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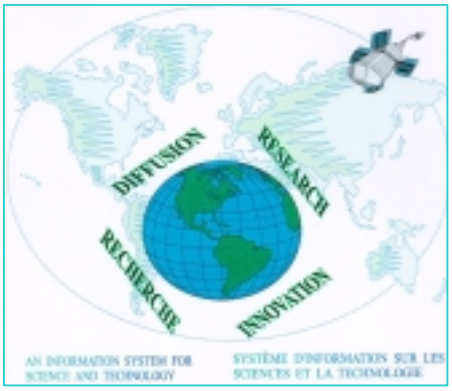
Innovation and Change in the Public Sector: A Seeming Oxymoron



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Innovation and Change in the Public Sector: A Seeming Oxymoron

Survey of Electronic Commerce and Technology, 2000

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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


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Preface

Innovation and the adoption and dissemination of technologies and practices are vital to economic growth and development. It is through innovation that new products are introduced to the market, new production processes are developed and introduced, and organisational changes are made. Through the adoption of newer, more advanced, technologies and practices, industries can increase their production capabilities, improve their productivity, and expand their lines of new 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, 1997 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 the innovation and advanced technologies and practices in the construction sector. And finally, a number of surveys have focused on the use and planned use of advanced technologies and practices: surveys of advanced manufacturing technologies were carried out in 1987, 1989, 1993 and 1998; and surveys of the use and planned information and communication technologies were carried out in 1999, 2000 and 2001.

The Electronic Commerce and Technology Survey 2000 contains two questions on organisational and technological improvements. These two questions provide the first cross-economy data on this issue, covering both firms in the private sector and organisations in the public sector. This working paper is the first several and will examine organisational and technological improvements in the public sector.

Acknowledgements

This report provides new Statistics Canada estimates of technological and organisational change based on information obtained from the Survey of Electronic Commerce and Technology, 2000. 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 by the contribution of many people including the methodologists and analysts supporting the Survey of Electronic Commerce and Technology as well as Mary-Ann Clarke-Wilkinson, Claire Racine-Lebel, Frances Anderson, Daood Hamdani and Fred Gault.

1. Introduction

The public sector is often considered staid and unchanging. Based on recent findings, this perception may need to be updated. Four-fifths of Canadian public sector organisations introduced significantly improved organisational structures or management techniques between 1998-2000. This rate of introduction of organisational change is twice that recorded by the private sector (38%). The public sector also led the private sector overall in the introduction of significantly improved technologies: 85% versus 44%. Structural differences between the private and public sectors may impact the rates of introduction of improved organisational structures and technologies for the sectors.

This paper is based on information from the 2000 Survey of Electronic Commerce and Technology (SECT) (see Annex for more details on the survey) and concentrates on the introduction of organisational and technological change in the public sector. To provide context, comparisons are made to the rates of introduction of organisational and technological change in the private sector. Rates of organisational and technological change in the public sector by employment size groups are presented. Finally, the paper concludes with a look at these changes in the public sector based on industrial classification.

2. Definitions of Organisational and Technological Change

Organisational change is defined by a positive response to this question from SECT, 2000:

> "During the last three years, 1998 to 2000, did your organisation introduce significantly improved organisational structures or implement improved management techniques?"

An additional question on training due to organisational change was asked.

> "If yes, did these improvements require training?"

The following two questions determined if firms were involved in technological and, if so, how were they involved:

> "During the last three years, 1998 to 2000, did your organisation introduce significantly improved technologies?"
>
> "If yes, how did you introduce significantly improved technologies? (*Check all that apply*)
>
> - by purchasing off-the-shelf technologies?
> - by licensing new technologies?
> - by customising or significantly modifying existing technologies?
> - by developing new technologies? (either alone or in conjunction with others)"

An additional question on training due to technological change overall was asked. (The question did not refer specifically to the type of technological change.)

"Did any of these improvements require training?"

3. Public Sector Organisational and Technological Change

In 2000, about one-tenth of private sector firms employed more than 20 people whereas the opposite was true for the public sector in which about one-tenth of organisations employed less than 20 people (See Table 1).

Introduction of change – either organisational or technological – had higher rates of occurrence in larger firms or organisations (See Table 2). The introduction of improved technologies in the private sector generally lagged that of the public sector. However, the lower overall rate for technological change recorded in the private reflects the low adoption rates for small firms that represent the majority of firms within the private sector. When firms and organisations of the same size are compared, the rates of introduction of technological change for firms and organisations of at least 100 employees varied little between the private and public sectors. This may be partly due to the costs associated with introducing technological change such as training and loss of productivity while the change is occurring. Smaller firms may find it more difficult to afford the effort required in undertaking technological change while maintaining a positive cash flow.

Table 1: Distribution of Private and Public Sector Enterprises, by Employment Size Groups, 2000

	Private Sector		Public Sector	
Employment Size Group	**Number of Enterprises**	**% of Enterprises**	**Number of Enterprises**	**% of Enterprises**
0	90,202	16.4%	-	-
1-19	394,063	71.5%	91	11.1%
20-49	40,548	7.4%	40	4.9%
50-99	13,757	2.5%	118	14.4%
100-299	8,091	1.5%	141	17.2%
300-499	1,873	0.3%	78	9.5%
500+	2,369	0.4%	352	42.9%
Total	550,903	100.0%	819	100.0%

Table 2: Percentage of Private and Public Sector Enterprises Introducing Organisational and Technological Change, by Employment Size Group, 1998-2000

PRIVATE SECTOR				
Employment Size Group	**Organisational Change**		**Technological Change**	
	% of firms	**Reliability***	**% of firms**	**Reliability**
0	18.1%	B	20.4%	B
1-19	37.5%	B	44.0%	B
20-49	65.6%	C	68.5%	B
50-99	71.5%	C	73.1%	C
100-299	84.6%	C	88.4%	C
300-499	68.7%	E	65.3%	E
500+	85.5%	C	92.3%	C
Total	38.3%	B	43.6%	B
PUBLIC SECTOR				
Employment Size Group	**Organisational Change**		**Technological Change**	
	% of firms	**Reliability**	**% of firms**	**Reliability**
0	-	-	-	-
1-19	97.6%	A	97.6%	A
20-49	61.5%	B	73.4%	B
50-99	90.2%	C	32.5%	E
100-299	60.6%	B	87.6%	A
300-499	72.5%	A	90.8%	A
500+	80.3%	A	97.3%	A
Total	78.6%	B	84.6%	D

*For an explanation of the reliability codes, see Annex 1.

In the public sector the rates of introduction of change – both technological and organisational – in this period varied somewhat by employment size group with the smallest administrations having the highest rates. For organisational change, almost every small administration (1-19 full-time employees) recorded some change between 1998 and 2000. This higher rate of organisational change seen in small administrations (98%) as compared to 80% for large administrations (500+ full-time employees) may be a product of employment size since implementing new management techniques or organisational structural changes may be more difficult for larger administrations.

Regulatory requirements that govern public sector organisations may inhibit organisational change. [1] However, when faced with the high rates of organisational change recorded by the public sector, perhaps further enquiry into the type of organisational changes and adoption of new management techniques is required.[2] In fact, the high rates of organisational change seen in the public sector across all employment size groups may reflect the regulatory environment that can impose organisational change and new structures from the centre on all public administrations within its jurisdiction.

Supposedly, the competitive environment in which private sector firms operate should influence the willingness to adapt new management techniques and organisational structures that they perceive will give them a competitive advantage/edge. However, in the private sector firms with less than 20 employees appeared to be less inclined towards organisational change. This lowered the rate of adoption of organisational change for the entire private sector. These findings concur with those published for establishments with less than 20 employees based on the Workplace Employee Survey, 1999 (WES). According to WES, the incidence of organisational change implemented by establishments also increased by employment size.[3] Management techniques and structures may evolve in small firms that often do not have the need for structured hierarchies and formal organisational structures including policies and strategies.

Within the public sector, no apparent pattern for adoption of organisational change occurred by employment size group. Perhaps this reflects central direction of small and medium size public administrations by larger central organisations. For example, the 1990s saw the federal government-wide policy of "delayering". Such policy is not made for the private sector. In fact, the private sector saw an increase in the rates of adoption

[1] Peter Holle in "Let civil servants work efficiently" (***Winnipeg Free Press***, November 14, 2001 p. A13) while commenting positively on Special Operating Agencies suggests the traditional public sector is characterized by "ponderous regulations and archaic operating systems".

[2] Detailed information on the types of organisational structural improvements or new management techniques was not asked in the survey.

[3] Leckie et al (2001). Table1.1 p. 12. For WES, 1999 organisational change included: integrating different functional areas; modifying the degree of centralisation; downsizing; relying more on temporary and/or part-time workers; re-engineering; increasing overtime hours; adopting flexible working hours; reducing the number of managerial levels; relying more on job rotation and/or multi-skilling; implementing Total Quality Management; outsourcing; collaborating more on interfirm R&D, production or marketing." Establishments and enterprises are two different units for collection analysis so caution must be used when making comparisons. However, "in the case of most small and medium-sized businesses, the enterprise and the establishment are identical" (Statistics Canada, 1998, p. 9).

between small and medium size enterprises with the rate levelling off at about 85% for medium and large firms.

4. Training When Technological or Organisational Change is Introduced

Introducing change, either technological or organisational, often requires training. In the period 1998-2000, four-fifths of the public sector enterprises that introduced organisational change provided training related to these changes (See Table 3). Similarly, public sector enterprises found that technological change also required training. In fact almost every technological change introduced included the extra cost of training with 98% of those public sector institutions that introduced technological change accompanying the change with training. The rate of training provided by private sector firms once again lagged at 74% for organisational change and 72% for technological change. Again the differences in providing training between the public and private sector could reflect operating environments. Training is costly. Whether or not employees are trained depends to a certain extent upon costs-benefits. For smaller firms, the introduction of organisational change was less likely to have been accompanied by training.

Table 3: Percentage of Firms Introducing Technological or Organisational Change Which Undertook Training in the Private and Public Sectors, 1998-2000

	Training for Organisational Change		Training for Technological Change	
	% of firms	**Reliability**	**% of firms**	**Reliability**
Public Sector	79.9%	D	97.9%	A
Private Sector	73.6%	B	72.4%	B

Public sector employment is almost always accompanied by union representation[4] and perhaps this explains in part the higher rates of training accompanying change. The presence of unions may influence rates of training as WES, 1999 found that workplaces with unions had higher training rates than those workplaces without unions (Leckie et al. 2001, p. 23).

Labour turnover also had an interesting impact on training according to WES. Establishments with no labour turnover had low training rates whereas establishments with low to medium turnover rates had high training rates and those with high turnover rates had medium training rates (Leckie et al. 2001, p. 21). Finally, workplaces with more professional employees were more likely to provide training than those workplaces with fewer professional positions. Training accessibility depends in part upon the firm's philosophy and strategy. Some firms may use short-term or contract employment to obtain and utilise specific skills. These short-term or contract workers are then let go

[4] Public sector employees – "government, crown corporations, and publicly funded schools or hospitals – were almost four times as likely as their private sector counterparts to belong to a union (70.1% versus 18.4%)" (Akyeampong, 2001, p. 47). For the private sector, the unionisation rate stood at 18.7% whereas for the public sector a rate of 69.9% was recorded in 2000 (Akyeampong, 2001, p.46.).

when their skills are no longer required. Also, some firms may not see the benefits of investing in upgrading of employees as these employees then have new skills that they can market.[5]

5. Methods of Introducing Technological Change

Four methods of introducing technological change are available from the Survey of Electronic Commerce and Technology, 2000. These are purchasing off-the-shelf technologies; licensing of new technologies; customising or significantly modifying existing technologies and developing new technologies (either alone or in conjunction with others).[6] Not surprisingly, introducing off-the-shelf technologies was the most popular of the methods employed to introduce technological change with both the public and the private sector (See Table 4). In fact, 85% of public sector organisations that introduced technological change purchased off-the-shelf technologies (73% for the private sector). Customising or significantly modifying existing technologies ranked second at 52% for the public sector and 41% for the private sector. Overall, the public sector's use of licensing new technologies at 43% far out-stripped that of the private sector at 15%. Finally for the public sector, developing new technologies was the last choice at 31% (18% in the private sector).

[5] See Baldwin and Johnson "Human Capital Development and Innovation: A Sectoral Analysis" for an argument on the role of training to firm's strategy. They conclude that formal training leading to labour skills upgrading is more likely to occur in the dynamic services sector rather than in manufacturing sector that relies on technology and research and development (R&D) strategies. The difference between the sectors is that the dynamic services sector is human capital intensive and therefore relies on labour skills, technology and R&D. This in turn differs from traditional services that look to labour skills and quality strategies for innovation. Scheutze in "How Do Small Firms Innovate in British Columbia?" argues that training information for small firms is poorly captured by cross-economy surveys. Such surveys generally capture formal training and do not include informal methods such as on-the-job training or learning. While the SECT did not differentiate between formal and informal training, the term itself may be interpreted as implying a formal structure. DeBroucker's work highlights this point by showing that the participation rate in employer-supported training increases with company size (p. 28). However, the trend of smaller firms providing less training repeats in the Workplace Employee Survey with just a quarter of establishments of less than 20 employees providing on-the-job training in 1999 (Leckie et al, p.20). Hamdani also refers to "the process of creative destruction in the economy (that) offers firms an opportunity to attract workers equipped with knowledge and skills accumulated at the competitors' expense." (Hamdani, p.14)

[6] Organisations that introduced significantly improved technologies solely through leasing would not have been able to respond to the questions on methods of introducing technologies.

Table 4: Types of Technological Change Introduced in the Private and Public Sectors, 1998-2000, All Firms and Firms With 500 or More Employees, 1998-2000

ALL FIRMS				
	Private Sector		Public Sector	
	% of firms	Reliability	% of firms	Reliability
Purchase of Off-the-Shelf Technologies	72.6%	B	85.4%	A
Licensing New Technologies	14.6%	B	43.4%	B
Customising or Significantly Modifying Existing Technologies	41.2%	B	51.9%	C
Developing New Technologies	18.2%	B	31.4%	B
FIRMS WITH 500 OR MORE EMPLOYEES				
	Private Sector		Public Sector	
	% of firms	Reliability	% of firms	Reliability
Purchase of Off-the-Shelf Technologies	86.8%	C	87.8%	A
Licensing New Technologies	43.6%	E	58.5%	A
Customising or Significantly Modifying Existing Technologies	70.0%	D	65.5%	A
Developing New Technologies	47.4%	E	42.4%	A

The value that organisations place on the ease of using or implementing already developed and supported technologies is shown in the high introduction rates for off-the-shelf technologies. Customising or developing new technologies requires dedicated resources including what can become extended periods of time, both of which are costly. Therefore, new development and customisation of technologies are often the choices of last resort particularly in smaller organisations. In both the public and private sectors, organisations with more than 500 employees had the highest rates for developing new or customising technologies.

6. Rates of Organisational and Technological Change and Training for Major Groups within the Public Sector

The Survey of Electronic Commerce and Technology provides information on three major groups within the public sector: educational services; health care and social assistance; and public administration. Organisations in health care and social assistance comprised over two-thirds of the organisations within the public sector (See Table 5). The remaining third is split quite evenly between educational services and public administration.

Table 5: Distribution of Public Sector Enterprises, by Major Group, 2000

	Number of enterprises	Distribution of enterprises
Educational Services	138	16.8%
Health Care and Social Assistance	556	67.8%
Public Administration	126	15.4%
Federal Government Public Administration	*(54)*	*(42.9%)*
Provincial and Territorial Public Administration	*(68)*	*(54.0%)*
Total Public Sector	819	100.0%

Very little difference was recorded in the rate of introduction of organisational change between the three public sector groups (See Table 6). However, the introduction of technological change in health care and social assistance (79.9%) fell short of that of either educational services (92.9%) or public administration (95.8%). Again this may be a factor of employment size. Almost two-thirds of the public administration's organisations and just over one-half of those in educational services employed more than 500 people. However, for health care and social assistance slightly more than one-third fell in this employment size category. Also, technologies used by the public health care system include very expensive medical devices that may have longer "shelf-lives" than other technologies. Hamdani commented upon this factor in his study on the Canadian engineering services industry (Hamdani, p. 20).

Table 6: Percentage of Public Sector Enterprises Introducing Organisational and Technological Change, by Major Group, 1998-2000

	Organisational Change		Technological Change	
	% of firms	**Reliability**	**% of firms**	**Reliability**
Educational Services	75.8%	B	92.9%	A
Health Care and Social Assistance	79.7%	B	79.9%	D
Public Administration	77.0%	C	95.8%	A
Federal Government Public Administration	*(86.0%)*	*C*	*(100.0%)*	*B*
Provincial and Territorial Public Administration	*(68.5%)*	*B*	*(92.3%)*	*A*

Again, when employment size is held constant for the three groups within the public sector, differences in adoption rates of organisational or technological change diminish. For instance, the rate of introduction of organisational change for organisations with more than 500 employees stood at 82.2% for educational services, 80.4% for health care and social assistance and 78.4% for public administration. For the same size of organisation, the rates for technological change were respectively 98.6%, 95.6% and 100%! (See Table 7).

Table 7: Percentage of Enterprises with More than 500 Employees Introducing Organisational and Technological Change, by Major Group, 1998-2000

	Organisational Change		**Technological Change**	
	% of firms	**Reliability**	**% of firms**	**Reliability**
Educational Services	82.2%	B	98.6%	A
Health Care and Social Assistance	80.4%	A	95.6%	A
Public Administration	78.4%	C	100.0%	A

Training rates for change, either organisational or technological, in all three groups of the public sector were generally high (See Table 8).

Table 8: Percentage of Firms Introducing Organisational or Technological Change Which Undertook Training, by Major Group, 1998-2000

	Training for Organisational Change		**Training for Technological Change**	
	% of firms	**Reliability**	**% of firms**	**Reliability**
Public Sector: Total	79.9%	D	97.9%	A
Public Sector: 500+ full-time employees	88.1%	A	99.2%	A
Educational Services	91.7%	B	96.6%	A
Health Care and Social Assistance	75.9%	E	98.3%	A
Public Administration	85.2%	B	97.9%	B

Within the three groups in the public sector some difference occurred in the rate of introduction of the four types of technological change. Purchasing off-the-shelf technologies rated first with all three groups at about 85% usage rate. For health care and social assistance licensing new technologies and customising or significantly modifying existing technologies almost tied for second leaving developing new technologies to place last. However, both educational services and public administration had higher rates for customisation than for licensing. And over half of the organisations in public administration developed new technologies, either alone or in conjunction with others.

7. A Comparison of the Public and Private Faces of Education and Health Care

Education and health care are activities carried out by both the public sector and the private sector. Overall, public sector educational and health care institutions are more likely to have adopted technological and organisational change than their private sector counterparts. However, once again firm size plays an important role in levelling adoption rates between the public and private sector. In fact, adoption rates for organisational change and technological change barely differed between private sector organisations with more than 500 employees and public sector administrations of the same size in either educational services or health care and social assistance (See Table 9).

Table 9: Percentage of Enterprises Introducing Organisational and Technological Change in Educational Services and Health Care in the Private and Public Sector, 1998-2000

Public Sector Enterprises				
	Organisational Change		**Technological Change**	
Educational Services				
	% of firms	**Reliability**	**% of firms**	**Reliability**
All enterprises	75.8%	B	92.9%	A
1-19 full-time employees	71.4%	D	71.4%	C
20-99 full-time employees	56.1%	C	74.3%	B
100-499 full-time employees	73.9%	B	94.7%	A
500+ full-time employees	82.2%	B	98.6%	A
Health Care and Social Assistance				
All enterprises	79.7%	B	79.9%	D
1-19 full-time employees	100.0%	A	100.0%	A
20-99 full-time employees	88.0%	C	33.1%	E
100-499 full-time employees	61.0%	B	87.2%	A
500+ full-time employees	80.4%	A	95.6%	A
Private Sector Enterprises				
	Organisational Change		**Technological Change**	
Educational Services				
	% of firms	**Reliability**	**% of firms**	**Reliability**
All enterprises	52.1%	D	54.4%	D
1-19 full-time employees	51.8%	D	55.6%	D
20-99 full-time employees	56.9%	E	55.8%	E
100-499 full-time employees	96.0%	C	98.6%	B
500+ full-time employees	72.9%	D	100.0%	B
Health Care and Social Assistance				
All enterprises	50.2%	C	49.5%	C
1-19 full-time employees	48.9%	C	50.0%	C
20-99 full-time employees	82.7%	E	69.0%	E
100-499 full-time employees	96.2%	B	-	F
500+ full-time employees	81.7%	D	100.0%	B

8. Concluding Remarks

Organisations faced many technological issues during the period 1998 – 2000 that may have required significant technological change. For instance, during the years running up to "Y2K" (Year 2000) many organisations adopted new technologies and adapted existing technologies to ensure that their systems remained operational. This activity surrounding conformity to Y2K, could have positively impacted the rate of technological

change in the period under study.[7] And since many larger organisations use custom systems, this phenomenon may also be partly the cause of the higher rates for customisation of existing technologies and development of new technologies seen in larger administrations. However, Y2K and information communication technologies should not overshadow the use and investment in other technologies by firms and organisations.

The years 1998 – 2000 saw much organisational and technological change in the public sector, most particularly within larger administrations. In fact, when employment size is taken into account, the public sector led the private sector in technological change and more than kept pace in organisational change. Some of the reasons for the high rate of technological change within the public sector could be due to conformity issues caused by Y2K. However, while Y2K was a preoccupation, e-governance has also come to the forefront. E-governance impacts how government agencies interact with constituents as well as how the agencies themselves operate. Similarly, the inter-play between universities and industry involving the transfer of not only knowledge and skilled workers but also of technology and research is coming to the forefront in policy pursuits. Many of these initiatives that might have impacted technology adoption could have been facilitated through research networks sponsored by the public sector.

The educational systems are also undergoing change that in part is facilitated by information communication technologies (**Facsimile**, Numbers 23 to 25, May 2001). Many educational initiatives depend upon classroom adoption of technologies. For instance, distance learning initiatives such as Pinchas Zukerman's work with music students are often in the press.[8] Also, educational institutions are offering courses and teaching resources by television and the Internet including SchoolNet.[9]

[7] The report from the February 1999 Survey on Canada's Preparedness for the Year 2000 Computer Problem indicated that small firms were less likely to have taken a structured multi-phased plan or less formal approach to ensure that their technology would function correctly in when the date changed to the Year 2000 than medium or large firms. See Brunet, Johnston and Wolfe for more information.

[8] Mr. Zukerman's biography states he "has pioneered the use of distance-learning technology in the arts." www.skassoc.com/biozukerman.htm. Margret Brady reported in "A brave new future for teaching music: Virtual classes" (***Financial Post***, April 18, 2001 E04) on Mr. Zukerman's collaborative work with the National Research Centre and Canarie Ince. In a monitored experiment, Mr. Zukerman from Ottawa taught a violin student in Montreal using the advanced video conferencing technologies. See also "Virtual reality takes a bow in teaching concert proteges: Tele-Virtuoso" by Colin Grey in the ***National Post*** August 14, 2000 E04.

[9] SchoolNet activities are widely reported in the media. Recent initiatives include the October 2, 2001 signing of a Memorandum of Understanding on learning technologies between Industry Canada and the Dutch Ministry of Education, Culture and Science. For information on SchoolNet see www.schoolnet.ca/nis-rei. Of interest some Canadian universities offer MBA and eMBA programs through Internet-based study, see Yahoo! Distance Learning.

New health services including pioneering surgery work in which a surgeon operated on a patient in another location using robotics highlights some of the advances in medical technologies.[10] And health information is highly sought after commodity on the Internet. [11] All of these initiatives to some extent explain high rates of organisational and technological change in the public sector.

The Canadian public sector, based on rates of organisational and technological change, is not staid and unchanging. Rather it is innovative and adaptive. The public sector is leading the way in both organisational and technological change.

[10] November 7, 2001 saw reports of long distance robotic surgery taking place in Canada. See Canadian Press articles including "Long-distance surgery amazes" in the ***Fredericton Daily Gleaner***, p. D8.
[11] Health information was the third most common reason households used the Internet in 2000 coming in behind e-mail and general browsing. (***The Daily***, July 26, 2001.) Due to the popularity of health information over the Internet, the American Health Information Resource Center semi-annually gives out its World Wide Web Health Award (see "HealthSCOUT is Recognized as an Industry Leader for Online Health Information," ***Business Wire***, Monday December 20, 1999.) The role of computerisation of medical profession is discussed in "Information, Computerisation and Medical Practice in France at the End of the 20th Century" (pp. 183-192) in ***Knowledge Management in the Learning Society***.


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Annex 1: Methodological Note

Industries are classified using the North American Industrial Classification System (NAICS). For the purposes of this paper, the public sector comprises enterprises in education services (NAICS 61), health care and social assistance (NAICS 62) and public administration (NAICS 91 excluding 913 local, municipal and regional public administration) that are publicly administered.

The 2000 Survey of Electronic Commerce and Technology (SECT) collected information on organisational and technology improvements among private and public sector enterprises. The survey covered all economic sectors, with the exception of agriculture and construction. The findings are based on a sample of approximately 21,000 enterprises with a response rate of 77% representing 93% of economic activity.

> The collection entity for the survey was the *enterprise*. This differs from production surveys that are typically establishment-based. An enterprise is the "organisational unit of a business that directs and controls the allocation of resources relating to its domestic organisations, and for which consolidated financial and balance sheet accounts are maintained…." (**NAICS,** Statistics Canada, 1998, p. 9).

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When estimates are published, a scale distinguishes between the various qualities of accuracy. It combines the effect of sampling (using the coefficient of variation) and the imputation rate (each imputation adds to the uncertainty of the results). The coefficient of variation 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. The imputation rate reflects the amount of imputation that took place to correctly fill and ensure consistency within records. Amongst all records to be imputed, there were some that were incomplete (but partially filled out), some that had invalid response patterns and finally some that did not satisfy edit rules. Many imputation methods were used: imputation using administrative data, historical imputation and donor imputation. Every record was identified and completed in order to change the respondents' answer by the least amount possible

Quality Indicator Interpretation

	Imputation Rate			
Coefficient of Variation	0.00 – 0.10	0.10 – 0.33	0.33 - 0.60	0.60 - +++
0.00 – 0.01	A	B	C	F
0.01 – 0.05	B	C	D	F
0.05 – 0.25	C	D	E	F
0.25 – 0.33	D	E	F	F
0.33 – 0.50	E	F	F	F
0.50 - +++	F	F	F	F

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