

High Technology Occupations in British Columbia

A joint project of:
BC STATS; Ministry of Finance and Corporate Relations and
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BC STATS

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1 INTRODUCTION

In 1452 Gutenberg invented the printing press and the world was changed forever. Much of the progress of the last five hundred years was made possible because the printing press allowed knowledge to be spread to more people in more detail than ever before. The printing press, in its day, was high technology. High technology is not a new thing, and adopting new technologies as they are developed has been a necessary component of economic growth from even before the invention of the printing press.

Today, the pace of technological advancement is ferocious. British Columbia's economy, like most economies, has a growing dependence on high technology. Understanding high technology and how it fits into the BC economy is essential to ensure growth and prosperity in the present and the future.

The term "High technology" brings to mind computer wizards working on powerful state-of-the-art computers solving problems that ordinary people hardly understand. In fact, high technology is everywhere and almost everybody uses it in one way or another. Cashiers in grocery stores use laser scanners to read the prices on the products. Police use photo radar to catch speeders. Computers are everywhere. None of these things were here fifty years ago.

Since almost all jobs use technology to some extent, it is difficult to determine whether a given job should be labeled high technology or non-high technology. Two separate methods were used in this paper to divide workers into high technology and non-high technology groups. The first method involved analyzing the industry a worker is in and classifying the worker as high technology if the industry makes high technology products. The second method looked at occupations and classified workers as high technology if they had skills relating to science or technology. The details of these processes are discussed in the methodology section.

These two methods for classifying workers as high technology divide workers in the BC economy into four groups.

1. Workers with high technology occupations working in the high technology sector
2. Workers with high technology occupations working outside the high technology sector
3. Workers without high technology occupations working in the high technology sector
4. Workers who neither have a high technology occupation nor work in the high tech sector.

This paper examines workers in these different categories.

The census data used in this study has information on both the number of people in each group and the average income of each group. In fact, the census data allows for each category to be broken down into finer industry and occupation levels to give an idea of what kinds of workers make up each group

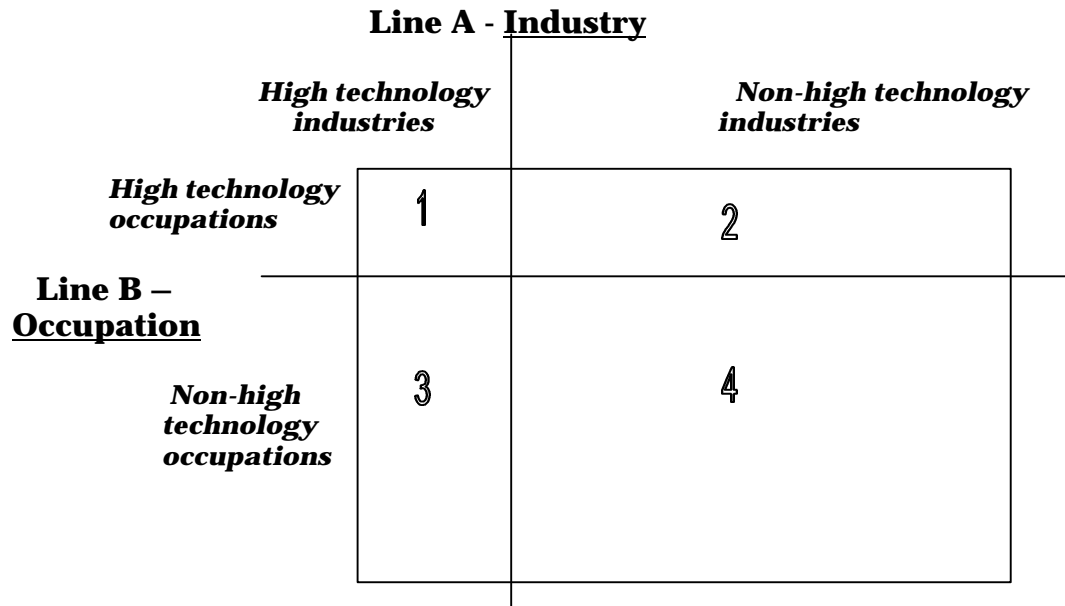
It is hoped that by studying the distribution of workers connected to high technology and their average incomes, it will be possible to learn more about the welfare of these workers and something about how high technology is incorporated into the BC economy.

2 AN INDUSTRY-BY-OCCUPATION FRAMEWORK

BC STATS has defined the high technology sector in terms of Statistics Canada’s Standard Industrial Classification (SIC)¹ system². In this paper, we use this SIC-based definition to divide workers in the BC economy between high technology and non-high technology industries. This division is represented by Line A (Figure 1), dividing a rectangle that represents the total BC economy into high technology industries to the left, and non-high technology industries to the right.

From the range of occupations that exist in BC, a number of occupations in the National Occupation Classification (NOC) have been identified as being high technology³. Based on this list of high technology occupations, we divide workers in BC into two major occupation groups: high technology occupations and non-high technology occupations. This is represented in Figure 1 by Line B, with high technology occupations in the top half, and non-high technology ones in the bottom half.

Figure 1. The BC Economy – industry-by-occupation representation.



The above scheme (Figure 1) allows us to identify four categories of workers:

¹ See Methodology for a list of high technology industries.

² See “Defining the High Technology Knowledge Sector in British Columbia” at www.bcstats.gov.bc.ca

³ See Methodology for details on the definition of high technology occupations.

Block 1 - High technology workers in the high technology sector;

Block 2 - High technology workers in non-high technology industries;

Block 3 - Non-high technology workers in the high technology sector;

Block 4 - Non-high technology workers in non-high technology industries.

This breakdown will be used throughout the report. At the start of each section, a smaller version of Figure 1 is shown in the left margin to indicate which blocks are being analyzed.

We begin with the overall picture of employment in BC (Blocks 1 to 4). Then blocks 1 to 3 are studied. Blocks 1 and 3 form the high technology sector and are examined together. Block 2, high technology occupations outside of the high technology sector, is then discussed.

A word of caution

The BC Stats definition of the high technology sector uses 4 digit SIC codes, the most detailed level available. The Statistics Canada data that this report is based on is only available at the 3-digit level. The higher level of aggregation in the data makes it more difficult to accurately separate the high technology industries from the non-high technology industries. Often an industry category will contain both high technology businesses and non-high technology businesses. Depending on the concentration of high technology businesses in the industry, the whole industry is either included or excluded. Either way, some of the crispness of the original definition is lost.

A second issue relates to changes in the definition of employment due to the method of data collection. In other data sources the methods used to collect the employment data are significantly different. For example, in the Survey of Employment, Payroll and Hours (SEPH), employers are surveyed monthly and employment refers to the number of paid employees, including working owners and directors in an industry. This report uses Statistics Canada census data that is collected once every five years through the process of self-enumeration of people ages 15 and older who are employed under particular occupation titles. A cross-tabulation based on the Statistic Canada data yields a particular set of results that may differ from those compiled from other data sources. It is more meaningful to observe the relative size of an industry or occupation group, rather than relying heavily on the absolute figures.

3 EMPLOYMENT

3.1 THE OVERALL PICTURE OF BC EMPLOYMENT

1	2
3	4

In 1996, nearly 1.7 million workers were employed in BC. Just over 7 per cent of workers were considered to be a part of high technology either because of the industry they work in or their occupation. These workers are represented by blocks one, two, and three. The high technology sector employs a high concentration of workers in high technology occupations. Half of all high technology sector workers have high technology occupations compared to just 3 per cent in non-high technology industries.

Although the high technology sector uses a much higher concentration of workers with high technology occupations than non-high technology sectors, there are actually more workers with high technology occupations outside of the high technology sector. This is because the number of non-high technology sectors is large enough to more than compensate for their sparing use of workers with high technology occupations.

Figure 2. BC employment distribution, 1996

	High technology Sector 66,845	Non-high technology sector. 1,609,810
High technology occupation 86,055	33,630 1	52,425 2
Non-high technology occupation 1,590,600	33,215 3	1,557,385 4

(Diagram not to scale)
Source: Detailed Table 1.

3.2 EMPLOYMENT IN THE HIGH TECHNOLOGY SECTOR

1	2
3	4

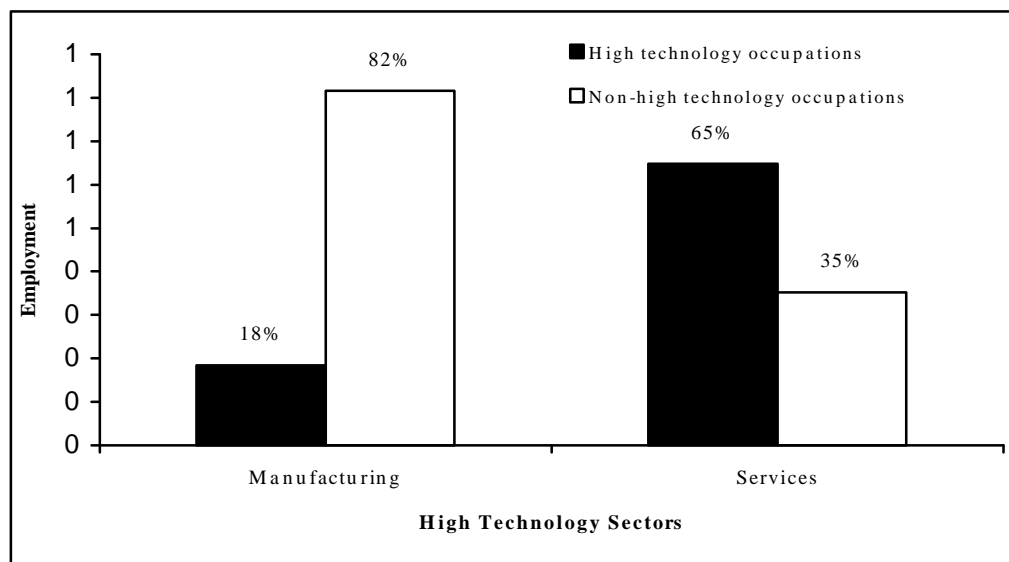
The high technology sector consists of industries that use sophisticated technology or highly skilled technical workers, block 1 and 3.

Within the high technology sector, there is considerable variation in how intensively workers with high technology occupations are used. To illustrate the extent of this variation, the high technology sector is broken down into two sub-sectors: Manufacturing and services. Figure 3 shows that the high technology service sub-sector has a much higher dependency on workers with high technology occupations than the high technology manufacturing sub-sector does. Since the high technology service sub-sector is bigger than the high technology manufacturing sub-sector, this means that the vast majority of workers with high technology occupations work for the high technology service sub-sector.

The high technology service sector contains businesses such as engineering firms where professionals offer their skilled services. These businesses consist of the professionals themselves and relatively few support workers. In contrast, high technology manufacturing industries have production and shipping functions. The manufacturing portion of the high technology manufacturing sub-sector is very much like manufacturing in any other sector. A welder who assembles satellite parts is doing basically the same thing as a welder who builds bicycles. Since high technology manufacturing companies need to do a considerable amount of work that is not high technology oriented, they support a lower percentage of workers with high technology occupations.

The extent to which the high technology manufacturing sub-sector appears to have more non-high technology workers is partly due to limitations of the available data. The high technology manufacturing sub-sector figures include more component industries that are not strictly high technology than is the case for the high technology service sub-sector. This partly explains the high technology manufacturing sub-sector's higher number of workers with non-high technology occupations. Although this problem accounts for some of the variation between the usage rates of high technology occupation workers, the difference is too large to be explained by this fact alone.

Figure 3. Employment distribution, by high technology sectors and major occupation categories.



Source: Detailed Table 2.

3.2.1 Focusing on High Technology Occupations, Block 1.

1	

As indicated by the key on the left, this section is concerned with high technology occupations in the high technology sector. High technology occupations are occupations that either require training in science or engineering or require the use sophisticated equipment.

Over half of the high technology occupation workers in the high technology sector are in *Architectural, engineering and other scientific and technical services*. When this category is combined with the other two industries in high technology service sub-sector, almost 90 per cent of the high technology occupation jobs are accounted for. The remaining high technology jobs are scattered across businesses in the high technology manufacturing sub-sector.

The high technology service sub-sector consists mostly of businesses that provide skills and expertise to other businesses. For example, engineering firms work for construction companies. Consumers do not go to engineers and buy plans directly. In effect, the role of the high technology service sub-sector is to help other companies and businesses get their jobs done more efficiently.

Figure 4 shows the prominence of *Architectural, engineering and other scientific and technical services* in the high technology service sub-sector and the importance of the high technology service industries overall in employment of workers with high technology occupations.

Figure 4. High technology occupation employment distribution, by high technology industries

Rank	High Technology Industries	Employment Count	% of Total
	Service Industries	29,785	
1	Architectural, engineering & other sci. & tech. services.	18,790	55.9%
2	Computer and related services	9,290	27.6%
3	Medical and other health laboratories	1,705	5.1%
	Manufacturing Industries	3,020	
4	Communication and other electronic equip. industries	1,000	3.0%
5	Office, store and business machine industries	845	2.5%
6	Other machinery and equipment industries	825	2.5%
7	Scientific and professional equipment industries	225	0.7%
8	Electrical industrial equipment industries	200	0.6%
9	Other manufactured products industries	200	0.6%
10	Aircraft and aircraft parts industry	155	0.5%
11	Industrial chemicals industries n.e.c.	145	0.4%
12	Pharmaceutical and medicine industry	130	0.4%
13	Communications and energy wire and cable industry	80	0.2%
14	Shipbuilding and repair industry	40	0.1%
	Total high technology workers in the high technology sector	33,630	100.0%

Source: Detailed Table 3.

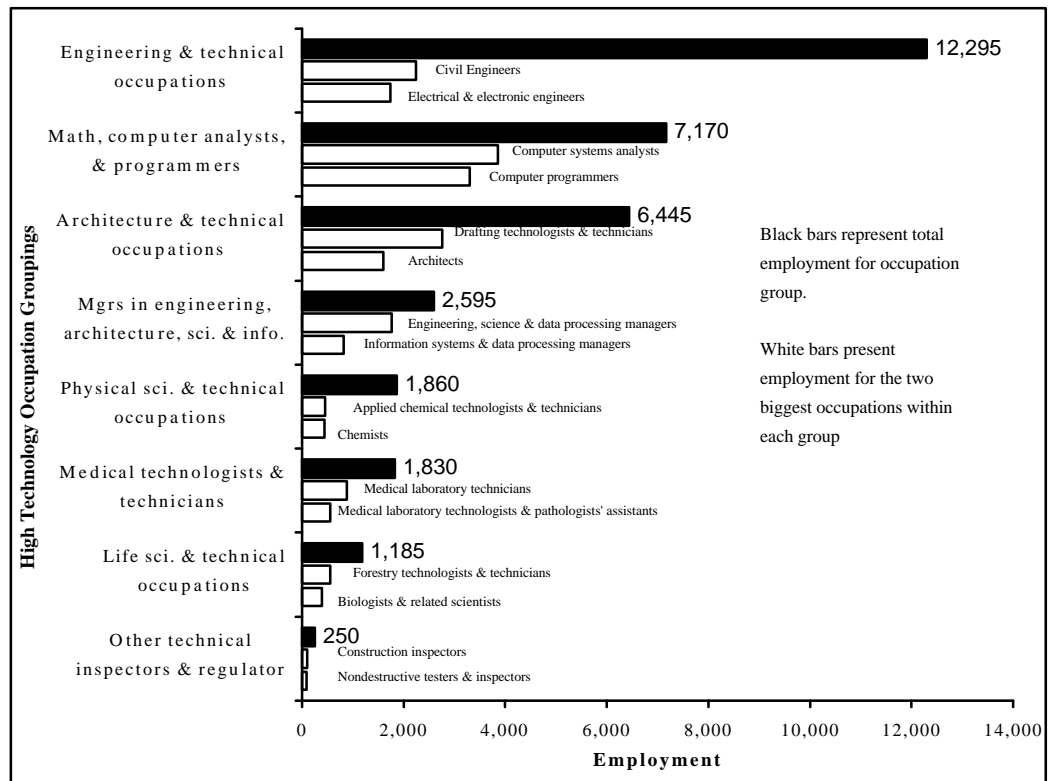
The workers in block 1 can also be broken down by occupation. There are 57 high technology occupations at the most detailed, four-digit, NOC level. These occupations have been aggregated into 8 broader occupation groups⁴. The groups are presented in Figure 5 along with the two biggest 4 digit NOC occupations in each group. The aggregates are useful because they provide an overview of the occupational categories. Seeing the two largest occupations in a category, however, helps show what kinds of jobs the category contains.

The biggest occupation group is *Engineering & technical occupations*. This occupation group accounts for over 35 per cent of workers in block 1. The largest two occupations are *civil engineering* and *Electrical & electronic engineering*, but other engineering occupations such as *mechanical engineering* and *computer engineering* are not much smaller.

⁴ Readers may refer to the Methodology for the list of high technology occupations at the four-digit level, and groupings derived from these four-digit occupations.

The next biggest grouping, *Math, computer analysts & programmers*, accounts for a further 21 percent of workers in block 1. The two biggest occupations in this group, which are both computer related, account for almost the entire grouping.

Figure 5. High technology occupation structure, by major occupation groups



Source: Detailed Tables 5 and 6.

3.2.2 Focusing on non-High Technology Occupations

3	

Block 3 represents non-high technology workers in the high technology sector.

The high technology sector employs just about as many workers with non-high technology occupations as workers with high technology occupations. Although this is true for the sector as a whole, there is substantial variation in the fraction of workers with non-high technology occupations across industries within the high technology sector.

The industries in the high technology service sub-sector use a much lower concentration of workers with non-high technology occupations than industries in the high technology manufacturing sub-sector. Figure 6 shows that for the high technology service sub-sector as a whole, non-high technology occupation workers are in the minority. *Architectural, engineering & other scientific & technical services* is the largest employer and has only 32 per cent of its workers in non-high technology occupations.

Figure 6. Per cent of workers with non-high technology occupations in the high technology service sector.

NOC Code	High technology service industries	Employment		Per cent
		Non-high technology occupation	High technology sector total	
775	Architectural, engineering & other scientific & technical services	8,790	27,580	32%
772	Computer & related services	6,270	15,560	40%
868	Medical & other health laboratories	1,135	2,840	40%
	Total service workers	16,195	45,980	35%

Source: Detailed Tables 3 and 7.

Figure 7 shows that in the high technology manufacturing sub-sector, a clear majority of workers have non-high technology occupations. Although all industries in this sub-sector have the majority of their workers in non-high technology occupations, there is substantial variation in the percentage of non-high technology workers across industries. *Office, store & business machine industries* has the lowest percentage, 62 per cent. *Shipbuilding & repair industry* has the highest, 96 per cent. This difference is substantial and indicates that the industries in the high technology manufacturing sub-sector use technology to differing degrees.

Figure 7. Per cent of workers with non-high technology occupations in the high technology manufacturing sub-sector

NOC Code	High technology manufacturing industries	Employment		Per cent
		Non-high technology occupation	High technology sector total	
319	Other machinery & equipment industries	5,010	5,835	86%
399	Other manufactured products industries	2,785	2,985	93%
335	Communication & other electronic equipment industries	2,240	3,240	69%
336	Office, store & business machine industries	1,370	2,215	62%
327	Shipbuilding & repair industry	1,085	1,125	96%
391	Scientific & professional equipment industries	1,080	1,305	83%
321	Aircraft & aircraft parts industry	875	1,030	85%
374	Pharmaceutical & medicine industry	870	1,000	87%
371	Industrial chemicals industries n.e.c.	860	1,005	86%
337	Electrical industrial equipment industries	660	860	77%
338	Communications & energy wire & cable industry	185	265	70%
	Total	17,020	20,865	82%

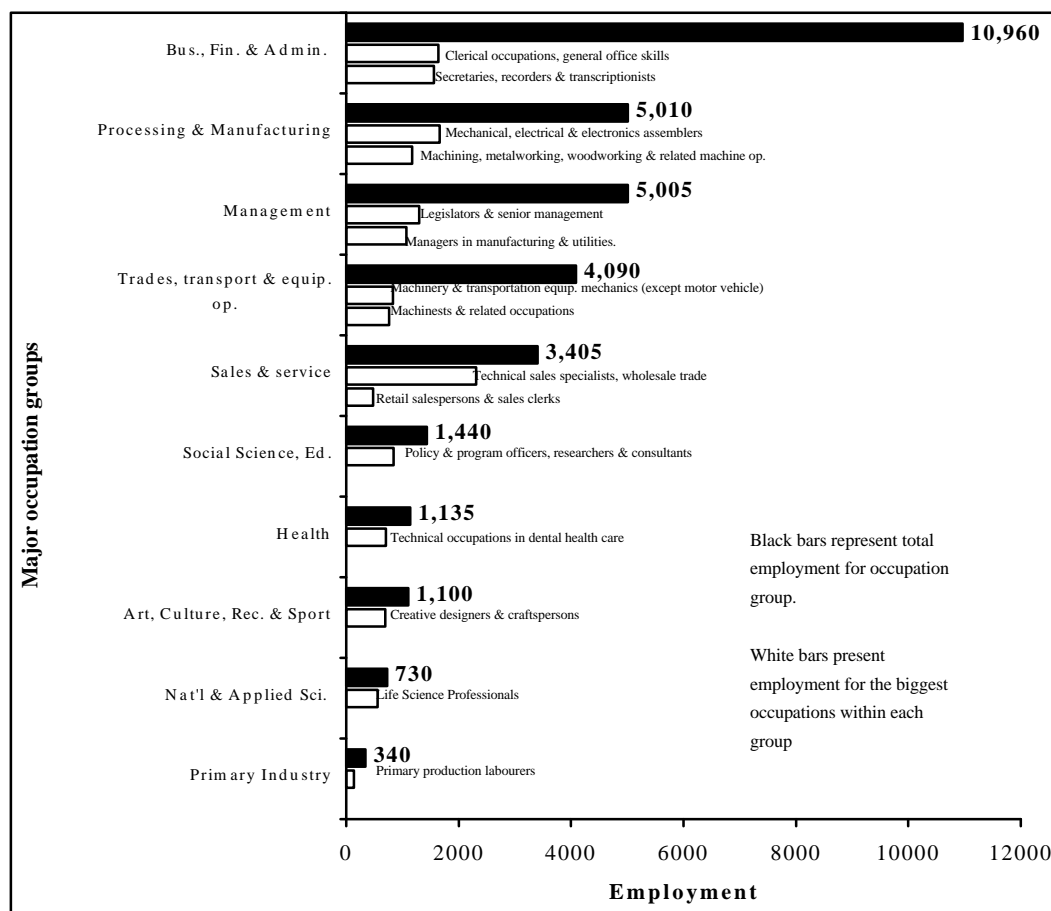
Source: Detailed Tables 3 and 7.

The non-high technology jobs can be grouped into ten categories based on the first digit of their NOC code. These groups are much broader than the groupings used in the 8 categories for the high technology occupations because they encompass all non-high technology occupations. Again, within each occupation grouping, one or two examples of occupations are given to help illustrate the kind of jobs the category contains.

Figure 8 shows that the largest occupation category in block 3 is *Business, Finance & administration*. The two largest occupations within this category are related to secretarial work. However, the category contains a broader spectrum of occupations ranging from *Office equipment operators* to *Library, correspondence & related info clerks*. High technology companies, like all other companies, need to take care of the day-to-day chores that keep a company running.

The second biggest occupation group in block 3 is *Processing and manufacturing*. Although there are a substantial number of workers in this category who work in *Architectural, engineering and other science and technology services* which is in the high technology service sub-sector, the vast majority of these workers work in the high technology manufacturing sub-sector. This partly explains why the high technology manufacturing sub-sector has a much higher concentration of workers with non-high technology occupations.

Figure 8. Employment of non-high technology workers in the high technology sector, by major occupation groups



Source: Detailed Tables 7 and 8.

3.3 EMPLOYMENT OUTSIDE THE HIGH TECHNOLOGY SECTOR

3.3.1 Focusing on High Technology Workers

2	

Block 2 represents workers with high technology occupations outside of the high technology sector

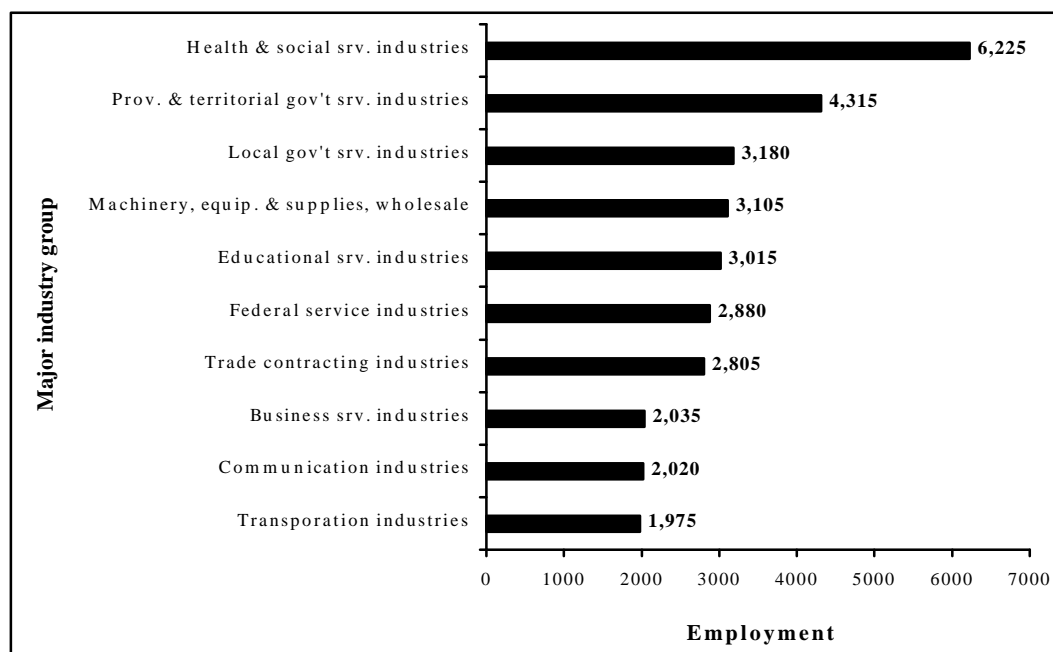
Just over sixty per cent of workers with high technology occupations work in industries outside of the high technology sector. Although there are more workers with high technology occupations outside of the high technology sector than inside, their percentage of the workforce is much smaller outside. In the high technology sector, roughly half of the workers

have high technology occupations. In the non-high technology sector, only three per cent of workers have high technology occupations. The reason there are more workers with high technology occupations outside of the high technology sector is simply because the rest of the economy is so much bigger that even its sparing use of high technology workers adds up to more than the total in the high technology sector.

Figure 9 shows that the largest industry employer in block 2 is *Health & social services industries*. Two thirds of these jobs are in medical technology jobs ranging from *Medical laboratory technicians* to *Respiratory therapists and & clinical perfusionists*. These high technology occupations are classified as high technology because they use high technology equipment and require scientific understanding to operate them.

The rest of the industries listed in Figure 9 fall into two broad categories. All three levels of government, Federal, provincial, and local are on the list. Governments need technology specialists to help deliver its services and carry out research. The rest of the industries on the list are industries that use high levels of mechanization or automation. *The communications industry*, for example, relies on sophisticated equipment to transmit information quickly and accurately. Specialists are needed to ensure that these systems are set up properly and run smoothly.

Figure 9. Top 10 non-high technology employers of high technology workers

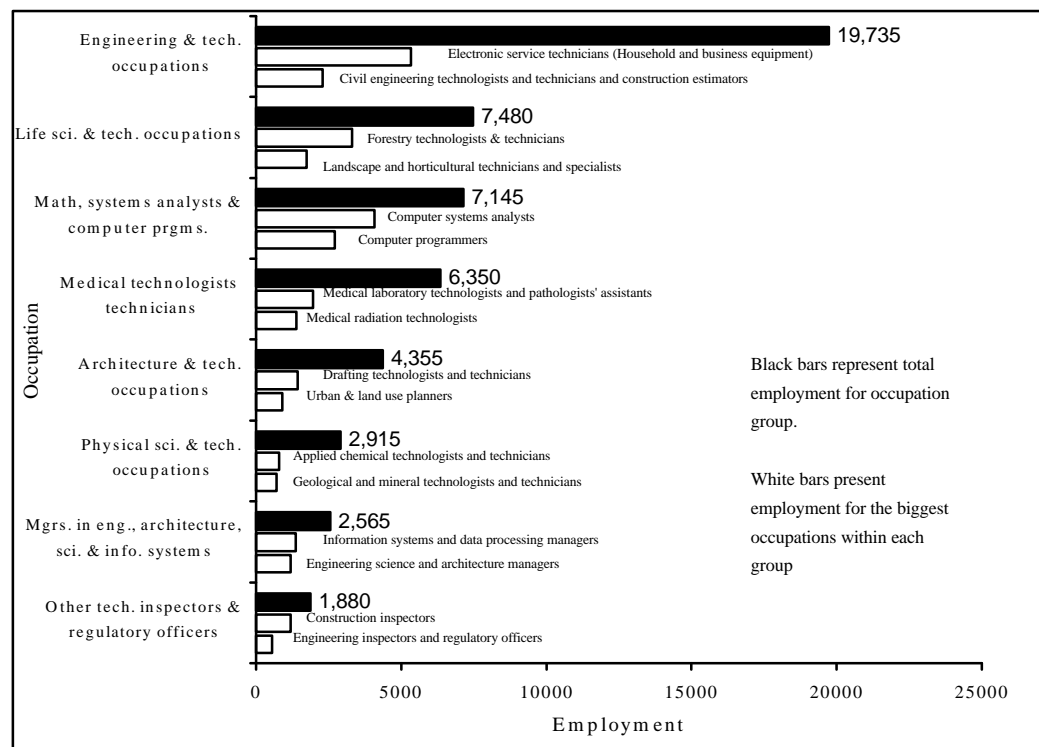


Source: Detailed Table 10.

The occupations in block 2 are usually focused on implementing technology as opposed to developing it. Figure 10 shows that *Engineering & technical occupations* is again the top employer of workers with high technology occupations. However, the technical occupations in engineering are more prominent outside of the high technology sector. The top two occupations in this group outside the high technology sector are *Electronic service technicians (Household and business equipment)* and *Civil engineering technologists and technicians and construction estimators*.

The next biggest high technology occupation group in block 2 is *Life science & technical occupations*. Looking at the occupations in this group shows that workers in this field are involved with the forestry industry and other outdoor work. This reflects the prominence of forestry in the BC economy.

Figure 10. Distribution of high technology workers outside the high technology sector, by major occupation groups



Source: Detailed Tables 4 and 11.

4 AVERAGE INCOME

4.1 AVERAGE INCOMES. WHAT AND WHY

The average incomes reported in this paper are for all individuals in BC who reported on the 1996 census that they were employed. Individuals who were employed part time or self-employed are reported along with individuals with regular full time jobs. This means that the average incomes reported may be lower than typical full time wages.

In this report, individuals with quite different jobs were grouped together. The groupings were made based on the general nature of the job, not the level within the job. For example, both engineers and their technical support staff are grouped together. Since the engineers have a higher level of education and often have more responsibility than the technical workers, they tend to be paid more. If the earnings of the combined group change, there are two possible explanations. The earnings for given occupations within the group have changed, or the mix of the occupations has changed.

In the data used in this report, it was not possible to differentiate between full time workers and part time workers or to differentiate between changes to individual occupations and changes in the mix of occupations in a group. This means that the results of this section on average incomes should not be used to make predictions about earnings for individuals. For example, it would be wrong for an electrical engineer to conclude that he or she will make more money working outside of the high technology sector simply because engineers as a group make an average of \$50,478 outside of the high technology sector compared to only \$47,811 in the high technology sector. Instead, the results of this section should be used to make inferences about income levels for groups of individuals who share common employment characteristics. In particular, comparisons of average incomes between groups give information about the relative prosperity of the two groups.

To aid in this kind of interpretation, Figure 11 shows how the average incomes of workers are distributed. Note that these figures are for average incomes, not individual incomes. This means that it is incorrect to conclude from Figure 11 that only 1 per cent of the population makes over \$83,939 a year. Figure 11 merely shows that, using the groupings generated by the occupation and industry categories, only 1 per cent of workers belong to groups with average incomes over \$83,939. However, this information is useful in this paper because it is average incomes that are reported.

Figure 11. Distribution of Average incomes in BC

Percent of BC workers in groups with average incomes greater than \$X	Average Income
90%	12,196
80%	15,405
70%	19,036
60%	22,867
50%	26,623
40%	31,281
30%	35,809
20%	40,471
10%	50,508
1%	83,939

Source. Detailed table 22

When interpreting average income numbers, the size of the group matters. Larger groups tend to have a greater diversity in their workers. This often means that the incomes of the workers vary as well, and when incomes vary, the average income of the group is often pulled closer to the average income for the province. Thus average incomes reported for smaller groups tend to have more variation.

4.2 THE OVERALL PICTURE OF AVERAGE INCOMES IN BC

1	2
3	4

The average income for workers in British Columbia is \$29,700. The provincial average has no special significance. It is used in this paper simply to represent a typical income. It should simply be kept in mind to get an idea of whether the average incomes reported are high or low.

Figure 12 shows the average incomes for the four blocks used in the employment section. The most striking feature of these numbers is that all the blocks related to high technology - blocks 1, 2, and 3 - are well above the provincial average and do not vary from each other much. Average incomes for workers with high technology occupations in the high technology sector are the highest. Yet the average income of workers with non-high technology occupations in the high technology sector, block 3 which is the lowest of the three, is less than 10 per cent lower. All three blocks have average incomes in the top 25 per cent of average incomes for the province.

It is not surprising that workers with high technology occupations have average incomes substantially above the provincial average because they are well educated. Engineers have a minimum of four years of university training. However, it is surprising that workers with non-high technology occupations in the high technology sector have incomes comparable to the wages of the high technology occupations. As will be seen in section 4.4, the high average salary for this group is also due to the fact that they are skilled workers. Their skills are not considered technology oriented but they are skilled none the less.

Figure 12 BC average incomes, 1996

	<i>High technology Sector</i> \$39,687	<i>Non-high technology sector.</i> \$29,282
<i>High technology occupation</i> \$40,950	\$41,190 [1]	\$40,779 [2]
<i>Non-high technology occupation</i> \$39,323	\$38,04 - [3]	\$28,936 [4]

4.3 WAGE RATES FOR HIGH TECHNOLOGY OCCUPATIONS IN THE HIGH TECHNOLOGY SECTOR

1	

As noted, workers with high technology occupations in the high technology sector have the highest average income, \$41,190, of the four main groups. In the Census data for all of BC, only 19 per cent of workers were in groups with an average income over \$41,190. This indicates that workers in block 1 are doing quite well compared to other BC workers. This section explores how average incomes vary within this group across occupations and between high technology industries.

The high technology occupations in the high technology service sub-sector have a slightly higher average income than the high technology occupations in the high technology manufacturing sub-sector but the difference is small. At the 3-digit SIC industry level, there is more variation. Figure 13 shows the average incomes for workers with high technology occupations in the top 3 and bottom 3 industries. The top three industries are significantly above the average for workers with high technology occupations in the high technology sector, but they only represent a small number of high technology workers. *Industrial chemicals n.e.c.* has the largest number, 145. Of the bottom three, *Medical and other health laboratories* has by far the largest number of workers with high technology occupations, 1,705. The average income for this group is close to the average income for BC as a whole. Thus, although workers in this industry have an occupation that is considered high technology and are in a high technology industry, they do not have an above average income. However, since the lowest average income for an industry in block 1 is still slightly above the provincial average, none of these groups of workers should be considered disadvantaged.

Figure 13. Average incomes for high technology occupations in top 3 and bottom 3 industries in the high technology sector.

	Industry	Average Income
Top 3	Industrial Chemicals n.e.c.	57,991
	Shipbuilding and repair	46,298
	Communications and energy wire and cable	45,721
Bottom 3	Communication and other electronic equipment	35,104
	Other manufactured products	30,992
	Medical and other health laboratories	29,790

Source. Detailed table 14

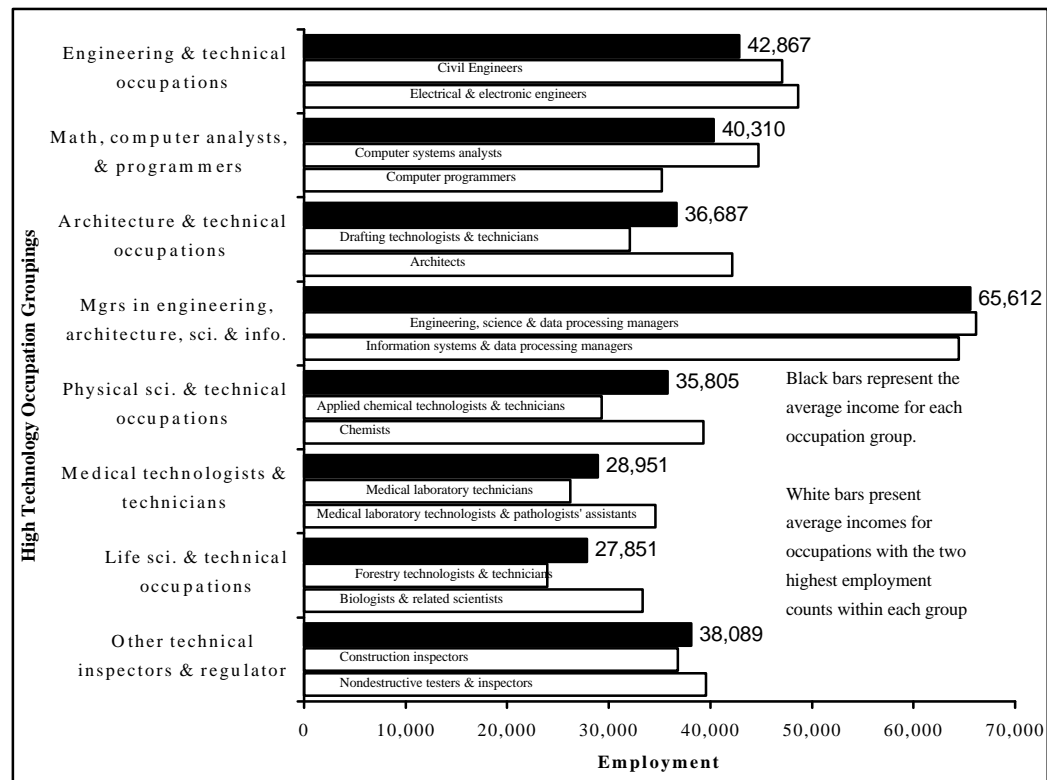
When the average incomes for workers in block 1 are broken down by occupation, there is more variation than when they are broken down by industry. This is because the industry breakdowns tend to mix workers with higher and lower average incomes. Most high technology companies

will have experienced senior managers as well as entry level technicians. The high incomes of the managers are offset by the low incomes of the technicians. The occupation breakdowns do not mix workers in this way. Instead, they focus on types of workers with similar jobs. When the managers are grouped together, they will have a much higher average income than the group of technicians.

Figure 14 presents average incomes for workers in block 1 using the same categories as Figure 5 in the employment section. The occupation groups are listed in the same order so that the first group, *engineering & technical occupations* has the largest employment of all the groups. The two occupations shown for each occupation group are the same ones reported before and are the largest in the group.

Only *Engineering & technical occupations* and *Managers engineering, architecture, sci & info* have average incomes higher than the average for workers in block 1, \$41,190. The size of *Engineering & technical occupations* and the significantly higher average income of *Managers engineering, architecture, sci & info* allow these two groups to bring up the average income for the 8 groups.

Figure 14. Average incomes for high technology occupation groups in the high technology sector.



Source. Detailed tables 15 and 16

4.4 NON-HIGH TECHNOLOGY WORKERS IN THE HIGH TECHNOLOGY SECTOR

3	

Block 3 represents workers with non-high technology occupations in the high technology sector.

As reported in section 4.2, the average income for this block is \$38,047. The average income is higher for non-high technology workers in the high technology manufacturing sub-sector than the high technology service sub-sector. However, the difference is less than 10 per cent. Again, there is more variation at the three-digit SIC level. Figure 15 shows the top three and bottom three industries in block 3. These six industries all have substantial numbers of non-high technology workers. The smallest is *Industrial Chemicals n.e.c.* with 860. This means that one or two successful or unsuccessful individuals are unlikely to have overly influence these average incomes. Instead, these average incomes are more indicative of the nature of the work done by workers with non-high technology occupations in these industries.

Figure 15 Average incomes for non-high technology workers for top 3 and bottom 3 industries in the high technology sector.

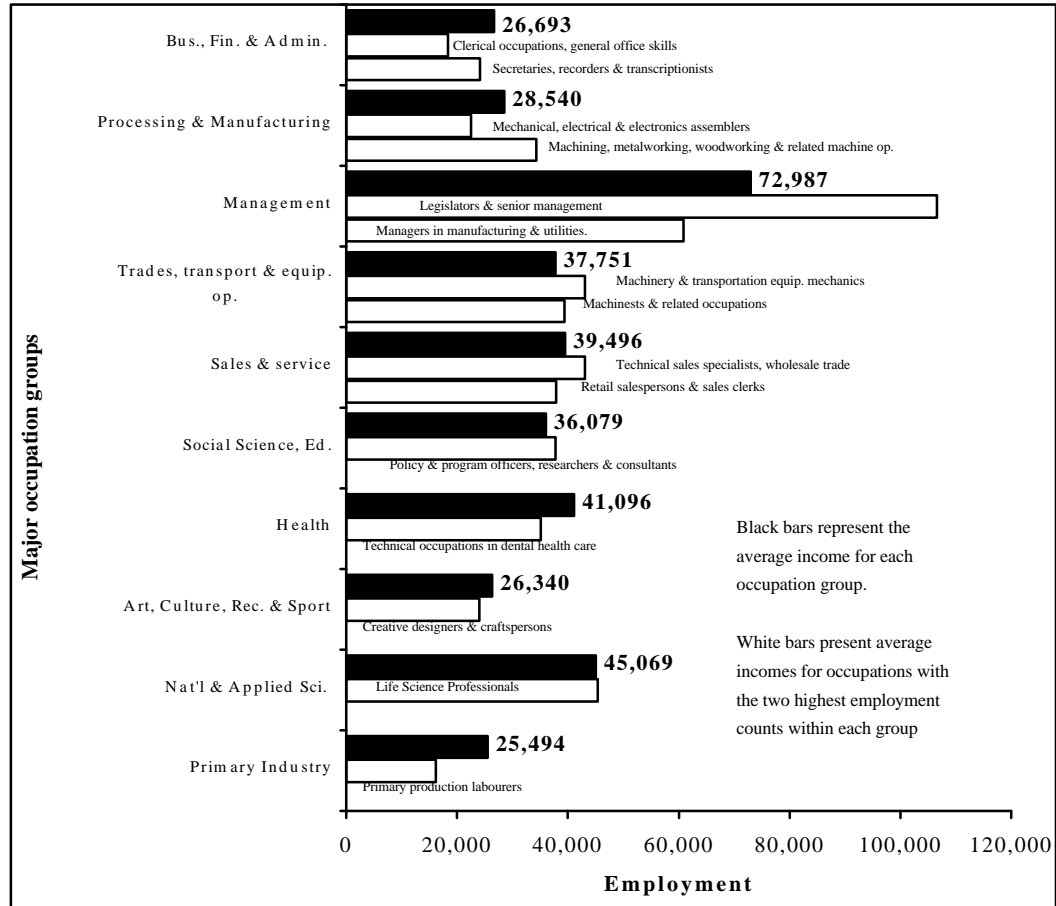
	Industry	Average Income
Top 3	Industrial Chemicals n.e.c.	70,824
	Other machinery and equipment	45,747
	Pharmaceutical and medicine	45,480
Bottom 3	Shipbuilding and repair	33,732
	Science and professional equipment	29,752
	Other manufactured products	26,804

Source. Detailed table 14

Similar to Block 1, the variation in the average incomes increases dramatically for block 3 when the workers are broken down by occupation instead of by industry. Figure 16 is set up in the same way as Figure 8. Again, the occupation groups are sorted by number of workers in Block 3. *Bus. Fin. & Admin* is the biggest. *Occupations unique to primary industry* is the smallest. Again managers have the highest average income. *Legislators & senior management* earn an average of \$106,551 in the high technology sector. This puts them well into the top 1 per cent of groups in terms of average incomes. At the other extreme are 135 *Primary production labourers* who earn \$16,203 in the high technology sector. This puts them in the bottom 25 per cent in terms of average income. There are a few groups that did a little better and a little worse than the

extremes shown. This information is contained in the detailed tables but is not shown here because the employment counts were very small.

Figure 16. Average incomes for non-high technology occupation groups in the high technology sector.



Source. Detailed tables 18 and 19

4.5 WAGE RATES OUTSIDE THE HIGH TECHNOLOGY SECTOR

	2

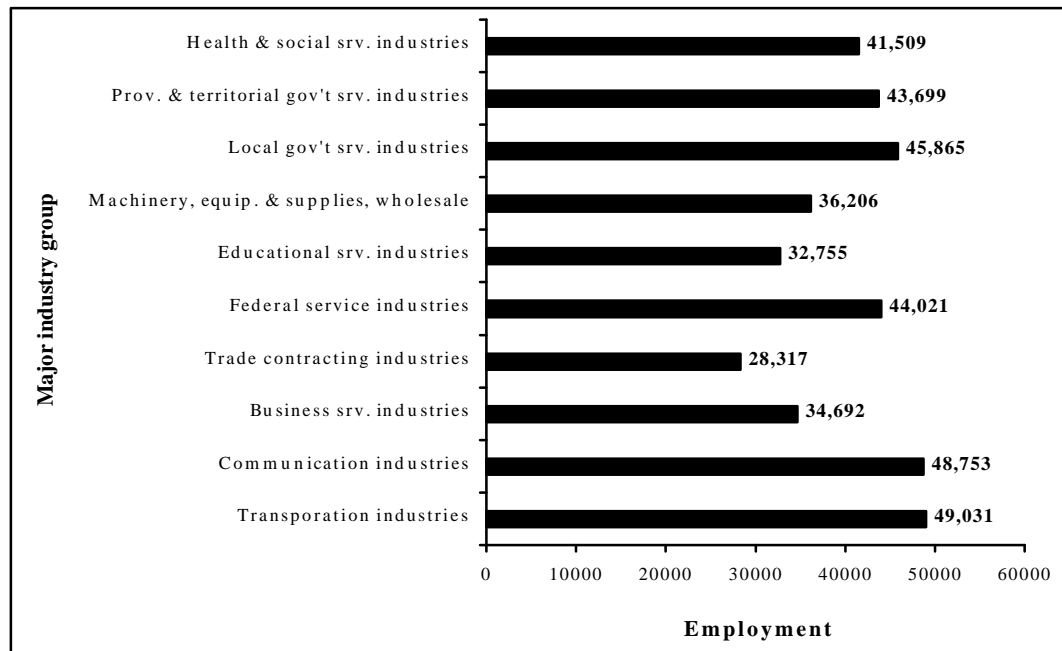
Workers in block 2 earn only slightly less outside of the high technology sector than their counterparts do inside the high technology sector. As was seen in the section on employment, the workers in block 2 are scattered throughout the rest of the economy in much lower concentrations than the workers in block 1.

In the employment section, the top 10 non-high technology industries in terms of employing high technology workers were presented in Figure 9. These 10 2-digit SIC coded industries account for 60 per cent of employment in block 2. Figure 17 uses the same format as Figure 9 but

reports average incomes for the industries. This means that the industries are again listed in order of number of employees in block 2. *Health and social services industries* is the biggest. *Transportation industries* is the smallest.

The industry variation in the average incomes of workers with high technology occupations outside of the high technology sector is comparable to the variation inside the high technology sector. In both cases, the majority of industries have average incomes between \$35,000 and \$45,000.

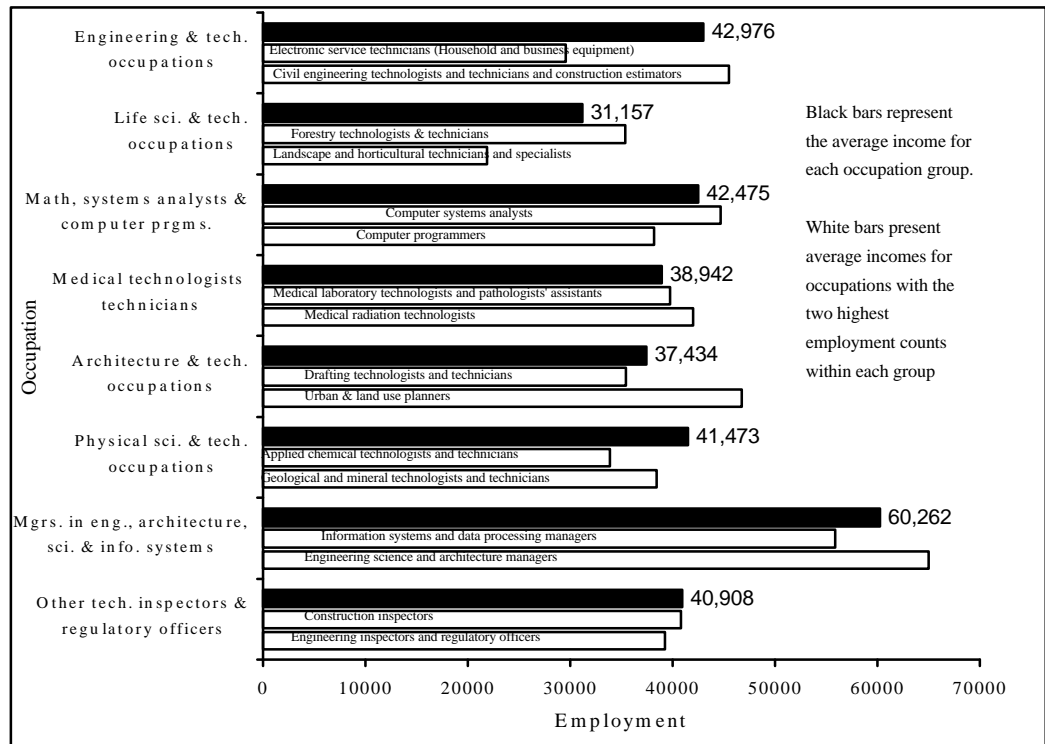
Figure 17. Average incomes for the top 10 non-high technology employers of high technology workers



Source. Detailed table 21

Figure 18 gives a breakdown of workers in block 2 by occupation. This figure is comparable to Figure 10 in the employment section and, as usual, follows the same order and thus has the groups listed in order of the number of workers each occupation has from block 2.

Figure 18. Average incomes of high technology workers outside the high technology sector, by major occupation groups.



Source. Detailed tables 19 and 20

5 METHODOLOGY

DEFINING HIGH TECHNOLOGY OCCUPATIONS

While it is generally acknowledged that the high technology sector is important to BC's economic growth, the types of occupations found in the sector, and occupation structure is less known. Up until now, there has been no set definition for high technology occupations. Within the Canadian context, a study by Avon⁵ defined science and technology workers in terms of the Canadian occupation classification system (NOC) (explained below). Engineers, scientists, technicians, systems analysts and related managers, for example, would be included because they are considered to be heavy users of technology, and are in occupations that are considered to be the sources of new technology. In terms of NOC, these include managers, professionals and technical staff in the natural and applied sciences occupations.

The United States' Bureau of Labour Statistics by contrast uses a definition of high technology workers based on surveys that asked employers about the occupations of their workers. Employers are also asked to designate workers who are engaged in research and development (R&D). Industries considered to be high technology are those with the proportion of R&D workers being at least 50 per cent higher than the average proportion for all industries surveyed. High technology workers are defined as those actually engaged in R&D⁶.

Our definition of high technology occupation is a variant of the above definitions. Rather than surveying employers, we make use of existing data from Statistics Canada. We define high technology occupations in terms of NOC. First, using the descriptions of the broad occupational groups, groups that are obviously not associated with high technology are eliminated. There are 10 broad occupation groups in NOC:

0. Management Occupations
 1. Business, Finance and Administration
 2. Natural and Applied Sciences and Related Occupations
 3. Health Occupations
 4. Occupations in Social Science, Education, Government Service and Religion
 5. Occupations in Art, Culture, Recreation and Sport
 6. Sales and Service
 7. Trades, Transport and Equipment Operators and Related Occupations

⁵ Avon (1995). *Human Resource in Science and Technology in the Services Sector*, Statistics Canada Cat. No.63-016-XPB. **CHECK FORMAT**

⁶ Luker and Lyons (June 1997). "Employment Shifts in High Technology Industries, 1988-1996." In *Monthly Labor Review*.

8. Occupations and Unique to Primary Industry
9. Occupations Unique to Processing, Manufacturing and Utilities.

From the above list of 10 broad occupational groups, eight are eliminated on the basis that they contain occupations that do not involve users of high technology and are not sources of new technology. The remaining two occupational groups which are deemed to be associated with high technology are: Natural and Applied Sciences and Related Occupations, and Health Occupations.

Individual occupation titles belonging to the above two groups are then examined. Occupations that require a scientific knowledge base to perform their main duties, are unrelated to primary industries, and involve the use of high technology equipment are selected. Simultaneously, the selection process is guided by our understanding of what is generally accepted as being high technology. For example, medical doctors are not considered to be high technology. While their jobs require a science knowledge base, their primary duties are associated with treating people. Medical technicians such as medical sonographer, however, are considered to be high technology occupations. While their jobs also involve treating people, they are more likely to be users of the latest medical technology. Table A represents the results of the above selection process, and the definition of high technology occupations used in this study.

Table A High Technology Occupations
<p>021 - Managers in Engineering, Architecture, science and Information Systems 0210 Engineering, Science and Architecture Managers 0211 Engineering Managers 0212 Architecture and Science Managers 0213 Information Systems and Data Processing Managers</p>
<p>211 - Physical Science Professionals 2111 Physicists and Astronomers 2112 Chemists 2113 Geologists, Geochemists and Geophysicists 2114 Meteorologists 2115 Other Professional Occupations in Physical Sciences</p>
<p>212 - Life Science Professionals 2121 Biologists and Related Scientists</p>
<p>213 - Civil, Mechanical, Electrical and Chemical Engineers 2131 Civil Engineers 2132 Mechanical Engineers 2133 Electrical and Electronics Engineers 2134 Chemical Engineers</p>
<p>214 - Other Engineers 2141 Industrial and Manufacturing Engineers 2142 Metallurgical and Materials Engineers</p>

<p>2143 Mining Engineers 2144 Geological Engineers 2145 Petroleum Engineers 2146 Aerospace Engineers 2147 Computer Engineers 2148 Other Professional Engineers, n.e.c. 215 - Architects, Urban Planners and Land Surveyors 2151 Architects 2152 Landscape Architects 2153 Urban and Land Use Planners 2154 Land Surveyors</p>
<p>216 – Mathematicians, Systems Analysts and Computer Programmers 2161 Mathematicians, Statisticians and Actuaries 2162 Computer Systems Analysts 2163 Computer Programmers</p>
<p>221 - Technical Occupations in Physical Sciences 2211 Applied Chemical Technologists and Technicians 2212 Geological and Mineral Technologists and Technicians 2213 Meteorological Technicians</p>
<p>222 - Technical Occupations in Life Sciences 2221 Biological Technologists and Technicians 2223 Forestry Technologists and Technicians 2225 Landscape and Horticultural Technicians and Specialists</p>
<p>223 - Technical Occupations in Civil, Mechanical and Industrial Engineering 2230 Civil Engineering Technologists and Technicians and Construction Estimators 2231 Civil Engineering Technologists and Technicians 2232 Mechanical Engineering Technologists and Technicians 2233 Industrial Engineering and Manufacturing Technologists and Technicians</p>
<p>224 - Technical Occupations in Electronics and Electrical Engineering 2241 Electrical and Electronics Engineering Technologists and Technicians 2242 Electronic Service Technicians (Household and Business Equipment) 2243 Industrial Instrument Technicians and Mechanics 2244 Aircraft Instrument, Electrical and Avionics Mechanics, Technicians and Inspectors</p>
<p>225 - Technical Occupations in Architecture, Drafting, Surveying and Mapping 2251 Architectural Technologists and Technicians 2252 Industrial Designers 2253 Drafting Technologists and Technicians 2254 Survey Technologists and Technicians 2255 Mapping and Related Technologists and Technicians</p>
<p>226 - Other Technical Inspectors and Regulatory Officers 2261 Nondestructive Testers and Inspectors 2262 Engineering Inspectors and Regulatory Officers 2264 Construction Inspectors</p>
<p>321 - Medical Technologists and Technicians (Except Dental Health) 3211 Medical Laboratory Technologists and Pathologists' Assistants 3212 Medical Laboratory Technicians 3213 Animal Health Technologists 3214 Respiratory Therapists and Clinical Perfusionists 3215 Medical Radiation Technologists 3216 Medical Sonographers 3217 Cardiology Technologists 3218 Electroencephalographic and Other Diagnostic Technologists, n.e.c. 3219 Other Medical Technologists and Technicians</p>

Our definition of high technology occupation will likely include some low-technology jobs. Conversely, some non-high technology occupations will include high technology jobs. These are unavoidable uncertainties that are a part of any high technology study. An advantage to our methodology is that it can accommodate changes to our basic understanding of what high technology is. The term high technology implies technology that is more advanced than existing technology. Since technology is changing, being adopted and then discarded so quickly, what is considered advanced technology today may not be considered advanced technology tomorrow. Our definition based on NOC can easily be adapted to incorporate updated definitions of high technology.

THE NATIONAL OCCUPATIONAL CLASSIFICATION (NOC) SYSTEM

The National Occupation Classification system is a three-tiered nested system of occupational groups. Within this structure, an occupation is defined as a collection of jobs grouped under one common title due to the similarities in the work performed. Each occupational group is therefore unique, yet the groups can be related to each other by similarities in the kind of work performed in each group. A job involves all the tasks a worker carries out to complete his or her duties⁷. NOC captures the range of occupational activity in Canada systematically using two criteria: skill level and skill type.

Skill level is the amount and type of education and training required to enter an occupation and perform the duties of the occupation. Experience, complexity and responsibilities typical to an occupation are considered and compared to other occupations to determine the skill level of an occupation. There are four skill levels in NOC reflecting four commonly accepted entry routes for employment. They range from skills acquired from on-the-job training to a university degree.

Skill type is broadly defined as the type of work performed. NOC identifies 10 broad occupational groups based on skill types. These have been listed above under the heading of *Defining high technology occupations*.

The highest level within NOC contains two-digit codes. The first digit indicates the skill type category; the second digit indicates the skill level category. Each **major group** with two-digit codes is composed of one or more **minor groups** with three-digit codes. Minor groups are in turn composed of **unit groups** with four-digit codes. The first three digit

⁷ Ministry of Industry, Science and Technology (1993). *Standard Occupation Classification 1991*. Cat. No. 12-565E.

indicate the higher level groups to which the unit group belongs. Reporting in this study is by three-digit and four-digit codes.

While NOC provides a convenient structure from which to select high technology occupations, it does not capture all the possible occupation titles. A number of occupational titles actually fall within each four-digit occupational group (the lowest level of classification). These 'other' occupations are not assigned a different occupation code.

The second system used to classify workers in this study is the Standard Industrial Classification (SIC) System. The SIC system, like the NOC system, groups workers together based on the nature of their work. However, instead of focusing on skills and job characteristics of the worker, SIC focuses on the output produced by the industry the worker belongs to.

Most industries require workers from many different occupations. A software company needs more than just programmers. Managers and administrative staff are needed to meet the day-to-day requirements of running a business. Sales staff may be needed to market the software. Although these workers have many different occupations, they are all working together to produce computer software. The SIC system would classify all the workers in a software business under *Computer and Related Services Industries*. The focus of the SIC system is on outputs instead of inputs.

HIGH TECHNOLOGY INDUSTRIES

BC STATS has developed a definition of the high technology sector in terms of the SIC⁸ system. This definition is comprised of 20 manufacturing industries, and 10 service industries at the four-digit (most detailed) level. While the high technology sector is defined in terms of four-digit SICs, reporting industries has been done at the three-digit level. This is the most detailed level at which the Statistics Canada Census data was available. Interpretation should therefore be made with care as the three-digit SICs contain both high technology and non-high technology industries. Table B shows the three-digit SICs that have been used, and indicates high technology components with a check mark.

⁸ Complete details of this definition are contained in Lawrance and Miller (1995). *Defining the High Technology / Knowledge Sector in British Columbia*, available at <http://www.bcstats.gov.bc.ca>.

Table B
High Technology Industries

√ indicates industries that fall within the high technology definition

HIGH TECHNOLOGY MANUFACTURING

319 Other Machinery and Equipment Industries

- 3191 Compressor, Pump and Industrial Fan Industry
- √ 3192 Construction and Mining Machinery and Materials Handling Equipment Industry
- 3193 Sawmill and Woodworking Machinery Industry
- √ 3194 Turbine and Mechanical Power Transmission Equipment Industry
- √ 3199 Other Machinery and Equipment Industries n.e.c.¹

321 Aircraft and Aircraft Parts Industry

- √ 3211 Aircraft and Aircraft Parts Industry

327 Shipbuilding and Repair Industry

- √ 3271 Shipbuilding and Repair Industry

335 Communication and Other Electronic Equipment Industries

- √ 3351 Telecommunication Equipment Industry
- √ 3352 Electronic Parts and Components Industry
- √ 3359 Other Communication and Electronic Equipment Industries

336 Office, Store and Business Machine Industries

- √ 3361 Electronic Computing and Peripheral Equipment Industry
- √ 3362 Electronic Office, Store and Business Machine
- √ 3369 Other Office, Store and Business Machine Industries

337 Electrical Industrial Equipment Industries

- 3371 Electrical Transformer Industry
- √ 3372 Electrical Switchgear and Protective Equipment Industry
- √ 3379 Other Electrical Industrial Equipment Industries

338 Communications and Energy Wire and Cable Industry

- √ 3381 Communications, Energy Wire and Cable Industry

371 Industrial Chemicals Industries n.e.c.

- √ 3711 Industrial Inorganic Chemical Industries n.e.c.

374 Pharmaceutical and Medicine Industry

- √ 3741 Pharmaceutical and Medicine Industry

391 Scientific and Professional Equipment Industries

- √ 3911 Indicating, Recording and Controlling Instruments Industry
- √ 3912 Other Instruments and Related products Industry
- 3913 Clock and Watch Industry
- 3914 Ophthalmic Goods Industry

399 Other Manufactured Products Industries

- 3991 Broom, Brush and Mop Industry
- 3992 Button, Buckle and Clothes Fastener Industry
- 3993 Floor Tile, Linoleum and Coated Fabric Industry
- √ 3994 Musical Instrument and Sound Recording Industry
- √ 3999 Other Manufactured Products Industries n.e.c.

HIGH TECHNOLOGY SERVICES

772 Computer and Related Services Industries

- √ 7721 Computer Services
- √ 7722 Computer Equipment Maintenance and Repair

775 Architectural, Engineering and Other Scientific and Technical

	Services Industries
	7751 Offices of Architects
√	7752 Offices of Engineers
√	7759 Other Scientific and Technical Services
868	Medical and Other Health Laboratories
√	8681 Medical Laboratories
√	8682 Radiological Laboratories
√	8683 Combined Medical and Radiological laboratories
√	8684 Public Health Laboratories
√	8685 Blood Bank Laboratories
√	8689 Other Health Laboratories
¹ "Not elsewhere classified"	

DATA ISSUES

Data for this study came from Statistics Canada's 1996 Census. Because census data collection occurs once every five years, we present in this study a static analysis of high technology occupations for the most recent census year of 1996.

Tables generated for analyses in this study are based on an industry-by-occupation cross-tabulation of employment and average income data. These data are collected based on a 20% sample of the employed labor force ages 15 years and over for 1996.

Census data is also collected through the process of self-enumeration. The results from this methodology would likely differ from those collected via a different methodology. The Survey for Employment, Payrolls and Hours (SEPH), for example, collects employment data by conducting industry survey of employers. Readers wishing to compare data across different publications by BC STATS should take into the account the data source and the methodology by which data were collected.

Employment is a count of those who work for pay or are self-employed. Average income is calculated by dividing the aggregate income of a specified group of individuals by the number of individuals with income in that group. The calculation is based on unrounded income data.

Because Statistics Canada adheres to strict rules of confidentiality, data for this study has been subjected to a rounding process. In cases where few individuals (1 to 9) are found in a particular occupation and industry, their employment count is rounded up to 10, or down to 0. All levels of data are tabulated first, then rounded at that level before aggregation of data to broader levels. Consequently, data for a particular occupation or industry group may not sum up across the different levels of occupation or industry classification. The treatment of average income data is dependent on whether or not employment count has been rounded. Where rounding has occurred, the average income may or may not be revealed, depending on the original value for employment.

Given our interest in the high technology sector, it becomes necessary to calculate an average income across a group of occupations and industries. We do so by dividing the aggregate income by the number of individuals in a specific group. For example, the average income for civil engineers for each high technology industry would be aggregated, and divided by the total number of civil engineers across these industries. In cases where a rounded employment is given, and the average income is concealed, our methodology would exclude this employment count from the total employment count across industries. The calculated average income for the high technology sector or a group of occupations would reflect all those industries or occupations for which an average income was provided.