Only partial questionnaires were imputed. In the case of total non-response, no imputation was performed. We simply reweighted responding units at estimation (see section 8. Estimation).

Many imputation methods were used: deterministic imputation, imputation using administrative data, historical imputation and donor imputation.

Deterministic imputation was used when answers from questions related to the question needing imputation lead to only one possible answer. 0.6% of the fields were imputed in this matter.

Imputation using administrative data was used to impute the question referring to the number of employees by using the number of employees available on the BR; 4.8% of the fields referring to the number of employees were imputed.

Historical imputation was used to impute some stable questions over time when the enterprise positively responded the year before. Only 106 fields were imputed under this method.

Donor imputation was finally used in the remaining cases to replace missing or incoherent values with those of the nearest respondent according to characteristics such as size, industrial classification and key variables from the questionnaire. We also checked to be sure that the imputed values did not affect the questionnaire’s consistency. Imputation was conducted within homogeneous groups, the initial imputation group corresponding to the stratum. If there were not at least 10 potential donors and 25% of donors in a group, or if imputation from all available donors would result in questionnaire inconsistencies, we moved to a more aggregated imputation group in the following order:
NAICS-3 level and size grouping;
NAICS-3 level;
NAICS-2 level and size grouping;
NAICS-2 level.
Private/Public Sector.

Note that outlier enterprises were excluded from the donor pool. When imputation was done, we adjusted the sales value over the Internet by the ratio of imputed and donor’s revenue; 3.5% of the fields were imputed by donors.

When we could not find a donor for an enterprise, it was manually imputed. This situation did not happen this year. Finally, when imputation was completed, we reapplied the initial edit rules to assure the consistency of all the questionnaires going into the estimation process. Imputation flags were created to keep information about imputed fields. Also, outlier detection was performed again on sales over the Internet as collected in 2004 and on the year over year difference between sales over the Internet in 2004 and in 2003 in order to detect outliers that could have been created during the imputation.

8. Estimation

Statistics Canada's Generalized Estimation System (GES) was used (see 2001 GES). The estimation was done in two phases: the first phase sample was the initial sample and the second phase sample was the respondents. The same stratification was used at both the first and the second phases.

Three types of estimates were produced:

1) In the case of **percentage variables (*P*)**, a ratio was used to derive an estimate.

$$\hat{P}_d = \frac{\sum_s w_i z_i p_i(d)}{\sum_s w_i z_i} \text{ where } p_i(d) = \begin{cases} p_i \; if \; i \varepsilon d \\ 0 \, otherwise \end{cases}$$

2) In the case of **categorical variables (*C*)**, again a ratio was used.

$$\hat{C}_d = \frac{\sum_s w_i z_i c_i(d)}{\sum_s w_i z_i} \text{ where } c_i(d) = \begin{cases} 1 if \; i \varepsilon \, d \; and \; the \; category \; was \; chosen \\ 0 \, otherwise \end{cases}$$

3) In the case of **numerical variables (Y)**, the usual estimator of the total was used.

$$\hat{Y}_d = \sum_s w_i y_i(d) \text{ where } y_i(d) = \begin{cases} y_i \; if \; i \varepsilon \, d \\ 0 \, otherwise \end{cases}$$

The variable w_i represents the final weights of the unit i after reweighting to take into account the non-response. The variable z_i is the auxiliary variable that may be revenue, the number of employees or others depending on the variable being estimated. This variable, if used, allows us to produce economically weighted estimates which give more weight to large units.

For formulas for variance estimation of a two-phase design for each type of variable (*P*, *C* and *Y*), please refer to Arcaro (1998).

Calculation of CV

The coefficient of variation (CV) is computed using the ratio:

$$CV(\hat{Y}(d)) = \frac{\sqrt{\hat{V}(\hat{Y}(d))}}{\hat{Y}(d)}$$

where the numerator represents the estimate's standard deviation. Variable Y may represent any of the types of variables already discussed. However, in cases of percentage or categorical variables, we modified the CV calculation by using Y(d)=0.5. This way, we avoid getting very small or very large CVs due to Y(d) being close to 1 or close to 0.

This coefficient tries to give a relative measure of the error made when using a sample instead of using a census to derive an estimate about the whole population.

9. Confidentiality

Some confidentiality rules were used to suppress any information that might lead to disclosure of the data supplied by a respondent. These rules allow Statistics Canada to comply with its mandate of non-disclosure of information supplied by respondents. The rules themselves are confidential and are not available for consultation.

10. Sampling Error and Non-Sampling Error

The difference between an estimate based on sample data and the value obtained by surveying the entire population is called the sampling error. This difference varies with sample size, variability of the variable of interest, sampling design, and estimation method. In general, the larger a sample, the smaller its sampling error. If the population is very heterogeneous, a larger sample size is required to produce a reliable estimate.

The sampling error is measured by a quantity known as the standard deviation. The latter indicates the expected variability of the estimate that would be produced if we sampled repeatedly. The actual value of the standard deviation is unknown, but it can be estimated from the sample.

Another measure of precision is the coefficient of variation (CV). The CV is simply the standard deviation expressed as a percentage of the estimate. Hence it is a relative measure of precision and can be used for comparisons across industries or provinces. The smaller the CV, the more reliable the estimate.

As well as sampling error, there are non-sampling errors such as frame problems, response errors, data capture errors, etc. Although every effort is made to keep such errors to a minimum, they always exist. They are not taken into account in computing the CV. Measures such as response rate, coverage rate, imputation rate and non-response studies (Duval, 2004) can be used as indicators of the possible extent of non-sampling errors.

Here are some results of the response rate among the 16,983 enterprises sampled:

Questionnaires completed: 46%
Questionnaires partially completed: 14%
No response before deadline: 28%
Unable to locate: 8%
Out-of-scope or out-of-business: 4%
Refusal: 0%

When the estimates are published, a scale distinguishes between the various qualities of accuracy. It combines the effect of sampling (using the CV) and the imputation rate (each imputed value adds to the uncertainty of the results). The scale is presented in Table 6.

Table 6 Quality indicator interpretation

	Imputation rate			
CV	0.00 to 0.10	0.10 to 0.33	0.33 to 0.60	0.60 and higher
0.00 to 0.05	A	B	C	F
0.05 to 0.10	B	C	D	F
0.10 to 0.15	C	D	E	F
0.15 to 0.25	D	E	F	F
0.25 to 0.50	D	F	F	F
0.50 and higher	F	F	F	F

A: Excellent B: Very good C: Good
D: Acceptable E: Use with caution F: Unpublishable

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