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**SECTOR PROFILE**

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**"INSTRUMENTATION AND INDUSTRIAL  
PROCESS CONTROL SYSTEMS"**

*Electrical & Electronic  
Branch*

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## INTRODUCTION

Worldwide, the instrumentation and process control systems industry has had one of the highest sustained growth rates and still has one of the highest potential growth rates in the secondary manufacturing sector. Because the products, markets and technologies involved in the sector are so diverse, the future possibilities for development of the industry are considerable. Virtually every facet of industrial activity that involves sensing, supervising, measuring, controlling and/or display of phenomena, represents an opportunity for the application of electrical and electronic instrumentation.

Industry output consists of products such as instruments, control devices and computer or micro processor-based systems that are used in commercial and residential energy management and security systems; resource explorations, industrial process control, bio-medical applications; generation, transmission and distribution of electric power and monitoring of nuclear radiation.

The potential for growth in this sector can be attributed to a number of social and economic factors. The necessity to conserve energy consumption, improve the precision and cost effectiveness of resource exploration and medical electronics, provide better environmental protection and working conditions, and generally improve industrial productivity, are significant forces behind increasing market demand for a wider and more sophisticated variety of instrumentation and control devices. The energy crisis, in particular, has created a need for more efficient use of energy and a corresponding need for more sophisticated controls in industrial production processes and other areas. At the same time, a number of recent developments in automation technology - including increased applications of digital controls, decreased costs of computer hardware, improved means of data transfer, techniques for originating less expensive software of better quality and the development of a wider range of specialized sensors - have resulted in significant cost reductions for many user industries.

These developments, together with other factors, have contributed to making the Instrumentation Sector an attractive one in which many promising opportunities can be developed and exploited to bring benefits not only to the electronics industry but to many sectors of primary and secondary manufacturing.

For purposes of this study, the Instrumentation Sector has been subdivided into seven subsectors which are highly differentiated from one another in terms of product lines, technologies employed, distribution channels used, degree of foreign-ownership, industry size and structure and markets served. For example, the production and marketing of an implantable heart-pacer manufactured by Medtronic differs in many fundamental ways from a Honeywell TDC2000 computer-based industrial process control system.

For analytical reasons, therefore, the industry has been given more rigorous examination at a disaggregated level in order to gain adequate

insight into industry performance and prospects. Accordingly, the general overview of the Instrumentation Sector which follows is augmented by seven subsector analyses which are published separately.

The seven subsectors include:

1. Industrial Process Control, Instrumentation and Automation Equipment and Systems;
2. Building Instrumentation and Automation Equipment and Systems;
3. Biomedical and Health Care Instrumentation;
4. Electrical, Electronic Data and Logic Test and Measurement Instruments and Systems;
5. Scientific, Analytical and Laboratory Instrumentation;
6. Remote Sensing and Environmental Instrumentation; and
7. Geological, Geophysical and Geotechnical Apparatus

### DEFINITION OF THE SECTOR

The instrumentation and industrial process control systems sector includes all establishments that produce apparatus or systems that sense, detect, supervise, measure, control and/or display single or multiple physical, electrical, chemical or other phenomena by use of electrical, magnetic, sound or light energy.

The sector does not include establishments that produce instrumentation and systems primarily for the defence, aviation and marine navigation markets.

It does include companies that manufacture electrically - and electronically-based apparatus for the medical, educational and other social sciences.

As the markets served by the electrical and electronics instrumentation companies still utilize some hydraulic, pneumatic and mechanical instrumentation and control systems, and as these controls are produced mainly by the same companies using electrical and electronics technology, these instruments and control systems are considered to form part of the industry in this sector.

### METHODOLOGY AND DEFINITION OF TERMS USED

Much of the information used in this study was accumulated directly from members of the industry through questionnaires, telephone conversations and personal interviews. Information provided by the industry includes data on annual sales, employment, export shipments, past and future growth, description of product lines and assessment of the markets served.

The imports for each subsector were determined from available "Import Analyses" conducted by the Department, pertinent statistics published by the trade journals, and sales figures obtained from major distributors such as Hewlett-Packard, Tektronics, Philips Electronics, Siemens A.G. and others. Exports were estimated from the company responses.

It should be noted that the term "sales" rather than "shipments" is used throughout the study. Many foreign-owned subsidiaries, for reasons of confidentiality or problems with costs, were reluctant to separate sales of Canadian made products from the goods imported from the parent organization or from products with nominal Canadian content. Therefore, the "sales" figures as stated in the study contain a percentage of imports and cannot be equated with "shipments" which normally represent goods with substantial, or maximum possible, Canadian content.

For purposes of arriving at the Domestic Market, "sales" were used and assumed to correspond to "shipments". The Domestic Market is equivalent to total estimated domestic sales plus imports minus exports.

## OVERVIEW OF THE INDUSTRY IN CANADA

### Supply Characteristics

Firms of all sizes, production capacity and technological capability participate in the Instrumentation Sector in Canada. Corporate ability and expertise varies from that of the largest instrumentation and systems houses with turn-key project capability, to the limited production capacity of the smallest firms manufacturing components and subsystems for larger companies in the sector or for industrial end-users with in-house application know-how of instrumentation and control systems.

Small size, however, is not always correlated with limited production or technological expertise. A number of Canadian firms, though small by the usual yardsticks, have established a significant presence in small, specialized markets and become internationally known for the quality and innovative content of their products. For example, no companies engaged in manufacturing geological and geophysical instrumentation earned sales revenues over \$3 million in 1978, yet this subsector provides what is undoubtedly the most diversified range of mineral exploration instrumentation in the world, supplying highly sophisticated instruments and exploration services to over 50 countries. Other examples of small, internationally successful Canadian companies are found in almost every subsector of the instrumentation and process control industry.

Although 80 percent of the firms in the Instrumentation Sector in Canada generate annual sales below \$2.5 million, the major share of economic activity is accounted for by the largest instrumentation and systems companies such as Edwards Company of Canada, Foxboro Company of Canada, Honeywell Limited and Johnson Controls, which are capable of commissioning and installing instrumentation and control systems on a turn-key basis for all user industries in their subsector markets. As a result of successfully serving the domestic market for decades, many of the largest firms have established a reliable reputation and developed significant end-user loyalty for their output. Substantial corporate resources have enabled them to develop considerable expertise in application know-how of the processes and systems utilized by end markets and capture the benefits of large volume production in a broad range of products. Services provided by the large instrumentation and systems houses include development of software, selection and purchase of hardware, software/hardware interface, training of the end-user's personnel in the operation of the system, and installation, servicing, and maintenance of systems on a long-term contract basis.

By international standards, however, even the key companies in this sector are relatively small. Of the nine companies reporting annual sales revenue over \$10 million, only three have sales ranging over \$30 million per annum.

Most of the major companies engaged in manufacture of instrumentation and process control equipment and systems are subsidiaries of multinational corporations. With some exceptions,

subsidiaries tend to operate in the traditional branch plant fashion. In many instances, these foreign-owned companies were established as Canadian affiliates to exploit the protected domestic market and as such, rely upon the product development activities of their parent companies rather than carrying out any significant research and development in Canada.

Overall export performance of the subsidiaries is also poor. Export markets may sometimes be denied to the Canadian subsidiary by the parent company and, even if not, there has been neither incentive nor necessity to mount serious export initiatives. In 1978, export sales of foreign-owned companies amounted to 13 percent of total sales.

Despite evidence that export and research and development activities of Canadian affiliates are generally below desirable levels, there are a few foreign-owned firms in Canada which have rationalized the manufacturing and research and development of one or more product lines on a corporate-wide basis. Other firms have given reason to believe that this trend may become more widespread in future.

At the other end of the manufacturing spectrum are numerous small and medium size firms, manufacturing a limited range of products for each subsector market. Many of these firms are Canadian-owned, with significant assets in innovative technologies and advanced products. As we observed above, in many instances, small firms have developed advanced technologies, exploited small, specialized niches in world markets not served by multinationals and earned an international reputation without attempting to compete with industry giants. Many of these firms are highly research and development oriented and relatively young, with less than ten years of business experience. In 1978, Canadian-owned companies exported more than 35 percent of their total output.

There may be cause for concern, however, with the future economic welfare of many of these small, export intensive indigenous firms. While technologically capable, their relatively shallow corporate resources limit their opportunities for growth. Much of their continued success depends on their ability to maintain costly research and development of new products to replace those that have become obsolete and thus maintain a competitive edge in the market. In addition, all Canadian-owned companies of any significance must rely heavily on export sales due to the small size of the domestic market and because of their narrow specialization. The costs of marketing these products internationally and the attendant service costs can also be significant drains on a firm's financial resources. Consequently, the availability of adequate financial assistance to support research and development and export activities is of vital importance to these firms.

While such problems are more characteristic of the small business population of the Canadian Instrumentation Sector, other factors may combine to constrain the tremendous growth potential of the industry as a whole. One of the most important limitations to growth is the increasing shortage of skilled labour. At present, it appears that

opportunities for application of complex instruments and computer-based systems are growing faster than the availability of systems designers, software engineers and technicians qualified to install, maintain and service the equipment. The shortage of trained personnel has also inhibited adoption of new technologies by many potential users who lack the expertise needed to operate sophisticated instrumentation and control systems. Other limitations to application of more sophisticated automation appear among heavy process industries who are reluctant to take technical risks because of the high cost of failures and process interruptions. In addition, the large amount of capital invested in existing technology necessitates a slower and more conservative application of the new technology in some of the subsectors. Social pressures have also contributed to more conservative adoption of methods of automation which displace labour in the production process.

Other factors have operated to constrain the growth of export markets. Limited product lines and lack of service and maintenance capability have proved to be major impediments to Canada's ability to compete in some world markets. While these disadvantages can be overcome, in part, through joint ventures or export consortia, in many instances Canadian companies are too small to participate successfully in such arrangements.

Clearly, though there are tremendous economic advantages to be gained through greater use of instrumentation and process control systems, a number of variables will shape and constrain the development of the industry in Canada.

### **Growth Rate**

The projected annual growth rate for the domestic market has not been attempted in this study because of the complexity and diversity of the industry and the concomitant variation in growth rates projected for different segments of the industry. Where possible, however, forecasts of future market growth have been indicated in the subsector profiles. The "Electronics Strategy Paper", originated by the Electrical and Electronics Branch, predicts slower growth rates for shipments than for the apparent domestic market between 1980-85. This is a historical trend dating back to 1972. Thus the domestic industry, including the Instrumentation Sector, is continuing to lose ground to imported goods.

### **Research and Development**

This industry sector undertakes considerably more research and development activity than does secondary manufacturing as a whole. Because entry into a number of the subsector markets is relatively easy, requiring limited capital investment, firms must undertake continuous research and development into new products in order to maintain a competitive edge in the marketplace.

Research and development expenditures as a percentage of sales were reported to range from 10 percent to 40 percent. The individual subsector figures, which are more meaningful, should be referred to for



any analysis of research and development intensity. Total research and development employment amounted to approximately 1350 employees, or 10 percent of total sector employment in 1978.

The table below gives some indications of relative research and development intensity across subsectors. It appears that research and development activity is negatively related to the size of the industry subsector; that is, research and development employment is proportionately higher in the smaller subsectors while sales revenue per unit of research and development employment is lower. This is due, in part, to the fact that volume production enables the large firms which predominate in the larger subsectors to derive greater returns from research and development employment per unit of output and, in part, to the fact that Canadian subsidiaries import a significant amount of technology from their parent organizations. In addition, because technological advantage is a more important competitive factor in the smaller subsectors, firms must devote a larger proportion of their resources to research and development of new products.

| SUBSECTORS   | TOTAL R&D EMPLOYMENT | R&D EMP. AS % OF TOTAL EMP. | SALES REV. PER UNIT OF R&D EMP. |
|--|----------------------|-----------------------------|---------------------------------|
| Industrial Process Control Systems & Instrumentation | 585                  | 11%                         | \$ 450,000                      |
| Building Instrumentation                             | 65                   | 1%                          | 3,123,000                       |
| Medical Electronics                                  | 120                  | 9%                          | 458,000                         |
| Test & Measurement Instruments                       | 110                  | 18%                         | 145,000                         |
| Scientific & Laboratory Instrumentation              | 130                  | 32%                         | 92,300                          |
| Remote Sensing & Environmental Instrumentation       | 170                  | 28%                         | 117,600                         |
| Geophysical Apparatus                                | 125                  | 34%                         | 88,000                          |
| SECTOR TOTAL   | 1305                 | 10%                         | \$ 444,000                      |

## INDUSTRY SIZE AND STRUCTURE

Almost 300 firms are engaged in the manufacture of instruments, automation equipment and process control systems in Canada. In 1978, these firms had a combined sales volume of about \$580 million and employed approximately 13,500 people. In terms of the domestic electronics market, in 1978, the Instrumentation Sector accounted for 21 percent of the total electronics industry and 22.5 percent of total employment in the electronics sector.

The instrumentation industry is dominated by a few large, primarily foreign-owned companies. Three percent of the total number of firms were responsible for 35 percent of sector sales in 1978.

By international standards, the key companies in this sector are relatively small. Only nine companies in the sector reported annual sales over \$10 million, though sales of the three largest producers range over \$30 million.

Almost all of the major companies concentrate their activity in the two largest markets - industrial process control and building instrumentation and systems. Six producers in these markets, Bailey Meter Company, Edwards Company of Canada, Foxboro Company of Canada, Honeywell Limited, Johnson Controls and Sentrol Systems, account for approximately 30 percent of total economic activity in the Instrumentation Sector.

At the other end of the spectrum are the vast majority of firms (approximately 80 percent) who generate annual sales below \$2.5 million. Fifty percent of this group report sales of less than \$500,000.

While companies of this size exist in every subsector category, the incidence of small firms is much higher in the smaller subsectors which produce biomedical electronics, test and measurement instruments, scientific and laboratory instrumentation, remote sensing and environmental instrumentation, and geophysical apparatus.

It should be noted that because so much of the economic activity of the Instrumentation Sector is accounted for by a small number of large firms in the two largest subsectors, reported performance of the entire sector tends to be biased by the corporate performance of these large firms, most of which are foreign-owned subsidiaries. Consequently, it is important to recognize that the sector is subdivided into a number of subsectors and examine industrial performance and structure at the subsector level.

A more rigorous examination of various aspects of the industry is provided by each of the subsector profiles.

Information on the size and distribution of companies in this industry, by subsector, is summarized in the following table:

**INDUSTRY SIZE AND  
STRUCTURE, 1978**

| SUBSECTORS  | DOMESTIC<br>MARKET<br>(\$M) | TOTAL<br>REPORTED<br>SALES<br>(\$M) | NUMBER OF<br>COMPANIES | TOTAL<br>EMPLOYMENT |
|---|-----------------------------|-------------------------------------|------------------------|---------------------|
| Industrial Process Control<br>Systems & Instrumentation | 325                         | 263                                 | 135                    | 5300                |
| Building Instrumentation                                | 271                         | 203                                 | 36                     | 4960                |
| Medical Electronics                                     | 164                         | 55                                  | 20                     | 1300                |
| Test & Measurement<br>Instruments                       | 85*                         | 16                                  | 30                     | 600                 |
| Scientific & Laboratory<br>Instrumentation              | 60*                         | 12                                  | 13                     | 400                 |
| Remote Sensing & Environmental<br>Instrumentation       | 32                          | 20                                  | 30                     | 600                 |
| Geophysical Apparatus                                   | 25*                         | 11                                  | 21                     | 365                 |
| SECTOR TOTAL  | 962                         | 580                                 | 285                    | 13525               |

Note: The figures which have been marked with an asterisk are considered to be low estimates of the size of the domestic market. Refer to the individual subsector profiles for an explanation of problems encountered in attempting to assess the size of domestic subsector markets.

See Methodology and Definition of Terms Used for an explanation of the terms used here and elsewhere in the tables.

**Subsector Size and Structure**

The sector has been subdivided into seven broad commodity groups or subsectors, which are highly differentiated from one another in terms of product lines, technologies employed, distribution channels used, degree of foreign-ownership, industry size and structure, and markets served. Apart from the few large companies which may be involved in more than one subsector, the majority of firms specialize in certain products and markets and hence are classified in only one subsector.

Basically, the Instrumentation Sector is composed of two mature industry subsectors serving almost the entire domestic demand for their products, and five smaller subsectors which are still in the formative stage, but with considerable potential for development in many product areas.

The major portion of economic activity in the Instrumentation Sector is accounted for by the two largest industry subsectors, which produce industrial process control systems and equipment and building instrumentation and automation equipment and systems. Manufacturers of these products account for approximately 80 percent of total sector sales and more than 75 percent of total employment.

The remaining 20 percent of sector sales is contributed by the five smaller subsectors which manufacture biomedical and health care instrumentation, test and measurement instruments, scientific and laboratory instrumentation, remote sensing and environmental instrumentation and geophysical apparatus.

In terms of sales volume and employment, manufacturers of biomedical and health care instrumentation make up the third largest category of firms in the Instrumentation Sector. Total sales for this group are more than double those of companies in any of the other smaller subsectors. In relation to total sector activity, however, the biomedical electronics subsector is relatively small. Biomedical electronics accounts for less than 10 percent of the economic activity in the Instrumentation Sector.

The remaining subsectors hardly qualify to be designated as identifiable subsectors. In terms of total Instrumentation Sector activity, their contribution is marginal. Each of the smaller subsectors accounts for less than 4 percent of total sector sales.

In some instances, the designated subsectors consist only of a loose grouping of companies which produce a limited range of products both for the domestic market and for export. For example, 70 percent of the firms producing test and measurement systems and instruments made sales of less than \$500,000 in 1978. Similarly, 50 percent of the manufacturers of remote sensing and environmental instrumentation and geophysical apparatus operated in this sales range. No domestic companies earned annual sales revenues over \$5 million in these product lines. Analytically, it is difficult to treat these firms in the same context as the large, well-established firms serving the major and more mature segments of the total market for instrumentation products. The problems that they face and the opportunities they provide are unique to each subsector.

#### REGIONAL LOCATION

Although most companies (55 percent) are located in Ontario, other provinces such as Québec, Alberta and British Columbia have a significant share of the Instrumentation industry. Approximately 13 percent of total companies are located in each of these provinces.

The regional distribution of industries in Canada is as follows:

|              | <u>Number of Companies</u> | <u>% of Total</u> |
|--------------|----------------------------|-------------------|
| Ontario      | 158                        | 55%               |
| Québec       | 39                         | 14%               |
| Alberta      | 36                         | 13%               |
| B.C.         | 34                         | 12%               |
| Manitoba     | 9                          | 3%                |
| Saskatchewan | 6                          | 2%                |
| P.E.I.       | 2                          | 0.7%              |
| Nova Scotia  | <u>1</u>                   | <u>0.3%</u>       |
| TOTAL        | 285                        | 100%              |

#### OWNERSHIP AND CONTROL

The Canadian Instrumentation Sector is composed of a relatively small number of foreign-owned firms with a significant share of the market, and a large number of Canadian-owned firms with a much smaller share of total sales activity. Although over 75 percent of the industry is Canadian-owned, indigenous firms contributed only 35 percent of total sales volume in 1978. The remaining 65 percent of market activity was attributed to less than 25 percent of the industry which consists of foreign-owned companies.

Seven of the nine major firms (i.e., with annual sales over \$10 million) are foreign-owned. Five of these Canadian subsidiaries: Bailey Meter Company, Foxboro Company of Canada, Honeywell Limited, Johnson Controls and Edwards Company of Canada overwhelmingly dominate the two largest industry subsectors (whose products include industrial process control systems and instrumentation and building instrumentation and automation equipment and systems.)

Market domination by foreign-owned affiliates is not as evident in the five smaller subsectors, (whose products include biomedical and health care instrumentation, test and measurement instruments, laboratory instrumentation, remote sensing and environmental instrumentation and geophysical apparatus.) Because the size of the Canadian market for many of these products is limited, there has not been as much incentive for foreign-owned companies to establish subsidiaries in Canada to serve the domestic market. In addition, the highly competitive nature of a number of the subsector markets necessitates continuous costly research and development activity to develop new products. Consequently, many foreign firms find it more profitable to import their products rather than resort to direct

investment in Canada. Share of sales by Canadian-owned companies in these subsectors varies from 55 percent to 100 percent of total market activity at the subsector level. Only two major foreign-owned affiliates produce for the smaller subsector markets; these are Medtronics of Canada Limited and Picker X-Ray Manufacturing Limited, which dominate the medical electronics market, together with Atomic Energy of Canada, a Canadian Crown corporation.

The breakdown of corporate ownership by level of sales is as follows:

| Sales Range                   | Number of Companies |            |           |
|-------------------------------|---------------------|------------|-----------|
|                               | Total               | Canadian   | Foreign   |
| less than \$500,000           | 118                 | 113        | 5         |
| \$.5 million to \$1 million   | 77                  | 69         | 8         |
| \$1 million to \$2.5 million  | 42                  | 23         | 19        |
| \$2.5 million to \$ 5 million | 23                  | 11         | 12        |
| \$5 million to \$10 million   | 16                  | 5          | 11        |
| \$10 million to\$ 20 million  | 5                   | 2          | 3         |
| \$20 million and over         | 4                   | 0          | 4         |
|                               | <u>285</u>          | <u>223</u> | <u>62</u> |

**DOMESTIC MARKET, EXPORTS, IMPORTS**

The following table summarizes data on the size of the domestic market, exports, imports and the balance of trade for the total industry and for each subsector:

DOMESTIC MARKET, EXPORTS  
IMPORTS, TRADE BALANCE, 1978

| SUBSECTORS   | DOMESTIC MARKET (\$M) | EXPORTS (\$M) | IMPORTS (\$M) | TRADE BALANCE (\$M) |
|--|-----------------------|---------------|---------------|---------------------|
| Industrial Process Control Systems & Instrumentation | 325                   | 45            | 108           | - 63                |
| Building Instrumentation                             | 271                   | 14            | 82            | - 68                |
| Medical Electronics                                  | 164                   | 32            | 100           | - 68                |
| Test & Measurement Instruments                       | 85                    | 7             | 76            | - 69                |
| Scientific & Laboratory Instrumentation              | 60                    | 6             | 54            | - 48                |
| Remote Sensing & Environmental Instrumentation       | 32                    | 9             | 21            | - 12                |
| Geophysical Apparatus                                | 25                    | 6             | 20            | - 14                |
| SECTOR TOTAL   | 962                   | 119           | 461           | -342                |

The domestic market for instrumentation and control products was estimated at more than \$900 million in 1978. Domestic industry supplies approximately half of this market, with the remaining share supplied by imports. The high level of imports underlines Canada's weak capability in many segments of the control and instrumentation industry.

The percentage of products which must be imported varies considerably across subsectors. The two largest subsectors (industrial process control and building instrumentation and systems) each supply the major portion of domestic demand for their products. By contrast, each of the remaining smaller industry subsectors supply as little as 10 to 33 percent of their respective domestic markets.

Total exports for the Instrumentation Sector represent only 20 percent of total sales. This figure, however, is not an accurate reflection of export performance at the subsector level. In fact, the ratio of exports to total sales is significantly higher for the majority

of small and medium-size companies who must rely heavily on export sales due to the small size of the domestic market and because of their specialized product lines. The table below contains a breakdown of export sales as a percentage of total sales at the subsector level.

| SUBSECTORS   | TOTAL REPORTED SALES (\$ Millions) | EXPORTS AS % OF SALES | % OF DM FROM DOMESTIC SOURCES |
|--|------------------------------------|-----------------------|-------------------------------|
| Industrial Process Control Systems & Instrumentation | 263                                | 17%                   | 66%                           |
| Building Instrumentation                             | 203                                | 7%                    | 70%                           |
| Medical Electronics                                  | 55                                 | 58%                   | 18%                           |
| Test & Measurement Instruments                       | 16                                 | 45%                   | 10%                           |
| Scientific & Laboratory Instrumentation              | 12                                 | 49%                   | 10%                           |
| Remote Sensing & Environmental Instrumentation       | 20                                 | 46%                   | 33%                           |
| Geophysical Apparatus                                | 11                                 | 55%                   | 19%                           |
| SECTOR TOTAL   | 580                                | 20%                   | 48%                           |

The smallest subsectors, where the incidence of small and medium-size firms is highest, are also the heaviest exporters. Manufacturers of industrial process control and building instrumentation and systems, who comprise the two largest industry subsectors, exported only 17 percent and 7 percent of their respective productions in 1978. These large subsectors are dominated by large, foreign-owned subsidiaries who direct their major marketing efforts at the Canadian market. As a result of their poor export performance and their dominance of total sector sales, export sales for the entire sector appear to be poor.

The main export market for the sector is the United States, which absorbs approximately 60 percent of all exports. The U.S. instrumen-



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INSTRUMENTATION AND AUTOMATION EQUIPMENT  
AND SYSTEMS**

Electrical and Electronics Branch

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INDUSTRIAL PROCESS CONTROL, INSTRUMENTATION AND  
AUTOMATION EQUIPMENT AND SYSTEMS SUBSECTOR

DEFINITION OF THE SUBSECTOR

This subsector includes all establishments and companies engaged in the manufacturing of computer based industrial process control centers and panels; instrumentation and automation systems for process and manufacturing industry; industrial indicating, recording and control instruments, (pneumatic and electric); sensors, process analyzers, programmable controllers, maintenance services for instrument users, system installation and start up services.<sup>1</sup>

It also includes telemetry, remote annunciation and displays, supervisory control and data acquisition systems and devices; elevator, materials handling, traffic and railway signalling and control systems; electric power, oil and gas industry monitoring instruments and automation systems; physical status monitoring devices and systems based on sensing temperature, moisture, pressure, pH, weight, flow, brightness radiation, humidity, vibration, positioning and other properties.

The following items are not meant to be a complete listing but only an illustration of the types of systems covered in this subsector:

1. Telemetry, Supervisory Control and Data Acquisition.
2. Electrical Load Management and Dispatching.
3. Oil and Gas Pipeline Automation.
4. Automatic Turbine Run-up, Control and Shut-down.
5. Burner/Pulverizer Automation for Coal Fired Units.
6. Production Automation for Thermal Recovery Oil Fields.
7. Dedicated Communication Systems for Power, Gas and Oil Industries.
8. Numerical or Computer-Controlled production processing (NC, CNC, Chemical Etching, etc.).

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FOOTNOTE:

This market sector does not include mechanical measuring and monitoring devices or standard industrial control apparatus such as motor starters, auxiliary relays, limit switches, or current switching and breaking devices.

9. Automation of batch manufacturing (non-process) facilities, (assembly of discrete parts and components, manipulation of their geometries, tests and measurements).

Examples: Postal Automation Equipment, Material Handling, Food Processing, Automatic Quality Control, Inspection, Gauging and Defect Detection; Railway and Vehicle Traffic Control; Unit Power; Fuelling Machine Controls, Annunciation, Alarm and Event Recording Equipment for Nuclear Power Plants.

10. Automatic Weighing Systems e.g. for pharmaceutical or meat processing industries.

Some of the individual meters and measuring devices covered by this sector are:

- annunciators
- strip chart recorders
- set-point indicators
- set-point controllers
- signal converters
- deviation meters
- analog computing devices and function generators.

#### SUBSECTOR CHARACTERISTICS

The basic function of an industrial process control system is the same for all primary and secondary industries - to monitor and regulate a manufacturing or a refining process. In all instances, the desired results include reduced labour costs, lower consumption of process energy and raw materials, increased productivity and improved quality.

Industrial process control systems can be divided into two distinct groups - those oriented towards process industries characterized by the presence of continuously flowing liquids and gases and those dealing with discrete components which are manipulated to assemble a finished product. Despite the similarity of the basic functions of process control systems used in the different types of industries, the actual design, systems and components used are peculiar to each industry.

Entry into the process control industry is difficult because of strong end-user loyalty to traditional suppliers and because of the large capital investment necessary to design and market an effective system. An intimate knowledge of the user's manufacturing process is a pre-requisite to customer acceptance.

Typical end users of these systems are: pulp and paper, minemill processing, petrochemicals; gas processing, transportation and distribution; primary metals production, textiles, food processing; oil production, refining; and transportation and electric power generation (fossil fuel, and nuclear), transmission and distribution industries.

The most significant recent development in process control technology is the application of digital controls which has resulted in superior

supervisory capabilities - improved reliability, greater adaptability and reduced costs of end products and control systems. Distributed control has been recognized as the optimal systems approach in the majority of applications. Many processes went on-line with digital control when the feasibility of the mini-computer became established in industrial applications. Microprocessors are now invading systems of this type, especially in distributed configuration. In addition, the less costly equipment is making digital control practical for automating smaller processes and plants like those found in plastics, textiles and the food processing industries.

Other recent developments in automation technology which have resulted in significant cost reductions for user industries include decreased costs of computer hardware, improved communications capability, techniques for originating less expensive software of better quality, and the development of a wider range of specialized sensors. Improvements in cathode-ray tube (CRT) displays are continuing to permit graphics of higher quality with greater flexibility at a lower cost.

Social and political considerations - such as protection of the environment, conservation of energy and resources, safety of manpower and the need for better working conditions - have had an important impact on the need for and application of process control equipment and systems in both industrial design and operation. In particular, the energy crisis has created a need for tighter energy integration and a corresponding need for more sophisticated controls. Thus, in a sense, the energy crisis can be viewed as creating a significant development opportunity for this industry.

Introduction of automated systems, has, in turn, imposed a number of social problems and constraints. Use of the new systems technology has resulted in wide-ranging effects on employment, occupational skills, training, and labour-management relations.

Canadian industry has yet to make an impact in the area of flexible automated manufacturing (FAM) and other associated processes such as computer-aided manufacturing (CAM). At present, the most important and promising area of FAM is robotics. Despite massive amounts of money spent on the development of robots with sensory capabilities (i.e. robots which can see, feel, recognize) in the United States, Japan and West Germany, none of these countries is yet marketing such robots. Canada is a small but important participant in this area through the development of a robot recognition system by Leigh Instruments, in co-operation with the National Research Council. In addition, Spar Aerospace Ltd., Chalk River Nuclear Laboratories and CAE Electronics Ltd., have done some work in the general area of robotics and could form a significant base for future efforts that could result in considerable improvement in productivity in almost all Canadian manufacturing industries.

SUBSECTOR STRUCTURE AND STATISTICAL DATA, 1978

The subsector at large employs approximately 2,800 production workers. This results in \$80,000 sales per production worker. This ratio will be somewhat higher for the large instrumentation companies. The high output in sales dollars per production worker indicates relatively low labour intensity which is characteristic of the industry as a whole. It also reflects the high foreign content of the equipment and systems produced in Canada, especially by the branch plants of multinationals. It should be noted, however, that although many Canadian subsidiaries display traditional branch plant characteristics, there are a few instances of systems developed in Canada by foreign-owned operations for the world market.

Data related to industry size and structure are provided below. In terms of numbers of participating companies, the industrial process control, instrumentation and automation equipment and systems subsector is by far the largest subsector of the Instrumentation Sector. In terms of sales revenue and employment, this subsector also dominates economic activity, but is almost equal in size to the building instrumentation and systems subsector. A number of companies produce for both markets. Foreign-owned companies overwhelmingly dominate the economic activity in this subsector. Out of 97 companies which provided information for this study, 37 percent were foreign-owned, accounting for over 60 percent of sales revenue in this product area.

All but one of the major companies are foreign-owned subsidiaries. In addition, the majority of medium-size firms are foreign-owned. By contrast, virtually all of the smallest companies (sales under \$1 million) are Canadian-owned.

|  |               |
|--|---------------|
| Estimated Domestic Market                | \$325 million |
| Total Number of Firms                    | 138           |
| Percentage Canadian Owned                | 71%           |
| Total Employment                         | 5300          |
| Total Reported Sales                     | \$263 million |
| Share of Sales from Canadian-owned Firms | 37%           |
| Total Exports                            | \$45 million  |
| Exports as % of Sales                    | 17%           |
| Research and Development:                |               |
| R&D Expenditure as % of Sales            | N/A           |
| R&D Employment as % of Total Employment  | 11%           |

Distribution of Companies by Level of Reported Sales, 1978:

|                              |     |
|------------------------------|-----|
| less than \$500,000          | 34  |
| \$0.5 million to \$1 million | 16  |
| \$1 million to \$2.5 million | 20  |
| \$2.5 million to \$5 million | 12  |
| \$5 million to \$10 million  | 11  |
| \$10 million to \$20 million | 3   |
| over \$20 million            | 1   |
| unidentified companies       | 41  |
| Total Companies              | 138 |

Regional Distribution of Companies:

|                  |    |
|------------------|----|
| Ontario          | 54 |
| Québec           | 14 |
| Alberta          | 12 |
| British Columbia | 12 |
| Saskatchewan     | 3  |
| Manitoba         | 2  |

Note: Only those companies who participated in the survey have been included in the regional distribution.

CORPORATE CHARACTERISTICS

Companies belonging to this subsector can be grouped into three categories with distinctive characteristics according to areas of specialization, degree of systems design and project management capability, degree of vertical integration, sales volume, in-house manufacturing content, etc.

(a) Large Instrumentation and Systems Companies

These companies are characterized by in-house capability in software development, software/hardware interface, sensor and analytical instrument and analog instrumentation manufacturing; assembly and fabrication of control panels and consoles, CRT display and monitors; installation and commissioning of systems (on a turn-key basis), servicing, installation and training of the end-user's personnel.

Aggregate domestic demand for this group of products has been estimated at \$160 million. The figure arrived at has been confirmed by several companies. A number of these are members of the Industrial Instrumentation Manufacturers Association.

Major suppliers in this group include Bailey Meter Company, Foxboro Company of Canada, Honeywell Limited and Sentrol Systems. Total sales for all companies in this group were in excess of \$116 million in 1978.

Interviews conducted with the key companies have evolved a number of company characteristics and have highlighted the following points:

- In-house manufacture of sensors is the key to adequate profits and market share.
- Companies which have expanded from the original base of analog instrumentation manufacture (e.g. Foxboro, Taylor, Bristol, Honeywell) still derive approximately 75% of their revenues from analog instruments and components and 25% from software and systems development. However, the latter facet of their operation will grow rapidly in the future at the expense of the original one.
- The revenues derived by large instrumentation companies and some systemhouses from installation, maintenance, commissioning and training of users' personnel can be as high as 10% of total. Certain foreign-owned companies employ more people in these areas than in manufacturing.
- Typical cost breakdown of a SCADA system is as follows:

|  |       |
|--|-------|
| Software/Systems Eng.                          | - 27% |
| Purchased Components and material <sup>1</sup> | - 44% |
| Labour   | - 24% |
|  | 95%   |
- Canadian content for a typical project averages out at about 60-65%
- Software/systems engineering content in process control projects (as differentiated from SCADA systems) can be high as 50% of the total.

**ii) Systemhouses with Limited Manufacturing and Assembly Facilities**

These companies are primarily software oriented and are capable of total system development, software/hardware interfacing, de-bugging, servicing and training. They do not manufacture instruments, computer hardware or sensors.

Total sales in 1978 for companies in this category were estimated at approximately \$38 million. Major firms include Automatec, Motorola, Milltronics Limited, Quindar Products Limited Interautomation and S.A. Engineering Ltd.

**iii) Subsystems and Components Manufacturers Including Custom Control Panels**

Equipment produced by companies in this group is usually sold to large instrumentation and system companies or to industrial users.

**FOOTNOTE:**

1. 50% of components are sourced from US. The balance of 5% is spent on quality assurance, technical documentation, training, packing, transportation and spares provisioning. It should also be noted that certain Canadian sourced equipment, e.g. PDP11 minicomputer has a high US content.



Major suppliers, defined as companies with sales volume of \$4 million or more, include:

Control and Metering Co. Ltd., Ferranti-Packard Ltd., Graphic Controls Ltd., ITT Barton Ltd., and Process Instruments Systems Ltd.

In 1978, sales for all companies in this category totalled over \$70 million.

#### VALUE ADDED

For a number of reasons, it is difficult to give an accurate estimate of the Canadian content in the end products manufactured by this subsector. In particular, it is difficult to evaluate the amount of work done for subsidiaries by their parent companies or to determine the value of purchased parts, sub-assemblies and complete systems or sub-systems manufactured by parent companies and supplied to end users through Canadian affiliates.

In addition, the proportion of Canadian content tends to vary with the type of equipment produced. In the case of very large instrumentation companies, significant Canadian content is contributed through systems/software design and application engineering functions. For example, in a typical cost breakdown of a computer-based industrial process control system, 25 percent of costs is due to imported American components, another 25 percent to Canadian materials, while 50 percent is attributed to Canadian software development, system design, factory labour, service and maintenance.

By contrast, the majority of firms which manufacture subsystems and components for the larger instrumentation and systems companies purchase about 50 percent of components from offshore sources, because domestic supplies are not available

Although figures vary from application to application, the average Canadian content for the entire subsector has been estimated to be between 60 and 65 percent.

#### RESEARCH AND DEVELOPMENT

Canadian-owned companies devoted a proportionately larger share of their resources to R & D than foreign-owned operations. The share of Canadian-owned companies in the total R & D employment<sup>1</sup> is reported as 66%, while their share of total sales is only 37%.

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#### FOOTNOTE:

1. The definition of R & D employment, as reported, requires further study as in many instances, a number of engineers and technicians engaged in systems/software design were included in the R & D category. Frequently, it is difficult to draw a distinction between the true R & D costs and application engineering work requiring development of dedicated software packages or complex modifications of existing components and hardware. A portion of the latter expenses is normally included in the bid price for a given project.

The large instrumentation companies, either Canadian-owned or those who possess a high degree of corporate autonomy allocate between 6-8% of sales dollars to research and development.

Only 5 out of 14 large instrumentation companies listed carry out any R & D work in Canada and 2 of them are Canadian-owned.

#### EXPORT PERFORMANCE

Out of 12 multinational affiliates, classified as "large instrumentation and systems companies", five reported export sales, ranging from 8 percent to 50 percent of total sales. A number of these limited their export efforts to projects financed by the Canadian International Development Agency and the Export Development Corporation; that is, to cases where they were in a preferred position vis-a-vis their U.S. parents. Total export sales of the companies in this category amounted to \$24.0 million. They were offset by a large margin by purchases of offshore components and materials the cost of which are estimated at \$45.0 million.

There exists a correlation between the size of an organization and its ability to be successful in export markets for industrial process control systems and instrumentation. Only a few companies, whose sales were under \$2.0 million, generated any export sales. Maintenance function and capability is an essential part of serving the markets in question. This handicap can be overcome by setting up dealer/service organization networks abroad, but the product ranges of small and some medium size companies are too narrow to be carried by reputable distributors or manufacturers' agents. Differences in code regulations, voltages, frequency and wiring practices are also recognized as significant barriers for organizations with limited financial resources.

#### INDUSTRY PROBLEMS

The industry has experienced and will continue to experience a number of problems on both the production and consumption sides of the market.

On the production side, major constraints to growth will include increasing costs of labour, shortage of skilled manpower and lack of standardization of software systems. A more immediate problem is created by the non-availability of, or delay in procurement of critical components and subassemblies which are normally sourced from the United States, even during periods when supply exceeds demand in the U.S. and other countries.

On the consumption side, a number of factors have operated to constrain use of industrial process control systems and instrumentation among user industries. In some instances, potential users are reluctant to adopt the new technology because they lack the expertise and sophistication needed to operate and maintain the systems. This situation is compounded by the fact that some high cost and complex systems have been characterized by inadequate and insufficient

reliability and maintainability. In a number of cases, computer-based systems have been oversold or misapplied, leading to disenchantment among end users.

In addition, the end user is often characterized by inertia and conservatism with respect to adoption of new technology.

This is particularly true of the heavy process industries with large capital investments, which are hesitant to take technical risks because of the high cost of failures and process interruptions.

#### FUTURE TRENDS

- Convergence of rapidly exploding software and microelectronics technologies will lead to a "second industrial revolution" in the 1980's in the way manufacturing is controlled and operated. Products to compete in this future market will require heavy capital and R & D investment. Thus volume manufacture based on increased share of domestic markets and larger export sales will be the key to competitiveness.
- These changes will favour larger, entrenched companies and will tend to reinforce their dominance of the market.
- As hardware becomes more standardized and economies of scale play a more important role, there may be greater rationalization of production by multinationals and thus less manufacturing in Canada by foreign-owned subsidiaries.
- At the same time, the need for small, specialized systems houses will remain. Microprocessor and minicomputer manufacturers will continue to penetrate isolated portions of Industrial Process Control Markets and do it quite well sometimes (Motorola, RCA). Although it is expected they will continue to increase their infringement of this market, application know-how of the process in question will remain a major factor in enabling a company to be successful.
- Market demand for industrial process control and instrumentation products is expected to increase because of the energy crisis and the tightening up of anti-pollution regulations. Many companies will re-evaluate their present production processes and demand more sophisticated control systems. In particular, there is a significant tendency to switch from electrical, mechanical and pneumatic controls to electronics.

#### TECHNOLOGY AND PRODUCT DEVELOPMENTS

- Transfer of large amount of data in a digital mode through microwave and optical fibre media.
- Increased use of ultrasonics in future sensor development (for accurate measurement of displacement, flow, consistency, gas analysis and temperature).

- Availability of new, specialized sensors will be the key to the sustained growth of advanced control systems for new applications.
- Merger of CAD/CAM into one activity "group technology" will ease batch-manufacturing problems and bottlenecks through coding and classifying each part, novel approaches in process engineering and planning and by developing the necessary software for machine tools.
- Programmable controllers employing microprocessor technology will not only continue to replace conventional relay-type control systems but will also lower the range of minicomputers used in process applications.
- Continuous increases in the application of distributed processing to optimize the complete process or plant. Central computers will optimize the entire process by issuing instructions to the various distributed microprocessor controllers, which are physically closer to the process, to change set points, flow rates, etc., as required.

#### PAST PERFORMANCE AND PROJECTED GROWTH

The growth of computers in industrial control has reached explosive proportions. The rate of growth (world-wide) of computer-based industrial installations over the past three years has averaged 67% per annum. In 1979, there were well over 200,000 digital computers world-wide in on-line industrial control applications.

One of the largest growth areas in this field is the programmable controller. 1979 world sales of these devices were estimated at \$230 million. They are applied 60% to manufacturing and 40% to process industries and for the last two years have grown at 100% per annum.

One of the most informative sources encountered during this study referring to the past performance and future growth of the Canadian process control industry was the paper entitled "Industrial Instruments" published in 1978 by Dr. J. Ross Peters, Senior Economist of the Royal Bank of Canada. The study was requested by the Industrial Instruments Manufacturers Association (IIMA). The input data sources were Royal Bank Economics Department, Statistics Canada and IIMA.

The trends and projections arrived at in the above study have been assumed to be characteristic of the entire sector, although the sales as defined are the sales of IIMA group which in 1978 amounted to \$120 million, approximately 46% of the total sales of the subsector.

INDUSTRIAL INSTRUMENTS  
SALES PRICE AND EARNINGS DATA  
1967-77 (\$000's)

|      | Sales in<br>Current<br>dollars<br>(000's) | Sales in<br>constant<br>dollars<br>(000's) | Sales<br>price index*<br>(1967 = 100) | %<br>change | Pre-tax<br>profits<br>(000's) | Pre-tax<br>profit<br>margin |
|------|---|--|---------------------------------------|-------------|-------------------------------|-----------------------------|
| 1967 | \$36,823                                  | \$36,823                                   | 100.0                                 | 0.0         | \$3,981                       | 10.8                        |
| 1968 | 41,839                                    | 41,465                                     | 100.9                                 | 0.9         | 2,715                         | 6.5                         |
| 1969 | 46,638                                    | 43,846                                     | 106.4                                 | 5.4         | 4,628                         | 9.9                         |
| 1970 | 53,887                                    | 48,212                                     | 111.8                                 | 5.1         | 5,707                         | 10.6                        |
| 1971 | 53,591                                    | 45,188                                     | 118.6                                 | 6.1         | 5,509                         | 10.3                        |
| 1972 | 55,859                                    | 44,497                                     | 125.5                                 | 5.8         | 3,753                         | 6.7                         |
| 1973 | 57,364                                    | 42,301                                     | 135.6                                 | 8.0         | 4,035                         | 7.0                         |
| 1974 | 71,712                                    | 45,698                                     | 156.9                                 | 15.7        | 6,040                         | 8.4                         |
| 1975 | 90,112                                    | 50,956                                     | 176.8                                 | 12.7        | 11,697                        | 13.0                        |
| 1976 | 101,409                                   | 52,273                                     | 194.0                                 | 9.7         | 12,383                        | 12.2                        |
| 1977 | 103,598                                   | 49,471                                     | 209.4                                 | 7.9         | 14,468                        | 14.0                        |

\* Used as a proxy for industrial instrument sales prices are the combined price indices for government capital investment, business non residential construction and business machinery and equipment investment

Source: Royal Bank Economics Department, Industrial Instrument Manufacturers Association and Statistics Canada.

The percentage breakdown of end-use industries for the years 1970 and 1978 shown below reflect the growth of the oil and gas industries which are at present the largest end-use market by a wide margin. The pulp and paper market and particularly the metals and mining markets have become much less important as instrument users.

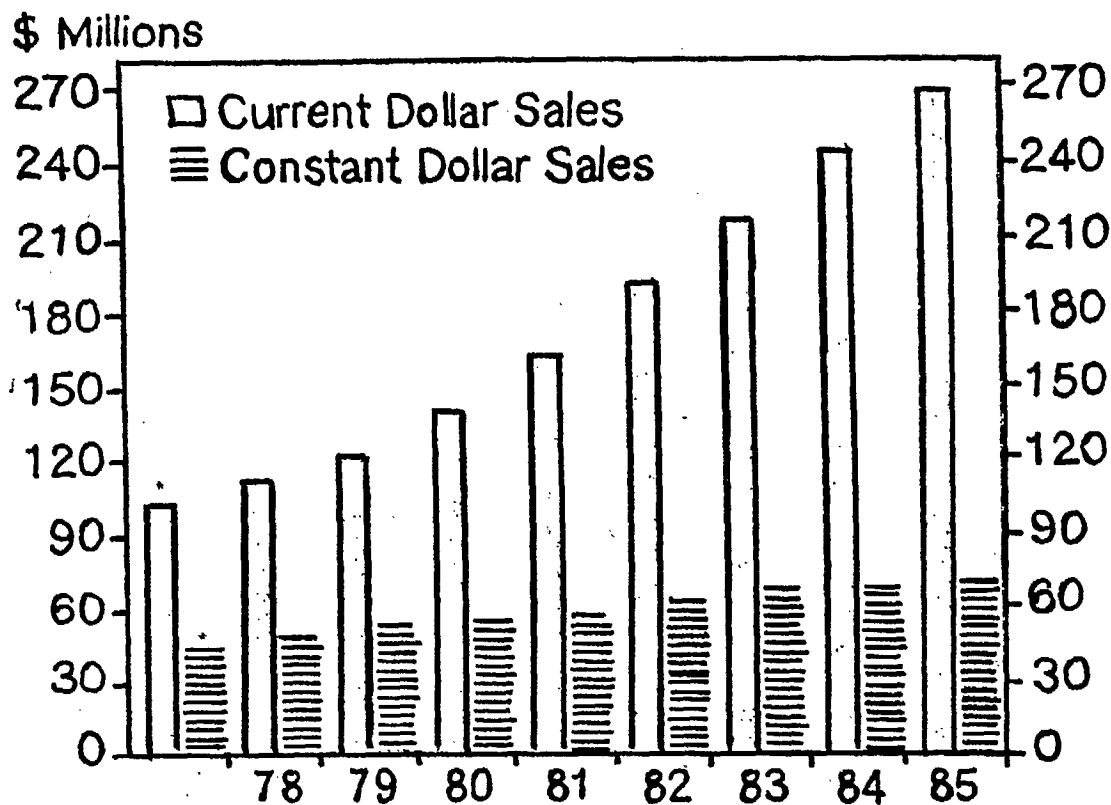
It is worthwhile noting that the four largest end-users comprised 58.1% of the total demand for industrial instruments.

PERCENTAGE BREAKDOWN OF END-USE  
MARKETS FOR INDUSTRIAL INSTRUMENTS

| December 31, 1970                        |       | March 31, 1978                           |       |
|--|-------|--|-------|
| Pulp and paper                           | 17.1  | Petroleum & gas                          | 21.5  |
| Metals & mining                          | 16.4  | Spare parts, supplies<br>& repairs       | 13.7  |
| Spare parts, supplies<br>and repairs     | 16.0  | Pulp & paper                             | 12.0  |
| Petroleum, gas & coal                    | 15.0  | Chemicals                                | 10.9  |
| Miscellaneous                            | 8.4   | Exports                                  | 9.8   |
| Power                                    | 6.5   | Miscellaneous                            | 8.4   |
| Chemicals                                | 5.1   | Metals & mining                          | 8.2   |
| Non-metallic minerals                    | 3.8   | Power                                    | 6.7   |
| Food & beverage                          | 3.4   | Food & beverage                          | 2.1   |
| Water & waste                            | 3.0   | Electronics research &<br>medical        | 1.9   |
| Electronics research &<br>medical        | 2.9   | Non-metallic minerals                    | 1.7   |
| Services, institutions<br>& construction | 2.0   | Water & waste                            | 1.4   |
| Textiles                                 | 0.4   | Services, institutions<br>& construction | 1.4   |
|  |       | Textiles                                 | 0.3   |
| <hr/>                                    |       | <hr/>                                    |       |
| Total                                    | 100.0 | Total                                    | 100.0 |

Source: Industrial Instrument Manufacturers Association.

INDUSTRIAL INSTRUMENTS  
LONG RUN SALES FORECAST  
1977-85 (ANNUALLY)



These figures indicate an increase from 1978 sales of \$50 million to \$70 million by 1985 in real terms, i.e. an increase of 40% over seven years. While projected sales may look healthy they may be either overestimated\* because of such factors as faster than anticipated technology changes, impact of tariff reductions and shifting of manufacturing from foreign affiliates in favour of more concentrated operations by parent companies owned abroad.

\* or underestimated

PARTICIPATING COMPANIES<sup>1</sup> AND MARKETS SERVED, 1978

A. Large Instrumentation and Systems Companies

These companies are characterized by in-house capability in software development, software/hardware interface, sensor and analytical instrument and analog instrumentation manufacturing; assembly and fabrication of control panels and consoles, CRT displays and monitors; installation and commissioning of systems (on a turn-key basis), servicing, installation and training of the end-user's personnel.

In this category, the companies<sup>2</sup> listed below have been identified:

| <u>Company</u>  | <u>Major Markets</u>   |
|---|--|
| Bailey Meter Company  | Thermal Power Stations,<br>Process Steam Generation  |
| Beckman Instruments Limited                                     | Chemicals, Metals  |
| Bristol Company of Canada                                       | All process Industries   |
| CAE Electronics Limited   | Hydroelectrics and<br>Nuclear Generating plants  |
| Fischer and Porter<br>(Canada) Limited                          | Electric Power, Heavy<br>Water   |
| Fisher Controls Corporation<br>Generation, Petro-chemical, Gas. | Pulp & Paper, Power  |
| Foxboro Company of Canada                                       | All Process Industries   |
| Honeywell Limited   | All Process Industries   |
| Leeds & Northrup<br>Canada Limited                              | All Process Industries   |
| Moore Instruments Co. Ltd.                                      | Analog Instruments, Sensors,<br>Actuators, (pneumatic and<br>electric), Relay and Control<br>Panels. |

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FOOTNOTE:

1. Companies in groups A, B and C submitted information which was used in the preparation of this industry profile. Companies in group D did not respond to the questionnaire.
2. Two companies which are in related business, namely CGE and Digital Equipment Company, have not been considered as being in the subsector.



| <u>Company</u>  | <u>Major Markets</u>  |
|---|---|
| Rochester Instruments Systems Limited   | Power Utilities, Process Industries                                   |
| Rosemount Instruments Ltd.  | Refineries, Oil Production, Nuclear.                                  |
| Sentrol Systems   | Pulp & Paper, Metal Coating   |
| Taylor Instruments Limited  | Petrochemical, Oil & Gas, Nonferrous Metals, Food Processing, Brewing |
| Westinghouse Canada Limited   | Power Utilities, Steel  |
| <b>B. <u>Systemhouses with Limited Manufacturing and Assembly Facilities,</u> primarily Software Oriented, capable of Total System Development, Software/Hardware Interfacing, De-bugging, Servicing and Training (do not manufacture instruments, computer hardware or sensors.)</b> |   |

In this category the following companies have been identified

| <u>Company</u>               | <u>Major Markets</u>                           |
|------------------------------|--|
| Automatic Ltée               | Power Utilities, Process Industries            |
| Canuck Engineering Limited   | Gas and Oil                                    |
| Centre-Electro-Technique     | Power Utilities, Transportation                |
| Crossby Electronics Limited  | Power Utilities, Gas and Oil                   |
| Datap Systems Limited        | Power Utilities, Gas and Oil                   |
| Glenayre Electronics Limited | Railways, Mines                                |
| GTE/Lenkurt Electric         | Pipelines, Utilities, Railways                 |
| Interautomation Limited      | Automotive, Cement, Petrochemical              |
| Milltronics Limited          | Material Handling, Process                     |
| Motorola-Dascan Division     | Power Utilities, Gas and Oil, Sewage Treatment |
| Omicron Systems Limited      | Power Utilities, Pipelines                     |
| Promac Controls Inc.         | Mining, Steel, Food, Petrochemical             |

| <u>Company</u>               | <u>Major Markets</u>  |
|------------------------------|---|
| Pulse Indi Electronics       | Printing, Cement, Pulp & Paper  |
| Quindar Products Limited     | Power & Water Utilities,<br>Pipelines, Transportation<br>Broadcasting |
| Robertshaw Controls Company  | Construction, Process   |
| Ruscan Logics Limited        | Local Utilities, Material<br>Handlings                                |
| S.A. Engineering Limited     | Power Utilities, Gas and Oil,<br>Petrochemical                        |
| Southwell Controls Limited   | Local Utilities, Process  |
| Telemecanique Canada Limited | Mining, Sawmills, Food<br>Processing, Oil                             |
| Tracon Engineering Limited   | Power Utilities, Mining   |

**C. Subsystems and Components Manufacturers Including Custom Control Panels** (Equipment usually sold to large instrumentation and system companies or to industrial users.)

| <u>Company</u>                | <u>Products</u>   |
|-------------------------------|---|
| Barnes Engineering CO. Ltd.   | Electrical, optical acoustic<br>sensors, production machinery<br>monitoring                   |
| Bentley Nevada (Canada) Ltd.  | Ind. process control subsystems   |
| Beta Machinery Analysis Ltd.  | Performance monitors for rotating<br>machinery vibration analyzers<br>power cylinder balancer |
| Bonder-Clegg & Co. Ltd.       | On stream X-ray analyzer potash<br>monitors   |
| Canadian Dynamics Nova Ltd.   | Custom control subsystem  |
| Canadian RGL Electronics Ltd. | Telemetry systems, tank liquid<br>level, gauging systems,<br>temperature and pressure sensors |
| Cantech Controls Ltd.         | Custom control panels   |
| Chimo Equipment Ltd.          | Oil drilling instrumentation  |

| <u>Company</u>                             | <u>Major Markets</u>   |
|--|--|
| Control and Metering Co. Ltd.              | Chemical feed systems, Ind. process control subsystems, custom control panels  |
| Cusco Industries Ltée                      | Custom control panels, mosaic graphics   |
| Dees Communications Eng. Ltd.              | Automation subsystems for highway construction and maintenance   |
| Direct Digital Industries Ltd.             | Telemetry systems, Digital data transmission modules for alarm systems, Remote annunciation  |
| Durand Controls Co. Ltd.                   | Industrial control subsystems, traffic controls  |
| Durmitor Inc.                              | Industrial control subsystems, machine tool automation   |
| Dynamic Controls Systems Ltd.              | Hydraulic servo controllers for sawmill  |
| Electro Design Ltd.                        | Industrial control subsystems  |
| Electronics Corp. of America               | Flame safeguard control photo electric detector for industrial process controls, components and subsystems for boilers and material handling equipment |
| Elkon Electrical Co. Ltd.                  | Custom control panels, modulated heat controls industrial heating devices  |
| Emerson Electric (Brooks Electronics Div.) | Flowmeters, liquid level indicators  |
| Ferranti-Packard Electronics Ltd.          | Status indicators, numeric modules, display associated control system  |
| Fluidynamics Devices Ltd.                  | Fluidic flowmeters   |
| Garrett Manufacturing Ltd.                 | Speed and temperature controls, communication modules for safety and alarm systems   |
| Graphic Controls Ltd.                      | Recorder charts, marking systems for recorders   |

| <u>Company</u>                  | <u>Products</u>  |
|---------------------------------|--|
| Halpen Engineering (1978) Ltd.  | Heat tracing systems,<br>temperature sensors and<br>controllers                            |
| Industrial Measurements Ltd.    | Machinery failure monitoring   |
| Inex Instruments Ltd.           | X-ray analyzers  |
| ITT Barton Ltd.                 | Sensors indicators<br>recorders, controllers   |
| ITT General Controls Div.       | Combustion controls for<br>residential, commercial and<br>industrial application           |
| Lanico Industries Ltd.          | Sensors (conductivity,<br>liquid level)  |
| Lisle-Matrix Ltd.               | Sensors and analyzers.<br>timing devices   |
| Lumonics Research Ltd.          | Ind. laser marking systems   |
| Markland Specialty Eng. Ltd.    | Water pollution sampling<br>systems, suspended solids<br>meters, sludge level<br>detectors |
| Metex Corp. Ltd.                | Custom control panels  |
| Modudata Systems Ltd.           | Telemetry equipment and systems  |
| Moniteq Ltd.                    | Combustion controls  |
| Normax International Ltd.       | Ind. process control<br>subsystems   |
| Petromatic Components Ltd.      | Flow and level sensors   |
| Porter Engineering Ltd.         | Log Scanners, servo positioners  |
| Process Instrument Systems Ltd. | Alarm and annuciation for<br>industrial process control,<br>Valve actuators                |
| Pro Controls Ltd.               | Custom control panels  |
| Promac Controls Inc.            | Telemetering equipment, and<br>Industrial process control<br>subsystem                     |

| <u>Company</u>               | <u>Products</u>   |
|------------------------------|---|
| Pyrotex of Canada Ltd.       | Temperature sensors, heat tracing, thermocouple cables  |
| Rantech Electronics          | Audio tone signal and data multiplexers for telemetry and supervisory controls  |
| Reuter-Stokes Canada Ltd.    | Sensors and controllers (for nuclear power stations) heat stress monitors   |
| Robotron of Canada Ltd.      | Resistance welding control equipment, Machinery tool automation, electronic timing equipment for industrial process control |
| RMS Industrial Controls Ltd. | Industrial process control subsystems   |
| SED Systems Inc.             | Agricultural and Industrial process control subsystems  |
| SIOC Ltd.                    | Monitoring subsystems, Annunciation panels, Events recorders  |
| Smith Roles Ltd.             | Agricultural machinery monitoring, Cyclone blowout detectors  |
| Southwell Controls Ltd.      | Industrial process control subsystems   |
| Startco Engineering Ltd.     | Industrial process control subsystems   |
| Sytrolec Controls Ltd.       | Custom control panels   |
| Techwest Enterprises Ltd.    | Automated mechanical and hydraulic systems, Data gathering and processing subsystems (opto-electronically)                  |
| Thermatic Controls Ltd.      | Temperature sensors and controllers   |
| Trimet Instruments Ltd.      | Industrial process control subsystems   |

Company

Products

United Electric Controls  
(Canada) Ltd.

Temperature and pressure  
sensors, Circular chart  
recorders, Heat tracing systems

Uni-Tel Ltd.

Telemetry, Data Acquisiton and  
Control sybsystems

Universal Technology Inc.

Industrial process control  
subsystems

Western Controls Ltd.

Custom control panels

Western Research &  
Development Limited

Air demand analyzer  
systems, Hydrogen sulphide  
analyzers

Western Stree Relieving  
Services Limited

Controls and Sensors for  
resistance heating and  
high velocity oil burners

**D. LIST OF COMPANIES IDENTIFIED TO BE IN THE SECTOR WHICH DID NOT  
RESPOND TO THE QUESTIONNAIRE**

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BRITISH COLUMBIA

APPLIED MICROSYSTEMS LIMITED  
CRESCENT CONTROLS LIMITED  
FORESTRAL AUTOMATION  
LLOYD CONTROLS LIMITED  
MICRODYNE ELECTRONICS  
ORENDA CONTROL SYSTEMS LIMITED  
PULSAR ELECTRONICS LIMITED  
QUADRA CONTROLS LIMITED  
SPIN TECH ELECTRONICS  
TECHWEST ENTERPRISES LIMITED  
WESTERN SCALE

ALBERTA

BAKER ENG. ENTERPRISES  
BARTRONICS, 1972 LIMITED  
GALGARY CONTROLS LIMITED  
DIGITECH LIMITED  
DOMSHY INDUSTRIES LIMITED  
EIM CONTROLS LIMITED  
HARDING INSTRUMENTS LIMITED  
INTERALIA TECHNOLOGIES LIMITED  
INTERCOMP RESOURCE DEVELOPMENT & ENG. LIMITED  
LYNES UNITED SERVICES LIMITED  
MARCOTTE SYSTEMS ENG. LIMITED  
MARK PRODUCTS LIMITED  
ROKE OIL ENTERPRISES LIMITED  
SIMARK CONTROLS LIMITED  
SPARTAN CONTROLS  
STAPLETON INSTRUMENTS LIMITED  
SYSTEM ONE AUTOMATION LIMITED  
TEKNICA RESOURCES DEVELOPMENT LIMITED  
UNIVERSAL INDUSTRIAL CONTROL DEVICES LIMITED  
VANCOUVER INDUSTRIES CONTROLS  
WILLOWGLEN COMPANY LIMITED

MANITOBA

BRISTOL AEROSPACE LIMITED

ONTARIO

BAYLEY ENGINEERING LIMITED  
CUSTOM CONTROL PANELS LIMITED  
HONEYWELL LIMITED  
ITT-POSTAL AUTOMATION DIVISION  
LEIGH INSTRUMENTS  
PENN-JOHNSON LIMITED  
POLYGAUGE INDUSTRIES LIMITED  
SIEMENS CANADA LIMITED

QUEBEC

ELECTRODESIGN LIMITED

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**SUBSECTOR PROFILE (NO. 2)**

**BUILDING INSTRUMENTATION AND  
AUTOMATION EQUIPMENT AND SYSTEMS**

Electrical and Electronics Branch



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BUILDING INSTRUMENTATION AND AUTOMATION EQUIPMENT AND SYSTEMS  
SUBSECTOR

DEFINITION OF THE SUBSECTOR

This subsector includes all establishments and companies primarily engaged in manufacturing of electrically and electronically-based equipment and systems for the security, fire alarm, heating, air conditioning and ventilating and energy management of residential, institutional, commercial and industrial buildings.

It includes companies specializing in the design, installation and servicing of computerized building controls and energy management systems. The majority of these companies manufacture at least a part of their equipment or hardware requirements. Individual sensors or devices such as room thermostats, humidistats, smoke, temperature, intrusion, pressure and other sensors are also included in this survey. Sensors incorporated or built into appliances, e.g. room air conditioners, humidifiers and heaters, including baseboard heaters, have not been included.

SUBSECTOR STRUCTURE AND STATISTICAL DATA, 1978

The building instrumentation and systems subsector is the second largest subsector of the Instrumentation Sector. Companies of varying sizes participate in this market. The majority of companies produce in the \$1 to \$10 million sales range. The largest share of the market, however, has been captured by three major multinational subsidiaries - Johnson Controls, Honeywell and Edwards Company of Canada - who account for almost half of the economic activity in this subsector.

The overwhelming dominance of the domestic markets by foreign-owned companies is expressed by the fact that their share of total sales is nearly 90%.

The rationalization of R&D and manufacturing between parents and Canadian affiliates, with one or two exceptions, does not exist.

The following data relates to industry size and structure in Canada:

|   |               |
|---|---------------|
| Estimated Domestic Market                         | \$271 million |
| Total Number of Firms                             | 36            |
| Percentage Canadian-owned                         | 64%           |
| Total Employment                                  | 4960          |
| Total Reported Sales                              | \$203 million |
| Share of Total Sales from<br>Canadian-owned Firms | 11%           |
| Total Exports                                     | \$14 million  |
| Exports as % of Sales                             | 7%            |

Research and Development:

|   |     |
|---|-----|
| R&D Expenditure as % of Sales           | N/A |
| R&D Employment as % of Total Employment | 10% |

Distribution of Companies by Level of Reported Sales, 1978:

|                              |           |
|------------------------------|-----------|
| less than \$500,000          | 8         |
| \$500,000 to \$1 million     | 6         |
| \$1 million to \$2.5 million | 8         |
| \$2.5 million to \$5 million | 5         |
| \$5 million to \$10 million  | 5         |
| \$10 million to \$20 million | 1         |
| over 20 million              | 3         |
| Total Companies              | <u>36</u> |

Regional Distribution of Companies:

|                  |    |
|------------------|----|
| Ontario          | 27 |
| Québec           | 4  |
| British Columbia | 3  |
| Manitoba         | 1  |
| Saskatchewan     | 1  |

SUBSECTOR CHARACTERISTICS

Because there are six distinct markets supplied by manufacturers in this subsector, the performance of the industry in Canada is examined in more detail according to the following markets served:

- a. Computerized building control systems for supervision and operation of electrical and mechanical systems including energy management systems in commercial, institutional and industrial buildings.
- b. Industrial, commercial and institutional fire alarm systems.
- c. Industrial, commercial and institutional security systems.
- d. Smoke detectors.
- e. Residential burglar alarms.
- f. Residential thermostats and protection controls for furnaces and air conditioning; automatic temperature setback systems, load management controls.
- g. Clocks and programming systems, attendance time/job recorders, plant operations status report systems.

a. **Computerized Building Control Systems for Supervision and Operation of Electrical and Mechanical Systems in Buildings, including Energy Management Systems, in Commercial, Institutional and Industrial Buildings.**

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The increasing costs of energy have created new business opportunities for companies capable of developing energy management systems. For all practical purposes, all new buildings over a certain size are now being designed with built-in energy saving elements. There exists also a huge market for retrofitting of the existing establishments. The two companies which dominate this market segment - Johnson Controls and Honeywell - have been in the business of supplying control systems for mechanical and electrical equipment for over 50 years. It was relatively easy for them to adjust to new conditions and to upgrade their existing computerized building control systems to provide an enhanced energy management function. Examples of such systems are Honeywell's Delta 1000 and Johnson Controls' TABS (Time Shared Automated Building Service). Services provided by these companies include development of software, selection and purchase of hardware, software/hardware interface, training of the end user's personnel in the operation of the system, installation, servicing and maintenance of the system on a long-term contract basis.

In addition, larger firms manufacture "in-house" a substantial portion of equipment components and hardware such as room and duct thermostats, valves, dampers, damper operators and pneumatic, electrical and electronic controls.

The companies listed below are active in all phases of systemhouse operations and are also manufacturers of equipment. The balance of the DM (24%) is served by mechanical and electrical contractors, with limited systems design capability, who purchase components and hardware locally or import them from the U.S. Examples of such firms are: Windler Electric, Sutherland-Shultz and State Electric. Another portion of the market is served by the building owners who engage consulting engineers and contractors; and by distributors/wholesalers with limited manufacturing capability (assembly only) who sell both to the owners and to the contractors.

The DM for this industry segment is estimated as \$110.0 million. The following manufacturers are participating in this market; their sales totalled \$84 million in 1978:

**Participating Companies, 1978**

Honeywell  
Johnson Controls  
MCC Power  
Robertshaw Controls  
Simplex  
Conspec Controls Limited  
Interautomation  
Pulse Indi Electronics  
Synerco Systems  
Energy Systems

In the past several years the market growth for new construction was in the range of 10-12% per annum, for service contracts and retrofit installations in the range of 25%. Similar rates of growth are forecast for the next two to three years.

b. Industrial, Commercial and Institutional Fire Alarm Systems

A fire alarm system for a typical application consists of a number of manual stations, temperature and smoke detectors, a central control panel, remote annunciation and a number of signalling devices (horns, bells or electronic signal generators). The complexity of the system varies from a local, single zone installation to a supervised, multi-zone, coded fire alarm system combined with a voice evacuation communications network.

The DM for this type of equipment is estimated at \$47.0 million. The companies which participate in this market are listed below; their total sales amounted to \$41 million in 1978:

Participating Companies, 1978

Edwards  
Pyrotronics  
Honeywell  
Mirtone Industries  
Simplex  
Johnson Controls  
Chubb Electronics  
Electrovox  
Fire Devices Manufacturing  
Presently Engineering  
Electric Power Mfg. Company  
SED Systems  
Viscount Industries

Future market growth is predicted at 15%. Past growth over the last three years amounted to 13.3%. It is not certain what effect the downward pressure on cost, due to the availability of low cost microelectronic components, will have on future growth forecasts expressed in dollars.

The market is heavily dominated by Edwards Company of Canada, an American affiliate which enjoys price, technological and market leadership. Together with all other affiliates, the U.S. multinationals have captured 84% of the Canadian market. All companies listed above serve 88% of the DM. Imports from countries other than the U.S. and from U.S. companies not listed above account for the remaining 12%. Imports are limited because different standards and regulatory code requirements and relatively more technologically advanced systems employed on this continent operate as barriers to trade for overseas producers.

A number of product lines are imported from the U.S. by the companies listed. In some instances Canadian content is almost negligible, while other devices are totally manufactured in Canada. Overall, between 50 to 60% of the material content is of non-Canadian (chiefly U.S.) origin. The low Canadian added value is illustrated by the fact that the average sales/employee is about \$80,000.

A significant portion of revenues is generated by larger manufacturers through entering into service contracts with the end users. In addition, a number of electrical contractors and dealers are equipped to perform servicing.

At present 75% of systems are sold for existing buildings while the balance of 25% is directed to new construction projects.

The following technological trends peculiar to this industry have been identified:

- changes in regulatory codes will stimulate sales of new systems for retrofit markets.
- substantial increase in the growth of multiplex system markets, now assessed at \$6-8 million, to replace existing dedicated lines.
- growth of "Fire Management" total systems approach to fire detection including strategically located detectors, verbal evacuation alarms directing people to certain areas, opening of all exit doors, automatically sending a signal to fire stations, controlling elevators and providing fire chief with a fire control console.
- increased use of advanced digital logic chips including microprocessors to enable constant monitoring of a multitude of different zones and to supply faster and more accurate data on potential or existing trouble; visual displays and hard copy capabilities.

c. Industrial, Commercial and Institutional Security Systems

The equipment covered in this study includes sensors (seismic, photoelectric, ultrasonic, microwave, infrared) local control panels, communication links and equipment manufactured for use by central station operators. It does not include perimeter intrusion systems or surveillance systems employing CCTV. The DM for these products is estimated at \$35 million. The factory shipments of Canada-based manufacturers in 1978 were in the range of \$13 million.

In the U.S. the manufacturers' shipments stood at approximately \$700 million, but the market served was broader in its definition than the one covered by this study.

The domestic industry is composed of foreign affiliates with low added value (mostly assembly operations) and a number of small Canadian companies supplying control panels to central station operators. The latter market has been assessed at \$3 - 4 million. The only Canadian-based operation with a significant presence in the marketplace is Amplitrol (now owned by Honeywell) which has captured a major share of the domestic bank security business. In addition, Amplitrol owns and operates 11 central stations across Canada.

Future growth of the industry has been forecast at anywhere from 25% to 11% in constant dollars. Because of this variation in forecasting the results of the survey may be misleading. However, it would appear that a figure of 13-15% is the closest one to the target. Past market growth over the last three years was in a similar range.

The following companies have been identified as manufacturers of burglar alarm systems for industrial and commercial buildings.

Participating Companies, 1978

Amplitrol (Div. of Honeywell)  
Contronic Controls  
Chubb Electronics  
Simplex  
Edwards  
Electronics Surveillance  
Tamshe Controls  
Sure-Guard  
Magna Digitronics

The balance of the domestic market i.e. 64% is being served by imports, chiefly from the U.S.

The decision to buy burglar alarm systems is usually based on economic factors rather than having to comply with the law (such as for fire alarm systems). A building owner may decide to buy or up-grade his existing system because of the high crime incidence in the area or the nature of goods sold or stored on the premises. In the absence of codes, the variation of burglar alarms installed is very wide. This condition tends also to permit low product quality, "fly by night" companies to survive and to give the entire industry a bad image.

The following trends which will significantly affect future directions of the industry have been identified: increased use of multiplex systems in large installations and for central stations; increasing dominance and share of the total market by large central station operators (especially these which have gone into

manufacturing of key devices and complete systems, e.g. Honeywell, ADT); increased use of digital dialers (which will replace tape dialers); lower equipment prices and lower incidence of false alarms; growing use of CCTV; infusion of microprocessor technology into the systems; development of low cost systems for small business; use of solid state components and modular construction.

Although not directly covered by this study, central station services represent a large portion of the total security/fire alarm market. Central station service companies provide fire prevention/detection, burglar protection and/or environmental protection (water, gas and temperature sensors). The connection from sensors to station is made through dedicated telephone company lines, multiplexing, radio transmission, or coaxial cables. The central station is made up of signal receiving equipment which detects a problem for a given subscriber.

In Canada the central station market, which in 1978 was assessed at approximately \$60.0 million is dominated by three large companies:

ADT  
Chubb  
Amplitrol

The balance of the market is being served by 16 regional companies. There are 45 central stations in Canada. A number of these companies manufacture certain lines of equipment for their own use.

d. Smoke Detectors

The Canadian market for these devices grew from 5,000 units in 1971, when smoke detectors first entered the market, to 2 million units in 1978. Because of the rapid increase in demand dozens of makes flooded the market, which led to price cutting. The average retail price for smoke detectors fell from \$50 in 1971 to less than \$15 to-day.

Out of 40 North American manufacturers serving the market in mid 1970, less than 20 are still active in the business.



The Canadian DM in 1978 was estimated at 2,000,000 units or \$25,000,000. Total factory shipments of the companies below amounted to approximately \$19 million in 1978:

Participating Companies, 1978

Dicon Systems  
Pyrotronics  
Westclox  
Tellus Industries  
Electric Power Equipment  
Hunter Enterprises  
Thermetic Controls

All the above makes have a Canadian content which is in excess of 70%. A number of components such as integrated circuits, radiation sources and ionization chambers cannot be purchased from domestic suppliers and are usually sourced from the United States.

The imports are predominately of U.S. origin, with such companies as Honeywell, Pittway Corporation, Fyrenetics, Emerson Electric and Baker Industries being the major suppliers.

The export sales of Canadian smoke detectors are becoming progressively more significant, and in 1978 amounted to approximately \$2.5 million. Major recipient countries of Canadian smoke detectors are Sweden, Norway, Australia and the U.K. Locally-made devices are currently selling for \$40 - 50 in Western Europe and in Scandinavian countries, where Canadian companies are encountering fierce competition from their American counterparts.

The domestic market was to peak out in 1979 or 1980 at around \$22.0 million. However, in 1979 it decreased drastically and unexpectedly, seriously affecting profitability of some manufacturers who were caught with excessive inventories of finished products as the market became saturated. This occurrence has given additional stimulus to the industry to diversify, mainly into the area of residential security equipment. The domestic market for smoke detectors is anticipated to stabilize in the next few years at about \$16-18 million.

Export shipments are anticipated to increase in the future with the introduction of combination photo-electric/ionization type detectors equipped with an escape light, manufactured by at least one Canadian firm.

Domestically there is an increasing trend to line voltage detectors vs battery powered ones.

e. Residential Burglar Alarms

Residential burglar alarms constitute a large potential market assessed at several hundred million dollars in Canada alone. No North American manufacturer has been able to exploit it to any

significant extent, chiefly because of the prohibitive costs which amount to over \$800 per installation.

Recent technological developments seem to have cleared that obstacle. The RF link, coupled with the continuing decline in costs of microelectronic circuits, eliminated the need for wiring and for professional installation which accounted for half of the cost of the system. The application of digital coding techniques has lessened the problem of false alarms. These breakthroughs could not have come at a better time for smoke detector manufacturers whose existing markets have reached "no growth" or declining stages and who were in desperate need of new and viable product lines.

At present only about 2% of the dwelling units in the USA are protected by security systems. U.S. factory shipments in 1978 were estimated at just over \$100 million. Smoke-alarm companies in Canada are also getting ready to capitalize on total-security equipment for residences. They are aiming at "install-it-yourself" systems combining separate alarm channels for intrusion, smoke and perhaps medical alert or appliance failure.

At present there are four Canadian manufacturers known to participate in this market: Thermetic Controls, Sure-guard Security, Westclox, Tellus Industries and Normex International Inc. Their combined factory shipments in 1978 were in the range of \$1.0 million. The DM in 1978 was estimated at \$3.4 million.

Based on the analysis of existing data, the domestic market is anticipated to grow to about \$16 million by 1983, the U.S. market to \$160 million and the rest of the world demand to \$174 million. Other Canadian manufacturers in addition to those mentioned above, who will enter the market in 1980/81 are: Dicon Systems, BEL-tronics and Pyrotronics.

The major U.S. - based competitors will be: G.E. Company, Honeywell, Pittway, Norelco, Emerson Electric Company (Statitrol), Masterlock, Fyrenetics Inc., ADT and Radio Shack.

Traditionally the residential security business has been fragmented and localized. In the U.S. alone more than 600 manufacturers sell equipment to over 15,000 local and regional service companies. The mortality rate among both groups has been estimated at 35 to 40% per year. The entry of major electronic manufacturers into this market will exert further pressure on smaller companies.

The future success of Canadian companies is largely predicated upon the innovative features of their product line, competitive costs, effective distribution channels, and follow-up servicing.

e. Residential Thermostats and Protection Controls for Furnaces and Air Conditioning Equipment, Automatic Temperature Setback Systems, Load Management Controls.

This segment of the instrumentation market is heavily dominated by four companies: Honeywell, Emerson Electric (White Rogers Div.), ITT (General Controls Div.) and Penn-Johnson (Johnson Controls Div.).

The DM has been estimated at about \$45.0 million. 87% of the D.M. was supplied by the local manufacturers.

Several makes of residential temperature setback systems are available now, but none are yet produced in Canada. Because of the rising costs of energy, these products will grow at a high rate and may eventually totally replace ordinary residential thermostats.

A more complicated device capable of responding to outside temperatures, wind velocity, building heat loss characteristics and the amount of setback and the time of day has been developed by Paragon Electric. This energy optimizer is a low cost alternative to higher cost microcomputer controlled systems. The latter systems will become more affordable to the average house-owner as the energy costs rise and the cost of microprocessors decrease.

g. Clock and Programming Systems, Attendance Time/Job Recorders, Plant Operations Status Report Systems.

The DM for the above product lines is estimated at between 6.0 to 7.0 million. The main participants in Clock and Programming Systems are Edwards Co. of Canada and Simplex International Time Equipment Limited.

Total factory shipments are in the range of \$5.0 million.

EXPORT PERFORMANCE

Export shipments in 1978 amounted to \$14.3 million or 7.2%. The three largest companies in the subsector Edwards of Canada, Johnson Controls and Honeywell have not been very significant exporters of the equipment produced in Canada.

The export sales of the Canadian affiliates of multinationals are offset by a large margin by imports of components and complete product lines from the American plants.

The smaller Canadian companies, with the exception of smoke detector manufacturers, are handicapped in their export efforts by the fact that the service function and capability is an essential part of serving the markets in question. This handicap can be partly overcome by setting up a dealer/service organization network in foreign countries, but the product ranges of small companies are too narrow to be carried by major distributors or manufacturers' agents. Differences in code regulations, voltages, frequency wiring practices, etc. are significant barriers to export sales in many offshore markets.

#### RESEARCH & DEVELOPMENT

The study confirms the overwhelming predominance of foreign-owned companies whose technology is developed south of the border. Two or three Canadian companies which are actively developing new devices and systems (with EDP assistance) account for the majority of the 65 people identified as being employed in R&D departments. The only multinationals with a selective R&D world product mandate are Edwards and Pyrotronics.

#### EMPLOYMENT & ADDED VALUE

The subsector employs about 2,000 production workers, which results in approximately \$100,000 of shipments/production workers. This indicates relatively low labour content which is characteristic of this industry as a whole and of the low value added of the Canadian affiliates of multinational companies.

#### FUTURE TRENDS

- Continued advancement of electronics in alarm and control systems, will lead to more sophisticated equipment which will help to stimulate equipment sales at a faster pace than service sales.
- Increased integration of fire prevention, fire detection, security and environmental conditions of a building will be accomplished by application of microprocessors to control inputs from the major sensing devices of these three major systems.
- Future integration of the above systems with energy management systems will take place, all controlled by a single computer.
- Companies normally involved in energy controls (Honeywell, Johnson Controls) and fire alarms (Edwards), will become more involved in total building systems.
- Central station operations and monitoring will expand to include environmental controls.

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**SUBSECTOR PROFILE (NO. 3)**

**BIOMEDICAL AND HEALTH CARE INSTRUMENTATION**

**Electrical & Electronics Branch**

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BIOMEDICAL AND HEALTH CARE INSTRUMENTATION SUBSECTOR

DEFINITION OF THE SUBSECTOR

This subsector includes all establishments and companies primarily engaged in manufacturing electrically and electronically-based instrumentation and apparatus for use in the biology, medical, surgical, otological, dental and veterinary markets. It does not include laboratory and scientific equipment unless it is specifically designed for use in the medical industry.

The following items are not meant to be an exhaustive listing but only indicative of the types of instruments covered in this sub-sector:

Diagnostic Apparatus;

- Anaesthetology Diagnostic Devices
- Cardiovascular Diagnostic Devices
- Ear, Nose and Throat Diagnostic Devices
- Gastro Urological Diagnostic Devices
- Neurological Diagnostic Devices
- Other Diagnostic Devices

Therapeutic Devices

- Cardiovascular
- Acoustic
- Gastro Urological
- Neurological
- Obstetrical and Gynaecological
- Cancer Treatment (Cobalt Bombs and Particle Accelerators)

Monitoring Devices:

- Physiological Functions Monitors
- Cardiac Monitoring Devices
- Neurological Monitoring Devices
- Pressure Monitoring Devices
- Respiratory Monitoring Devices
- Temperature Monitoring Devices
- Patient Monitoring Devices
- Obstetrical and Gynaecological Monitoring Devices
- Other Monitoring Devices

Clinical, Laboratory Instrumentation Specifically for use in Bio-Medical Application:

- X-ray and related radiation instruments, ultrasound and nuclear imaging systems.
- Surgical and medical instruments and apparatus.
- Implant and other prosthetic devices.
- Other hospital equipment and supplies.
- Specialized veterinary apparatus.

## SUBSECTOR CHARACTERISTICS

Health care presents an unique opportunity to improve the quality of life in our society through electronics. In medical research, a myriad of electronic instruments ranging from electronic microscopes, to pin-point size microelectrodes and ambular patient maintaining systems contribute enormously to the prevention, identification and treatment of disease.

In particular, the unique capabilities of integrated electronics are easily adaptable to medical instruments with high benefits to the quality and availability of health care.

What is visible now is the initial impact of microelectronics and integrated electronics on health care. It is apparent that a new era of revolutionary advances in medical instrumentation is about to take place.

Sales of surgical, medical and dental instruments and supplies in North America are increasing, notwithstanding the high inflation rate and efforts to contain health care costs. International markets for medical equipment are also expanding because of the growing worldwide emphasis on adequate health care.

Electromedical equipment and medical electronics devices have become the dominant product sector and at present account for approximately 2/3 of total industry shipments. Such products include electrocardiographs, heart pacemakers, defibrillators, patient monitors, ultrasonic scanners and surgical support systems.

U.S. industry shipped \$2.5 billion worth of electromedical equipment in 1979. In Canada, health care expenditures are becoming increasingly higher and reached 8% of GNP in 1979.

Against this background, the Canadian grouping of companies, which is not a sector in the full sense of the word, can be considered to be in an embryonic stage of development. Canada is the only western industrialized nation which imports more than 80% of domestic requirements.

Domestic sales of Canadian manufacturers, which amounted to \$23 million in 1978, corresponded to approximately 14 percent of the domestic market for electromedical devices. In general, Canadian manufacturers have narrow product lines, providing one or two specialized products to specific market segments. Accordingly, many products such as computerized patient monitoring systems, surgical support systems, medical information systems, nuclear, ultrasonic and certain types of X-ray imaging systems and automated clinical laboratory analysis units and many other devices must be sourced from abroad.



Fifty-five percent of total sales were originated by Canadian-owned firms, who represent 80 percent of total subsector firms. Although few of the companies are foreign-owned, two of these are major firms (ie Medtronics and Picker X-Ray) with a large volume of sales.

Proportionately large export sales, which constitute more than 50 percent of total output, demonstrate the sector's ability, whether the company is large or small, to compete successfully in international markets.

The major area of export concentration is the United States. In 1978, Canadian electromedical devices represented 7 percent of total imports to the American market for these products.

#### SUBSECTOR STRUCTURE AND STATISTICAL DATA, 1978

In terms of sales volume and employment, manufacturers of biomedical and health care instrumentation make up the third largest group of manufacturers in the Instrumentation Sector. In relation to total sector activity, however, the biomedical electronics subsector is relatively small. Biomedical electronics accounts for less than 10 percent of total Sector activity.

The data below provides information on industry size and structure:

|  |               |
|--|---------------|
| Estimated Domestic Market                | \$164 million |
| Total Number of Firms                    | 20            |
| Percentage Canadian-owned                | 80%           |
| Total Employment                         | 1300          |
| Total Reported Sales                     | \$55 million  |
| Share of Sales from Canadian-owned Firms | 55%           |
| Total Exports                            | \$32 million  |
| Exports as % of Sales                    | 58%           |

#### Research and Development:

The relatively high average R & D costs, reported as proportional to 11 percent of total sales, confirm that, in addition to high inherent costs of the complex technologies utilized, government safety and performance regulations tend to increase the time and expenditures required to develop, market-test, certify and produce new products or to improve existing ones. R&D employment represents 9% of total employment.

Industry dependence on government assistance to help subsidize R & D expenditures is reflected in the fact that 12 out of 20

companies have received or are currently receiving government funding in the form of IRAP or PAIT programs.

In many instances, IRAP funding was followed by further government assistance to enable the companies to commercialize the results of successful research efforts.

Distribution of Companies by Level of Reported Sales, 1978:

|                              |           |
|------------------------------|-----------|
| less than \$500,000          | 8         |
| \$500,000 to \$1 million     | 3         |
| \$1 million to \$2.5 million | 4         |
| \$2.5 million to \$5 million | 2         |
| \$5 million to \$10 million  | 0         |
| \$10 million and over        | 3         |
| Total Companies              | <u>20</u> |

Regional Distribution of Companies:

|                  |    |
|------------------|----|
| Ontario          | 12 |
| Québec           | 5  |
| Manitoba         | 2  |
| British Columbia | 1  |

### INDUSTRY PROBLEMS

A major problem for the industry has been the traditionally low share of the domestic market captured by Canadian firms. To some extent, this situation has continued because of lack of emphasis on product research and development, which has resulted in a weak industrial infrastructure, limited product range and a large deficit in the balance of trade.

Although several centers for pure medical research are located throughout Canada, and there is ready access to other internationally recognized centers, few product development establishments exist. One such establishment, the Biomedical Instrumentation Unit of the University of Toronto, has in the past received financial assistance from the Department of Industry, Trade and Commerce. The setting up of additional facilities of this nature is one of the pre-requisites to any major expansion of a domestically based electromedical device industry.

Limited product lines and resources have inhibited Canadian ability to compete for large off-shore products (such as equipping hospitals) against foreign multinationals whose equipment ranges from bedpans to nuclear particle accelerators. Furthermore, because sales of foreign competitors are often heavily subsidized by their governments, Canadian companies are at a greater competitive disadvantage.

At the same time, the absence of an adequate distribution and service network in Canada has discouraged indigenous industry from

trying to penetrate the domestic market as successfully as it might. Many companies export in excess of 70 percent of their production.

Increasing proliferation and restrictiveness of government regulations are considered to be significant constraints to the growth of small and medium-size companies. Product approval by government regulatory bodies is both costly and lengthy (up to 2 years) because of increasingly stringent requirements. Consequently, smaller companies which lack financial resources to cope with long delays and costly market introduction programs may become casualties as the economic environment worsens.

Other constraints to growth, particularly for small companies, include: price competition from imported devices; inability to bid on a wide range of products required on specific projects; inability to finance the necessary level of R & D activity; product liability insurance costs which are high in relation to coverage; and high interest rates on short term loans needed for expansion.

Further problems are encountered among users of biomedical and health care instrumentation. Encouraging the medical profession to accept new products can be a difficult and lengthy process. Buying decisions of medical practitioners tend to be governed by such factors as peer preference, familiarity with specific makes of equipment (often dating back to school days), general conservatism and the need to be trained in use of the equipment.

Finally, lack of consolidation between provinces of purchasing policies to favour Canadian-made equipment and devices has contributed to lost market opportunities for Canadian manufacturers.

#### FUTURE TRENDS

In the United States, electromedical devices have become the dominant product sector and now account for two-thirds of total medical device shipments. U.S. sources predict real growth in shipments of electromedical devices amounting to 7 percent annually between 1979-1984.

According to "A Statistical Profile of the Medical Devices Industry in Canada" issued by the Chemicals Branch, Department of Industry, Trade and Commerce, the Canadian market for all medical devices in 1977 was \$845 million. The estimated market for electromedical devices only is approximately \$124 million for 1978. Since these figures indicate much lower content of electrically and electronically based medical devices in Canada, the possibility exists that with greater user acceptance, the growth rate in Canada will surpass that projected for the United States.

The two most important growth areas of the industry are: Patient Monitoring Systems and Medical Information Systems. The first sector is expected to grow at a compound annual rate of 18%, while the second one by 28%. The patient monitoring equipment is in a

state of transition. Clinical resistance to the use of computers in monitoring is dissipating as users realize the advantages offered by such systems. Interest in computer-based systems is particularly high in the area of cardiac monitoring, with arrhythmic and ambulatory ECG monitoring emerging as the fastest growing segments of the market.

Medical Information Systems are designed to improve the delivery of health care in both patient and outpatient facilities through the use of computer technology and information science. The typical MIS functions are: financial management; patient control; communications; distribution of orders for materials, services and information; and automation of repetitive tasks.

In the short run, technology will remain to be seen as the main "culprit" in rapidly increasing costs of health care, which in the USA alone have reached a total of about \$124 billion. However, political and social pressures will stimulate rapid adoption of new technologies and devices in order to obtain higher quality medical care and to reduce long run health costs through automation of laboratory equipment, computer applications in hospital administration, patient monitoring systems and increased use of medical information systems.

Despite the dampening effect of government regulations and legislation (both in Canada and the U.S.A.) on medical device manufacturing, the demand for this industry's products is expected to grow both in North America and in major industrialized countries such as West Germany, Japan, France, and in the Scandinavian countries which have traditionally led the world in health care expenditures/capita.

To summarize market outlook for Canadian biomedical electronics - the current low value of the Canadian dollar, continued tendency to improve the quality and quantity of health care in all industrialized countries, foreign acceptance of Canadian products and availability of Crown assistance for R & D projects are considered to be favourable factors which will stimulate the growth of Canadian firms.

#### TECHNOLOGY AND PRODUCT DEVELOPMENTS

The health care industry is undergoing a profound change, with computers and microprocessors becoming the real "work horses" of the electronic and communications revolution in the field of medicine. As business machines, they aid in hospital administration, record keeping, billing and in ordering of drugs and supplies. On a more sophisticated basis, computers perform a wide range of medical tasks in research, education and patient care. Monitoring devices, which are widely used now, permit a nurse at a single control console to keep tabs on a number of patients, watching their blood pressure, temperature, pulse and breathing rate. Computers are moving into the area of disease prevention, multi phasic medical examinations and mental health.

It is possible now to send electrocardiogram readouts over long-distance telephone lines and tests are under way to transmit them via satellite. A compact electronic package, a telephone line and a computer can be combined for remote monitoring of patients at home.

Application of microelectronics to diagnostic, therapeutic and clinical instruments will lead to the refinement and better definition of various X-ray, ultrasound and nuclear imaging systems. A new family of products will be developed to aid the blind and deaf, such as speech-output reading machines and tele-ear systems which are fully automated and accurate. These products, together with reliable blood analyzers and other clinical instruments, will be a major growth segment.

CAT (Computerized Axial Tomography) scanners have already been used successfully in a variety of clinical diagnoses, but new uses are being added continuously (such as diagnosis of strokes). On the other hand, due to rising prices and high initial cost (\$750,000 per unit), CAT manufacturers, in order to maintain their market share, are offering used or repackaged scanners with relatively low scanning capability which are sold at approximately \$200,000 to \$400,000.

Clinical applications of ultrasound diagnosis will broaden considerably to include liver, kidney and urinary systems as well as obstetrics and gynecology. The introduction, two years ago, of digital scanner converters to ultrasound produced a significant technological advance. The ultrasonic devices have now progressed to a real-time capability (moving images). It is largely this aspect of diagnostic ultrasound that is responsible for its great success thus far and promises a high future growth rate.

Medical linear accelerators, still in their infancy, and under development by AECL, will dominate radiotherapy during the next five years at the expense of cobalt-60 teletherapy units.

Pain suppression and biofeedback devices will find increased application in many controversial areas in conjunction with radiotherapy and chemotherapy.

Recent research has confirmed the possibility of eventual replacement of X-ray film by data storage in computer memory banks.

Complex computer programming and large amounts of computer memory will be employed in arrhythmia detection systems and automated scanning techniques for ECG monitoring, including analysis and trending capability. This will apply to both hospital based and ambulatory ECG monitoring.

PARTICIPATING COMPANIES, 1978

The listing given below provides the names of manufacturers identified as participating in the general market of "Biomedical and Health Care Instrumentation".

PARTICIPATING COMPANIES

PRODUCTS

|                                 |  |
|---------------------------------|--|
| Atomic Energy of Canada Ltd     | General radiation therapy equipment; Cobalt and linear accelerator for cancer treatment                |
| Bach-Simpson Limited            | Blood flow measuring devices   |
| B.C. Medical Manufacturing Ltd. | X-ray tables   |
| Biosig Incorporated             | "Insta-Pulse" heart rate monitor   |
| EKEG Electronic Limited         | Biomedical electronic equipment for research and testing; Telemetry equipment, Electronic thermometers |
| Elkay Electronics Limited       | Intravenous sensors  |
| Harco Electronics Limited       | EKG electrodes and cable sets; Defibrillators; Electrocardiographs                                     |
| Isolation Systems Limited       | Biomedical Electrical tester models; Electrical testing units for hospital equipment                   |
| John Fortin Company Limited     | Medical electronics; Defibrillator testers   |
| Madsen Electronics Limited      | Audiometers; Speech therapy instruments  |
| Medtronics of Canada Limited    | Heart pacemakers   |
| Mono-Research Labs Limited      | Automated feeders for handicapped people   |
| Owl Instruments Limited         | Lesion generators; Heart rate indicators; Nerve stimulators  |
| Payton Associates Limited       | Medical electronic instruments for blood analysis  |

PARTICIPATING COMPANIES

Picker X-Ray Mfg. Limited

Radionics Limited

Rodrol Instruments Limited

Siemens Electric Limited

Thought Technology Limited

Unitron Industries Limited

PRODUCTS

X-ray equipment

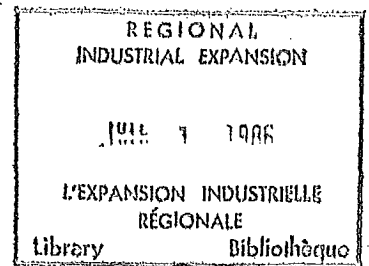
Digital echo electro-  
encephalograph to calculate  
displacement and size of  
central brain structure.

Rheumatism and Arthritis  
therapy instruments

Dental X-ray equipment

Bio-feedback devices for  
stress measurement

Hearing aids



SUBSECTOR PROFILE (NO. 4)

ELECTRICAL, ELECTRONIC DATA AND LOGIC  
TEST AND MEASUREMENT INSTRUMENTS AND SYSTEMS

ELECTRICAL AND ELECTRONICS BRANCH



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| Future Trends                                  | 4           |
| Participating Companies                        | 5           |

DEFINITION OF THE SUBSECTOR

This subsector includes all establishments and companies primarily engaged in manufacturing electrically and electronically-based instrumentation and systems that are used to measure electrical, optical or acoustic signals for the electrical, electronics, telecommunications, data transfer, and computer industries. It includes the majority of inspection, quantitative and qualitative analysis and measuring instruments and systems used in quality control, R&D and test and inspection functions in the aforementioned industries.

The following items are not meant to be an exhaustive listing but only indicative of the types of instruments covered in this subsector:

1. Electrical and Electronic Signal Test and Analysis and Measuring Instruments:
  - Voltmeters
  - Ohmmeters
  - Ammeter
  - Multi-meters
  - VOM's
  - VTVM's
  - Gaussmeter
  - Oscilloscopes
  - Signal Analyzers, Generators
  - Electronic Spectrum Analyzers.
2. Special Data, Computer and Telecommunications Instrumentation
3. Specialty Electrical Equipment and Measurement Test Instruments and Apparatus
4. Semiconductor, Board and System Test Systems
5. Automotive Test and Analysis Instruments and Systems
6. Materials, Aids and Equipment used for Teaching of Electricity and Electronics in High Schools, Colleges and Universities.

SUBSECTOR STRUCTURE AND STATISTICAL DATA, 1978

The data given below outlines the size and structure of this subsector industry in Canada:

|  |               |
|--|---------------|
| Estimated Domestic Market                      | \$85 million  |
| Total Number of Firms*                         | 30            |
| Percentage of Canadian-owned                   | 90%           |
| Total Employment                               | 600           |
| Total Reported Sales                           | \$16 million  |
| Share of Total Sales from Canadian-owned firms | 75%           |
| Total Exports                                  | \$7.2 million |
| Exports as % of Sales                          | 45%           |

Research and Development:

Almost half (12) of the identified companies have in the past received R&D support from government.

|   |     |
|---|-----|
| R&D Expenditure as % of Sales           | 38% |
| R&D Employment as % of Total Employment | 18% |

Distribution of Companies by Level of Reported Sales, 1978:

|                              |          |
|------------------------------|----------|
| less than \$500,000          | 21       |
| \$0.5 million to \$1 million | 6        |
| \$1 million to \$2.5 million | 1        |
| \$2.5 million to \$5 million | <u>2</u> |
| Total Companies              | 30       |

Regional Distribution of Companies:

|          |    |
|----------|----|
| Ontario  | 14 |
| Québec   | 9  |
| Alberta  | 2  |
| B.C.     | 2  |
| Manitoba | 2  |
| P.E.I.   | 1  |

\* Of the 30 manufacturers considered to be in this subsector, 7 are manufacturers of "Educational Equipment for Teaching of Electrical and Electronic Courses". These firms have been included in this subsector for statistical convenience rather than for analytical reasons.

### SUBSECTOR CHARACTERISTICS

Out of 30 companies identified by the study, less than 5 demonstrated high growth rate or aggressiveness in the marketplace.

Relatively high export sales (45 percent of total subsector sales) are generated primarily by companies servicing educational institutions, because the domestic market for their products are almost non-existent.

One third of the firms have a volume of sales below \$0.5 million and are in the early stages of their development.<sup>1</sup>

In the U.S.A., where there is a larger and more identifiable sector, competition in the electronic test and measuring instrument industry is characterized by:

1. ease of market entry (little investment in plant and equipment is needed);
2. the predominance (in numbers) of small firms and small markets;
3. heavy technological demands; and
4. growing emphasis on export sales.

The majority of U.S. firms serving this market have sales of less than \$6.0 million. Many product markets are small and segmented and remain unattractive to large companies. At the same time growth is extremely difficult. The lead time between the development of a new product and its market introduction is relatively long. Many products have a life-cycle of 3-5 years so that the rate of technological obsolescence is very high and new product development is both costly and risky. The average R&D expenses in the U.S. are 4 to 5%. For industry leaders, this figure increases to 8 to 9% of sales.

In Canada there are no manufacturers of Automatic Test Equipment (ATE) used to determine whether an integrated circuit, a component or PCB is operating properly. Growth of these products has primarily reflected the increased complexity of electronic circuits, the incorporation of integrated circuits into a variety of products and systems and the high cost of labour to debug products. Shipments of ATE in the U.S. are projected to increase from \$302 million in 1980 to \$750 million in 1990.

In the U.S., the market for Test and Measuring Instruments jumped by 18% from 1978 to 1979. This growth is expected to stabilize at a 14% annual rate for the next 4 years according to the annual market survey conducted by "Electronics" (a U.S. publication). It is anticipated that the Canadian market for these devices will grow at a somewhat lower rate.

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1. Thus the average gross R&D expense of 48% derived from the questionnaires is almost meaningless, in the overall context of the subsector operations. The average growth rate of 42% ought to be interpreted in a similar fashion.

There is no available data to arrive at the Canadian ADM with any degree of accuracy. The only possible indication is the U.S. domestic market figure for 1978 of \$2.25 billion. Considering the present status of our microelectronics industry, as compared to that based in the U.S., one would guess that the ADM is about 1/25 of the above figure or \$85 million.

#### FUTURE TRENDS

The advent of the microprocessor will lead to more intelligent and sophisticated instruments and accelerated upgrading of conventional equipment. Instruments will be able to acquire, store and mathematically manipulate information. Other capabilities added by the application of microprocessors will be realized, such as programmability, faster operation, improved precision, lower power requirements and greater flexibility in design, servicing and check out systems.

As most manufacturing processes are moving in the direction of complete automation, or semi-automation, test and measuring equipment will play an increasingly important role in the monitoring of quality of product during fabrication.

The electronics and transportation industries will remain the largest markets for T&M equipment in the foreseeable future.

Prices of T&M equipment have increased less rapidly in the past than in other sectors of industry. This trend is anticipated to continue during the next several years.

Increased dominance of the marketplace by large instrumentation and electronics companies with resources to meet rapidly evolving technological requirements will continue. However, at the same time rapidly changing technologies and market demands will continue to allow smaller, specialized manufacturers to be successful in narrow segments of the markets.

Because test instruments cut across so many aspects of the economy and are not tied to one specific market or industry segment, overall demand will be most directly related to general business activity and not subject to dramatic fluctuations.

PARTICIPATING COMPANIES

The listing given below provides the names of manufacturers identified as participating in the general market of "Electrical, Electronic Data End Logic Test and Measurement Instruments and Systems", in 1978.

| <u>Participating Companies</u>               | <u>Product</u>  |
|--|---|
| Amber Electro Design Ltd.                    | Audio test equipment  |
| Auto Car Park Controls Ltd.                  | Coded card readers; coin station; clocks                                |
| Bach-Simpson Ltd.                            | Electrical measuring and test instruments                               |
| Baytronics Ltd.                              | Strip chart recorder; calibration sets                                  |
| Beta Machinery Analysis Ltd.                 | Engine diagnostic equipment   |
| Centrodyne Corporation Ltd.                  | Electronic taximeter  |
| Consultronics Ltd.                           | Telecom test and maintenance equipment                                  |
| Detronics Ltd.                               | Capacitor leakage testers; base board heater testers; toaster testers   |
| DiffRACTO Ltd.                               | Custom built industrial inspection systems                              |
| Electro-meters Company Ltd.                  | Panel meters and accessories  |
| Electrical Testing Instrument                | Testing and measurement instrument for electrical power industry        |
| Labtronics Ltd.                              | Moisture meter and temperature probes for grains and storage facilities |
| Morgan Schaffer Corporation                  | Transformer fault gas detector  |
| National Electrolab Ltd.                     | Telecommunications test equipment                                       |
| Pylon Electronic Development Company Limited | Telecommunications test apparatus                                       |
| Rockwell International of Canada             | Gas meters and regulators   |
| Russel Ultra-sound Devices Ltd.              | Pipeline corrosion detector and monitor                                 |

Participating Companies

Product

Tele-radio Systems Ltd.

Surge surrestor testers

Tribar Industries Ltd.

Police radar systems

Viscount Industries Ltd.

Telephone test equipment

EQUIPMENT FOR ELECTRICAL AND ELECTRONICS EDUCATION

Canadian Research Institute

Advanced electrical and electronic training and testing equipment; meters; distribution panels and laboratory instrumentation

CETA Ltd.

Student learning systems for electricity, electronics and electron physics courses

H.O.P. Consulab

Materials for teaching electricity and electronics in high schools, colleges and universities

Labvolt Ltd.

Electromechanical systems for teaching electricity and power technology

Logix Enterprise Ltd.

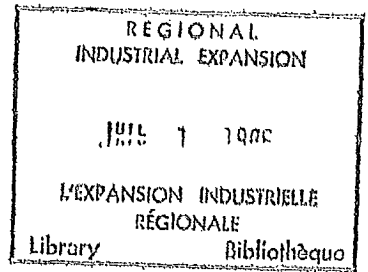
Laboratory kits for experiments in electricity, electronics, computers, optics, aeronautics, radio technology and astronomy

Reid Electric and Equipment Ltd.

Educational Panels of the study of Ohm's Law and automobile lighting circuits

J.R. Stephenson

Prewired electrical techlab equipment



SUBSECTOR PROFILE (NO. 5)

SCIENTIFIC, ANALYTICAL &  
LABORATORY INSTRUMENTATION

ELECTRICAL AND ELECTRONICS BRANCH



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## DEFINITION OF THE SUBSECTOR

This subsector includes establishments and companies primarily engaged in manufacturing electrically and electronically-based instruments and apparatus used in scientific establishments and laboratories undertaking research and development or other qualitative and quantitative analysis not directly involved in the manufacturing or industrial process; it does not include engineering, agriculture, mapping, geophysical and other identification and classification oriented instrumentation or systems which are separately identified; does not include medical and biomedical or electrical and electronic test and measurement instrumentation; it does include laboratory electrical, electronic, sound or light standards, special analysis instruments for measuring flow, temperature, humidity, etc., that produce an electrical signal and whose major use is in a laboratory or in research and development.

The following items are not meant to be an exhaustive listing but only indicative of the types of instruments covered in this sub-sector;

### Lasers

- Scientific and Research

### Accelerators

- Particle

### Autoclaves

### Electro Optical Instruments

- Photometers
- Spectrometers
- Spectrophotometers
- Chromatographs
- Interferometers
- Colorimeters
- Light Sources

### Fluid and Mass Analysis Apparatus

- Precision laboratory level controls
- Ph meters
- Salinometers
- Flowmeters, laboratory
- Turbidimeters, laboratory
- X-ray fluorescence analyzers
- Atomic absorption spectrometers
- Nuclear magnetic resonance analyzers

Laboratory and Scientific Standards & Calibration Apparatus

- Capacitance
- Resistance
- Voltage
- Inductance
- Decade Boxes

Special Laboratory Apparatus

- Flow
- Density
- Temperature
- Pressure Transducers

SUBSECTOR STRUCTURE AND STATISTICAL DATA, 1978

The data given below outlines the size and structure of the industry in Canada:

|  |              |
|--|--------------|
| Estimated Domestic Market*                     | \$60 million |
| Total Number of Firms                          | 13           |
| Percentage of Canadian-owned                   | 100%         |
| Total Employment                               | 400          |
| Total Reported Sales                           | \$12 million |
| Share of Total Sales from Canadian-owned firms | 100%         |
| Total Exports                                  | \$ 6 million |
| Exports as % of Sales                          | 49%          |

Research and Development:

The majority (10) of the identified companies have in the past received federal R&D support.

|   |     |
|---|-----|
| R&D Expenditure as % of Sales           | 30% |
| R&D Employment as % of Total Employment | 32% |

Distribution of Companies by Level of Reported Sales, 1978:

|                              |          |
|------------------------------|----------|
| less than \$500,000          | 4        |
| \$0.5 million to \$1 million | 6        |
| \$1 million to \$2.5 million | 2        |
| \$2.5 million to \$5 million | <u>1</u> |
| Total Companies              | 13       |

Regional Distribution of Companies:

|         |    |
|---------|----|
| Ontario | 10 |
| Québec  | 3  |

---

\* Data presently available is not sufficient to allow an accurate estimate of the Domestic Market. Present information suggests that the DM lies between \$60-\$80 million. This figure will be refined when more accurate data becomes available. The United States market for these instruments was estimated at \$1560 million in 1978.

### SUBSECTOR CHARACTERISTICS

The study has identified thirteen manufacturers of this type of device in Canada. All the companies participating in this market are Canadian-owned and generally have been established by engineers or scientists who have gained their expertise in such institutions as the National Research Council, Atomic Energy of Canada Limited and various Canadian universities.

The majority of companies manufacture only one product or a family of products based on the same technology. At present, apart from Lumonics Research Limited, Guildline Instruments and possibly Photochemical Research Associates Limited there are no apparent candidates for accelerated growth or significant contribution to the instrumentation sector's output and economic benefits.

The main end-users of these products are: universities, government agencies, industrial and independent research laboratories.

Reliance on government funding for R&D is another common characteristic of the firms in this subsector.

In the U.S., the market for analytical instruments grew slowly with overall sales increases of 10% from 1978 to 1979. According to the annual market survey conducted by "Electronics", this trend should continue over the next 4 years. Similar growth rates are anticipated in Canada.

### FUTURE TRENDS

Improvement in performance and range will continue with the increased application of microprocessors. Faster reading rates, higher accuracies and self-calibration will become standard features in higher priced instruments.

These factors, resulting in rapid obsolescence of existing instruments, will contribute to the growth of a replacement market in this subsector.

Automated instrument self-calibration will become increasingly important in high accuracy bench instruments where a typical user may spend as much as the original price of the instrument, every two to five years, in calibration costs alone.

Instrument dollar value will continue to increase with the higher degree of technical sophistication for more complex devices. At the other end of the scale, lower priced general purpose instruments will proliferate and capture a part of the laboratory and analytical instrumentation market.

More computational capabilities, such as ratio taking, sorting, scaling of physical units and offsetting, will be built into the instruments.

The accelerated utilization of microprocessor controlled units will favour larger technologically sophisticated companies at the expense of "single device" manufacturers.

PARTICIPATING COMPANIES

The listing given below provides the names of manufacturers identified as participating in the general market of "Scientific & Laboratory Instrumentation", in 1978.

| <u>Company</u>                 | <u>Product</u>   |
|--------------------------------|--|
| Aptec Engineering Ltd.         | Nuclear radiation detectors;<br>Geiger-Mueller counters;<br>hyperpure germanium detectors;<br>fixed gamma area monitors, liquid<br>effluent monitors, hand and foot<br>personal contamination monitors,<br>portable uranium analyzers;<br>alpha-beta Geiger counters     |
| Bomen Inc.                     | IR spectrometers   |
| Canadian Research Institute    | Custom-built laboratory equipment<br>and instrumentation   |
| Corporation Scientific Claisse | Programmable Fluxers of Apparatus<br>to transform materials into forms<br>suitable for analysis  |
| Gentec Inc., Research Ltd.     | Laser; joulemeters   |
| Guildline Instrument Ltd.,     | Potentiometers; resistance<br>bridges; conductivity,<br>temperature and depth sensors and<br>measuring systems; voltmeters,<br>current transformer test sets; HV<br>capacitance bridges, high<br>resistance teraohmmeters,<br>resistance bridges, temperature<br>bridges |
| Inax Instruments Ltd.          | X-ray fluorescence analyzers,<br>radon counters  |
| Infrasizer Ltd.,               | Particle sizers  |
| Lumonics Research Ltd.,        | Research lasers; industrial laser<br>marking systems   |
| Metrix Instruments Ltd.,       | Fast-speed medical ventilators,<br>three-dimensional flowmeters,<br>laser-beam particulate matter<br>monitors  |
| Omicron Ltd.,                  | Barometers; thermometers   |

Company

Photochemical Research Ltd.

Semco Instruments Co. Ltd.

Product

Nano second fluorometers, pulsed  
light sources, research lasers

Scanning electron microscopes;  
and accessories.

REGIONAL  
INDUSTRIAL EXPANSION

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RÉGIONALE

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SUBSECTOR PROFILE (NO. 6)

REMOTE SENSING AND ENVIRONMENTAL INSTRUMENTATION

ELECTRICAL AND ELECTRONICS BRANCH



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## DEFINITION OF THE SUBSECTOR

This subsector includes manufacturers of a wide variety of instruments which detect, measure, transmit, record and/or analyze characteristics of the natural environment. These instruments are characterized by open loop operation, i.e., they are typically not used in any kind of process control situation.

From a technological point of view, the subsector may be conveniently divided into four part-subsectors,<sup>1</sup> as follows:

- a. Remote Sensing
  - b. Oceanographic Instrumentation
  - c. Meteorological Instrumentation
  - d. Pollution Detection Instrumentation
- a. Remote Sensing

In its broadest sense, this term refers to all forms of non-contact detection and measurement techniques. In practice, it is restricted to electromagnetic energy sensors, usually operating from an airborne or spaceborne platform. Such sensors, combined with associated data acquisition, processing and analysis systems, contribute to a wide variety of inventorying, mapping and monitoring tasks, such as:

- surveillance of ocean and coastal traffic;
- ice reconnaissance;

---

1. While this distinction is useful from a technological viewpoint, there is little value in attempting to separate statistical data, since:

- the total subsector sales are not large, in comparison with other subsectors of the instrumentation industry, and
- there is considerable overlap between the above groupings, such that it is often difficult to categorize a particular firm. This occurs e.g., when a technology associated with one group is used for an application associated with another.

Examples are:

- i) the Barringer Correlation Spectrometer (COSPEC) is a remote sensing device to detect SO<sub>2</sub> and NO<sub>x</sub> pollutants, and therefore could be classified as a) or d)
- ii) an oceanographic buoy from Hermes Electronics Limited fitted with meteorological instruments could be classified as b) or c)

- pollution monitoring;
- siltation;
- search and rescue operations;
- forest mapping;
- agricultural crop assessment;
- land use monitoring;
- geological structure mapping for mineral exploration.

The data, which is usually reproduced as some form of imagery, may be available either in analog form, such as aerial photographs, or digital form, such as on the Computer Compatible Tapes used for storing LANDSAT scenes.

The image receiving/processing system receives the raw satellite signal, strips off the data, applies elementary corrections and produces a basic image. The image analysis system applies precision geometric corrections to the basic image, enabling the image to be correlated with terrestrial mapping grids. It also provides a number of special features for classification of the data to facilitate, for example, determination of the acreages occupied by different crop or tree types. Enhancement of data by assigning false colours, contrast stretching, and various other types of manipulation is also provided.

The overall technological lead within Canada in this specialized and complex field is held by Canada Centre for Remote Sensing (CCRS) a division of the Department of Energy, Mines and Resources. No significant sensor industry exists in Canada, although some developments have taken place at CCRS. Remote sensing capability can, however, be said to exist in Canadian industry at three levels. First, there are a number of consultants whose capabilities include system design, mission planning and execution, and/or image analysis and interpretation. Secondly, there are a number of manufacturing firms which have specialized hardware expertise in one or another aspect of remote sensing; this group includes companies such as Barringer Research Limited, Bristol Aerospace Limited, and BOMEM Inc. Thirdly, a small number of firms are fully immersed in manufacture of hardware specifically for image data processing analysis. These firms include MacDonald, Dettwiler and Associates Limited (image processing and analysis systems and image recorders), OVAAC 8 International (Canada) Incorporated (image analysis systems) Imapro Inc. (image recorders), and Norpak Ltd. (graphic terminals).

b) Oceanographic Instrumentation

This grouping includes instruments which measure, record and process ocean and seabed characteristics, or which are specifically designed to facilitate oceanographic exploration and exploitation. It does not include electronic systems which provide communication, navigation or housekeeping facilities for commercial surface vessels. The following are typical of this category, but do not in any sense represent a complete listing: tide gauges, wave height recorders, CTD (conductivity, temperature and depth) measuring instruments, instrumented buoys, acoustic releases, underwater telemetry systems,

underwater navigation systems, diver communication systems, profiling sonars, fish finding sonars; and instrumented towed vehicles for underwater data gathering.

c) Meteorological Instrumentation

This field includes instruments which measure, record and process atmospheric data. These products can be grouped into the following categories;

- a large variety of basic sensors, for measurement of temperature, pressure, wind velocity, humidity, dewpoint, rainfall rate and total precipitation. This group includes airborne types (radiosondes), recording and non-recording variants, and some purely mechanical varieties.
- a limited variety of more complex electronic sensors, such as videographs (fog detectors), ceilometers, transmissometers, and weather radar.
- automatic weather stations, which may include several sensors, integrating and multiplexing circuitry, provision for transmission to a central point by radio, land line or satellite, and an independent power source.
- data processing equipment for weather imagery produced by satellite or radar.

Some types of instrumentation in each of the four categories listed above are or have been manufactured in Canada. However, development of new instrumentation has in general not kept pace with technological advances, and certain products, particularly in the second category, have become obsolete. Some interest has been expressed by the companies concerned in developing new products.

There appears to be significant latent capability in meteorological instrumentation in Canada. Several companies are known to have developed weather stations, and made one or two sales, but did not aggressively promote the products. In mid-1977, when the Department of Supply and Services circulated a Request for Proposal to update the Cape St. James weather station in the Queen Charlotte Islands, it received forty-two responses. While many of the responding firms were in the systems business, the large majority were not in the meteorological instrument business.

d. Pollution Detection Instrumentation

Instrumentation in this group detects and/or measures the degree of air or water pollution. It does not include devices which operate in a closed loop system for pollution control, as for instance stack monitors for sulphur compounds.

These instruments vary from the very complex to the relatively simple, in technological terms. At the simpler end of the scale are gas

detectors which check the level of e.g., carbon monoxide in an enclosed parking garage. Somewhat more complex are electro-optical detectors, which can be passive monitors of SO<sub>2</sub> and NO<sub>x</sub> like the Barringer COSPEC.

At the most complex end of the spectrum are certain instruments for trace vapour detection. The earliest of these was the SCENTRY system, manufactured by Leigh Instruments Ltd. This class of instrument is presently undergoing a high degree of refinement in Canada; at least four different technological approaches to the problem are known to be in use or under development. The TAGA (Trace Atmospheric Gas Analyzer) developed by SCIEX Ltd. may well be the most advanced such instrument available.

### SUBSECTOR STRUCTURE AND STATISTICAL DATA, 1978

The data given below outlines the size and structure of this subsector industry in Canada:

|  |              |
|--|--------------|
| Estimated Domestic Market                      | \$32 million |
| Total Number of Firms                          | 30           |
| Percentage of Canadian-owned                   | 87%          |
| Total Employment                               | 600          |
| Total Reported Sales                           | \$20 million |
| Share of Total Sales from Canadian-owned firms | 82%          |
| Total Exports                                  | \$ 9 million |
| Exports as % of Sales                          | 46%          |

#### Research and Development:

More than half (19) of the companies have received in the past or are currently receiving government funding for R&D programs.

|   |     |
|---|-----|
| R&D Expenditure as % of Sales           | N/A |
| R&D Employment as % of Total Employment | 28% |

#### Distribution of Companies by Level of Reported Sales, 1978:

|                              |           |
|------------------------------|-----------|
| less than \$500,000          | 15        |
| \$0.5 million to \$1 million | 11        |
| \$1 million to \$2.5 million | 3         |
| \$2.5 million to \$5 million | 1         |
| Total Companies              | <u>30</u> |

#### Regional Distribution of Companies:

|              |    |
|--------------|----|
| Ontario      | 18 |
| B.C.         | 4  |
| Québec       | 2  |
| Nova Scotia  | 2  |
| Alberta      | 1  |
| Manitoba     | 1  |
| P.E.I.       | 1  |
| Saskatchewan | 1  |

## SUBSECTOR CHARACTERISTICS

As a general rule, the major markets for instruments in this subsector is the aggregate of government agencies concerned with the care and study of the natural environment. A secondary market includes universities and other teaching institutions. In addition, certain types of instrumentation, particularly in the oceanographic field, are of use to commercial operators; examples are the Huntec Deep Tow System, and the underwater acoustic equipment available from Mesotech Systems Limited, which can be used for exploration of potential offshore oil well sites.

### **The Role of Government**

Since domestic and foreign government agencies represent the most significant market for the companies in this sector, it is not surprising to find that agencies of the Canadian federal government have played strong supporting roles in the development of the industry. Government influence is exerted through provision of funds for instrument development, especially through the Unsolicited Proposal Program of Department of Supply and Services, and through licensing of technology, as well as through its purchasing policies. An understanding of this government participation is helpful to an understanding of the industry.

Remote Sensing technology is important to Canada, since it offers a space-age solution to resource management problems in vast, largely uninhabited areas. In recognition of this fact, the Canada Centre for Remote Sensing (CCRS) was established in 1972 as a division of Department of Energy, Mines and Resources. CCRS' activities encompass data applications (to forestry, agriculture, land use, ice monitoring, etc.) reception and processing of satellite data, airborne surveys, R&D and user services. Interfaces with industry exist in each area. For instance, R&D activity includes development of advanced sensors, which can then be transferred to industry.

CCRS has two receiving stations for LANDSAT data, one located in Prince Albert, Saskatchewan and the other in Shoe Cove, Newfoundland. MacDonald, Dettwiler and Associates Limited has participated in both stations. MDA's success in these Canadian installations has had a definite impact on the company's successful landing of several foreign contracts. CCRS' sensor development has included a laser fluorosensor, an airborne instrument which detects and classifies floating oil spills. Assistance in this project was provided by Barringer Research Ltd., and the device has now been incorporated into that company's product line.

With respect to meteorological instruments the Atmospheric Environment Service (AES) of Department of the Environment has traditionally taken a strong technological lead in this field, and has made every effort to support Canadian industry through its purchasing policy. In 1977, AES established by contract with Sangamo Company Limited the Meteorological Instrument Technology Center (MITC), under which Sangamo undertook both

to supply a substantial proportion of AES' standard instrument requirements and to make efforts to sell these instruments in the export market.

Sangamo's export efforts were not successful (only 1 small export order was obtained in 3 years). Moreover, Sangamo's parent firm has made a recent decision to withdraw the company from meteorological instrument manufacture in Canada.

AES has also assisted Bristol Aerospace Limited in the development of the MAPS (Modular Automatic and Programming System) for automatic weather stations. Some 30 of these stations have now been deployed. Bristol has refined the product line through continuing development, and export sales are anticipated.

Canada Centre for Inland Waters, formerly part of the Inland Waters Directorate for Environment Canada, has exercised considerable ingenuity in the specification and development of prototype instruments for its own use. It has funded development at Computing Devices Company of a microprocessor-controlled data acquisition system for water science; other R&D projects have been undertaken with Hermes Electronics Limited and Digital Equipment of Canada Limited.

Federal government agencies have also had an impact on the oceanographic instrument industry in Canada. Three such agencies are:

1. Bedford Institute of Oceanography, Dartmouth, Nova Scotia, a branch of Environment Canada. BIO operates Canada's largest research vessel, the 4780-ton CSS Hudson, which can be used for testing of Canadian products.
2. NORDCO (Newfoundland Oceans Research and Development Corporation), established in 1975 by the federal government, through the Department of Regional Economic Expansion and the Newfoundland provincial government.
3. Institute of Ocean Sciences, Patricia Bay, B.C., which is composed of elements from both Department of Fisheries and Oceans and Department of Energy, Mines and Resources.

### INDUSTRY PROBLEMS

The meteorological, oceanographic and pollution detection industry groups suffer from lack of depth, i.e., there is not a complete spectrum of equipment manufactured here, and some of the manufacturers produce highly specialized items appealing to a narrow range of customers. Sales volumes are typically low, and with the current budgetary curbs within Canadian government the near-term domestic sales outlook is not promising.

There is also a natural tendency for non-government buyers in all countries to avoid investing in pollution control equipment until forced to do so by government fiat or legislation. There are no Canadian trade associations or publications, to help instill an industry consciousness.

There is little incentive to try to develop an export market, in standard meteorological instrumentation, since many countries have, and tend to favour, an indigenous industry. The export potential of more sophisticated equipment, however, is considerably better. Canada has only isolated examples of suppliers of this type of equipment.

A major problem faced by manufacturers of image analysis equipment is the need for user education to develop the market. Remote sensing can be considered as many solutions looking for many problems, and there is still a general lack of awareness among potential users of what it has to offer, and how image analysis can assist in the interpretation of information.

#### FUTURE TRENDS

- The extension of the national boundary to 200 miles offshore will have a favourable impact on certain product lines, e.g. fishing sonars, insofar as it facilitates a renovation of the fishing fleet.
- The trend toward the use of microprocessors in instruments will continue, although this trend is not as pronounced as in, say, the geophysical instrument sector.
- Through technological and software advancement, the price of image analysis equipment will drop, and the demand for such equipment should improve considerably over time.
- Increasingly stringent anti-pollution regulations may cause increased demand for pollution detection equipment.



PARTICIPATING COMPANIES

The following is a list of the manufacturers considered to be included in this subsector in 1978.

| <u>Name</u>                              | <u>Category</u> | <u>Products</u>   |
|--|-----------------|---|
| Aanderaa Instruments Ltd.                | Ocean           | Water Level Recorders and Accessories   |
| Acme Engineering Products Ltd.           | P.D.            | Gas Detectors   |
| Aero-Aqua Ltd.                           | Met.            | Radiosonde Systems, Weather Stations  |
| Analygas Systems Ltd.                    | P.D.            | Gas Detectors   |
| Applied Microsystems Ltd.                | Ocean           | Tide Gauges; Wave Recorders; Current Meters; Salinity, Temperature & Depth Profilers, etc.  |
| Barringer Research Ltd.                  | R.S.,<br>P.D.   | COSPEC (Correlation Spectrometers for Remote Detection of Atmospheric Pollutants), AIRTRACE, SURTRACE (Airborne Particulate Monitoring Systems) |
| BOMEM Inc.                               | R.S.,<br>Met.   | Balloon-Borne and Laboratory Interferometric Spectrometer   |
| Bristol Aerospace Ltd.                   | Met.            | Automatic Weather Station   |
| Canadian Applied Technology              | Ocean<br>P.D.   | Telemetry, Data Acquisition & Control Systems   |
| Canadian Instrumentation & Research Ltd. | R.S.            | Computer-Based Image Scanning & Analysis System using TV Camera; Digitizer Optical Correlator & Recorder for Synthetic Aperture Radar (SAR)     |
| C-Tech Ltd.                              | Ocean           | Fish Finding Sonars   |
| D.G. Instruments Limited                 | Met             | Sonic anemometer/<br>thermometer  |

|   |                |  |
|---|----------------|--|
| Guildline Instruments Ltd.                          | Ocean          | CTD Probes, Lab Salinometer  |
| Huntec ('70) Limited                                | Ocean          | Deep Tow System  |
| Hermes Electronics Limited                          | Met.,<br>Ocean | Instrumented Buoys,<br>Sonobuoys, Rescue<br>Beacons  |
| Imapro Incorporated                                 | R.S.           | Colour and B/W Image<br>Records  |
| Leak 'X' Devices Ltd.                               | Ocean<br>P.D.  | Oil & Gas Detection;<br>Oil Slick Tracking<br>Buoys  |
| Leigh Instruments Ltd.,<br>Industrial Products Div. | P.D.           | Explosives SCENTRY   |
| MacDonald, Dettwiler &<br>Associates Ltd.           | R.S.<br>Met.   | Receiving, Processing and<br>Analysis Systems for<br>LANDSAT and Meteo-<br>rological Satellite Image<br>Data             |
| Markland Specialty                                  | P.D.           | Water Sampling and<br>Analysis Systems   |
| Mesotech Systems Ltd.                               | Ocean          | Sonar Bottom Profilers;<br>Submersible Navigation<br>Systems; Acoustic Undersea<br>Devices Underwater<br>Telephones etc. |
| Muirhead Systems Ltd.                               | Met.           | Weather Radar Remoting;<br>Facsimile Switching<br>Systems & Interfaces   |
| Optech Inc.   |                | Lidar (Laser Radar) for<br>Atmospheric Measurements  |
| Orion Electronics Ltd.                              | P.D.           | Oil slick Tracking Buoys   |
| OVAAC 8 International<br>(Canada) Inc.              | R.S.           | Image Analysis<br>Systems  |
| Sangamo Company Ltd.                                | Met.           | Wind Measuring<br>Instruments, Rain Gauges,<br>Radiosondes, Barographs,<br>etc.  |

| <u>Name</u>                                      | <u>Category</u> | <u>Products</u>  |
|--|-----------------|--|
| SED Systems Inc.                                 | R.S.            | ADRES (Aerological Data Reduction System ) Ozone Spectrophotometer, Data Collection Platform Receiving & Processing Systems, Met. Satellite Receiving & Processing Systems |
| Sonotek Ltd.                                     | Met.            | Digital Barometer Integrating Temperature Sensor   |
| Sperry Gyroscope Div. of Sperry Rand Canada Ltd. | Met.            | Videographs (Fog Detectors)  |
| Ultra-Tech Systems Ltd.                          | Ocean           | Acoustic Telemetry Systems and Beacons   |



SUBSECTOR PROFILE (NO. 7)

GEOLOGICAL, GEOPHYSICAL AND  
GEOTECHNICAL APPARATUS

ELECTRICAL AND ELECTRONICS BRANCH

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## DEFINITION OF THE SUBSECTOR

This subsector includes all companies primarily engaged in the manufacture of instruments for determination of earth characteristics.<sup>1</sup> Two general classes of such instruments are available from Canadian sources: geophysical and geochemical, both designed for mineral exploration.

The industry will therefore be defined primarily in terms of these two categories, with a third category of "miscellaneous" to account for certain additional classes of which very few Canadian examples exist.

### a) Geophysical Instruments for Mineral Exploration

This class includes by far the greatest number of subsector 7 instrument types manufactured in Canada. Some idea of the variety of such instruments can be gained from the following list:

#### Airborne:

- Magnetometers (for measurement of earth's magnetic field)
- Electromagnetic (EM) Systems (for measurement and analysis of echoes from transmitted electromagnetic impulses)
- Spectrometers (for measurement and analysis of natural nuclear radiation)
- Data Acquisition systems and recorders

#### Ground:

- Magnetometer
- EM Systems
- Spectrometers
- Gravity meters
- Induced Polarization equipment
- Resistivity equipment
- Borehole Systems

#### Marine:

- Magnetometers

### b) Geochemical Instruments for Mineral Exploration

A significant source of supply for these instruments exists in Canada. Most of the instruments sold are radon detectors, for the measurement of radon and related gases which are frequently associated with the presence of uranium ore. These are available from four companies.

EDA Instruments Inc.

1. The subsector does not include related industrial equipment, such as on-line ore analysis equipment used in mills.

Scintrex Limited  
Bondar-Clegg and Company, Instrument Division  
Pylon Electronic Development Co. Limited

Beyond the above, several specialized instruments exist:

Alphameter - an integrating radon detector available from Alpha Nuclear.

Mercury detectors - available from EDA and Scintrex.

Analyzers for uranium, lead isotopes and other elements - available from Scintrex Limited.

c) Miscellaneous

**Seismic Systems**

There does not appear to be any significant Canadian manufacturer of land instrumentation for seismic exploration, the traditional surface method for exploring for hydrocarbons. An electronic system designed for earthquake detection is available from D.G. Instruments Limited, but is not understood to be particularly suitable for exploration.

Some "unapproved" electrical methods exist for petroleum exploration, but little is known of the technical approaches used and results obtained. Also, certain types of mining exploration surveys, using for example EM instrumentation are believed to provide useful data for oil exploration.

It is but just to say that significant contributions in software for reduction of oil exploration data have been made by Canadian software houses. An example is the SEISLOG technique developed by Teknica Resource Development Limited, which is recognized by the Society of Exploration Geophysicists and the American Association of Petroleum Geologists.

**Geotechnical**

Isolated examples only exist in this field.

- A Piezometric Permeability Profiler, for measurement of water pressure during drilling, is manufactured by Westbay Instruments Limited, Vancouver.

- An Automatic Bit Locator, which senses and telemeters the position of a drill bit, is being marketed by Vec-Tel Petroleum Services Ltd., Calgary.

- An Electronic Level, for gravimetric and other surveys, is manufactured by GDD Instruments Inc.

While the above are all produced for market sale, some companies have developed their own ingenious instrumentation for in-house use.

SUBSECTOR STRUCTURE AND STATISTICAL DATA, 1978

The data given below outlines the size and structures of the subsector industry in Canada:

|  |              |
|--|--------------|
| Estimated Domestic Market <sup>1</sup> | \$25 million |
| Total Number of Firms                  | 21           |
| Percentage Canadian-owned              | 95%          |
| Total Employment                       | 365          |
| Total Reported Sales                   | \$11 million |
| Total Exports                          | \$ 6 million |
| Exports as % of Sales                  | 55%          |
| Research and Development:              |              |

It is noted that 80% of the responding firms have received federal government financial assistance of some kind. The preferred forms of assistance are R&D tax incentives and direct R&D funding.

- 
1. The Domestic Market for the total sector cannot be estimated with any degree of accuracy. For mineral exploration instruments, it is probably around \$6 million.



SUBSECTOR STRUCTURE AND STATISTICAL DATA, 1978 (cont'd)

|   |                  |
|---|------------------|
| R&D Expenditure as % of Sales           | 32% <sup>2</sup> |
| R&D Employment as % of Total Employment | 34%              |

Distribution of Companies by Level of Reported Sales, 1978:

|                              |          |
|------------------------------|----------|
| less than \$500,000          | 11       |
| \$0.5 million to \$1 million | 7        |
| \$1 million to \$2.5 million | <u>3</u> |
| Total Companies              | 21       |

Regional Distribution of Companies:

|         |    |
|---------|----|
| Ontario | 19 |
| Québec  | 1  |
| B.C.    | 1  |

---

2. In considering this figure, it should be noted that:

- some of the R&D costs have been funded, either under customer contracts or through government grants;

- the sales base used here is instrument sales only. Many firms in this subsector have income derived from other activities as well, such as geophysical surveying and consulting work, so that the firm's R&D expenses as a percentage of total firm revenue is usually 10-15%. However, for individual firms in the subsector, total R&D to total sales range from zero to over 30%.

### SUBSECTOR CHARACTERISTICS

The companies in this sub-sector provide what is undoubtedly the most diversified range of mineral exploration instrumentation in the world. Although not large in terms of any of the usual yardsticks, the industry has become internationally known for the quality and innovative content of its products. The growth of the industry was initially fed by the requirement for sophisticated instrumentation to penetrate the glacial debris which covers our own mineral deposits. Also, the presence of a vigorous and internationally-active geophysical survey industry, which evolved after a government decision many years ago to contract out its survey work, has combined with the manufacturers and the specialists in the Geological Survey of Canada to generate a synergy which has had a powerful effect on development of exploration instrumentation in Canada.

The Canadian association that comes closest to representing the interests of this group is the Prospectors and Developers Association; many of the professionals belong to the Society of Exploration Geophysicists and other international organizations.

The dominant firm in this subsector is Scintrex Limited, which manufactures a broad variety of high quality equipment, including magnetic, electromagnetic, gravity, resistivity, radiometric, geochemical and induced polarization equipment, both airborne and ground, totalling over sixty standard lines. Some 75% of the company's sales of instruments and exploration services are exported to over 50 countries. This Canadian-owned firm is likely the largest company in the world specializing in such instrumentation.

Future developments in this subsector will be influenced in large part by the level of demand for oil exploration instrumentation by the major oil companies located in Canada. At present, the subsector supply side is heavily weighted in favour of mineral exploration instruments. Manufacturers of seismic systems used in oil exploration are almost non-existent. This situation has evolved because, although a demand for both types of instrumentation has existed in Canada, the oil majors have tended to purchase or lease their seismic instrumentation from preferred sources of supply in the United States. This corporate procurement practice has suppressed any inducement for a Canadian industry to develop. For a country having so much oil exploration activity, the existence of virtually a complete void in the field of seismic instrumentation manufacture is regrettable.

While the market prospects for Canadian-made seismic instrumentation are improving, Canadian manufacturers will have to provide very advanced equipment to compete with the sophisticated digital systems available from the United States and Europe.

### MARKETS SERVED

Major customers served by this subsector include:

- a) geophysical exploration contractors
- b) mining companies
- c) oil companies
- d) government agencies responsible for exploration and resource development
- e) universities

During the last few years, demand for geophysical exploration instrumentation has been strong, particularly in the Third World, where developing countries have been awakening to, and becoming anxious to exploit, their mineral wealth. Since such decisions have been made by governments rather than the private sector, demand has remained firm despite the slump in base metal prices and in mineral exploration activity. This trend can be expected to continue in the near term.

### INDUSTRY PROBLEMS

A major problem being experienced by the industry is fragmentation. Companies are typically owned and managed by geophysicists, who, exhibiting a characteristic independence, would rather operate their own companies than work for someone else. Several of them have in fact spun-off from larger firms to start their own businesses. The result has been a proliferation of small firms, many of whom compete directly with each other for a limited world market.

On the other hand, this situation is not without its benefits. The variety of such instrumentation available in Canada is unique in the world. Also, the stimulus of competition has been at least partly responsible for the high level of technological achievement within the industry. The fact that the number of firms has been steadily increasing in recent years indicates that saturation of current demand levels has not yet been reached; however, at the next cyclical downturn, many of the smaller firms are likely to experience cash flow problems.

### FUTURE TRENDS

The most important technological trend in this field is the emergence of digital instrumentation. In ground equipment, this trend is taking the form of the incorporation of microprocessors, which provide instant data reduction in the field, faster operation and consequently greater cost-efficiency.

In airborne equipment, both microprocessors and mini-computers are being used. The impact of digital design is being manifested as:

- automatic operation, i.e. elimination of the equipment operator from the flight crew.

- increased emphasis on signal processing to derive more information from geophysical data.
- use of the airborne computer for automatic plotting of maps from new geophysical data, at base camp after the day's flying. This feature requires a precise navigation system which is both optimized for the survey task and highly integrated with the data acquisition and control system.
- integration of different types of instrumentation, with the possibility of real time correlation of data from several instruments.

These trends may lead to de-emphasis of the less cost-effective ground follow-up surveys.

PARTICIPATING COMPANIES, 1978

Scintrex Limited  
McPhar Instruments Corp.  
EDA Instruments Inc.  
Exploranium/Geometrics  
Geonics Limited  
Crone Geophysics Limited  
Barringer Research Limited  
Huntec ('70) Limited  
Pylon Electronics Development Limited  
Phoenix Geophysics Limited  
Westbay Instruments Limited  
Instrumentation G.D.D.  
Sander Geophysics  
Bondar-Clegg & Company Ltd.  
Instrument Division  
D.G. Instruments Limited