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Electronic Components

Electronic components (SIC 3352) are the hardware building blocks of the electronics industry. They include microelectronics (monolithic and hybrid semiconductor integrated circuits and discrete semiconductors), printed circuits, connectors, capacitors, resistors, switches, relays, transformers, and a number of other components such as power supplies.

Canadian Position

The Canadian electronics components industry is a knowledge-intensive, export-oriented, high value-added, research-driven industry. It has close ties to the telecommunication equipment, software products, computer services, and instrumentation industries. With Canadian production amounting to over $4 billion in 1995, this subsector approaches telecommunications equipment ($6.8 billion) in terms of manufacturing output, with exports of $5.2 billion. The exports in 1995 were $4.3 billion.

There are an estimated 210 firms in the subsector, dominated by firms such as Nortel, IBM, Mitel, C-MAC and Circo Craft. The electronic components subsector is concentrated primarily in Ontario and Quebec, with a secondary concentration in lower mainland B.C. The industry employs over 13 000 people and is responsible for approximately 1.1 percent of total manufacturing output in Canada.

Canada's labour productivity compared to that of the United States has improved by 22 percent since 1991 (the gain against Europe is even more pronounced). The CAGR of Canadian electronic component shipments substantially outpaced that of total Canadian manufacturing output from 1981 to 1994. During the same period, Canada's electronic component export annual growth rate of 15.3 percent outpaced import annual growth of 8.9 percent, and remained above the annual growth rate of total Canadian exports.

With exports of $3.5 billion, Canada is becoming an important player in certain subsectors of the electronic components market. An indication of this trend is in printed circuits, where world-class facilities exist in all areas. Canadian exports of printed circuits in 1995 were $615 million, while imports were $926 million.

With semiconductors, global telecommunications manufacturers Nortel and Mitel maintain medium-scale wafer-production facilities, which are migrating from totally captive supply to an increasing level of merchant supply to licensees and external customers. Nortel also has a world-class facility to fabricate and package optoelectronic devices and modules. Canadian fabless firms (i.e. companies that design but do not fabricate), such as PMC-Sierra and ATT, are recognized worldwide as leading developers and suppliers of broadband networking components and advanced video-processing components.

Canada's export competitiveness in electronic components is highlighted by the fact that over 80 percent of the industry's output is directed to export markets.

International Environment

Microelectronics

Market Size: Microelectronic semiconductor components represent the majority of business activity and products in the electronic components industry. The Semiconductor Industry Association forecast 1996 global semiconductor revenues of US185 billion.

Growth Rate: Semiconductor penetration continues to grow, and is expected to account for 20 percent of the total cost of electronic systems by the year 2000. The worldwide semiconductor market is expected to grow at an 18 percent CAGR, from US$155 billion in 1995 to an estimated $350 billion by the year 2000.

Major Markets: Worldwide semiconductor consumption by region is North America(33 percent), Japan(29 percent), Europe (19 percent) and the rest of the world (19 percent). The United States is the major current export market (88 percent) for Canadian electronic components of all types.

Market Trends: According to Technology Forecasters Inc., the leading product markets for electronic components are computers and computer peripherals, communications products, consumer electronics, industrial and instrumentation products, and automotive electronics. Market trend reports in the telecommunications and communications industry predict that the most dynamic markets will be wireless and mobile communications, specialized mobile radio and on-premise switching equipment. Digital broadcast and multimedia markets are expected to experience significant growth based on increased expenditures on home entertainment.

Printed Circuits and Multichip Modules

Market Size: Printed circuits and multichip modules are second in importance only to semiconductors in the North American electronics industry. The worldwide printed circuit market grew to $65 billion in 1995. Rapid evolution of semiconductor technology has placed enormous cost and performance demands on electronic interconnect and packaging. In the opinion of the Electronic Industry Association, development of new technology and an industry infrastructure to meet future system interconnect and packaging needs will require close collaboration among industry, universities and government.

Growth Trends: Automotive electronics, PCS and broadband communications are the primary growth drivers. According to Electronic Packaging and Production, much of the growth in the automotive electronics market is expected to occur in the Asia-Pacific region.

Other Components

Fibre-optic devices and connectors will continue to be the fastest-growing passive component categories, followed closely by printed circuit connectors.

Main Challenges and Opportunities

Canada's opportunity in the electronic components industry is to leverage its microelectronics capability to create growth in applications businesses and across the whole of the electronic components sector.

Prosperity in the 21st century will be the result of informed decisions by both people and machines. Timely, accurate information about anything, anywhere will result in products, processes and services that will enable wealth generation and enrichment of life beyond anything experienced in the 20th century.

Information will be delivered by microelectronics and its companion technology, software. Microelectronics and software will not only enable wealth generation, they will be major value contributors, and therefore will be inherently large wealth-generating industries in their own right. The monotonic increase in performance versus the decreasing cost of microelectronic-based solutions will continue to create new markets, and will stimulate ongoing enhancement opportunities in established markets. With low access barriers and a variety of possible financial entry strategies, intellectual capital is the main barrier to successful entry into the microelectronics market, and availability of trained people the limiting constraint on business growth.

Microelectronics is unique in that, while the system competitiveness lies within a few tiny components, most of the cost lies elsewhere (in PCs, for example). Thus, there are many technical ways to engineer the solution, and business success depends on managing the technical and commercial variables simultaneously (i.e. the total solution value chain) to produce the best business solution. The few companies in Canada that have developed this expertise compete very successfully at component and system levels in international markets. These companies have traditionally been the source of experienced core people for most successful start-up companies.

Given the nature of the entry barriers, growth is possible across the full spectrum of company size from SME to MNE. New companies will be most successful if they have experience in total value-chain management, if they excel in applications engineering, design and marketing, and if they remain flexible on local content elsewhere in the chain. The growth challenge for the Canadian microelectronics industry is to increase the number of companies meeting these criteria, without depleting the core resources of the current leaders.
The challenge for governments is to assure an adequate supply of trained people to fuel industry growth. Actions are required to attract, develop and retain experienced people, and to increase the throughput, skills relevance and retention of new people. High-calibre microelectronic research and manufacturing environments are key attractions for these globally mobile resources. Governments also have important roles in foreign marketing and sales support and in export facilitation.
For application-specific components, the optimum overall growth strategy is Canadian application engineering and component design, combined with lowest-cost global sourcing. For standard components, international business growth requires that Canada be a low-cost producer. The United States is the major market for both classes of components, due to its size, proximity, common standards, and business/trade ties with Canada.

Strategic Direction

The essence of the electronic components growth strategy is to increase the talent pool of those experienced in microelectronics value-chain management, matching this with an increased supply of appropriately trained new people, while concurrently addressing issues that impede the creation and international growth of new companies.

Maintain national core competence in all elements of the value chain

Access to core competence across the entire microelectronics value chain is vital for Canadian industry and for individual companies if they are to successfully pursue strategies of selective excellence in the high-leverage disciplines. Equally important, this broad core competence is a visible symbol of stability needed to attract and retain high-calibre people in both research and industry. The individual core competencies may be organizationally/geographically diffused, and may include elements from industry, government and academia, but their completeness and accessibility require national oversight.

Stimulate people development and training in the high-leverage disciplines; retain domestic and attract foreign talent

For sustainable growth, the strategy must increase the total pool of trained people, excel in development of the high-leverage disciplines, and maintain a balance between experienced and new people in the industry. Use research to develop people with the skills most valued by industry, and improve retention of Canadian-educated and trained people.

Accelerate sustainable business growth by facilitating the start-up and development of new domestic microelectronics companies

Given an adequate supply and mix of people, MNEs generally have most of the infrastructure for business growth. Start-ups and SMEs can benefit from a variety of assistance, ranging from international door opening, trade shows and export facilitation to immigration assistance, infrastructure support, financial assistance and tax incentives.

Action Proposals

Note: This section summarizes results of an industry survey based on the 1997-98 CIBS Electronic Components strategy and identifies proposed leaders and involvement by Industry, Government and Academia.

- attract foreign investment in two to five major silicon fabrication facilities over the next five years for national economic development
- increase the quantity and wealth-creation potential of new and experienced knowledge workers available to industry
    - funding collaborative industry/university research);
    - increasing the use of government-funded enterprises e.g. Canadian Microelectronic Council (CMC), Canadian Research Council (CRC), the National Research Council (NRC) for industry-relevant training and internships;
    - using industry skills development as a measure of research value; and
    - establishing research and educational programs in marketing and business to capitalize on our science and
    - engineering know-how.
- establish a co-ordinated effort to attract, retain and expand a quality, knowledge-intensive microelectronics work force (GI/i) by:
    - developing a comparison package to position Canada vs. the United States as a career/family location for Canadian and foreign personnel;
    - creating industrial scholarships with bilateral job commitments;
    - reducing disincentives for quality foreign students (tuition fees, immigration issues, work permits, accreditation); and
    - addressing personal tax differential between Canada and the United States.
- encourage multiple informal mechanisms for knowledge sharing and dissemination, e.g. common interest groups, best practices exchanges, assisted secondments, start-up mentoring (I/ga);
- create an industry/government/academia advisory council to provide ongoing national oversight of Canada's microelectronics value-chain competence, establish high-value wealth/job creation elements on two-, five- and 10-year horizons and recommend appropriate action (IGA);
- develop mechanisms to encourage win-win spin-offs (GI/i) by:

- introducing public incentives for "white knight" proactive investors; and
- commercializing government lab technology.

- provide assistance to Canadian companies in marketing abroad (GI/i) by:
  - promoting Canadian sector capabilities and "door opening";
  - organizing trade shows;
  - developing/disseminating market information; and export facilitation.

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