SECTOR COMPETITIVENESS FRAMEWORKS

COMPUTER EQUIPMENT

PART 1 – OVERVIEW AND PROSPECTS

Spectrum, Information Technologies and Telecommunications Sector
Information Technology Industry

Secteur du spectre, des technologies de l'information et des télécommunications
Industrie de la technologie de l'information

Canada

COMPUTER EQUIPMENT

PART 1 – OVERVIEW AND PROSPECTS

PREPARED BY:
INFORMATION TECHNOLOGY INDUSTRY BRANCH

This *Overview and Prospects* is the first of two companion documents on the Canadian computer equipment industry in the **Sector Competitiveness Frameworks** series, which is being produced by Industry Canada in collaboration with Canada's key stakeholders in the industry. *Part 2 — Framework for Action* will be prepared in coming months, based on discussions with major industry stakeholders, following study and review of the *Overview and Prospects*.

The **Sector Competitiveness Frameworks** series focusses on opportunities, both domestic and international, as well as on challenges facing each sector. The objective is to seek ways in which government and private industry together can strengthen Canada's competitiveness and, in doing so, generate jobs and growth.

Part 1 — Overview and Prospects is being made available for distribution in printed as well as electronic forms. In all, some 29 industrial sectors are being analyzed.

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FOREWORD

The new Canadian marketplace is expanding from national to global horizons and its economic base is shifting increasingly from resources to knowledge. These trends are causing Canadian industries to readjust their business approaches, and government must respond with new tools to help them adapt and innovate. Industry Canada is moving forward with strategic information products and services in support of this industry reorientation. The goal is to aid the private sector in what it is best qualified to do — create jobs and growth.

Sector Competitiveness Frameworks are a series of studies published by Industry Canada to provide more focussed, timely and relevant expertise about businesses and industries. They identify sectors or subsectors having potential for increased exports and other opportunities leading to jobs and growth. During 1996 and 1997, they will cover 29 of Canada's key manufacturing and service sectors.

While they deal with "nuts and bolts" issues affecting individual sectors, the Sector Competitiveness Frameworks also provide comprehensive analyses of policy issues cutting across all sectors. These issues include investment and financing, trade and export strategies, technological innovation and adaption, human resources, the environment and sustainable development. A thorough understanding of how to capitalize on these issues is essential for a dynamic, job-creating economy.

Both government and the private sector must develop and perfect the ability to address competitive challenges and respond to opportunities. The Sector Competitiveness Frameworks illustrate how government and industry can commit to mutually beneficial goals and actions.

The Sector Competitiveness Frameworks are being published sequentially in two parts. An initial *Overview and Prospects* document profiles each sector in turn, examining trends and prospects. The follow-up *Framework for Action* draws upon consultations and input arising from industry–government collaboration, and identifies immediate to medium-term steps that both can take to improve sectoral competitiveness.

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1 HIGHLIGHTS

The objective of this examination of the computer equipment industry is to help strengthen its competitiveness in Canada and its ability to generate jobs and growth for Canadians. This document focusses on the international opportunities and challenges facing the industry.

According to* The World Competitiveness Yearbook *for 1996, Canada ranks fourth in the world based on the number of computers per capita and sixth both in computing power and in the number of computers in use. Computer hardware manufacturers are at the leading edge of Canada's move toward a knowledge-based economy, reinforcing our strength in telecommunications, computer software and advanced manufacturing technologies. Moreover, these manufacturers are key agents in the technological change process as a whole . . .

- Canadian firms in the global computer equipment industry manufacture electronic computers and related electronic peripheral equipment used in various computing applications. The industry includes makers of mainframes, mid-range computers, workstations, personal computers and memory drives. It also comprises firms that produce peripheral equipment such as printers, monitors, keyboards and certain parts of computers such as video, networking and audio controller cards.

- Computer equipment is used in hundreds of thousands of Canadian businesses and homes to serve customers more efficiently. Computer equipment also links Canadians with international business contacts via the Internet and other computer communications channels.

- Our computer market is estimated to be the eighth largest in the world, just behind those of Spain and Italy.

- While the business market is currently larger, the major market driver is household demand. Applications such as telecommuting and the Internet are fuelling consumer purchases of new equipment and peripherals.

Computer manufacturers contribute to the nation's wealth both directly — through job creation and generation of orders for other businesses — and indirectly — by increasing the capacity to use other technologies, including telecommunications systems, resource-processing systems, environmental-sensing systems and traffic control systems more fully and efficiently . . .

- According to Statistics Canada data for 1994, the Canadian industry consisted of almost 300 companies and employed approximately 14 000 people.
- The Canadian computer equipment industry produces items that reduce Canada's dependence on imported goods and services and contributes positively to Canada's international trade performance.
- Multinational enterprises (MNEs) operating in Canada, such as Digital, IBM, Unisys and Hewlett Packard, represent the majority of the manufacturing activity and often carry North American product mandates. Canada is a competitive location of operations due to its highly qualified personnel, advanced design and manufacturing methods, and high-quality working and living conditions.
- The two largest Canadian computer manufacturing plants employ about 2 500 people each; the next three largest plants have about 500 employees each. There are also many small companies and plants that develop specific computer technology applications for Canadian and international niche markets.

Canada's computer industry is a strong and growing industry . . .

- In 1994, the computer equipment industry contributed an estimated $3.6 billion to Canada's gross domestic product (GDP), reflecting impressive growth since 1986, when its contribution was only $750 million.
- Industry shipments grew from $3.3 billion in 1993 to $5.8 billion in 1995.
- In 1994, average shipments per computer industry employee were $410 000. This is more than three times the average for the total Canadian manufacturing sector.

- Dataquest, a private consulting firm, predicts that the North American growth rate of personal computer demand will slow by the end of this century. European and Asian markets, however, are expected to grow twice as fast as the North American market between now and the end of the decade, at which time both of these regional markets should be the same size as the U.S. market.

1.1 Major Trends

Investment is important to the Canadian computer industry . . .

- In the production of computer hardware, technological leadership requires leading-edge design, manufacturing equipment and software, all of which become outdated very quickly and require regular infusions of capital to meet replacement and update costs.
- Investment in the Canadian computer industry showed a sharp downturn in 1992, from $225 million the year before to a long-term low of $125 million. This drop coincided with a period in which computer manufacturers suffered losses.
- The relative volatility in annual investment in the Canadian computer industry demonstrates the influence of a few key firms such as Digital Equipment, Hewlett Packard and Celestica, which make the major investment decisions.

Canadian computer industry profits remain fairly volatile, an experience shared in the U.S. . . .

- Earnings have varied from a loss of $45 million in 1989 to a profit of $300 million in 1995.
- Canadian computer company net profit margins were higher than those of their publicly traded U.S. counterparts in 1995.

The industry has increased its employment, drawing mainly from a pool of people with advanced university degrees . . .

- Total employment in the Canadian computer industry has grown in both absolute and relative terms. While total Canadian manufacturing employment decreased from 2.1 million in 1981 to approximately 1.6 million in 1994, employment in the computer equipment industry grew at an annual average rate of 5.8 percent. At the end of 1994, approximately 14 000 people were employed in the Canadian computer equipment industry.

- In keeping with worldwide structural changes and in response to heightened international competition, Canadian manufacturers have reduced overhead staff significantly. Layers of management staff and administrative personnel usually associated with marketing, sales, informatics, finance and communications have been eliminated. Instead, companies are hiring more manufacturing and design employees.

- Over the long term, the Canadian computer equipment industry has increased capital and human resources investment in research and product development. Since 1982, the ratio of research and development (R&D) staff to total employees has grown from approximately 7 percent to over 20 percent. Employment of highly skilled personnel with advanced university degrees has increased markedly as a result.

Rapid technological change is a constant within the industry . . .

- Advances in materials, coupled with continued miniaturization of semiconductor devices and maximization of component density, require computer firms to stay at the leading edge of design and manufacturing technology if they are to be world-class competitors.

Sustainable development is a key result of this industry's activities . . .

- The Canadian computer equipment industry is a key contributor to sustainable development technologies now in use across the resource processing sector. These technologies typically reduce wastage of materials and lower consumption of industrial energy, resulting in less pollution of the natural environment and greater conservation of natural resources for future generations.

- Computers and related telecommunications equipment are essential to many home-based businesses. Because they facilitate communication electronically, rather than physically, computers and related telecommunications equipment have potential environmental benefits.

- The computer manufacturing industry itself is typically highly efficient in its use of both energy and materials. Key areas of environmental concern being addressed by the industry include recycling precious and toxic metals used in the manufacturing process, and management of toxic wastes produced during the production of computers and peripheral equipment.

1.2 The Bottom Line

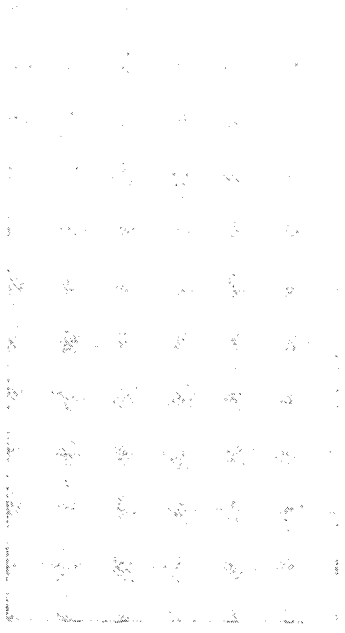
A number of issues are important for the long-term success of the computer equipment industry, requiring government and industry to work together to ensure continued growth . . .

Investment

- The level of corporate income tax in Canada must be competitive in order to ensure a healthy level of capital is available from internal sources. Industry Canada concludes that corporate taxation levels in Canada are competitive with those in the U.S. and other major trading nations. However, government and industry need to review Canadian capital cost allowance rates as they apply to the computer equipment industry to ensure that Canadian corporations are competitive with U.S. companies.

- Computer equipment industry attributes such as high levels of soft or intangible assets (for example, research and development and human resources) make debt financing relatively difficult for computer firms to obtain.

- Public equity markets are an important source of financing for information technology firms. Equity market regulations should strive for an efficient capital market environment in Canada so that these companies can be better served.



Foreign Investment

- Compared with the U.S. computer equipment industry, Canada has been less successful at attracting foreign direct investment, especially in the past few years.
- Several MNEs headquartered in the U.S. have remained committed to investment in Canada, but Canada has been less successful at attracting Japanese investment in semiconductors and peripheral producers.

Trade

- Canadian small and medium-sized enterprises (SMEs) face major challenges in leveraging successes in exporting to the U.S. into European and Asian successes as well. This is particularly important, since the current trend in the computer equipment industry is toward international specialization.
- In December 1996, several countries meeting under the auspices of the World Trade Organization (WTO) agreed to eliminate most tariffs on computer equipment, telecommunication equipment and related goods by January 1, 2000. Canada had already agreed to significantly reduce tariffs on computer equipment during the Uruguay Round of multilateral trade negotiations ending in 1994.
- In the computer equipment industry, trade shows and mission-related activities are less productive than the collection of European and Asian market information and intelligence tailored to meet Canadian industry needs. Such market information benefits a larger number of companies.

Domestic Market

- Competitive Integrated Systems Digital Network (ISDN) rates are important to ensure the success of Canadian firms that design and manufacture ISDN cards and firms that employ ISDN technology.
- Both foreign multinationals in Canada and Canadian-based computer companies have achieved significant success by targeting niche markets.

Human Resources

- Community colleges and industry need to work together to train computer equipment industry management, researchers and technicians.
- Cooperation and more extensive information sharing between universities and industry will help ensure that graduates are aware of current innovations.

Technology

- The U.S. federal government offers significant subsidy support for computer R&D, potentially placing the Canadian computer industry at a competitive disadvantage.
- Canada does not offer the same level of direct support to the computer equipment industry as the U.S.; instead, the federal government offers tax incentives under the Scientific Research and Experimental Development (SR&ED) tax credit program. The recently clarified SR&ED guidelines on software development will impact the computer hardware industry, since many computer companies perform significant amounts of software development.
- The low level of technology transfer between public institutions and private companies has motivated Industry Canada to examine the need for a Technology Road Map to focus on medium-term technology requirements based on market needs, and to help identify needed technological training and skills such as communication skills.

Profitability

- Industry net profits were generally positive but low between 1988 and 1994. This trend seems to have been duplicated in the U.S., where average net profit margins fluctuated between a gain of 2 percent in 1991 and a loss of 7.5 percent in 1994.
- The relatively low profits are probably due to the fact that the computer equipment industry is very internationally competitive.

Statistical Issues

- International comparison of financial and other performance factors is complicated by the fact that data sources are not homogeneous. Continual effort is required to ensure that statistical classification becomes internationally consistent.
- As technologies continue to develop and converge, it is important to ensure that new products are classified under appropriate industry categories.
- Reliable demand figures for domestic and international business and residential customers for computers also remain elusive. Production and trade data continue to lag behind a rapidly evolving industry situation, and therefore tend to be less useful for planning and decision making than they might otherwise be.

By meeting these challenges, the Canadian computer and peripheral equipment manufacturing industry can maintain its importance in the domestic economy and improve its performance in rapidly growing international markets for computer equipment.

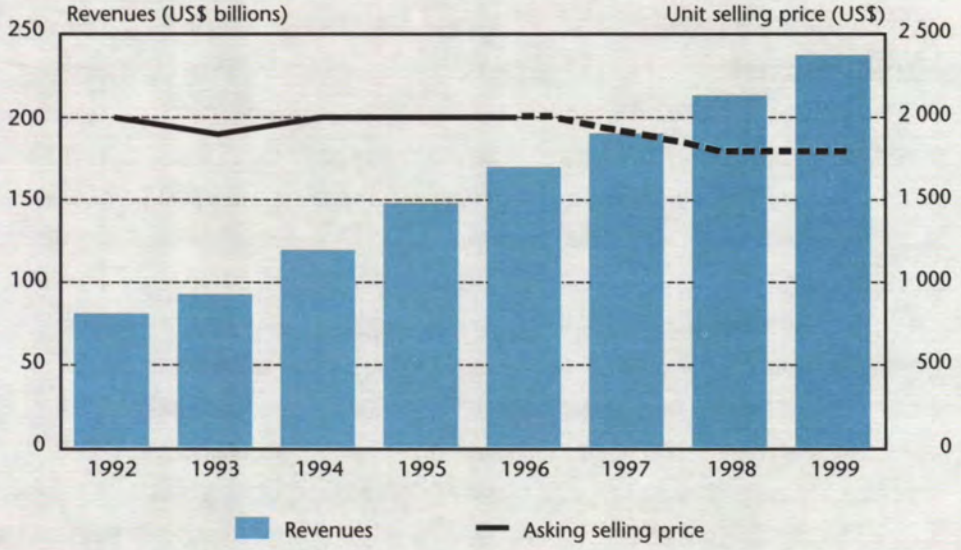
2 KEY POINTS ABOUT THIS INDUSTRY

2.1 Global Context

Industry production grows as computer use pervades all sectors

The computer equipment industry continues to grow rapidly as computers become an integral tool in all industries. There is also an increasing number of households purchasing computers in order to communicate with work, school, banks, etc., and to take advantage of new on-line services such as the Internet. By 1999, total worldwide annual shipments of personal computers (in current dollars) are expected to reach US$189 billion (Figure 1). Annual revenue growth is anticipated to exceed 12.6 percent over the 1994–99 period. Not readily apparent in the revenue shipments data is the fact that unit shipment growth rates are much higher than revenue shipment growth. This difference results from the annual decrease in the average price of computers.

Figure 1. Estimated World Demand for Personal Computers[a]



[a] Includes desktop and mobile computers and servers.

Source: Dataquest, *Computer Systems and Peripherals*: Industry Trends, 1995.

Significant restructuring has resulted in increased numbers of small firms

The international computer equipment industry underwent a significant adjustment over the 1988–93 period as a result of the personal computer (PC) revolution. An industry largely made up of, and controlled by, a handful of multinational enterprises (MNEs) such as IBM and Digital Equipment suddenly opened up to smaller PCs, workstation competitors and networking video controllers.

The industry began restructuring in the late 1980s and early 1990s as sales, operating margins, and profits of mainframe and mid-range manufacturers began to shrink year by year. When the larger players stumbled, smaller companies such as Compaq, Sun, and Hewlett Packard, with their lower costs and more open architectures, began to grow rapidly.

Top 10 firms account for half of global production

The world's top 10 computer manufacturers are responsible for just over 50 percent of global computer production, while 75 percent of production is carried out by the top 25 firms. The remainder of the industry is populated by hundreds of smaller regional computer manufacturers who assemble and integrate systems, generally with smaller market shares but also at lower prices. These smaller companies have slowly captured a small but significant share of the market. Similar concentration patterns exist in the hard drive, printer and monitor segments.

U.S.-owned companies generate 75 percent of the production of the top 25 firms, while Japanese and European-owned companies represent approximately 15 percent and 9 percent, respectively. U.S.-owned companies among the top 25 are responsible for 56 percent of worldwide production.

Much computer production actually takes place outside the countries of major ownership. Computer manufacturing facilities are more evenly distributed around the world than the ownership of these firms. It is particularly interesting to note the economic benefits certain trading regions receive from foreign manufacturing investment. In particular, Asia Pacific is a main focus for manufacturing investment, with production there growing almost 10 percent annually. This growth is due to the investment-friendly nature of most countries in the Asia Pacific region; low-cost manufacturing facilities backed by an effective transportation and communication infrastructure combined with a fast-growing regional market make these countries a key investment location.

2.2 North American Context

Growth in NA market has been strong, but is likely to slow

The U.S. market for computers is the largest in the world, with over US$45 billion in sales in 1995. Dataquest predicts that the U.S. demand growth rate will decrease toward the end of this century as the market moves toward saturation. However, this slowdown is likely to be tempered by rapid technological turnover rates and as the Internet and telecommunications services change. Dataquest also predicts that Canada's growth in demand for computers and related equipment will slow, but not to the same extent as in the U.S.

Canada is integrated into NA market

Canada has long been considered an integral part of the North American market. Many MNEs no longer describe their markets in terms of national boundaries; instead, North American reporting relationships are becoming increasingly regional and product-based. For example, IBM describes its market segments as west of the Rockies, central and east, from the Arctic to south of the Yucatan Peninsula.

During the past decade, MNEs in Canada have undergone significant restructuring. Canadian-based European subsidiaries such as Philips and Olivetti have downsized. At the same time, however, subsidiaries of American firms such as Hewlett Packard and Digital have grown. Within the pattern of North American manufacturing, there appears to have been some movement of higher-value-added activity out of Canada. More assembly-oriented, lower-value-added manufacturing has been transferred to Canada by U.S.-owned MNEs.

Some Canadian MNE plants have major NA product mandates

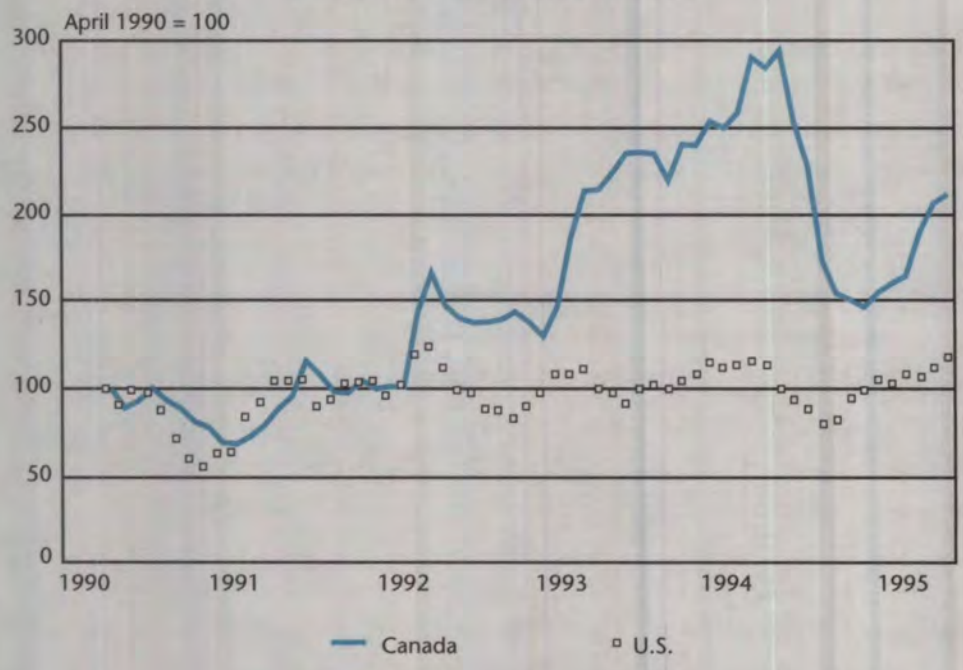
Nonetheless, Digital Equipment has concentrated its North American personal computer manufacturing in Kanata, Ontario. The decision entailed relocating computer production from Mexican and U.S. operations to the Canadian facility. On the other hand, Digital's semiconductor manufacturing is done largely in the U.S.

As North American reporting relationships become increasingly regional and product-based, general managers of Canadian subsidiary plants are more likely to report to a U.S.-based manager. These managers are often responsible for a particular range of related products, which may be manufactured in different regions or countries.

Both Canada and the U.S. have experienced fluctuating levels of profitability, with year-to-year variations in profits and losses. Most recently reported 1995 Canadian profits are large. Soon-to-be-tabulated profits for 1996 are also expected to demonstrate significant growth.

Based on a market-value weighted index of publicly traded Canadian computer firm stock prices, the performance of Canada's computer equipment industry seems favourable (Figure 2). Over the past five years, the Canadian computer industry stock market index has significantly outperformed that of the U.S. The Canadian computer stock market index has also outperformed the rest of the market, as represented by the TSE-300. These results indicate that the market has positive future expectations for the Canadian industry.

Figure 2. Computer Industry Stock Market Performance, Canada and the United States



Source: Industry Canada. "Canada–U.S. Comparative Financial Analysis of the Computer Hardware Sector," Information Technology Industry Branch, Ottawa, 1995.

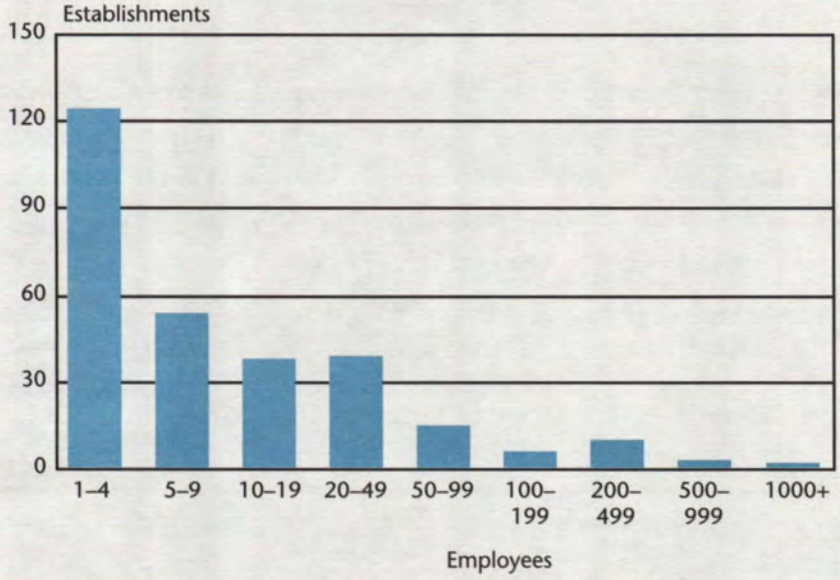
2.3 Canadian Industry Snapshot

Canadian industry comprises 300 companies, 14 000 employees

The Canadian computer equipment industry in 1994 consisted of almost 300 companies, employing approximately 14 000 people. Companies range from large MNEs to small, local operations that are involved in the design and manufacture of electronic computers, peripheral equipment, data storage devices, computer terminals and fully assembled computer processor boards.

The two largest Canadian plants, Digital and Celestica (a former subsidiary of IBM), employ approximately 2 500 people each, while the next three plants have about 500 employees each. Some 178 computer manufacturing establishments in Canada have fewer than 10 employees, which suggests that they either subcontract most of their manufacturing, buy a high percentage of finished subassemblies from outside suppliers, or both (Figure 3).

Figure 3. Canadian Computer Companies, by Number of Employees, 1994



Source: Statistics Canada, *Business Register*, special run.

MNEs such as Digital, Unisys and Hewlett Packard provide a disproportionate share of the manufacturing jobs in this industry. However, the recently Canadian-acquired Celestica and several Canadian-based companies such as ATI, Advanced Gravis, Seanix and Matrox also employ several hundred Canadians each.

Some substantial players are Canadian-owned

MNEs operating out of Canada often carry North American product mandates and represent the majority of the manufacturing activity. Only 12 plants were responsible for almost 82 percent of total Canadian production in 1994. Within this small group, MNEs clearly dominate.

Looking at the regional distribution of plants, Ontario has a dominant position as home for Canada's computer industry. Shipments during 1994 were worth $5 billion, with an annual growth rate of about 15 percent for 1988–94. Growth rates for 1988–94 are not available on a provincial basis except for Ontario and Quebec. However, evidence suggests that most of the growth for the rest of Canada takes place in British Columbia, Alberta and Manitoba.

Most Canadian plants are located in Ontario

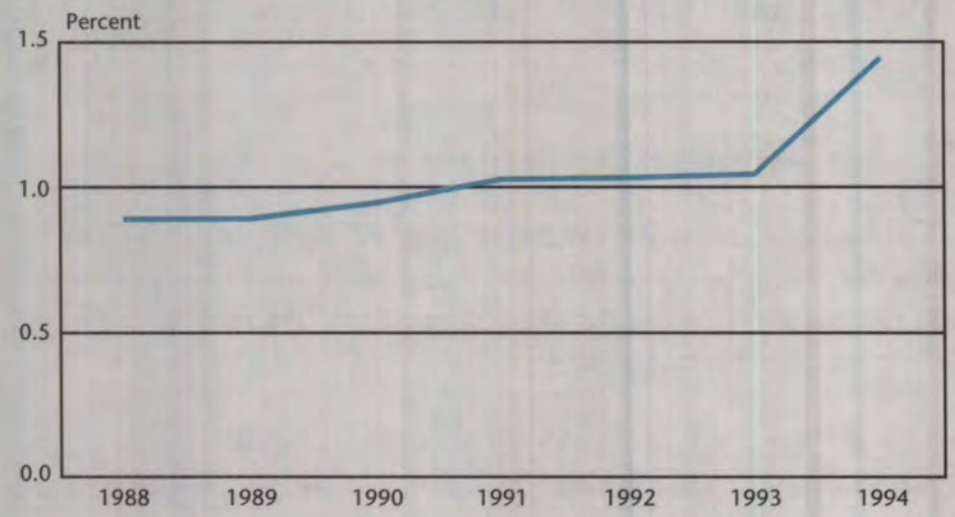
2.4 Performance and Competitiveness Factors

Output

GDP contribution nearly triples in 6 years . . .

The computer equipment industry contributed an estimated $3.6 billion (in constant 1986 dollars) to Canada's real gross domestic product (GDP) in 1994. This figure reveals the industry's impressive growth since 1988, when the computer industry's real GDP contribution was $1.3 billion. Total shipments (in current dollars) have also experienced impressive growth from $2.8 billion in 1988 to $5.8 billion in 1994. The computer equipment industry is becoming an increasingly important component of Canadian manufacturing activity. Computer shipments as a share of total manufacturing shipments increased from 0.89 percent in 1988 to 1.45 percent in 1994 (Figure 4).

Figure 4. Computers as a Share of Total Manufacturing Shipments



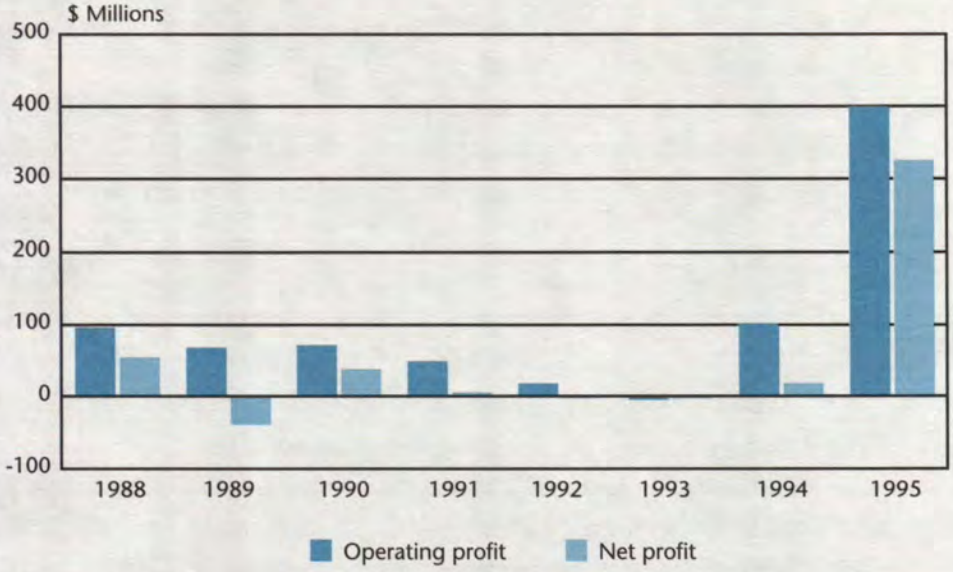
Source: Statistics Canada, *Annual Survey of Manufactures*, annual.

Financial Performance and Profitability

. . . despite steady decline in profitability during 1988–93

Another important performance measure is financial performance and profitability (see Annex A — *Computer Statistics*). Aggregated operating profits and net profits for computer equipment and related services highlight the steady decline in profitability during 1988–93 (Figure 5). This decline in performance is believed to be influenced by the large change in market demand for personal computer-based systems and the restructuring of North American MNE operations. At about the same time, the economy was being challenged by two macroeconomic influences that almost certainly had an impact on profitability: an overinflated Canadian dollar during 1989–91, and a period of recession during 1990–92. The 1994 and 1995 quarterly results, however, strongly indicate the tremendous turnaround in financial performance achieved by the Canadian computer equipment industry.

Figure 5. Canadian Computer Industry Financial Performance[a]



[a] Profit levels for 1988 to 1993 are annual year-end figures, whereas 1994 and 1995 operating and net profit figures are aggregated quarterly results, which will be eventually revised for year-end accounting adjustments and extraordinary changes.

Source: Statistics Canada, *Financial and Taxation Statistics for Enterprises,* Catalogue No. 61-219.

Net profits for U.S. publicly traded firms also showed a steady decline over the first half of the 1990s. A slight upward turn appeared in 1995, but U.S. computer companies still registered a negative net profit margin. Based on these data, the Canadian computer industry appears to be more profitable than the U.S. industry. However, it is important to realize that these two samples are not directly comparable, since the U.S. sample includes only publicly traded companies.

Canadian profit record seems to surpass that in U.S. . . .

The internationally competitive nature of the computer equipment industry also contributed to relatively low profits. Strong competition from low-cost computer producers — particularly those located in Asia — helped drive down the prices of computers, thereby diminishing profits. However, many Canadian firms that have captured niche markets have managed to remain profitable.

. . . even with competition from low-cost Asian producers . . .

Indications are that Canadian small and medium-sized enterprises (SMEs) and MNE subsidiaries have weathered the industrial adjustment process and are beginning to increase sales and profits significantly. Revenues grew from $3.5 billion in 1993 to well over $4 billion in 1994, and are estimated to have reached almost $5.5 billion in 1995.

. . . and achieve significant profit growth in mid-1990s

Employment and Productivity

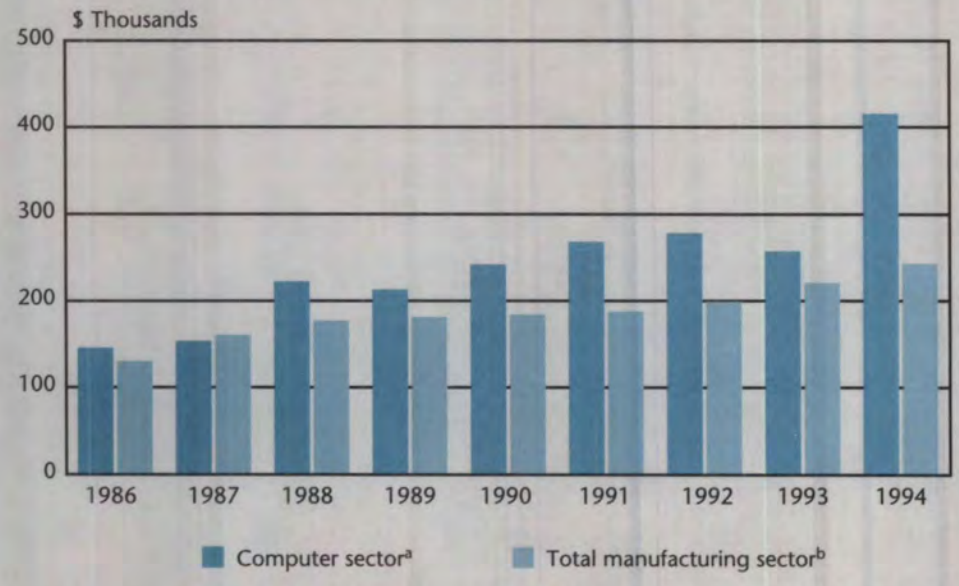
Industry employment grew during period of downsizing in most other sectors

While the computer equipment industry has experienced both profit and loss cycles over the past decade, total employment has grown in both absolute and relative terms. Total Canadian manufacturing employment decreased from 2.1 million in 1981 to approximately 1.6 million in 1994, but employment in the computer industry grew on average by 5.8 percent annually. By the end of 1994, approximately 14 000 people were employed in the Canadian computer industry.

Canadian labour productivity exceeds that in U.S. computer equipment industry

Each computer equipment industry employee on average in 1994 produced shipments valued at $410 000 (Figure 6). In the U.S., shipments per employee grew by 8 percent annually between 1988 and 1994. Comparatively, labour productivity in the Canadian computer industry has grown by 12.8 percent a year since 1986. This growth is probably due to the significant change in employment structure. From 1988 to 1994, for example, administration and management employment shrank by almost 40 percent, while production departments grew by almost 43 percent. This partly reflects the strategy of multinationals to move their management staff to a central location in the U.S.

Figure 6. Comparison of Shipments per Employee, Computer and Total Manufacturing Sectors



[a] Compounded average growth rate for the computer sector for 1986–94 = 12.8%.
[b] Compounded average growth rate for the total manufacturing sector for 1986–94 = 5.2%.

Source: Statistics Canada, *Annual Survey of Manufactures*, annual.

Labour Costs

Labour costs in Canada are lower than in U.S.

Comparative data indicate that labour costs in the computer equipment industry are significantly lower in Canada than in the U.S. In fact, as of 1994, U.S. production wages on average were 40 percent higher when converted into Canadian currency. Administrative salaries in the U.S. were approximately 21 percent above the Canadian average. Since the relative prices of inputs such as labour and capital are key determinants of competitiveness, lower labour costs provide Canadian firms with a distinct advantage over U.S. counterparts.

R&D Incentives to Increase Competitiveness

Government support through tax incentives is important to Canada's computer industry

Government support for R&D investment in the computer equipment industry is an important issue. Most industrialized countries have identified the computer sector as a strategic industry and have implemented several R&D programs to increase the international competitiveness of their industry.

In the U.S., direct R&D support for the computer industry exceeded $1 billion annually during 1988–91. The closely related semiconductor industry also received almost $500 million a year in direct funding. In addition, the U.S. spends almost $2 billion a year (in foregone revenues) on its R&D tax credit program. While an analysis of this funding by industry is unavailable, a National Science Foundation/Government Accounting Office (*Science and Engineering Indicators*, Washington, D.C.: NSF/GAO, 1993) report singled out the computer equipment industry as one of the primary beneficiaries.

While Canada does not subsidize its computer industry with direct grants, it does provide research and development incentives under the scientific research and experimental development (SR&ED) tax credit program. Industry Canada estimates that almost $1 billion was spent in 1995 (in foregone revenues) on this R&D tax credit program. Data on amounts received from this tax credit program are not available by industry; nevertheless, the benefits to the computer hardware industry are significant.

2.5 Domestic Demand Factors

Canada's computer market is world's 8th largest

The Organisation for Economic Co-operation and Development (OECD) estimates that Canada's computer market is eighth largest in the world, just behind those of Spain and Italy. However, this market is supplied mainly by imports; in 1994, approximately 60 percent of the Canadian market was supplied by imports. Canada's trade deficit in computers and peripherals in the same year was $4.7 billion.

Computer demand grew by 12% annually since 1988

Canadian apparent domestic demand for computer-related goods has increased on average by almost 12 percent a year since 1988. Statistics Canada data (*Annual Survey of Manufactures*, and *Canadian Merchandise Trade Statistics*, TIERS) show that total demand reached $10.5 billion in 1994, almost 41 percent more than in the previous year. Unlike most other industries, demand for computer equipment has continued to grow despite recessions. During the last two recessions (1981–82 and 1990–92), structural changes in the computer equipment industry ensured continual demand and production growth.

Businesses are the primary purchasers of computers. In 1992, the total non-household demand for computers was $5.4 billion. However, this estimate is conservative, because computers leased by companies, rather than purchased, are not included in this total.

Household demand is major market driver

While the business market is currently the largest market, the major market driver is household demand. Applications such as telecommuting and the Internet are fuelling consumer purchases of new equipment and peripherals. The penetration rate of computers has almost tripled from 10 percent in 1986 to 29 percent in 1995. Every percentage increase represents the sale of at least 104 000 new computers (not counting replacement purchases).

Households with higher levels of education and higher incomes are more likely to own computers. To help ensure global access to computers and the Internet, the federal and provincial governments have implemented several different programs. For example, Industry Canada initiatives such as SchoolNet, Community Access and Computers for School facilitate access to computers and the Internet.

3 CHANGING CONDITIONS AND INDUSTRY RESPONSE

3.1 Capital Investment and Depreciation

The key factor that influences the decision to invest is expected profits, which are determined by forecast revenues, the cost of capital, exchange rate risk, government taxation rules, labour costs, etc.

Computer manufacture uses range of capital equipment

Designing and manufacturing computer equipment requires a wide range of capital equipment. Equipment requirements range from advanced workstations for software and computer-aided design tool development to surface mount circuit board placement machines, and from advanced assembly lines to automated electronic test gear.

Investment in Canadian plants fell off during first half of 1990s

Annual capital investment in the computer equipment industry showed a sharp downturn in 1992, falling from $223 million the year before to a long-term low of $125 million This drop coincided with the 1990–92 recession, which is not surprising, since investment tends to be procyclical. Computer manufacturers also suffered losses during this period. Post-1991 restructuring and multinational rationalization led to wide variations in the flow of capital investment from 1992 to 1995. This volatility in annual investment in the computer industry mostly demonstrates the influence of a few key firms such as Digital, Hewlett Packard and Celestica.

While capital investment is prone to wide fluctuations due to economic conditions, Canada's position is significantly below that of its international competitors. Internationally, Canadian investment as a percentage of value-added is the lowest among members of the Group of Seven (G-7) most industrialized countries. OECD data for 1980–90 suggest that capital investment in the Canadian computer industry continues to hover at approximately 3 percent of GDP annually, whereas capital investment in other countries seems to be converging to about 12.5 percent of GDP.

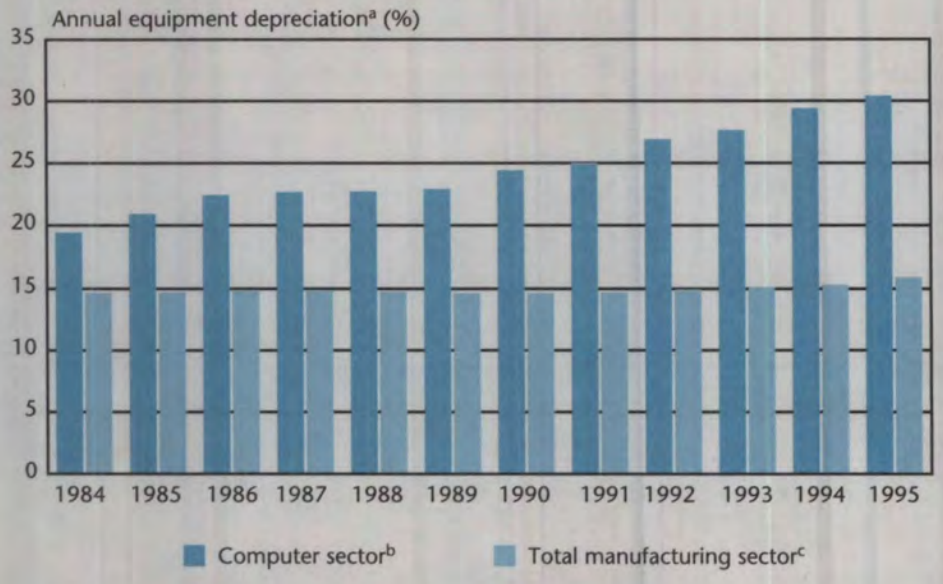
Computer firms must stay at leading edge of design, technology to become world-class competitors

Advances in materials, continued miniaturization of semiconductor devices and the constant effort to maximize component populations in a given space require computer firms to stay at the leading edge of design and manufacturing technology if they are to be world-class competitors. The drive for technical leadership requires advanced and flexible design, manufacturing equipment and software, all of which become outdated very quickly. The industry therefore requires regular infusions of capital to meet replacement and update costs. Since computer equipment manufacturers often develop products with life cycles measured in months, companies must reduce fabrication costs quickly while increasing performance and functionality.

Machinery and equipment depreciate rapidly

In line with these industry pressures, the depreciation rate of computer manufacturing equipment has increased, especially compared with the average rate of depreciation for the manufacturing sector as a whole. A decade ago, annual computer manufacturing equipment depreciation stood at 20 percent, while the manufacturing average was slightly below 15 percent a year (Figure 7). Ten years later, the computer average is above 30 percent a year, almost double that of the Canadian total manufacturing average.

Figure 7. Comparison of Manufacturing Equipment Depreciation, Computer and Total Manufacturing Sectors



[a] Annual equipment depreciation as a share of the total net stock of equipment.
[b] Compounded average growth rate for the computer sector for 1984–94 = 3.7%.
[c] Compounded average growth rate for the total manufacturing sector for 1984–94 = 13.3%.

Source: Statistics Canada, *Survey of Capital and Repair Expenditures*, annual.

Longer CCA schedule may effectively increase relative cost of capital in Canada

Given the accelerating rate of obsolescence of computer manufacturing equipment, government and industry need to review Canada's capital cost allowance (CCA) schedules to ensure that Canadian corporations operate in a comparable environment (for the purpose of calculating corporate income taxes). Material differences in the allowable depreciation schedules between Canadian and U.S. manufacturers may effectively raise the relative cost of capital.

Preliminary analysis done by Nicholas Trudel ("Canadian and American Depreciation Allowance Effects on the Computer Industry," 1996, available on Industry Canada's *Strategis* web site at http://www.strategis.ic.gc.ca) suggests that the U.S. modified accelerated cost recovery system (MACRS) may be more flexible and better equipped to reflect actual depreciation rates than the CCA. Since many Canadian establishments compete with U.S. counterparts, it is important that they operate within a comparable environment if they are to be competitive.

Canadian firms need similar tax terms to remain competitive with U.S.

The net result of the MACRS is that U.S. firms, if necessary, may depreciate almost 80 percent of their manufacturing equipment by the third year, and fully depreciate the equipment by the fifth year after initial purchase. U.S. tax regulations allow computer manufacturing firms to use a double declining rate of 40 percent for manufacturing equipment until the point when straight line depreciation exceeds double declining depreciation. Canadian computer manufacturers with the same equipment reach the 80 percent depreciation rate only in the fifth year, and are in a position to fully depreciate the equipment only when the federal government closes the asset class in the tenth year.

3.2 Financing

The Canadian computer sector is a relatively new sector in Canada. As a result, only a few firms within the sector can internally finance their capital and R&D investment requirements. Therefore, the majority of firms require outside debt or equity financing. SMEs often face financing obstacles. MNEs do not face the same financial obstacles, since they often have access to capital through their parent company. However, there is no evidence that access to capital is more difficult in Canada than in other countries.

Firms raise capital through debt or equity financing

The cyclical nature of the computer industry often creates large cash flow fluctuations. For undercapitalized firms, this can lead to bankruptcy. Many computer firms face capital constraints because they are perceived as being high risks. Intangible assets such as intellectual property and human resources as well as the short history of this industry make debt financing relatively difficult to obtain. However, the public equity market has recently become more receptive to computer companies because these companies are recognized as having high growth potential.

As a result, public equity markets have become an important source of financing for the computer and information technology (IT) sectors in general. Equity financing from venture capital, private placements and public stock offerings enables investors to expect a relatively higher rate of return to reflect the higher perceived risks associated with the computer and other high technology sectors.

Public equity markets are important source of financing

Provinces are working to harmonize securities regulations

The securities regulatory environment is an important element determining the efficiency of public equity markets. While U.S. securities regulations are largely the responsibility of the Federal Securities and Exchange Commission, Canadian securities regulations are governed and set by provincial regulators. All public offerings and exempt private placements must therefore meet the eligibility criteria and documentation or disclosure procedures of each province in which the securities in question will be offered. While regulators are constantly trying to harmonize requirements, there is still no automatic or mutual recognition between provinces.

3.3 Foreign Direct Investment

Recent trade agreements such as the Canada–U.S. Free Trade Agreement (FTA), implemented in 1989, the North American Free Trade Agreement (NAFTA), involving Canada, the U.S. and Mexico, implemented in 1994, and the General Agreement on Tariffs and Trade (succeeded by the World Trade Organization in 1995), have transformed the marketing and manufacturing strategies of MNEs. Canada is now viewed as part of the North American market. The result of this structural change is that Canada competes directly with the U.S., the largest manufacturer of computers, to attract foreign direct investment.

Canada lags U.S. in attracting investment in computers

Relative to the U.S. computer industry, Canada has been less successful in attracting foreign investment. In Canada, the overall effect of FTA restructuring has been neutral. Statistics Canada data indicate that foreign computer manufacturing assets have increased only slightly, from just below $600 million in 1989 to just over $600 million in 1993. On the other hand, the U.S. has seen a significant increase in foreign assets. According to the U.S. Bureau of Economic Analysis (*Foreign Direct Investment in the U.S.: Operations of U.S. Affiliates of Foreign Companies*, annual), the foreign assets in the computer and electronic component industries (semiconductors) have increased from US$8.6 billion in 1987 to over US$19.4 billion in 1991. While the growth in assets may not be totally attributable to new foreign direct investment, the trend does suggest that significant new foreign investments are being made in the U.S. computer industry.

Qualified personnel at lower cost is incentive to maintain branch plants in Canada

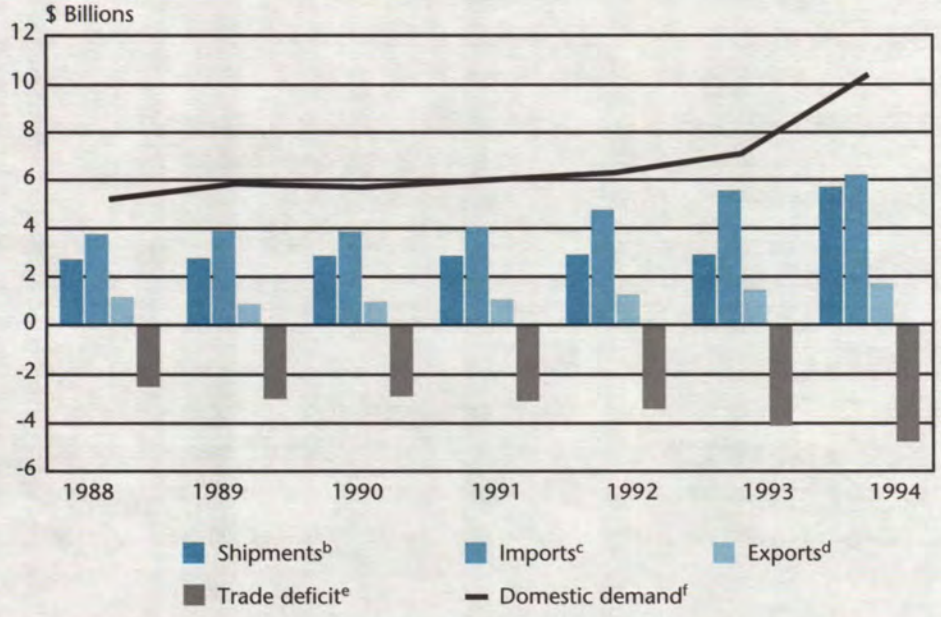
Canada's pool of relatively low-cost engineering and manufacturing people close to the U.S. border is a strong incentive for U.S. corporations to invest in the Canadian computer industry. With labour costs as much as 40 percent lower in Canada than in the U.S., this country should be an attractive place for foreign investors looking for competitive value-added close to the U.S.

3.4 Trade

The total demand for computer-related goods reached $10.5 billion in 1994 (Figure 8). Much of this demand was met by large and rapidly growing rates of computer imports from abroad, resulting in trade deficits amounting to almost $4 billion in 1994. Canada's exports of computer and peripheral equipment have also increased in recent years, growing faster than imports since 1990.

Canadians import substantial amounts of computers and peripheral equipment

Figure 8. Computer and Peripheral[a] Production and Trade Balance



[a] Includes computers, memory storage, monitors and printers but not computer parts.
[b] Compounded average growth rate for shipments for 1988–94 = 13.3%.
[c] Compounded average growth rate for imports for 1988–94 = 9.7%.
[d] Compounded average growth rate for exports for 1988–94 = 6.0%.
[e] Compounded average growth rate for the trade deficit for 1988–94 = 11.2%.
[f] Compounded average growth rate for domestic demand for 1988–94 = 12.4%.

Source: Statistics Canada, *Canadian Merchandise Trade Statistics*, TIERS CD-ROM.

Canada is not alone in facing substantial deficits in computer equipment trade. OECD figures from 1990 show that only Japan had a trade surplus in this sector, the U.S. having moved rapidly from surplus to deficit between 1981 and 1989.

Exports have grown, largely due to MNEs

In Canada, increased competitiveness has reduced average annual growth in the trade deficit position to 8.4 percent a year. Domestic exports totalled almost $6 billion in 1994. The majority of this growth comes from Canada's multinational computer corporations, which account for almost 80 percent of total exports.

Canada–U.S. trade dominates the export scene. In 1994, more than 90 percent of Canada's total computer exports were to the U.S., with the European Union in a distant second place with about 5 percent. However, since some of the larger Canadian producers such as Digital and IBM are U.S.-owned, it is likely that product initially shipped to the U.S. may become part of shipments from the parent company to third-party export customers.

Exports in some subsectors are near trade balance

Despite a reliance on U.S. computer and peripheral manufacturers, Canada has developed strengths in some specific areas. In the case of controller cards (including network adapters, etc.), computer accessories and computer parts (power supplies, populated boards, etc.), Canada has come close to achieving a trade balance.

ITA makes step toward global elimination of tariffs on IT products

At a World Trade Organization meeting in December 1996, trade ministers from 28 countries that conduct most of the world's trade in information technology endorsed the Information Technology Agreement (ITA). The ITA covers some 400 products including semiconductors, automatic processing machines, and computer screens and monitors (except those generally associated with televisions). Under this agreement, import tariffs on computers, semiconductors and telecommunications equipment will be eliminated between July 1, 1997, and January 1, 2000. Since the Uruguay Round negotiations, Canadian tariffs on most computer equipment have been removed.

In 1997, approximately 30 countries, representing nearly 90 percent of the US$600 billion in annual trade in computers and electronic information equipment, are expected to sign the ITA. This agreement has the potential to stimulate trade in information technology products by providing access to markets that were previously protected by high tariffs. Canadian high technology companies potentially stand to benefit from the opening of new markets in Europe and Asia.

3.5 Human Resources

Employment in computer equipment industry is growing; 14 000 in 1994

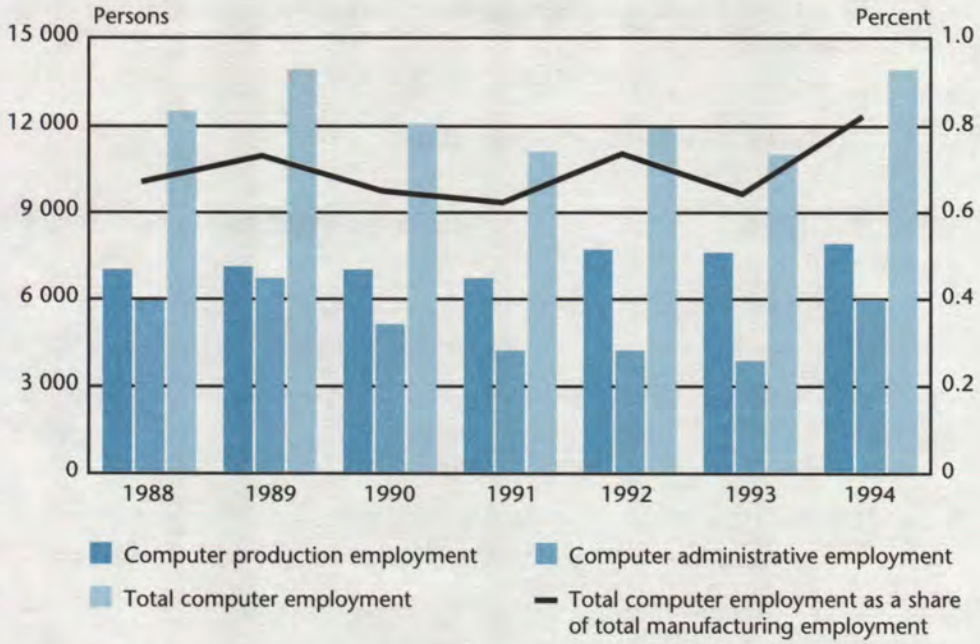
Total employment in the computer equipment industry has grown in both absolute and relative terms in recent years. While total Canadian manufacturing employment decreased from 2.1 million in 1981 to approximately 1.6 million in 1994, employment in the computer industry grew on average by 5.8 percent annually. By the end of 1994, approximately 14 000 people were employed in the Canadian computer equipment industry.

Measures of labour productivity indicate that Canadian computer companies have performed fairly well relative to other G-7 countries. Total value-added per worker has increased significantly in the past few years. In fact, until 1989, value-added per worker in Canada appeared to be increasing more rapidly than in any other G-7 nation.

Recent growth in value-added per worker may be partially attributed to the fact that Canadian manufacturers have reduced overhead staff significantly. The computer industry's labour profile has undergone considerable upheaval over the past few years (Figure 9). The layers of management staff and administrative personnel usually associated with marketing, sales, informatics, finance and communications have been reduced. Instead, companies are hiring more manufacturing and design employees. The reduction of management staff between 1989 and 1993 is partly accounted for by the restructuring of Canadian subsidiaries of MNEs, whereby many overhead functions such as marketing, sales and customer support have been relocated to the U.S.

Upheaval in labour profile sees reduction in managers, increase in production staff, with growth in value-added per worker

Figure 9. Computers and Peripherals Employment



Source: Statistics Canada, *Annual Survey of Manufactures*, annual.

The Canadian computer industry has increased human resources investment in research and product development. Since 1982, the ratio of research and development staff to total employees has grown from approximately 7 percent to over 20 percent. (While these Statistics Canada data also cover manufacturers of office equipment such as photocopiers, the majority of firms surveyed within this group are computer manufacturers.)

Industry is employing more R&D staff; 20% of total in 1994

Industry hires more university graduates . . .

Closer analysis of computer and office equipment R&D staffing highlights changing requirements. Since 1982, the number of R&D staff with Bachelors degrees grew on average almost 16.5 percent a year. The ratio of Bachelors increased from approximately 46.7 percent of R&D personnel to almost 62 percent. The number of engineers and scientists with Masters degrees has also increased substantially over the past decade, making up 16.0 percent of total R&D staff today.

. . . has higher demand for skilled workers

Recently, some IT companies have had difficulties in recruiting highly skilled workers. These difficulties raise a concern over a potential skill shortage of IT workers. To help alleviate these problems, government, industry and schools (universities and colleges) have implemented new training programs targeted at fulfilling anticipated labour demand.

According to Statistics Canada, wages and salaries in the computer industry have been growing gradually for the past decade. Average Canadian computer industry wages and salaries rose from $29 600 in 1988 to over $36 000 in 1994, for an average annual growth rate of 3.6 percent. This is only slightly lower than the 4 percent average annual growth rate experienced in the U.S. computer industry. However, wages and salaries in Canada remain significantly lower than those in the U.S.

3.6 Research and Development

Most firms perform at least some R&D; some of it in software rather than hardware

Computer firms, like many high technology firms, regard R&D as an important long-term asset. With computer product life cycles in the range of six months to a year, firms must continually innovate. In Canada, the great majority of domestic and MNE computer firms perform considerable R&D to ensure that their products remain competitive. R&D is targeted toward several different aspects of production such as design of computer systems and subsystems, manufacturing technologies and software development.

OECD data indicate that, at the beginning of this decade, Canada ranked third after Japan and the U.S. in terms of the computer industry's R&D contribution as a share of total manufacturing R&D. In 1991, the computer industry contributed approximately 9 percent of total manufacturing R&D.

R&D varies with degree to which firms integrate their products

The range of technology research among computer firms varies with the degree to which firms integrate their products. At the lower range of product integration, a lower degree of design and research is required to remain competitive. However, computer firms from assemblers to designers all perform some degree of technology development.

The most prevalent form of R&D is geared toward the design of computer systems, subsystems and semiconductor components. There is, however, no large-scale production of semiconductors in Canada. Canada's success lies mainly in the design of subsystems, especially industrial processing cards, video/image cards, sound cards, networking cards, etc. This success is partly linked to Canada's relatively strong performance in telecommunications equipment.

Most R&D targets design

Canadian-based subsidiaries of MNEs also carry out some degree of R&D. Hewlett Packard and IBM, for example, undertake a significant and wide range of product R&D. Digital Canada, on the other hand, being mainly a production facility, performs a small amount of manufacturing-related process development work.

In general, Canadian computer companies have maintained a commitment to R&D, with expenditures increasing by almost 6.5 percent a year between 1988 and 1994. As a percentage of shipments, Canada's R&D investment has averaged around 11 percent, keeping pace with the international computer industry norm of approximately 10 percent. In 1994, the ratio of R&D to shipments fell, due to a significant increase in shipments. This drop may signal a shift away from designing toward manufacturing and assembly, but conclusions cannot be drawn for a few more years.

Industry R&D amounts to 11% of shipments

Many industrialized countries have identified the computer sector as a strategic industry and have put in place R&D programs to increase the international competitiveness of their industry. Canada does not support its computer sector to any meaningful extent with direct grants. It does, however, provide R&D incentives under the SR&ED tax credit program. In 1995, this tax program represented approximately $1 billion in foregone tax revenue for all industries.

Canada does not subsidize R&D, offers tax incentives instead

In 1994, Industry Canada and Statistics Canada surveyed computer companies about their R&D activities. (It should be noted that of the 125 computer manufacturers that received this survey, only 77 provided sufficient information to be included in the analysis.) This survey revealed that SME firms with sales of less than $5 million invested over 25 percent of their revenue on R&D, whereas medium-sized firms with sales of $5–20 million performed R&D at a rate of 12 percent of their sales. These data confirm the high technical barriers to market entry for new companies in the computer sector. Large firms, including several MNEs, invested about 7.5 percent of their revenues on R&D.

Level of R&D investment is high, indicating a high barrier to market entry

Little public–private collaboration exists on computer R&D

The Industry Canada/Statistics Canada survey results also indicate that very little technology licensing, contracting and collaboration exists between public and private performers of R&D. Firms seem to rely mainly on other firms for technological acquisition. Only 4 percent of the total 49 technology licensing agreements were made with universities. In addition, very little R&D was contracted out to separate institutions, and there is relatively little cooperation among private and public research institutes.

Awareness of current public research is critical if cooperative opportunities are to be identified. Surprisingly 58 percent of the firms surveyed responded that their knowledge of current public research was low. Factors such as cost, distance and differences in research interests all contributed to this lack of awareness. To address this lack, Industry Canada is currently examining the role of a Technology Road Map to facilitate cooperation and collaboration between public and private groups doing research in the computer industry.

3.7 Sustainable Development

Industry makes important direct and indirect contributions to sustainable development

The Canadian computer equipment industry is a key contributor to sustainable development technologies now in use across the resource processing sector. These technologies typically reduce wastage of materials and lower consumption of industrial energy, resulting in less pollution of the natural environment and greater conservation of natural resources for future generations.

Computers and related telecommunications equipment are essential to home-based businesses. Because they facilitate communication electronically, rather than physically, computers and related telecommunications equipment have potential environmental benefits.

The computer manufacturing industry itself is typically highly efficient in its use of both energy and materials. Key areas of environmental concern being addressed by the computer and peripheral equipment industry include the recycling of precious and toxic metals used, and management of toxic wastes produced, in the manufacturing process.

4 GROWTH PROSPECTS FOR THE INDUSTRY

4.1 Demand Outlook

Major growth in PC sales is forecast globally

The global computer market is dominated today by the impressive growth of PC product sales. While traditional mainframe and mid-range sales have undergone a well-publicized slowdown, PCs and related peripheral equipment are fuelling worldwide computer demand. In fact, a major factor in the demise of the centralized and expensive mainframe has been the emergence of cost-effective, distributed PC-based processing networks across the business scene.

Dataquest predicts that by the end of 1997, the annual value of PC shipments will be almost double that of 1990. Since 1993, annual personal computer revenue growth has averaged approximately 11 percent, which more than offset the rapid decline in mainframe sales.

Slower U.S. growth will be recouped in faster-expanding Asian, European markets

Growth patterns differ widely around the world. With over US$45 billion in annual sales during 1995, the United States is certainly the largest market in the world. However, Dataquest projects that annual PC sales growth in the U.S. will slow from 15.3 percent to 4.3 percent a year for the balance of the decade. On the other hand, European and Asian markets are expected to grow twice as fast as the North American market between now and the end of the decade. By the year 2000, both of these regional markets are expected to equal the size of the U.S. market. Dataquest predicts that Canadian PC market demand will grow from US$4.2 billion in 1995 to over US$5.6 billion in 1999.

Household purchases of PCs are growing

The use of computers in industry is still far more prevalent than household use in major industrialized countries. However, this trend is beginning to reverse. In the United States, annual household sales are predicted to equal sales to business and industry by 1998.

Computers are becoming important communication tool

The driving force behind household demand is the desire to use computers as a communication tool. Key factors for the recent increase in household demand are new user-friendly computer programs for a variety of applications, lower costs and easy access to the Internet. Improved data communication systems such as ISDN and cable networks enhance the computer market by providing faster and better Internet access. New technologies improve the capabilities of computers and stimulate demand for years to come.

4.2 Key Industry Strengths

Canada has niche market players, especially in design of controller cards

The majority of Canadian computer firms design and manufacture computer controller cards. These cards plug into computers to optimize the processing of digital signals from a variety of input and output devices. With hundreds of possible input and output devices such as video monitors, printers, modems, network cards, routers, electronic instrumentation equipment, point-of-sale debit cards and computer-controlled production machinery, Canadian computer controller manufacturers can compete on a global scale within their own niche.

The Canadian computer equipment industry is small relative to the U.S. or Japanese markets. However, Canadian companies focus their strengths in varied areas of the computer and peripheral industry. By targeting niche markets, some Canadian SMEs have attained high levels of success.

Canadian manufacturers of **terminals and portable computers** include Hewlett Packard, Symcod, DAP Electronique, Epson Canada, Logisys, Teknor, Thought Technology and Dynapro. While Canada does not produce portable computers in high volumes, the terminal manufacturers highlighted above are known to be performing well.

In the **computer systems** industry, Canadian companies include Digital, Seanix, Mind Computers, Cemtech, Hewitt Rand and Sidus. Small Canadian companies like Seanix and Sidus export actively. Canada may well achieve a trade balance in computer systems within the next five years if exports continue to grow at the current rate.

Participants in the production of **computer peripherals** include Advanced Gravis, Electrohome, Epson, Coreco, Dalsa and Cymbolic Sciences. Niche markets for application-specific products, such as point-of-sale printers and bar code readers, touch screens, joysticks and specialized high-speed cameras have generated success for Canadian SMEs in the peripherals business. However, unless Canada is successful in attracting foreign investment in display manufacturing, the current $1.35 billion trade gap in peripheral equipment is unlikely to narrow.

Controller cards include telecommunications networking and interface equipment and are an area of particular Canadian strength, at least partially because Canada has a strong telecommunications sector. The niche orientation of many of these products has allowed Canadian designers to develop leading-edge products in graphics, networking and sound applications independently of major computer manufacturers. Companies like ATI, Matrox, Eicon, Gandalf and Advanced Gravis are often found within the world's top three market share holders within their product specific markets.

Computer memory storage systems include CD-ROM and floppy disk drives, hard disks and tape drive systems of all kinds. Unisys in Winnipeg is by far the largest Canadian manufacturer of memory products. Smaller Canadian niche firms include Mindflight, Dynatek and Legacy Storage. All of the Canadian firms are subsystem developers, which usually entails integrating memory drives into a separate unit and incorporating proprietary access controllers to enhance the functionality or performance of disk access and speed.

4.3 Current and Anticipated Challenges

Government–industry cooperation is needed to address challenges

A number of issues are important for the long-term development of the computer equipment industry. A cooperative effort between the industry and government is important to deal with and overcome legislative challenges. However, the industry itself must recognize future challenges and address them now. Major areas of concern are capital investment, trade, R&D and human resources.

The importance of capital investment within the computer equipment industry cannot be overstated. New investment is important to ensure reduction of production and development costs. When considering expansions, companies generally compare the total projected cost with expected revenues to ensure that the venture exceeds the company's established investment hurdle rate. Beyond forecast revenues, key factors likely to influence an investment decision include the cost of labour, exchange rates, capital costs and government taxation rules.

The rate of depreciation of capital equipment has become a major concern in the computer industry. Ten years ago, computer manufacturing equipment depreciated at 20 percent a year; and today the average figure is over 30 percent a year. This means that computer manufacturers must invest an ever-increasing amount to stay ahead of the competition. Given these accelerating rates of obsolescence, it is imperative that Canadian capital cost allowances have the capacity to truly reflect real depreciation within the industry.

Trade development is key to computer industry growth

Canadian computer companies face a major challenge in trade development. The trend toward market globalization is particularly strong in high technology industries such as the computer industry. Canadian and foreign companies compete for a share of the world market. For Canadian firms to be successful in this market, it is important to leverage U.S. export successes into global success. Government efforts have to be in place to ensure the elimination of tariff barriers, and to provide the industry with sales information for targeted foreign markets like Europe and Asia.

To remain competitive, Canadian computer companies have to innovate continually, so R&D is critically important. To ensure the continued growth in the productivity of the Canadian industry, an environment conducive to R&D work is essential.

4.4 The Bottom Line

Computer equipment is strong growth industry

The computer industry is growing rapidly and is expected to continue growing well into the next century. With new capabilities, the usage of computers is spreading and will continue to spread. The convergence of computers and telecommunications is also generating new technologies, thereby driving markets to expand dramatically. To secure its future, this industry must keep pace with rapid technological change in order to remain a leading-edge industry. Continuous improvement in productivity and international competitiveness can be achieved only through R&D, human resources investment and market development.

Global opportunities for computer and peripheral manufacturers are significant. Expanding markets in Asia and Europe will provide new export opportunities, but there will be strong competition in these markets. Canada has to leverage U.S. export successes into Asian and European successes.

Firms should focus on potential growth areas and niche markets

Canadian companies must focus their resources on potential growth markets if they are to achieve continued success. Since Canada is a relatively small player in the global market, recognizing niche markets and capitalizing on them is important. Cooperative agreements between Canadian and foreign companies are also important to continued success.

More cooperation between the private and public sectors is essential to the continued success of the Canadian industry. The second phase of this Sector Competitiveness Frameworks project — the *Framework for Action* — will attempt to address competitiveness issues, priorities and proposed responses. Continual work is required to ensure that the competitive environment in Canada is maintained and improved.

For information concerning specific computer equipment companies, please visit the *Canadian Company Capability* listing on Industry Canada's *Strategis* web site at:

strategis.ic.gc.ca/cdnccc (english)
strategis.ic.gc.ca/rec (french)

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Annex A
COMPUTER STATISTICS

The major sources of data used in this analysis are Statistics Canada, the U.S. Department of Commerce, the U.S. National Science Foundation, the OECD, and Dataquest (a private consulting firm). Analysis concerning computer equipment production data is based on Statistics Canada's *Standard Industrial Classification* (SIC) system under the code SIC 3361: Electronic Computing and Peripheral Equipment Industry. The Canadian production and employment data are from Statistics Canada's *Annual Survey of Manufactures*, while the establishment counts are from Statistics Canada's *Business Register* (special run).

Statistics Canada provides a lengthy definition of the Electronic Computing and Peripheral Equipment Industry, which includes the following major products:

- **Electronic computers** include supercomputers, mainframes, mid-ranges, mini-computers, personal computers, workstations and laptops, and other computers.
- **Peripheral equipment** interfaces or plugs into computers via a parallel or serial cable and is often referred to as input-output devices. These generally include printers, plotters, monitors, keyboards, joysticks, mouse, desktop and handheld scanners.
- **Computer storage equipment** refers to devices that store digital bits of information data independent of whether power is on or off. These secondary memory products include hard drives, floppy drives, optical disk drives and larger storage (disk arrays) subsystems.
- **Loaded computer processor boards** are fully populated and unpackaged computer subsystems. These snap into mainframe, mid-range, PC and workstation expansion slots located on the motherboard. Loaded computer processor boards are usually application-specific, and include computer motherboards, video boards, audio boards, process controller boards, LAN networking interface boards (Ethernet, Token, FDDI, mainframe emulation), telecommunication network interface boards (fax, modem, ISDN), and other peripheral performance-enhancing boards (SCSI).
- **Computer terminals** are a hybrid between an output device and a workstation. Within this environment, the terminal acts as both a display and an input device. Data processing is usually located on a remote computer, with complex video generation and communication processing allocated to the terminal. The most prominent distinction between a computer and a terminal is the terminal's lack of a secondary memory storage unit (hard drive) and/or a CPU microprocessor.

Readers should note that some analysis makes reference to a larger grouping of firms. Major Industry SIC 336, Office and Business Equipment Industry, is occasionally used in the analysis because data are not available at the four-digit SIC level. The Office and Business Equipment Industry combines the Electronic Computing and Peripheral Equipment Industry with the Office Equipment Industry (photocopiers, ATM machines, etc.); however, computer equipment manufacturing represents approximately 80 percent of this combined industry.

The 1994 GDP value is in constant 1986 dollars and is estimated from the value-added ratio of SIC 3361 to SIC 336 multiplied by the GDP for SIC 336. This estimation procedure is required because GDP data are no longer available at the four-digit SIC level after 1993.

Unlike production data, financial data are collected at the corporate level. Statistics Canada uses a slightly different grouping of firms and business entities in its aggregation of financial statistics. The data are collected for the broader code CC13-130: Computer Equipment and Related Services Industry.

When collecting financial statistics, Statistics Canada surveys a similar and related category of computer firms; however, the population does differ from the industrial production statistics used primarily throughout this report. It is also important to note that financial data are collected at the corporate level, unlike production data, which are collected at the plant level. However, the financial results represented in the text do encompass most computer manufacturing firms within Canada, and as such the data are fairly representative of the computer industry.

Canadian wage data are taken from Statistics Canada sources (*Annual Survey of Manufactures*), and comparable U.S. wage data come from the U.S. Department of Commerce (*Census of Manufactures*).

Trade statistics used in this analysis are based on the internationally agreed upon Harmonized Commodity Description and Coding System (HS). Several countries, including Canada, are finding the task of properly and consistently classifying computer goods within the appropriate harmonized trade classification code increasingly challenging. Rapid digitization and technological convergence is increasing the difficulty of correctly classifying products and applications.

Continued technological convergence trends, such as the convergence between computers, consumer electronic goods (household computers, monitors, HDTV, CD-ROMs, electronic games), and telecommunication equipment, will continue to challenge the abilities of those individuals charged with classifying these products and will always introduce some margin of error within both the industry and trade statistics. To respond to these issues, Industry Canada, in partnership

with other federal and international departments, is striving to ensure greater consistency during the classification phase, and further harmonization and conformance with international trade and industrial classification systems.

The nature of the computer industry makes it difficult to adjust for changes in price levels due to the rapid improvement of computer quality and performance. The price level does not capture these quality changes because it is based on a fixed bundle of goods. The majority of the analysis in this document is based on current-dollar statistics, since the rapid technological change in this industry cannot be reflected in constant-dollar terms. However, this approach is not a bad proxy (at least for the past eight years), since the computer equipment price level has not changed dramatically.

Price Index for SIC 3361: Electronic Computing and Peripheral Equipment Industry

	1988	1989	1990	1991	1992	1993	1994	1995
Price index (1986 = 100)	99.7	102.9	100.8	98.5	98.2	100.4	100.9	99.8
Share of coverage (%)	60	60	60	60	60	60	60	60

Annex B
SECTORAL RISK ANALYSIS

Because the computer industry in Canada is relatively new, most new SMEs rely on outside financing for their capital requirements. The intangible nature of computer firm assets makes financing computer firms difficult relative to more traditional industries.

The stock prices of publicly traded computer firms are very volatile due to the dynamic nature of the industry. This volatility creates both systematic and unsystematic risk for the investor. Capital market theory states that only the systematic risk is relevant in assessing the risk of a financial asset, since unsystematic risk can be diversified away.

Beta, the measure of systematic risk, is derived from the capital assets pricing model (CAPM). A financial asset with a beta of zero implies no risk or no correlation with the market. An example of an asset with a zero beta would be a U.S. treasury bill, since it is risk-free. A fully diversified portfolio has a beta of one. For example, the beta for the whole market itself is one. The Standard and Poor 500 (S&P-500) and the Toronto Stock Exchange 300 (TSE-300) are often used as proxies of a fully diversified portfolio and therefore have a beta of one. Assets with a beta larger than one are more risky than the market, while an asset with a beta between zero and one is less risky than the whole market.

Comparing the beta or measure of risk for both the U.S. and Canadian computer industry (from a portfolio of publicly traded computer firms) indicates that the U.S. computer industry is more risky than the U.S. market (S&P-500) while the Canada computer industry is less risky than the market (TSE-300).

Total volatility (systematic and unsystematic) of stock prices affects the industry perceived level of risk. This volatility is measured by the standard deviation of returns from holding a portfolio of computer stocks. The standard deviation was estimated at 9.4 and 8.7 percent, on a monthly basis, for Canadian and U.S. computer industries, respectively. In Canada, the compounded growth rate from holding a portfolio of computer stocks from 1990 to 1995 was 16.2 percent, whereas in the U.S. an equivalent computer stock portfolio experienced only a 3.3 percent growth between 1990 and 1995.

Debt financing for the computer industry is difficult, since computer firms often lack substantial tangible assets and have short corporate histories. Unlike equity financing, where the investor can subsidize poorly performing firms from the firms that achieve exceptional returns, debt holder returns are capped at the interest rate charged.

The difficulty in obtaining debt financing for computer firms relative to equity financing exemplifies the importance of well functioning public equity markets in Canada.

Annex C
EQUITY FINANCING

A critically important source of financing for the computer industry, and for the information technology (IT) industry in general, is the public equity market. While the public equity market has been traditionally the preserve of large high-tech firms such as Northern Telecom, IBM, and Systemhouse, smaller firms are increasingly going public to finance their growth. An indication of this growing usage is the number of firms that went public between 1993 and 1995.

Proceeds from an initial public offering (IPO) add equity capital to a firm. For small and medium-sized IT firms, an IPO is usually the first large inflow of capital, beyond smaller private venture placements. Approximately 15 small and medium-sized Canadian computer and communications firms accessed public equity markets and received over $350 million dollars in financing from 1993 to 1995.

The Vancouver Stock Exchange (VSE) and the Alberta Stock Exchange (ASE) can accommodate financing requirements in a range from $100 000 to $5 million for smaller companies, while the Toronto Stock Exchange (TSE) and Montreal Stock Exchange (MSE) are often the exchange of choice for larger offerings.

To determine the trend and develop an indication of the growing importance of the equity market as a source of financing, Industry Canada sponsored a report on securities regulations and related issues faced by public and private firms. The document *Access to Equity Financing for the Computer and Telecommunications Industry in Canada: Issues, Costs, and Perceptions* (Marketing Edge Consultants, Ottawa, 1996) contains an analysis of the equity financing market. The results suggest that each year increasing numbers of computer-related firms are going public. A decade ago, becoming a public company was usually associated with much larger companies. These days, many small and medium-sized firms are using the equity market to finance product development and international marketing. Of the 20 responding public companies, over 70 percent of these employed fewer than 250 people.

The report also reveals that stock option and purchase plans are used as an important means of attracting, retaining and motivating staff. Surprisingly, over 90 percent of the responding public companies have in place an employee stock option or purchase plan. While some of the companies may restrict eligibility to certain technical and management staff, over 40 percent of the companies offer the plan to most of their employees. In addition, 80 percent of the employers indicated that these types of compensation practices were important to their organization. It would seem that at least within the computer and data communications industry, the distinction between owner, worker and shareholder is blurring rapidly.

Turning to where computer companies are listed, the TSE accounted for almost 85 percent of the listings, while the MSE, VSE and ASE were used by approximately 15 percent of the companies. The smaller, or junior, exchanges are primarily used by small or start-up firms wishing to obtain smaller amounts of equity than those usually acquired on the more senior TSE and MSE exchanges. Of the 20 public companies, seven were listed on the VSE or ASE. When asked, five of these companies indicated that the junior exchanges were very important in the early development of their firm. Research indicates that the VSE and ASE have developed some unique public offering and private placement initiatives for smaller companies, which safeguard the interest of investors.