

## WHERE ARE THE WOMEN?

### A BENCHMARK STUDY OF WOMEN IN HIGH-TECHNOLOGY FIELDS IN SCIENCE AND TECHNOLOGY IN BRITISH COLUMBIA

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#### ABSTRACT

*Where Are the Women* is a benchmark study commissioned by the Women in Science, Technology, Trades and Engineering Committee (WISTTE), with project leadership provided by the Society for Canadian Women in Science and Technology (SCWIST). WISTTE is a network of organizations that promotes the participation and recognition of women in science and technology and is chaired by Dr. Judith Myers, a Zoology professor at the University of British Columbia and SCWIST Vice President, Programs. Most of the previous studies on labour market profile in the high technology sector do not provide gender breakdowns of data. SCWIST identified a need to develop benchmark data on gender distributions to provide balanced labour market analysis and to assist in human resources planning. In this study, we found that there are still a number of areas in science and technology where women are under represented. This trend starts in the secondary schools, where there are low participation rates by female students in fields of study that would lead directly to employment in high technology. At the post-secondary level, women are particularly under represented in the areas of engineering, physics and computer science. This under-representation of women directly effects employment distribution and retention in the high technology labour force.

#### BACKGROUND

For the past two decades, the Society for Canadian Women in Science and Technology (SCWIST) has worked to promote opportunities for women in science and technology. With the generous support of Dr. Michael Smith, SCWIST volunteers have organized *ms infinity* conferences to encourage female students to study mathematics and science. Recently, SCWIST developed an interactive CD-ROM that profiles eight female role models working in a variety of jobs in science and technology; this resource has been distributed to schools in British Columbia<sup>1</sup>. In 1996 SCWIST joined the Women in Science, Technology, Trades and Engineering Committee (WISTTE) to work with industry and academic representatives on the issues of recruitment, retention and encouragement of women working in science and technology.

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<sup>1</sup> A limited number of copies of the CD-ROM are available from the SCWIST Office – [scwist@sfu.ca](mailto:scwist@sfu.ca).

At the start of the study, some documentation was available on the under-representation of women who were studying in these fields, but little data was available on the numbers of women who were working in science and technology positions. The rapid growth of technological change, coupled with the shortage of skilled workers in high technology, meant that many high technology employers were forced to recruit for workers outside the province and the country. This pointed to the importance of gathering data on the participation of these highly trained women in the high technology work force. In order to document a key human resources issue, SCWIST led the Steering Committee of WISTTE in gathering benchmark data on the participation of women working in high technology in BC and in profiling the issues encountered by these women in their education and work experiences.

This study reports on the participation of women who are working in science and technology fields in BC. It involved a descriptive analysis based on Statistics Canada Census data as well as telephone surveys of more than 300 male and female employees and of 50 employers that explored in depth views on human resources issues and career development. Four focus groups of working women and students provided qualitative data on the issues encountered by these women during their education and work experience.

In general terms the high technology sector has been defined as including industries which are involved in the development and manufacturing of high technology products, including software.<sup>2</sup> The core set of industries matches the high technology sector definition used by the BC Ministry of Finance in their study of the high technology sector. This analysis also included telecommunications and electric utilities. Science and technology occupations include all occupations classified by the National Occupational Classification (NOC or SOC 1991) as *professional* or *technical* occupations in either pure science or applied sciences. Results were obtained from special runs of Statistics Canada Census data (especially 1991 and 1995 data) and Labour Force Surveys. Telephone surveys of more than 300 male and female employees and telephone surveys of 50 employers provided information on reasons for career choices and issues encountered in the work place. The study was funded with support from Human Resources Development Canada and the Ministry of Advanced Education, Training and Technology in the Government of British Columbia.

The results of this study indicate that while both men and women are very satisfied with their career choices, women are still struggling against limiting stereotypes about their aptitudes and capacities. Employers pointed out that the pool of available women would expand if girls were encouraged from an early age to pursue the relevant fields of study. They pointed out that increased participation of women in science and technology will require flexible work options and clear information about career potential throughout the educational period.

## **WOMEN IN THE SCIENCE AND TECH WORK FORCE**

There is a very low proportion of women working in science and technology occupations across Canada. Women's share of the science and technology workforce is slightly lower in BC than in the rest of Canada. Women make up 14.4 percent of the high technology scientific workforce in BC, compared to 16 percent for the Canadian total. The Canadian total is influenced by the Ontario pattern, where women comprise 16.7 percent of the scientific workforce of the high technology industry sector.

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<sup>2</sup> More detailed information on the definition of the high technology sector can be found in Appendix B: Technical Notes and Data Sources of *Where Are the Women*.

**Table 1: Women in Science and Technology Occupations Across Canada in 1996**

	<b>BC</b>	<b>Alberta</b>	<b>Ontario</b>	<b>Canada</b>
Employment Share All Industries (%)	15.7	16.6	18.5	17.7
Employment Share High Tech Field (%)	14.4	14.9	16.7	16.0

SOURCE: 1996 Census of Canada. HRDC special runs

### **HIGH TECHNOLOGY SECTOR**

There has been a significant growth in the science and technology work force in BC between 1991 and 1996. In 1996 there were 93,000 employees compared to 77,000 employees in 1991, an increase of 20 per cent. In the high tech sector, which are mainly engineering and computer services firms, the increase between 1991 and 1996 was 32.5 per cent which was greater than the increase in all science and technology areas. The number of women employed in the high tech sector in BC increased by 48 per cent in this period. *Overall, however, the proportion of female workers in science and technology occupations is low.*

There were significant employment gains for women in several scientific, engineering and technical occupations from 1991 to 1996. Computer engineering showed the largest increase followed by biology and related science, mechanical engineering and electrical/electronic engineering. Computer programmers and systems analysts remain the largest specific science and technology occupations for women in the high technology sector. Despite continuing skills shortage, the employment growth rate for women in computer programming and systems is significantly lower than in many other science, engineering or technology fields.

### **PROFILE OF WOMEN WORKING IN HIGH TECHNOLOGY SECTOR**

The high rate of growth in the high tech sector has resulted in employers hiring a considerable number of younger workers. The special tabulations of 1996 Census Canada data show that almost half the women working in high tech are younger than 35 years old. In the employee survey where 333 employees were interviewed, 77 per cent of the women and 61 per cent of the men were younger than 39 years old.

The work patterns in the high tech sector show that a significant proportion of workers are self employed. In the high tech sector, 24 per cent of men and women were self-employed in contrast to 14 per cent of workers across science and technology industries. A higher proportion (32 per cent ) of women who are managers in high tech are self-employed in comparison to men (23 per cent). Female managers represent 10 per cent of the managers in engineering and information sciences and they tend to be younger than their male counterparts.

More women worked part time: 40 to 50 percent of women compared to 30 to 40 per cent of men. The leading reason given by both men and women for working part-time was "Combining work and studies" although "Combining employment and parenting" was given as a reason by 25 per cent of the women and 0 per cent of the men.

In reviewing all science and technology occupations, more women than men had completed a university degree, (55 percent women compared to 45 per cent of men). In the technical occupation group within high tech, 33 percent of women had completed a university degree compared with 21 per cent of men.

*This raises some questions: why is there such a difference in education level between men and women working in technical positions? Are these women who have completed a degree being under-utilized? Are they being required to have a higher degree of training for the same jobs?*

## EARNINGS IN THE HIGH TECHNOLOGY SECTOR

The 1996 Census Canada data show that there is relatively little “gender gap” in earnings in several industries within the high technology sector. In the Computer Services industry, the earnings for men and women are very close, showing only 5 per cent difference in full-time income for people working a full year. The largest difference occurs in engineering and architectural services where women in professional positions who are working full-time earn about 75 per cent of the income of male professionals.

**Table 2: Earnings of Science and Technology Professional Workers**

Selected Industry		Full-time, full-year	
		Number	Average Income
Manufacturing Of Communications Equipment	Male	325	47,653
	Female	20	39,726
	Women's earnings ratio	83%	
Pharmaceutical Manufacturing	Male	40	41,149
	Female	25	47,381
	Women's earnings ratio	146%	
Telecommunications	Male	710	55,261
	Female	120	46,861
	Women's earnings ratio	80%	
Electric Power	Male	465	63,212
	Female	100	58,213
	Women's earnings ratio	96%	
Computer Services	Male	3,985	50,459
	Female	860	47,690
	Women's earnings ratio	92%	
Engineers and Architectural Services	Male	6,555	54,875
	Female	560	40,530
	Women's earnings ratio	62%	

Source: Census of Canada, 1996, Special tabulations

The difference in salaries is most striking in engineering and architectural services in which women in professional positions who are working full-time for a full-year earn an average of \$40,530 and full-time male professionals earn an average of \$54,875. While female biologists earn an average income of \$42,930, male biologists earn an average income of \$44,871. In civil engineering there is a substantial difference with women earning an average income of \$42,709 while males earn \$55,298. For mechanical engineers, women average \$38,084 and men, \$57,112. The average income for a female chemical engineer is \$39,644 while the average income for male chemical engineers is \$60,008.

A comparison of mathematicians, systems analysts and computer programmers in engineering, architectural and other services shows that women working full-time, for a full year, earned an average of \$39,481 compared to men earning \$50,014. This average female earning of \$39,481 falls below the average salary of \$44,802 across all industries in the high technology sector.

### THE WORK ENVIRONMENT

The employee data was gathered from a telephone survey of 300 men and women working in scientific and technical occupations in BC. This survey provided quantitative information on demography, education, career moves and current working situation. The employees were chosen from seven professional and technical occupational clusters in the BC labour force. These clusters were *Computer-related* (computer programmers, software developers, computer system analysts); *Electrical/Electronic/Computer Engineering Professionals*; *Life Science Professionals*; *Other Professional Engineers*; *Biology and Life Science Technicians/Technologists* and *Mapping and Drafting Technicians*.

Both men and women were quite satisfied with their career progress to date; approximately 90% were mainly or completely satisfied which is a high degree of satisfaction from employment.

**Table 3: Are you satisfied or dissatisfied with your Progress to date in Your Career**

	Total sample N=333	Male N=168	Female N=127
Completely satisfied	57%	53%	62%
Mainly satisfied	32%	35%	28%
Partially satisfied	7%	10%	5%
Not satisfied	4%	3%	4%
Refused	<1%	0%	1%

Most of the men and women planned to stay in a similar line of work. Of those individuals who were considering changing fields, none of the males gave family responsibilities or the need for more flexible scheduling as a reason, while 19% of the women wanted time for family or flexible scheduling.

When questioned whether harassment had been a problem in their career, the majority of respondents did not feel it had been a problem. Among those working at the professional level, 83 per cent of the males and 65 per cent of the females felt strongly that it had not been a problem. Of those respondents who felt harassment had been a problem in their career, 7 per cent of the respondents were men and 22 per cent were women. The majority of the employers (45 out of 50) reported they had taken steps to ensure a work environment free of harassment that supported the dignity and self-esteem of every employee.

The employee survey showed that women working in the science and technology fields surveyed share many of the perspectives of their male colleagues. There are notable differences between them that reflect the challenge of young women facing limiting stereotypes about their aptitudes and capacities. And as they become involved with family responsibilities, the balance of work and family is a challenge for many women today.

The employer survey interviews from four high technology sector groups showed the expectations of 79 per cent of the employers that the demand for professional and technical workers would increase over the next two years. 0 per cent thought it would decrease. Employers found a shortage of people in the intermediate levels where it is important to have strong interpersonal skills to deal with clients and co-workers. Many female employees in high tech have strengths in interpersonal communication that they developed as they pursued career goals in an area dominated by males. As the industry matures, it will be interesting to see if women are given opportunities to work at the intermediate and management levels or whether more of them will follow an entrepreneurial path and set up their own companies.

One advantage of doing contract or consulting work is the greater flexibility in terms of scheduling of work hours. In fact, the majority of the employers surveyed in the high tech sector do offer flexible work scheduling so employees are given the option of banking overtime hours and taking days off. For women, a larger issue may be the satisfaction of dealing with the entrepreneurial challenge of "being your own boss" and having control of the major business decisions such as finance and hiring.

#### **CHOICES AT THE HIGH SCHOOL LEVEL**

The classes chosen by students in high school are important because they will influence the careers of students in the future. Many young women choose not to take mathematics and science courses particularly in grades 11 and 12, and this can limit their opportunities for further studies in university. Some educators have noted that girls are interested in and perform well in science courses in primary school but peer pressure has a powerful influence on the decisions young girls make. The statistics from the BC Government, Ministry of Education on selected Grade 12 examination results provide useful indicators of science choice on leaving high school.

**Table 4: Grade 12 BC Student Completing Examinations by Selected Course and Gender**

		<b>1996</b>	<b>1997</b>	<b>1998</b>
<b>Biology</b>	Total	13,635	14,035	15,207
	Female as per cent of Total	63.1%	63.9%	65.0%
<b>Chemistry</b>	Total	12,066	12,013	12,726
	Female as per cent of Total	49.9%	49.4%	50.3%
<b>Mathematics</b>	Total	18,966	19,508	20,768
	Female as per cent of Total	46.8%	46.9%	46.9%
<b>Physics</b>	Total	6,946	6,908	7,325
	Female as per cent of Total	31.8%	29.1%	29.7%

Source: Ministry of Education Reports on Examinations

Biology, Chemistry, Mathematics and Physics are often key to further studies and to careers in a science or technology field. The proportion of female students taking these courses gives some indication of gender gaps and points to areas where women's participation in science and technology should be addressed. Physics is a key course for engineering studies and is showing little increase in participation by female students in recent years. Of those students taking the Grade 12 Physics examinations, 29.7 percent were female which is much lower than the percentages of women taking Mathematics, Chemistry and Biology. *Do the female students in high school realize the extent to which they are limiting their future training with these choices?*

One critical factor is the choice of subjects that female students are making in high school. In Grade 12 Physics, 27 per cent of women and 24 per cent of men received letter grade A on their final exams. This demonstrates the ability of women to succeed in the sciences. One of the participants in a Focus Group described comments from a grade 11 physics teacher that "he didn't think we should take grade 12 physics because girls don't do physics." In this case, the young woman felt challenged to go ahead but admitted some students would have been discouraged. *The direction and advice from teachers and counsellors is an important component in the education system so that all students will have a chance to keep options open for their future careers.*

### PREPARING FOR CAREERS IN SCIENCE AND TECHNOLOGY

The education of women preparing for careers in science and technology is very important. From 1991 to 1995, there has been a modest increase in the proportion of women receiving degrees in engineering and applied sciences.

**Table 5: Percentage of Women Granted Degrees in Engineering and Applied Sciences**

	<b>B.Sc.</b>		<b>M.Sc.</b>		<b>Ph.D.</b>	
	<b>Canada</b>	<b>BC</b>	<b>Canada</b>	<b>BC</b>	<b>Canada</b>	<b>BC</b>
<b>1991</b>	14.6	14.7	13.2	13.2	9.1	14.6
<b>1995</b>	20.3	19.1	29.1	19.2	9.4	7.5

Source: Statistics Canada Cat. No. 81-229

In 1995 in British Columbia, women represented 39 per cent of the students receiving Bachelor's degrees in Mathematics, 33 per cent in Chemistry, 20 per cent in Computer Science and 15.8 per cent in Engineering. In Biology women represented 56.6 per cent of students who graduated with a BSc. degree.

Although the number of female students enrolled in Engineering has increased in the last decade, the low numbers of female students who are choosing Computer Science is an issue of some concern.

Information from the Graduate Survey of the University Presidents' Council of BC shows that both men and women are making choices to study in Science or Applied Sciences because they are "interested in the subject area"; that is, they find the subject challenging and enjoy it. In this context, it appears that female students do not view Computer Science as an appealing subject.

## CONCLUSION

The recent growth of the high technology sector has created many career opportunities for graduates from science and technology related programs. Although working women are under-represented in many of the high technology industries in BC, most of them are highly educated, they are relatively young and are finding a high degree of satisfaction from their work. There is not a significant “gender gap” in the earning differentials between men and women in this sector and the majority of employers are open about offering flexible working hours. These findings provide benchmark data about women working in high technology in BC. *This data about an important human resource issue points to a pattern in our education system which is creating skill shortages in the high tech sector.*

The reality is that the statistics show that the numbers of women who are working full-time in this sector has not increased in most areas. There has been a slight increase in the enrolment of women in engineering programs but there does not appear to be an increase of women in computer science programs. The high proportion of female students in biology courses show that women will make choices in science courses if they feel it will lead to an interesting career such as medicine or pharmacy. *Students should have an opportunity to know about the variety of work in high tech sector jobs, good salaries and working conditions.*

One key factor is the lack of relevant career planning information. Several women said they would like to see teachers, parents and counsellors provided with more relevant information on the range of jobs available. There was discussion by the women about whether working in the high tech sector was only for “techies”. The group felt that as information on the skill shortage for jobs in this field increases and as more people learn about the diverse range of jobs available, people with a wide range of employment goals and non-technical interests will enter these fields. Educators, employers and government agencies must collaborate to develop and disseminate information about how to prepare for a wide range of careers in high technology. This information should show that strong interpersonal skills are an important component of the required skill set.

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The full report of *Where Are the Women* is available at: <http://taz.cs.ubc.ca/wistte>