

Computers in the workplace

Graham S. Lowe

Debates about the effects of information technology on work present many conflicting images. Critics envision an information age marked by mass unemployment and dehumanized work for those remaining in the workforce. Advocates counter that such technology offers the potential to create a post-industrial economy of skilled workers. These debates replay themes first articulated over two decades ago.¹ Two issues remain largely unresolved: the actual pace of change and the manner in which the move toward a service-based, increasingly technological economy has affected job content and security.

Discussions of new information technology (IT) – what most people associate with personal computers – typically assume that its rate of adoption and diffusion is rapid and accelerating, resulting in significant implications for workers, firms and the economy as a whole. Indeed, the technology seems to have changed Canadian industry considerably.²

Using two cycles of the General Social Survey (GSS), this article examines changes in workers' computer literacy between 1989 and 1994, as well as growth in computer use in the workplace. It also looks at the effects of technology on job content and security.

Statistics Canada's 1989 GSS provided a detailed review of workplace computerization since 1984, documenting mainly positive responses to questions about job content and job security (Lowe, 1991 and 1992). Its benchmark measures were repeated in the 1994 GSS, for which comparisons were made with 1989 (see *Data source*).

Graham S. Lowe is with the Department of Sociology at the University of Alberta. He can be reached at (403) 492-0487.

Data source

The 1994 General Social Survey (Cycle 9) used a random sample of 11,500 individuals. The sample size of the 1989 GSS (Cycle 4) was 9,338. The data were weighted to the non-institutionalized population aged 15 and over in the 10 provinces. Both surveys were conducted by telephone and had high response rates: 80% in 1989 and 83% in 1994. GSS samples are sufficiently large and representative of adults living in the 10 provinces that estimates for the total adult population are possible. For reasons of sampling variability, questionnaire design, methodology, and so on, estimates from the two sources will differ. However, these differences are not large enough to alter the conclusions drawn.

The GSS asked respondents three questions regarding their ability to use a computer. Respondents were first asked, "Have you ever taken any courses on how to use computers?" Given that taking a computer course is neither a prerequisite for being able to use a computer nor an indicator of computer skills, a second question was posed in 1994: "Can you do anything on a computer (excluding video games [like] Nintendo), for example, word processing, or data entry?" In 1989, the question on ability to use computers included computer games: "Can you do anything on a computer, for example, play games, word processing or data entry?" Respondents who could use a computer were asked which of the following they had done in the 12 months prior to the survey: played games, engaged in word processing, data entry, record keeping, data analysis or programming, used an online data service

(asked in 1994 only), or anything else. Not asked was the location – home, workplace, educational institution, or some combination – for each activity.

The GSS measured workplace computer use with the following question, asked of respondents who were working at a job or business at the time of the survey: "Do you use computers such as mainframes, personal computers or word processors in your job?" This question captured data on information processing technology, particularly office automation, which has accounted for most workplace technological change since the 1980s (McMullen, Leckie and Caron, 1993). However, the GSS does not examine the use of new industrial technologies such as robots, computer-controlled machines, computer-assisted manufacturing, automated materials handling systems, point-of-sale terminals, and mobile special-use computers used by a range of workers such as utility meter checkers, couriers, travelling sales representatives, and so on.

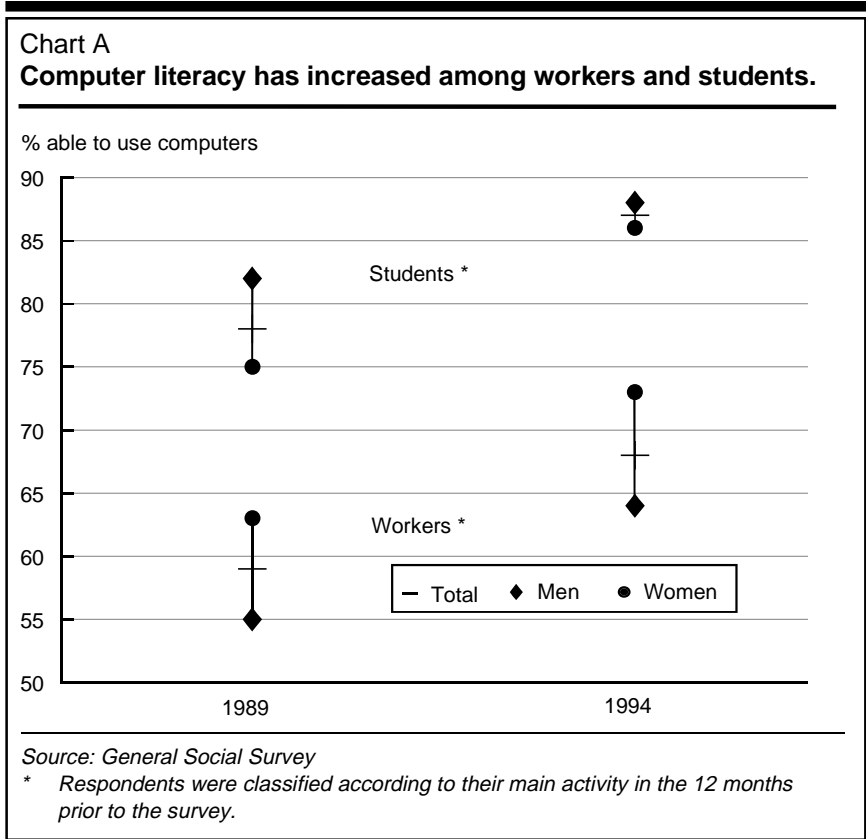
The survey adopted a broader focus when assessing the effect of technological change in the preceding five years. Employed respondents were asked, "In the last five years, how much has your work been affected by the introduction of computers or automated technology? Would you say...greatly? somewhat? hardly? not at all?" Those who answered "greatly" or "somewhat" were then asked a series of questions designed to determine the perceived effect of computers or automated technology on job skills, job security, and intrinsic interest in the last five years.

Computer literacy of workers and students

According to survey respondents, computer literacy among the employed³ increased from 59% to 68% between 1989 and 1994 (Chart A). Comparable figures for students are

78% and 87%.⁴ This increase is evident for both sexes.

Most types of computer use have been increasing among workers. Specifically, the use of word processing, data entry, record keeping, and data analysis rose during the period, while



among 15 to 19 year-old workers and most among those over age 45.

Workplace computerization shows considerable provincial variation. Alberta, British Columbia and Ontario had levels above the national average and experienced the largest gains in such activity between 1989 and 1994. Two provinces with low levels of computer literacy, Newfoundland and New Brunswick, also had low levels of computer use on the job.

The IT revolution seems to have penetrated further into workplaces than into homes or elementary and secondary schools. Between 1986 and 1996, home computer ownership increased three-fold, from 10% to 32% of all households (Statistics Canada, 1997). Yet the ratio of students per computer remains poor at the elementary and secondary levels, despite the relatively high computer literacy of 15 to 19 year-olds (Oderkirk, 1996). Similar data for postsecondary institutions are unavailable, although it

programming and playing computer games have both declined (Chart B). One in five workers reported having used the Internet in 1994 (not documented in the 1989 GSS).

Computer use on the job

In 1994, 48% of employed persons (6.2 million) used a computer (personal computer, mainframe or word processor) at work, a marked increase from 35% in 1989 (Table 1). Women were more likely than men to use computers on the job in both years. Despite their high levels of computer literacy, young workers (15 to 19 year-olds) were the least likely of any age group to do so (16%), perhaps because many of those who were employed worked in lower-level service jobs. On-the-job computer use was highest in the 25-to-34 and 35-to-44 age groups, especially among women (60% in both age groups). Workplace computer use over the five years increased in all age groups – least

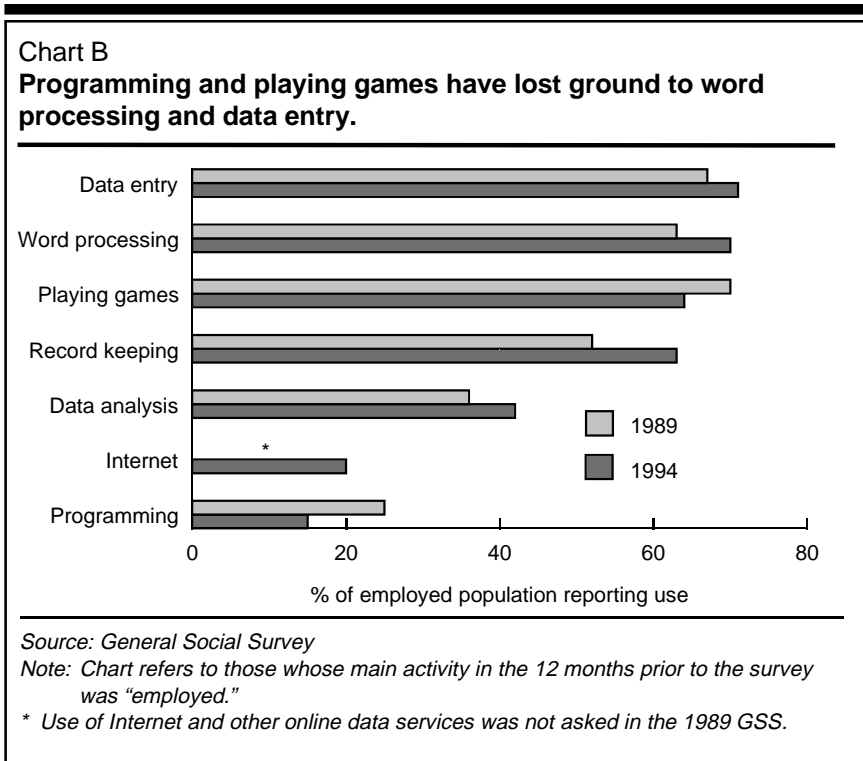


Table 1
Computer use on the job, by sex, age and province

	Use of computers on the job			
	1989		1994	
	Number of users	% of employed	Number of users	% of employed
	'000	%	'000	%
Both sexes				
All age groups	4,212	35	6,202	48
15-19	101	13	109	16
20-24	407	30	528	41
25-34	1,465	41	1,857	53
35-44	1,318	42	1,975	55
45-54	652	32	1,256	48
55-64	261	23	420	38
65 +	--	--	57	24
Men				
All age groups	2,152	32	3,188	44
15-19	52	13	58	16
20-24	167	24	259	39
25-34	734	37	933	48
35-44	699	41	963	50
45-54	345	30	684	46
55-64	152	22	253	39
65 +	--	--	38	24
Women				
All age groups	2,060	38	3,014	52
15-19	49	13	51	16
20-24	240	36	269	44
25-34	731	46	924	59
35-44	618	44	1,013	60
45-54	306	35	572	50
55-64	110	25	167	38
65 +	--	--	--	--
Canada				
	4,212	35	6,202	48
Newfoundland	48	29	82	41
Prince Edward Island	--	--	--	--
Nova Scotia	132	34	175	45
New Brunswick	85	28	111	37
Quebec	940	32	1,294	42
Ontario	1,785	37	2,658	52
Manitoba	163	33	209	41
Saskatchewan	107	25	176	42
Alberta	426	37	664	50
British Columbia	515	37	815	51

Source: General Social Survey, 1989 and 1994

Note: Table includes respondents employed at the time of the survey.

appears that universities have been closer to the leading edge of IT (Lowe and Krahn, 1989).

Considering the possibilities for decentralized, flexible work arrange-

ments such as "teleworking," Canada has made slow progress. For example, in 1995 about one million employees (9% of the total) worked some or all of their regularly scheduled hours at

home. Only 22% in this group were provided with a computer by their employer and 14% were supplied a modem (Akyeampong, 1997). And the fact that in 1996 only 7% of households used the Internet (Statistics Canada, 1997) tempers some of the bold claims being made about the information super-highway.

Computer literacy gap

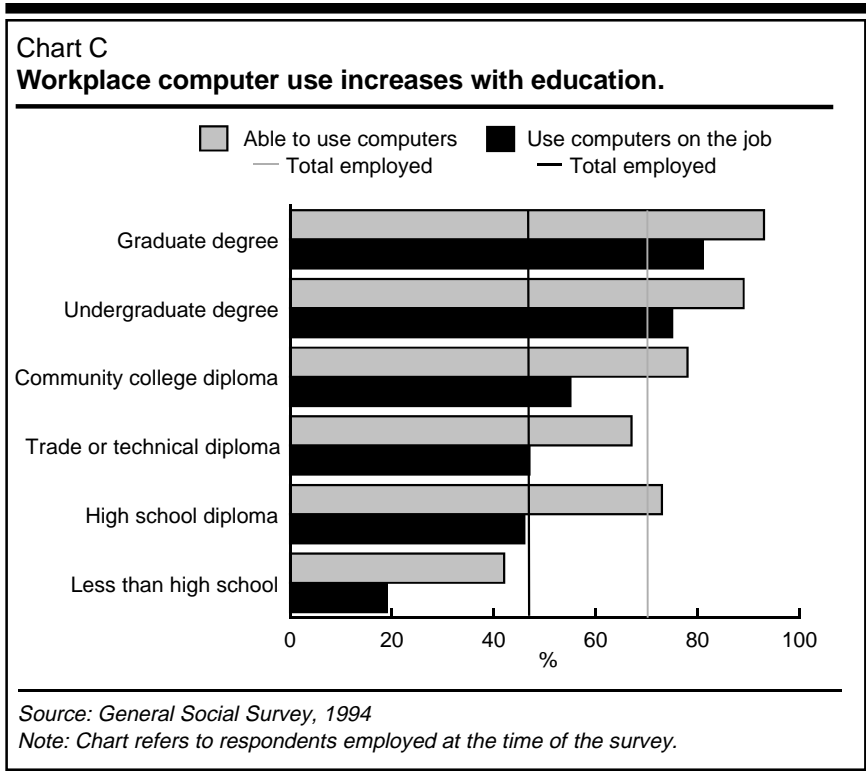
The gap between computer literacy and actual use of computers on the job persists. In 1989, 59% of workers could use a computer, yet only 35% did so in their job. By 1994, while 70% of the employed were able to use a computer, only 48% did so at work (Chart C). This gap was smallest for those with a university education (a difference of 12 and 14 percentage points for holders of graduate and undergraduate degrees, respectively) and greatest for workers whose highest level of education was a high school diploma (27 percentage points).

Occupation and industry patterns

Four occupational groups recorded well-above-average computer use (Table 2). Almost all workers in natural sciences, engineering and mathematics occupations reported using computers in 1994. Some 76% of managerial and administrative employees did so, up from 52% in 1989. Use was also high in clerical and teaching occupations. Services, primary occupations, and construction and transportation all recorded low use of computers.

As in 1989, business services and public administration had high levels of computer use in 1994. About half of the employees in distributive services and in community services used computers in their jobs. Construction and personal services recorded relatively low levels of use.

Changes in the occupational and industrial distribution of employment affect patterns of use. For example,



although natural sciences, engineering and mathematics jobs had the highest level (93%), the number of users increased by only 4,000 between 1989 and 1994 – a negligible 1% growth rate. By contrast, manufacturing and processing occupations gained around 260,000 new computer users, even though the 1994 percentage was only 30%. This occupation registered an impressive 132% jump in computer users over five years, compared with 47% for all occupations. Similarly, computer use among sales workers, which rose from about one-third to one-half, resulted in an additional quarter of a million users. The distribution of computer users by occupation and industry also changed slightly between 1989 and 1994.

Time spent at the screen

Average weekly hours of computer use on the job increased from 16 in 1989 to 18 in 1994 (Table 3). As in 1989, natural sciences, engineering and

mathematics occupations, clerical occupations and artistic, literary and recreational occupations recorded relatively long hours in 1994 (25, 23 and 21, respectively). In contrast, primary and teaching occupations reported only 5 and 7 hours.

Weekly hours of computer use vary less by industry than by occupation. In 1994, employees in business services, finance, and distributive services each reported just over 20 hours weekly of computer use. Community services had the lowest average (12 hours).

The diffusion of automated technology

In 1994, 34% of the employed reported that their work had been greatly affected by the introduction of computers or automated technology in the previous five years, up from 29% in 1989 (Table 4). Results for the workforce as a whole differ little by sex.

In managerial and professional occupations, technological change had greatly affected 46% of employees during the 1989-to-1994 period, an increase from 38% during the 1984-to-1989 period. Comparable figures for clerical, sales and service occupations are 34% and 29%. Just 20% of workers in manual occupations had been greatly affected during the second period, up from 16%. One group reported high percentages in both five-year periods: by 1994, 53% of men in managerial and professional occupations had been greatly affected by such change (compared with 45% earlier).

The effect of IT on job content and security

Of those workers who believed their job had been greatly or somewhat affected by the introduction of computers or automated technology in the five years prior to the GSS, 68% said their required job skills had increased by 1989; this rose slightly to 71% in 1994. In 1989, 70% reported no effect on job security, though this figure declined somewhat to 67% in 1994. In both years, just over 60% said that work had become more interesting as a result of the introduction of computers or automated technology.

In 1989 and 1994, only 2% of workers affected by technological change claimed that this had reduced the skill requirements of their job. Similarly, just 4% in both years stated that technological change had made their job less interesting. However, 19% of workers affected by technological change believed in 1994 that their job security had decreased as a result, up from 11% in 1989.⁵ This is a very important change in the general pattern over the decade considered. This perception was likely influenced by the context of technological change in the 1990s: public sector layoffs, corporate downsizing, high unemployment, and growing awareness of economic globalization.

Table 2
Computer use on the job by occupation and industry

	Use of computers on the job						Change in computer users on the job	
	1989			1994			Absolute increase, 1989-1994	% increase, 1989-1994
	Number of users	% of employed	Distribution	Number of users	% of employed	Distribution		
	'000	%	%	'000	%	%	'000	%
Occupation								
All occupations	4,212	35	100	6,202	48	100	1,990	47
Managerial/administrative	995	52	24	1,585	76	26	590	59
Natural sciences/engineering/mathematics	478	79	11	482	93	8	4	1
Social sciences	129	38	3	205	63	3	76	59
Teaching	308	45	7	488	70	8	179	58
Medicine/health	141	22	3	245	32	4	104	74
Artistic/literary/recreational	98	37	2	160	54	3	62	63
Clerical	1,088	55	26	1,275	70	21	187	17
Sales	354	34	8	609	51	10	255	72
Service	138	10	3	230	15	4	92	67
Primary	45	11	1	93	18	2	48	106
Manufacturing/processing	197	14	5	459	30	7	261	132
Construction/transportation	113	12	3	216	18	3	102	91
Other occupations	88	20	2	127	29	2	38	43
Not stated	--	--	--	--	--	--	--	--
Industry								
All industries	4,212	35	100	6,202	48	100	1,990	47
Primary	102	21	2	202	31	3	100	99
Manufacturing	653	31	16	801	41	13	148	23
Construction	61	11	1	138	20	2	78	128
Distributive services *	605	42	14	818	53	13	214	35
Retail trade	399	24	9	640	39	10	242	61
Personal services	80	9	2	381	24	6	302	378
Business services/finance	953	60	23	1,351	82	22	398	42
Community services **	748	34	18	1,191	51	19	443	59
Public administration	549	50	13	649	71	10	100	18
Not stated	63	40	2	--	--	--	--	--

Source: General Social Survey, 1989 and 1994

Note: Table includes respondents employed at the time of the survey.

* Includes transportation and wholesale trade.

** Includes education, health and social services.

Discussion

According to the General Social Survey, computer literacy in the workforce increased between 1989 and 1994, and on-the-job computer use grew to about half of all workers. Paradoxically, despite being the most computer literate, young workers reported lower levels of workplace com-

puter use than did other age groups. Generally, the reported level of computer skills in the workforce has exceeded the recorded use.

The pace of computerization and automation increased from 1984 to 1989 and from 1989 to 1994. But workers in both study periods who experienced technological change in their

jobs tended to view it in positive terms: higher skill requirements, more interesting work, and less apparent threat to job security than might be expected.

These latter findings are corroborated by various case studies (Long, 1993, for instance). While aggregate Canadian trends mirror those in

Table 3
Average weekly hours of computer use on the job by occupation and industry

	Average weekly hours of use	
	1989	1994
Occupation		
All occupations	16	18
Managerial/administrative	15	19
Natural sciences/engineering/ mathematics	23	25
Social sciences	8	14
Teaching	8	7
Medicine/health	13	10
Artistic/literary/recreational	18	21
Clerical	21	23
Sales	14	17
Service	12	13
Primary	8	5
Manufacturing/processing	13	14
Construction/transportation	12	15
Other occupations	16	16
Industry		
All industries	16	18
Primary	11	13
Manufacturing	17	18
Construction	14	13
Distributive services *	18	21
Retail trade	14	17
Personal services	14	17
Business services/finance	19	22
Community services **	14	12
Public administration	15	18

Source: General Social Survey, 1989 and 1994

Note: Table includes respondents employed at the time of the survey. Employed persons who did not report hours of computer use are excluded.

* Includes transportation and wholesale trade.

** Includes education, health and social services.

Britain, the absence of comparable American data makes it difficult to draw parallels with that country (Gallie and White, 1993). However, one U.S. observation that automation has contributed to skill reductions among clerical workers raises the possibility that different methods for measuring skill may influence findings (Cappelli, 1993).⁶

The diffusion of information technology in Canadian workplaces is contributing to the increasing labour

market polarization documented since the early 1980s (Economic Council of Canada, 1991). The heaviest users of information technology are professionals, such as scientists, engineers and managers – the so-called “knowledge workers” – as well as clerical workers.

So far, few Canadians attribute past or expected job loss to technological change. This perception may tap only direct effects of technological change, but even assuming some

unmeasured, indirect effects, predictions of massive job losses by some critics may be somewhat overstated.

Acknowledgements

This paper is based on a report prepared for the Centre for Information Technology Innovation (CITI), Industry Canada. The author wishes to acknowledge CITI's support of this research, in particular the helpful suggestions provided throughout the project by David Tippin.

□

Notes

1 See, for example, Braverman (1974), Bell (1973), Rifkin (1995), Noble (1995) or Zuboff (1988). Drucker's knowledge workers (1993) or Reich's (1991) symbolic analysts are portrayed as the new elite of the information age.

2 Technology's effect on the overall quality of work life depends on how fully it is integrated: work reorganization around new technologies is less common, and more difficult to implement, than technological change *per se*. See, for example, Betcherman et al (1994); McMullen, Leckie and Caron (1993), and Baldwin and Diverty (1995). See also Long's 1993 study of 114 large Canadian private sector firms in all major industrial sectors, 1990 to 1991. For a summary of this, see Kling and Dunlop (1993).

3 In this section of the article, respondents are classified according to their main activity in the 12 months prior to the survey. Elsewhere, their status at the time of the survey applies.

4 In general, persons under age 25 are far more likely to be able to use computers. Furthermore, the GSS asked for self-assessment of skills. Young people are generally more comfortable using technology, whether or not their skills are appreciably greater than others'.

5 Any respondent who reported losing a job in the 1984-to-1989 (Cycle 4) or 1989-to-1994 (Cycle 9) period was asked why this had happened. So few cited the introduction of automation or new technology that reliable estimates cannot be provided. It is possible, however, that

Table 4
Effect of introduction of computers or automated technology on work in the last 5 years, by occupation and sex

	Total employed population		Work affected by introduction of computers in last 5 years					Not stated *
			Greatly	Somewhat	Hardly	Not at all		
			%	%	%	%		
	'000	%	%	%	%	%	%	
All occupations (1989)								
Both sexes	12,155	100	29	15	14	41	1	
Men	6,726	100	29	17	15	39	--	
Women	5,428	100	29	13	14	44	1	
All occupations (1994)								
Both sexes	13,035	100	34	17	11	36	2	
Men	7,193	100	34	17	11	36	2	
Women	5,841	100	35	17	10	36	2	
Managerial/professional (1989)								
Both sexes	4,442	100	38	18	15	29	--	
Men	2,450	100	45	19	13	23	--	
Women	1,992	100	29	16	17	37	--	
Managerial/professional (1994)								
Both sexes	4,674	100	46	20	10	22	1	
Men	2,315	100	53	20	8	18	--	
Women	2,359	100	39	21	12	26	2	
Clerical/sales/service (1989)								
Both sexes	4,401	100	29	13	13	44	1	
Men	1,526	100	26	16	16	42	--	
Women	2,876	100	31	11	12	45	--	
Clerical/sales/service (1994)								
Both sexes	4,591	100	34	14	10	39	2	
Men	1,710	100	32	15	12	38	3	
Women	2,881	100	36	14	9	40	2	
Manual (1989)								
Both sexes	3,217	100	16	15	15	53	--	
Men	2,691	100	16	16	16	51	--	
Women	526	100	16	9	10	64	--	
Manual (1994)								
Both sexes	3,677	100	20	16	12	49	2	
Men	3,104	100	21	17	13	48	2	
Women	573	100	17	13	9	59	--	

Source: General Social Survey, 1989 and 1994

Note: Table includes respondents employed at the time of the survey.

* This category includes "don't know" and "not stated" in 1994.

other commonly cited reasons for job loss (for example, a shortage of work, staff reductions) were indirectly influenced by technological change, and respondents may not have been aware of this. (See Lowe [1992] for a discussion about these Cycle 4 findings.)

6 Unlike both the GSS and the British survey, the Cappelli study used evaluation scores based on surveys by Hay Associates, rather than workers' self-assessments of their skill requirements.

References

- Akyeampong, E.B. "Work arrangements: 1995 overview." *Perspectives on Labour and Income* (Statistics Canada, Catalogue no. 75-001-XPE) 9, no. 1 (Spring 1997): 48-52.
- Baldwin, J.R. and B. Diverty. *Advanced Technology Use in Canadian Manufacturing Establishments*. Catalogue no. 11F0019MPE no. 85. Ottawa: Statistics Canada, 1995.

Bell, D. *The Coming of Post-Industrial Society: A Venture in Social Forecasting*. New York: Basic Books, 1973.

Betcherman, G. et al. *The Canadian Workplace in Transition*. Kingston: Industrial Relations Centre, Queen's University, 1994.

Braverman, H. *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*. New York: Monthly Review Press, 1974.

Cappelli, P. "Are skill requirements rising? Evidence from production and clerical jobs." *Industrial and Labor Relations Review* 46, no. 3 (April 1993): 515-530.

Drucker, P.F. *Post-Capitalist Society*. New York: HarperBusiness, 1993.

Economic Council of Canada. *Employment in the Service Economy*. A research report prepared for the Council by G. Betcherman et al. Ottawa: Economic Council of Canada, 1991.

Gallie, D. and M. White. *Employee Commitment and the Skills Revolution*. London: Policy Studies Institute, 1993.

Kling, R. and C. Dunlop. "Controversies about computerization and the character of white collar worklife." *The Information Society* 9, no. 1 (January 1993): 1-29.

Long, R. "The impact of new office information technology on job quality of female and male employees." *Human Relations* 46, no. 8 (1993): 939-62.

Lowe, G.S. *Human Resource Challenges of Education, Computers and Retirement*. Catalogue no. 11-612-XPE, no. 7. Ottawa: Statistics Canada, 1992.

---. "Computers in the workplace." *Perspectives on Labour and Income* (Statistics Canada, Catalogue no. 75-001-XPE) 3, no. 2 (Summer 1991): 38-50.

Lowe, G.S. and H. Krahn. "Computer skills and use among high school and university graduates." *Canadian Public Policy* 15, no. 2 (June 1989): 175-188.

McMullen, K., N. Leckie and C. Caron. *Innovation at Work: The Working with Technology Survey, 1980-91*. Kingston: Industrial Relations Centre, Queen's University, 1993.

Noble, D.F. *Progress without People: New Technology, Unemployment, and the Message of Resistance*. Toronto: Between the Lines, 1995.

Oderkirk, J. "Computer literacy - a growing requirement." *Education Quarterly Review* (Statistics Canada, Catalogue no. 81-003-XPB) 3, no. 3 (Autumn 1996): 9-29.

Reich, R.B. *The Work of Nations: Preparing Ourselves for 21st-Century Capitalism*. New York: Alfred A. Knopf, 1991.

Rifkin, J. *The End of Work: The Decline of the Global Labor Force and the Dawn of the Post-Market Era*. New York: G.P. Putnam's Sons, 1995.

Statistics Canada. *Household Facilities by Income and Other Characteristics, 1996*. Catalogue no. 13-218-XPB. Ottawa, 1997.

---. "Computer use in the workplace." Catalogue no. 12F0052XPE. Ottawa, 1995.

Zuboff, S. *In the Age of the Smart Machine: The Future of Work and Power*. New York: Basic Books, 1988.

Perspectives on Internet

Perspectives on Labour and Income is now offering its Highlights section, What's new? and Subject index on the Internet.

Gopher is an Internet tool that allows users to browse through an easy-to-navigate, text-based, hierarchical menu system. Information describing Statistics Canada and its products and services is housed in TALON's gopher. To link to our gopher server, type: **gopher gopher.statcan.ca**

The Statistics Canada World Wide Web site can be reached at: **http://www.statcan.ca**

order@statcan.ca is an e-mail address from which you can order data products or request additional information.

Are you moving?

Please forward your name, old address, new address, telephone number and client reference number to: **Statistics Canada, Operations and Integration Division, Circulation Management, 120 Parkdale Avenue, Ottawa, Ontario K1A 0T6**; or call (613) 951-7277 or 1 800 700-1033 toll free, or fax (613) 951-1584.

Please allow four weeks notice to ensure uninterrupted delivery.