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## Business Indicators ♦ July 2001

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### Which BC Industries Qualify as High Tech?

#### Introduction

Despite recent high profile stock market adjustments, the designation “high tech” is synonymous with growth and development. From running shoes to aerospace, everything that could conceivably be so designated gets the high tech label.

From the point of view of economic analysis, the high tech designation is in some ways not much more precise than the popular usage. Economists try to group industries or firms to make them easier to analyse and describe. To be effective, industry or firm groupings should be quite uniform internally while quite different from other groupings in the economy. Theory tells us that the “high tech” group should in the long run be distinguished by high performance, simply because “technology is the most obvious cause and effect of the cumulative wealth of rich nations”.<sup>1</sup> But we can not define it on that basis and then proceed with performance measurements. That would be circular reasoning. So what else is it about high tech that makes it “high tech”?

We begin with the knowledge that research and development is the basis of technological advancement. Therefore it is logical to assume that where research and development (R&D) effort is greatest, technology is likely to be “highest”. This assumes that R&D effort is uniformly

successful, and that high technology firms or industries must create technology, rather than purchase it. Nevertheless, R&D effort remains a standard for assessing technology levels.

A second standard by-passes the amount of R&D effort, and looks at the nature of products and services that a firm or industry produces. Products that are recognized as high tech may be specified by panels of experts. Paradoxically, the experts may look at the R&D that went into a product in making their choices, but presumably a product could win the “high tech” label even if its creation involved fewer scientists and lesser budgets than other possible candidates. In addition, with the product standard, a firm or industry could be high tech by virtue of its product line, even if the firm or industry did not actually develop the product.<sup>2</sup>

A third way of grouping would rely on high tech sector experts to designate the firms or industries that comprise the sector. This of course is somewhat circular as well, since one would have to define the sector in order to choose the appropriate experts in it. Nevertheless, there is little debate about what constitutes the core of the sector. The expert’s contribution is to help with the more subtle distinctions.

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<sup>1</sup> Malecki, Edward J., Technology and Economic Development, Longman Scientific and Technical, 1991, p.7.

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<sup>2</sup> Products that are made by advanced processes, however, are not automatically high tech. For example, a mushroom from a high tech greenhouse is still just a mushroom.

Clearly, there is both art and science in deciding what “high tech” really means. What follows is an account of how BC STATS has applied some mathematics (arithmetic, really) to the challenge of re-defining the high tech sector for use in reports and economic analysis. The results are preliminary and will be refined considerably before being adopted for use in BC STATS’ reports on the high technology sector that will be produced in 2002 and subsequent years.

### **The Advent of NAICS**

Most of the business and economic statistics produced in Canada to date have been prepared on the basis of the Standard Industrial Classification (SIC). The SIC is a four-digit code developed by Statistics Canada, and was last reworked in 1980. Rather than prepare a further update to the SIC on its own, Statistics Canada partnered with the United States and Mexico to develop a coding system that would be as uniform as possible, to support the North American Free Trade Agreement (NAFTA). The resulting coding system is the North American Industry Classification System (NAICS). For the past three years, Statistics Canada has been working to switch all its business and economic statistics over to NAICS, a job that is now nearing completion.

In the past, BC STATS has defined the high technology sector in terms of selected SIC industries.<sup>3</sup> Because new data will now mostly be available only in NAICS terms, BC STATS must change as well. In addition, because it is more recent than the SIC, NAICS does offer some advantages in defining the high technology sector. For

example, the SIC industry “Computer Services” has been broken down under NAICS to include “Data Processing Services”, as well as “Computer Systems Design” and “Software Publishers”. The breakdown also extends to “Database and Directory Publishers”. This level of detail helps to refine the high tech sector definition and in this example, it distinguished the directory publishers, who may be better grouped with other publishers than with other higher technology businesses.

### **The NAICS-SIC Dilemma**

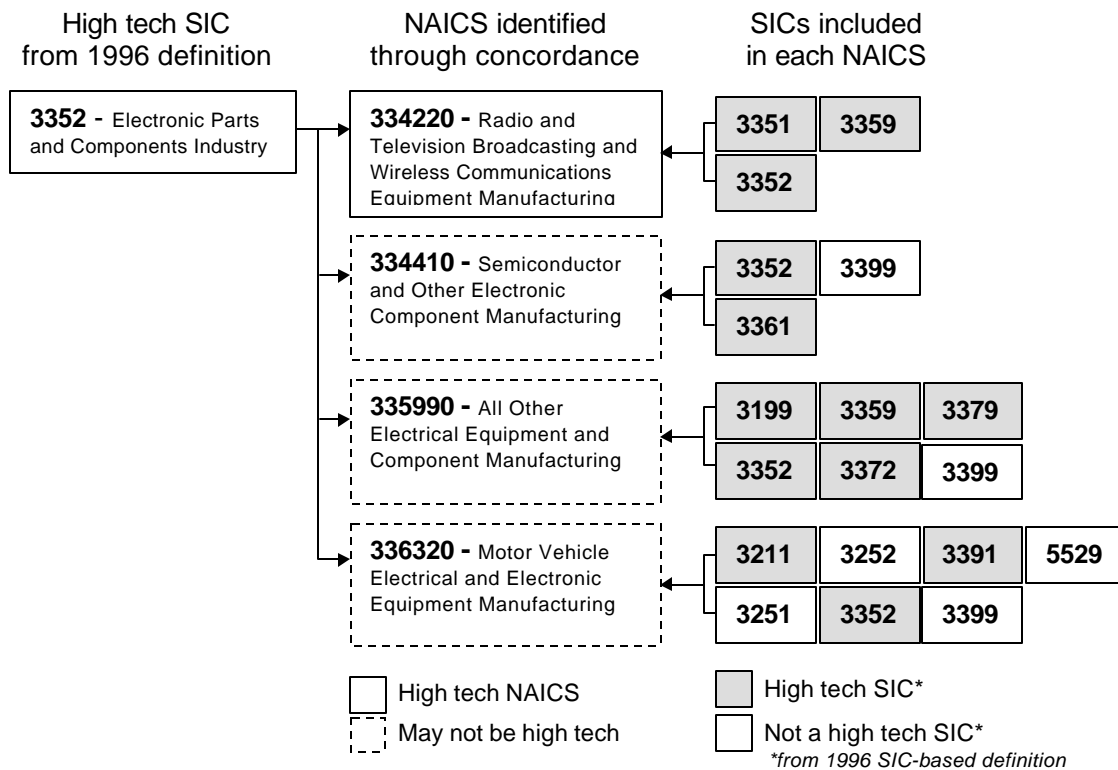
If NAICS merely provided more detail than the SIC, updating the high technology sector definition would be a relatively simple matter. However, NAICS is actually a new and different classification scheme. Concordance tables show that each NAICS code may be made up of one or more SIC codes, or parts of SIC codes. And NAICS codes that contain what were high technology SICs may also contain low technology SICs.

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<sup>3</sup> The methodology for selecting SICs is described in the 1996 report “Defining the High Technology / Knowledge Sector in British Columbia”, available at [http://www.bcstats.gov.bc.ca/data/bus\\_stat/hi\\_tech.htm](http://www.bcstats.gov.bc.ca/data/bus_stat/hi_tech.htm)

The illustration below uses the Electronic Parts and Components industry as an example of how SIC industries can be affected by the switch to NAICS. Reading from left to right, it first appears that the industry has been split into four. However, the boxes on the far right show other SICs that also make up part of the four new industries.

Of these SICs, some were formerly designated high technology (those shaded grey) and some were not. Therefore only NAICS 334220 can definitely be deemed high tech on the basis of how industries were defined in the past. The remaining three NAICS industries may or may not be properly deemed high tech. More refined methods are needed to make the determination. Some such methods implemented by BC STATS are described on the following page.



## The Fifteen Methods

As outlined in the Introduction, there is no definite way to identify which industries should be included in the high technology sector. However there are some general principles of what is important, and these in turn can guide specific calculations or methods. BC STATS has implemented fifteen detailed sets of calculations under the banner of four principles. This work is summarized below in a few sentences for each principle. A detailed methodology paper will be made available on the BC STATS web site during the month of August.

### *Concordance*

Concordance methods start with SIC industries that were deemed to be high technology by BC STATS in the past. They then identify the NAICS codes that are related to these SICs. To implement this, BC Stats tracked each individual firm in the high tech SICs and determined what NAICS coding they had subsequently received from the Business Register Division of Statistics Canada.

### *Commodity Lists*

The commodity list approach examines commodity outputs to identify high technology manufacturing industries. This approach begins by identifying a list of commodities, which contain significant research and development and represent the leading edge of progress in their field. The industries that produced these commodities may be identified as high technology industries, depending on how significant the high technology products are in relation to the total shipments of the industry.

### *Research Activities*

This is the principle that high technology involves high levels of research and development. The implementation uses data collected for the 2000/2001 BC

Manufacturers' Directory<sup>4</sup> (BCMD). Respondents were asked about the proportion of scientists and engineers (%S&E) and the proportion of total sales spent on research and development (%R&D) within their firms.

### *Company Lists*

Various companies and organizations in the province produce listings of companies in the high technology sector. While the criteria for inclusion in these lists may vary, they often reflect widely held opinions from the community at large. The methods was implemented by obtaining lists from *Business in Vancouver*, from *Techwest*, and from the *Centre for Policy Research on Science and Technology* at Simon Fraser University. The firms on these lists were coded according to NAICS, and those codes that figured most prominently were identified as high tech sector candidates.

## High Tech Election

Each of the four principles was supported by at least two distinct calculation methods. For example, under *Company Lists* each of the three lists examined produced a separate set of NAICS codes that are candidates for inclusion in the high technology sector definition. In total, fifteen separate lists of NAICS candidates were produced under the four principles. Naturally, these lists tend to overlap, with certain NAICS codes being referenced repeatedly. However, the lists are not always in total agreement.

The solution was to hold a simple "election" of the NAICS codes, on the basis of "one list – one vote". Those NAICS codes that received more than 50% of the possible "votes" were added to the high technology sector definition. This resulted in a definition comprised of 24 NAICS codes. Of these, six

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<sup>4</sup> BC Manufacturers' Directory is compiled by BC Stats (<http://www.made-in-bc.ca/>)

had only the minimum requirement of 50% of possible votes, while one (Software Publishers) was selected by all of the relevant methods.

**The Preliminary List**

The preliminary list of high technology NAICS industries is presented below, together with the number of methods that agreed on the inclusion of each industry.

Perhaps as interesting is the list of industries that were not included, because the list is certainly not final. It was obtained by a series of possibly arbitrary calculations, and now requires some “sober second thought”. For example, it includes some wholesalers and retailers, which are categories not considered for inclusion previously. And it includes some types of diagnostic laboratories, while excluding others. Readers are invited to consult the detailed methodology paper, and to submit comments on both the inclusions and exclusions. Final results will be published later in the year. This will help ensure a strong foundation for measurements of the high technology sector over the coming decade or longer.

NAICS	Industries Proposed for Inclusion in High Tech Sector Definition	Share of possible votes
511210	Software Publishers	100%
334512	Measuring, Medical and Controlling Devices Manufacturing	87%
334210	Telephone Apparatus Manufacturing	80%
334410	Semiconductor and Other Electronic Component Manufacturing	80%
334511	Navigational and Guidance Instruments Manufacturing	80%
335990	All Other Electrical Equipment and Component Manufacturing	80%
417320	Electronic Components, Navigational and Communications Equipment and Supplies	75%
541710	Research and Development in the Physical, Engineering and Life Sciences	75%
541510	Computer Systems Design and Related Services	75%
334110	Computer and Peripheral Equipment Manufacturing	73%
334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	73%
335315	Switchgear and Switchboard, and Relay and Industrial Control Apparatus Manufacturing	67%
325410	Pharmaceutical and Medicine Manufacturing	67%
336410	Aerospace Product and Parts Manufacturing	67%
334290	Other Communications Equipment Manufacturing	60%
339110	Medical Equipment and Supplies Manufacturing	53%
334310	Audio and Video Equipment Manufacturing	53%
335920	Communication and Energy Wire and Cable Manufacturing	53%
514210	Data Processing Services	50%
541620	Environmental Consulting Services	50%
417310	Computer, Computer Peripheral and Pre-Packaged Software Wholesaler-Distributors	50%
443120	Computer and Software Stores	50%
541330	Engineering Services	50%
621510	Medical and Diagnostic Laboratories	50%