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# A PROFILE OF THE MINING MACHINERY AND EQUIPMENT SECTOR IN CANADA

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March 1982



Government  
of Canada

Gouvernement  
du Canada

Industry, Trade  
and Commerce

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et Commerce

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AND EQUIPMENT SECTOR IN CANADA

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Machinery Branch  
Department of Industry, Trade  
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## INTRODUCTION

The objective of this profile of the Canadian mining machinery and equipment sector is to provide some insight into the nature of the sector and its markets and to outline its capability to supply the expected needs of the mineral industries as well as the principal opportunities and constraints shaping its growth five to ten years ahead.

Increased demand for mining machinery and equipment should follow in the wake of major new investments in mineral development expected in the years immediately ahead. In this regard, there is a new focus of attention on the state of the mining equipment sector in Canada and particularly on its ability to take advantage of these new opportunities.

In offshore markets, particularly in developing countries, major new resource developments are expected in the next decade as mineral markets improve. These new developments will be needed to overcome a shortfall in mineral output which has resulted from a period when depressed metal prices and relatively high taxation and interest rates, together with regulatory actions aimed at easing environmental problems, have all combined to delay the introduction of new mining ventures.

Canadian mineral production is also expected to increase sharply. Capital expenditures to be undertaken in Canada by all mineral industries during the 1980s should increase sharply as a predicted boom in mineral development gradually takes hold after a cyclical period of marginal growth in the Canadian mining industry. Increased activity in mineral resource development is of particular significance to mining equipment firms since it should provide an opportunity to use the domestic market as a base for new growth and counterbalance somewhat the sector's high reliance on export markets.

Considerable information for this profile has been obtained from a survey of 81 companies that are involved in the production and marketing of major equipment items used in mining and mineral processing. A list of these companies and of other Canadian companies manufacturing mining equipment is provided in Appendix C.

## SECTOR DEFINITION AND DESCRIPTION

The mining equipment sector encompasses a wide range of capital goods required for all phases of mineral exploitation, including exploration, production (open pit and underground mining), concentration, smelting and refining.

However, a high proportion of the major equipment items used by the mining industry are also used in a wide variety of other industry sectors, particularly the construction industry. For purposes of this analysis, therefore, all heavy machinery and equipment, primarily designed for and used in the exploration and development of solid minerals, has been included within the definition. Earth moving equipment and heavy construction equipment used primarily by the construction industry in the building of highways, streets and bridges, etc. has not been included.

Based on this definition, information and data has been obtained from two groups within Statistics Canada, Standard Industry Classification (SIC) 315, which describes equipment devoted exclusively to mining operations. These groups are mining and ore processing equipment and rock drilling and related equipment. To the extent possible, the analysis presented and the conclusions drawn are based on the data available for these groups.

This very general definition, however, still does not adequately describe the diverse range and variety of equipment which is included. To do this, it is necessary to identify the products in relation to the functions they serve in carrying out each stage of the total 'mining process'.

### Exploration

The exploration process in the mining industry is carried out through a series of drilling operations to obtain core samples for analysis. These operations are performed through varied ground conditions including rock, shale, etc., and require a wide assortment of machinery and equipment including diamond core drilling rigs and ancillary equipment such as drill rods, drill bits, core barrels, and fishing tools.

### Production

To produce ore from underground mines, shafts and tunnels are constructed, often through hard rock, requiring the drilling of holes and the insertion of dynamite charges. Mobile electric, hydraulic and pneumatic drill jumbos are widely used in these operations, together with portable percussion type pneumatic rock drill equipment used in special applications. Other types of equipment commonly associated with the production phase of underground mining operations include mine hoists, shaft conveyances, and associated equipment such

as skips, cages, loading pockets, etc., as well as light stoper and airleg drills, multiboom jumbos, stopewagons and slusher hoists and scrapers. In addition, many mining operations require specially designed transportation equipment such as mine cars, load-haul-dump units, low profile end dump trucks and utility vehicles. Many of these machines are specially designed to operate efficiently in constricted areas.

Producing from open pit mines, on the other hand, presents a significantly different equipment requirement to that found in underground mining. In open pit operations, it is usually necessary to have large scale machines in order to operate efficiently. For instance, large tractor mounted drills are used for the most part to drill blast holes while power shovels, drag lines, bucket wheel excavators, specially designed large capacity bulldozers, front end loaders and mammoth off-highway vehicles are also required.

In addition, stationary air compressors to supply large quantities of compressed air to power drills, loaders and other equipment as well as ventilation equipment including large fans and ducts, pumps to remove water and facilitate the removal of ore/water suspensions and ever increasing quantities of environmental equipment are all required to support the production phase of the mining operation.

#### Concentration

The concentration of ores which has been removed from the ground requires, in its early stage, equipment to break down the ore so that the mineral can be separated from the gangue. Vane type crushers are utilized for primary crushing stages, often undertaken at the mill. Separation of the ore from the gangue requires a wide variety of separation devices in common use including magnetic separators, concentrating tables, vibrating screens, stacker reclaimers, grinding units, mixers, agitators and flotation cells.

#### Smelting and Refining

Beyond the concentration stage it is not possible to provide a general description of the machinery and equipment used to refine the ore due to the many different processes used to up-grade the different varieties of minerals mined in Canada and much of the equipment needed at the smelting and refining stage is produced to individual user specifications. In general, however, there is a requirement for dryers, reactors, precipitators, heat exchangers, furnaces, casting machines, kilns, bullion furnaces and retorts.

## SECTOR PERSPECTIVE

### Overview

The mining equipment sector in Canada comprises approximately 120 companies, located primarily in Ontario and Quebec, employing about 6,000 directly in the production of mining equipment, including many skilled workers and professionals. Annual shipments are \$342 million or 4 per cent of total Canadian machinery production. In 1980, the sector, which has grown at an average annual rate of 12.2 per cent since 1965 in current terms, exported \$205 million or 60 per cent of total shipments (up from 28 per cent in 1965) with the American market absorbing about two-thirds of these export sales. In comparison, sector growth during this period has been somewhat ahead of the growth of both the machinery industry as a whole and total manufacturing (both 11 per cent). At the same time, however, imports increased their share of the Canadian market growing from \$47.4 million in 1965 (52 per cent) to \$372 million in 1980 (73 per cent).

The sector is dominated by about a dozen large integrated machinery manufacturers, mostly foreign owned, with the remaining companies having annual sales of less than \$2 million. The sector has good technical capability based largely on imported technology. It specializes in geophysical equipment and has an excellent reputation in hard rock drilling, particularly underground diamond drilling equipment.

Based on renewed mineral development expected in Canada and other countries, the outlook for growth in the medium-term is good and it is estimated that production could grow at 15 per cent per year to reach \$1.4 billion in current terms by 1990. This compares to a 13 per cent average annual growth rate expected for total machinery manufacturing during the same period.

While substantial growth is expected, there are some issues or problems which are constraining the sector from reaching its full potential. These include the continuing severe import competition in the domestic market, and the structural deficiencies of the major foreign-owned subsidiaries which, for these firms, is characterized by restricted export mandates and insufficient indigenous R & D and market development. Additional constraints result from the lack of international stature of many of the smaller, mostly Canadian-owned firms and the absence of comparable tariff protection to that enjoyed by principal foreign competitors over a wide range of products.

### International Perspective

Canada is one of the leading world producers of mining machinery and equipment. The other major international producers of mining equipment in order of approximate annual production are: United



States \$2.3 billion, West Germany \$1.5 billion, United Kingdom \$1.3 billion, Finland \$0.6 billion, Japan \$0.4 billion, Sweden \$0.3 billion, and Australia \$0.2 billion (Canada \$0.4 billion).

Canada's relatively harsh and remote geological environment has had a significant influence on the development of the mining equipment sector, notably in its specialization in geophysical exploration and hard rock underground diamond drilling equipment and in the development of a range of processing equipment to treat the variety of ores mined in this country, particularly milling and concentrating equipment required for the beneficiation of hard metal ores. In this regard, it is similar to the industry in many other countries of the world where mining equipment supply capability has been shaped by the nature of the resource base in the home market.

It is noted that the majority of world mining machinery industries cover a broad range of equipment needs from ore extraction to final processing. However, most have developed a particular area of specialization or concentration of equipment technology, for instance:

- In Finland, small scale hard rock underground mining and equipment for the flotation of sulphide ores, magnetic concentration of iron ores, instrumentation and process automation are all areas of particular strength.
- In West Germany, the development of the mining machinery sector in that country has been largely based on and closely follows the cyclical pattern of the country's coal production industry. In fact, mining equipment developments there have assisted the West German coal industry to obtain the highest productivity in Europe during the last ten years.
- In the United States, the development of mining machinery was, during its early years, almost exclusively based on coal. The U.S. industry is quite broadly based now with expertise in a wide range of mining equipment, however new developments are being undertaken related to the production of large scale "continuous miners" and "longwall mining machines" which have their primary use in coal mining. These machines range in cost from \$300,000 to major installations costing between \$3 and \$7 million each.
- In Japan, the emergence of the mining machinery industry is a unique story. With virtually no resource base in its domestic market, Japan has nevertheless the fastest growing mining machinery and equipment industry in the world acquired mainly through an extension of a well-established base in capital goods production and marketing.

CORPORATE STRUCTURE

Products and Services

The sector can supply from domestic production a large proportion of the equipment required for all phases of mineral exploitation. In this regard the industry now offers the full range of exploration equipment. In fact, in geophysical exploration, Canada is recognized as a world leader and has a 60 per cent share (\$10 million) of the world market for this kind of equipment. On the extraction side, Canadian manufacturers can supply about 50 per cent of the equipment needed for open pit mining and 70 per cent for underground mining. At the concentration stage, supply capability is in excess of 80 per cent for non-ferrous ores with the exception of some equipment such as humphrys spirals and there is virtually complete coverage for the concentration and treatment of iron ore. Canadian ability to supply equipment for non-ferrous metal smelters hinges on the selection of the smelting process. For certain metals (lead, zinc, nickel, copper) Canadian mining firms have developed their own process technologies which, if selected for a given project, improve Canadian supply prospects. Canadian ability to supply equipment for non-ferrous metal refineries, particularly electrolytic zinc refineries, is also very strong.

There is limited capability to supply the very large heavy equipment required to operate efficiently in open pit mining, particularly blast hole drilling equipment and loading and hauling equipment. There is only selected capability for surface coal mining equipment and no Canadian source of supply for underground coal mining equipment. In addition, the entire mining equipment sector has been undergoing a process of some rationalization in recent years and in many equipment areas products are limited in the range of sizes and types which are manufactured. Appendix A provides a detailed assessment of Canadian manufacturing capability by product type and classification. Appendix B provides a list of products not available from Canadian production.

The sector has good technical capability in the areas in which it is specializing acquired mainly through licence arrangements from foreign parent companies. However, there is somewhat limited turnkey capability in the Canadian mining equipment sector, with the exception of equipment and services for geophysical exploration and equipment packages for beneficiation, i.e., concentrating plants and pelletizing plants. There is a particular weakness in the ability of the sector to put together complete packages requiring underground and open pit equipment since Canada is limited in the range of types and sizes of equipment that can be supplied. For Canadian projects this problem can often be resolved as developers are capable of selecting individual items of equipment from Canada and integrating them with items supplied from the United States. In offshore projects, however,

the inability to supply complete turnkey projects is a definite competitive disadvantage.

In the process of growing with the Canadian mining industry, Canadian consulting firms have established a good international reputation in the major mineral producing countries of the world. The range of their services include airborne surveys, ground based geological and geophysical exploration services and mine engineering, ore treatment and metal processing. With some notable exceptions, the consulting/service industry is almost entirely Canadian owned. It is made up of hundreds of consultants from highly specialized one-man operations to large multi-disciplinary firms with several hundred employees. Overall it is estimated that about 40 Canadian firms have export experience with the top 15 probably responsible for the vast bulk of Canada's mining service exports which are in excess of \$20 million annually. This impressive growth of the Canadian mining consulting firms is a very positive development for the mining equipment sector in Canada since equipment sales are strongly influenced by the recommendations and specifications put forward by the consulting firms.

#### Firm Size

Production of mining machinery in Canada is dominated by 12 large firms which account for close to 70 per cent of the total annual production of this equipment and approximately 60 per cent of the sector employment. Average shipments and employment for large firms are \$20 million and 300 employees respectively.

The remaining production is accounted for by approximately 108 individual firms each producing roughly \$1.2 million annually of equipment and employing on average 25 workers.

Overall, the size of the individual production units devoted to mining equipment is large compared to the average for the total machinery industry, with weighted average shipments close to \$5 million and employment of some 100 versus \$4 million and 60 employees for the total machinery industry.

#### Plant Scale

Plant scale is normally not a major competitive factor for most Canadian mining equipment manufacturers. As noted above, the size of individual mining equipment production facilities is large in comparison to the average size of Canadian machinery manufacturers in general. In addition, in many cases the relatively large proportion of custom engineered work, together with production of a limited quantity of large individual products at any one time which is the norm in this kind of industry, allows Canadian producers to match the scale of their foreign competitors during periods of normal demand. In cyclical periods of unusually high activity however the scale of plant facilities becomes of more concern. In these circumstances Canadian mining equipment manufacturers are often faced with the need to decline new orders or offer uncompetitive delivery commitments because of limited

space. In general, the industry considers that the cyclical nature of the demand for mining equipment is a major factor governing the profitability of their operations and that the need to incur high fixed overheads and maintain significant material inventories during slack periods is a major problem. In this regard, the efficient management of capacity utilization of plant facilities in producing mining equipment is a constant concern and the need to balance plant loads is the major reason a majority of firms making mining equipment also produce equipment for other markets.

## FACTORS OF PRODUCTION

### Materials and Supplies

Most manufacturers of mining equipment are able to source the majority of their materials and components in Canada although at prices which range from 10 to 20 per cent higher for certain components than comparable items sourced from the United States. Materials and components which are regularly imported and in which supply problems sometimes occur include: specialty steels, stainless steel and manganese forgings, engines and hydraulic components, electric apparatus and systems, vehicle transmissions and axles, diesel engines and large gear boxes:

### Labour

The availability of skilled labour is presently a major concern for mining equipment manufacturers in Canada as it is in most capital goods industries. Persistent shortages of machinists and welders in particular are troubling the sector and the added cost of recruiting and training these employees is adversely affecting productivity and profitability.

### Capital

While the mining equipment sector is affected by financial limitations that are common to other sectors of the machinery industry and indeed to other industry groups in general (e.g., high interest rates, scarcity of investment capital, etc.) there are certain aspects of this factor which have a particular impact on mining equipment firms. These include:

- a) the need to tie up working capital in work in progress for the construction of large machines where production may extend over a prolonged period;
- b) heavy feasibility study costs, including the need for extensive promotional effort often in distant markets;
- c) the need to maintain large engineering staffs and skilled employees during periods of cyclical downturn;  
and,
- d) the difficulties in countering tied and concessional financing advantages of foreign suppliers in bidding for large capital investment projects in Canada and abroad.

### Energy

Mining equipment firms, like most capital goods manufacturers, are relatively light users of energy as compared to resource based or processing industries. Accordingly, the sector should be able

to contend with increased energy costs and possible shortages. In fact, the sector presently depends mainly on natural gas for heating and heat treating processes where supply is relatively favourable.

Regional Structure

The mining equipment sector is highly concentrated in Ontario and Quebec with approximately 85 per cent of production taking place in these two provinces. Selected production capability also exists in proximity to several of the resource centres across Canada.

TABLE I

EMPLOYMENT AND PRODUCTION BY REGION

<u>Region</u>	<u>Establishments</u>		<u>Employment</u>		<u>Production</u>	
	<u>#</u>	<u>%</u>	<u>#</u>	<u>%</u>	<u>\$M</u>	<u>%</u>
Quebec	24	20	1680	28	72	21
Ontario	65	54	3060	51	216	63
Prairie Provinces	17	14	600	10	17	5
British Columbia	14	12	660	11	37	11

The geographical distribution of mining machinery and equipment manufacturing follows very closely the pattern that exist's for the total machinery industry. This reflects the early industrial development pattern which resulted in much of the country's secondary manufacturing industry locating in central Canada. Locational factors affecting mining equipment production are heavily weighted in favour of proximity to skilled labour, materials and technological inputs and services available in the large urban centres rather than to mineral development areas which are widely scattered and often in remote areas.

Since mining equipment firms use large quantities of steel, electrical supplies and instrumentation as well as very large and expensive investment castings, their proximity to suppliers of materials and services contributes significantly to the maintenance of efficient manufacturing operations. For instance, by being close to the source of these principal components and suppliers, equipment producers can avoid the cost of transporting these items over long distances and maintaining them in inventory for extended periods of time. In addition, the cyclical nature of the market for mining equipment has resulted in a regular pattern of subcontracting out of major components as a means of coping with the rapid buildup and subsequent slackening in production. In addition, proximity to good transportation networks is an important factor in view of the need to ship large, bulky items to widely dispersed market areas.

Accordingly, the existence of a well developed network of suppliers and service companies in those urban areas where other

capital goods industries are located has helped to attract mining equipment firms to the area as well.

Nevertheless, where there are plants outside major urban areas, these regional producers initially established near resource developments in order to serve the particular needs of the local resource development. Accordingly, equipment manufacturers can be found in several areas of Northern Ontario and Northern Quebec as well as some western resource centres. These firms initially manufactured bulky custom-made products involving relatively little specialized inputs where proximity to the mine site produced significant cost advantages as well as quick access to needed information. Although changing input factor considerations have altered locational performances, over time these firms have continued to develop in regional areas while expanding their businesses to serve the broader needs of other industries and non-mining markets.

#### Specialization and Integration

The majority of firms engaged in the production of mining equipment are integrated multi-product operations manufacturing machinery for a variety of user industries. For instance, there are very few firms (10 per cent) producing goods solely for the mining industry and these companies account for only 15 per cent of mining equipment production and employment. In all remaining firms, the manufacture of mining equipment is carried out along with other products and for these firms, mining equipment accounts for less than half of their annual production on average.

Producers of mining equipment include some of Canada's largest manufacturers of heavy industrial machinery. The types of products produced by these firms and others generally includes a variety of equipment which although designed or customized for the mining equipment market is similar in nature to equipment used in other processing industries. Accordingly, very few of these firms need to rely heavily on work derived from the mineral industries and can adjust production to take advantage of other markets. Nevertheless, production is noticeably concentrated on equipment for resource based industries, construction, and petroleum and chemical processing industries.

For the most part, specialized mining equipment does not lend itself to mass production nor is it entirely custom made. For certain smaller items (e.g., small pumps and rock drills), where design is basically standard and demand is sufficiently steady, production in short runs for stock is practicable. Larger, more customized, equipment (e.g., crushers, large compressors, and classifiers) are often built to specification on the basis of adaptations from standard plans. In certain instances, machines require complete custom fabrication which on occasion must be performed on the job site.

Production by subsidiary operations in Canada is often a duplication of product lines found in the parent company. However, as a result of corporate rationalization and specialization agreements, Canadian subsidiary operations have become the sole source for entire classes of equipment produced within the corporate organization in several cases. In addition, in close to one-quarter of the foreign controlled companies operating in the sector, Canadian subsidiary operations have partial product responsibility for a limited range of sizes or types of equipment needed within the corporate structure, with a full mandate to market these products in all world markets. In addition, in recent years there has been a trend toward product specialization among Canadian-owned companies. Areas of product specialization include underground trackless material handling and drilling equipment, rubber lined slurry, pumps, small diameter grinding mills, compactors, light portable diamond drilling equipment and off highway and dump trucks.

#### Technological Competence

Canadian mining equipment firms generally have a high level of technical capability, based to a large degree on the availability of foreign technology acquired through corporate affiliation or leasing arrangements. In addition, R & D work being undertaken in Canada by equipment firms has been increasing in recent years. For instance, it would appear that these firms now spend approximately 1.0 per cent of their sales in some form of R & D compared to 0.7 per cent ten years ago. In addition, mining equipment firms have been increasing their R & D expenditures by an average of 11 per cent per year in nominal terms during the same ten year period, about equal to the rate for all machinery firms. Examples of significant product development programs which have been undertaken by mining equipment firms in Canada include: research and development in diamond drilling, underground utility vehicles, electrification of underground material transportation units, and remote control of material loading and transportation equipment.

However, mining equipment firms in Canada undertake only limited long-term R & D programs either individually or in conjunction with their major customers, the mining operators. In this regard, funding limitations and the inability to adequately recover investments would appear to be the major constraints on higher R & D levels for these firms. For instance, the custom engineered nature of much of the mining equipment business makes it difficult for equipment firms to adequately amortize their R & D expenditures over subsequent equipment sales. This is in sharp contrast to the situation of the major mining operators who can usually derive repeated profits from the application of new developments in process technology. In some cases, however, this has also worked to the advantage of mining equipment firms who have successfully tapped into these new developments.



An additional constraint to the establishment of long-term R & D budgets by mining equipment firms relates to the cyclical nature of mining developments. In this regard, the uncertainty surrounding the level and timing of major mining developments mitigates against the establishment of major R & D programs devoted to specialized mining equipment exclusively and has led to R & D programs oriented towards products which serve more than one market.

The subsidiaries which carry out regular R & D in Canada are usually companies with a rationalization agreement with their parent corporation under which the subsidiary has been allocated a product mandate by the corporate organization. At the same time, these firms rely heavily on their corporate relationships to acquire the latest technology that has been developed by the parent company and easy access to this technology has enabled Canadian firms to remain competitive. However, in many cases, this reliance on imported technology, while cost effective, introduces a time lag into the introduction of the latest products, detracts from the ability of subsidiary companies to get quickly into new world markets and leaves them somewhat lacking in indigenous knowledge and experience. In addition, the R & D that subsidiary firms do undertake is often carried out to adapt existing technology to the particular requirements of their major customers. Also, some subsidiary firms acknowledge that R & D activities carried out by Canadian subsidiary firms often involve market related "intelligence" on new process technology acquired from customers so that these can be reflected in product development being undertaken by the parent company.

Similarly, the R & D being undertaken by Canadian-owned mining equipment firms in Canada often involves adopting innovations acquired through licensing arrangements or innovative activity based on particular opportunities arising in the domestic market.

#### Ownership and Control

About 75 per cent of Canadian mining equipment manufacturers are subsidiaries of parent companies located mainly in the U.S. and these firms account for 80 per cent of all production in this sector.

The initial establishment of Canadian-based mining equipment production by foreign firms in Canada was influenced by several factors. In particular, the significant equipment demand provided by the relatively large and diversified Canadian mineral resource base and the fact that the customized nature of most of the equipment required close and regular contact with mining developers was of considerable importance. In addition, manufacturers resident in Canada also obtained attractive tariff rates for exports to certain British Commonwealth resource-based markets, such as Australia and New Zealand.

The ownership pattern of this sector has enabled it to achieve a higher level of overall capability and profitability than

would otherwise have existed, as a result of ready access to the technical, financial and marketing resources of parent corporations. However, in some instances, foreign control has tended to encourage the fragmentation of production and has restricted the range of industrial activities such as market development and R & D activities that subsidiaries could undertake in Canada. In recent years, however, some of these negative aspects have been offset by a number of product specialization or rationalization agreements between U.S. parents and Canadian subsidiary operations.

The effect of foreign ownership on the export performance of Canadian subsidiaries producing mining equipment is significant. For instance, approximately 45 per cent of Canadian subsidiaries are completely free to undertake export sales in any market while 55 per cent are restricted in some manner from pursuing new business outside Canada. Of these restricted firms, 15 per cent are not permitted to export at all, 25 per cent are permitted to export only to the extent that such exports are financed through the Canadian International Development Agency (CIDA) and/or the Export Development Corporation (EDC), while the remaining 15 per cent would appear to have partial export autonomy of an unspecified nature. In addition, exports by subsidiary firms in the sector are often made through corporate sales affiliates or are co-ordinated within the corporate structure in some manner.

MARKET STRUCTURE

The most predominant feature of the mining equipment market is its cyclical nature. Resource development activities are strongly affected by the cyclical nature of world mineral prices as well as the availability and cost of financing. Table II illustrates the pronounced cyclical behaviour of this market as demonstrated by shipments over the last 15 years when compared to the rate of growth of non-resource based machinery products in Canada.

TABLE II

AVERAGE GROWTH IN SHIPMENTS OF MINING EQUIPMENT  
VS. NON-RESOURCE BASED MACHINERY

	1965-1980 (%)	1965-1970 (%)	1970-1975 (%)	1975-1980 (%)
<u>Mining Equipment</u>	12.2	7.2	12.3	15.3
<u>Non-Resource Based Machinery</u>	11.1	10.3	9.8	13.3

The market for mining equipment is to a large degree shaped by the particular requirements of the principal mining developers. The frequent requirement to have major equipment custom engineered or adapted to the individual process or techniques being utilized in the mining operation necessitates close contact between mining engineers, engineer procure contract (EPC) firms and equipment suppliers. For the Canadian mining machinery firms this requirement constitutes a unique problem particularly in their home market since most major resource development companies in Canada are subsidiaries of foreign-based (mostly U.S. firms) often with firmly entrenched procurement biases based on the experience of their foreign parent. In addition, the Engineering Procurement Contracting (EPC) service industry, although growing rapidly, is not yet as well developed in Canada as elsewhere and resource developers are often served by foreign-based consulting firms of this kind. The cumulative effect is to favour foreign-based machinery manufacturers whose reputation is known and accepted or where there has been favourable past experience to rely on.

Price trends in the mining equipment market have generally followed the world inflationary trend and there is no evidence that Canadian equipment prices have risen faster than those of their foreign competitors. In this regard there would appear to be a number of factors working against any significant price differentials between Canadian and foreign producers. In the first instance, mining equipment manufacturers in other countries are very competitive in bidding on Canadian requirements and are often able to quote on major

equipment items with financial assistance from their home governments or through tied financing arrangements. In addition, Canadian mining equipment producers are not protected by tariffs over a wide range of equipment. Also, mining firms are large and sophisticated purchasers and are in a good position to ensure that they acquire equipment at competitive prices.

While price is always an important factor in mining equipment markets, it is often not a determining factor. Less than 25 per cent of the companies surveyed in connection with this review consider price as the most important factor in marketing their product. Most identified "established reputation", "flexibility in meeting customers' particular requirements", and "ability to serve quickly" as the key factors influencing their sales.

Environmental concerns are also a factor that is having an increasing effect on the nature of the mining equipment market. On the one hand increased environmental preoccupations are leading to new equipment sales to deal with pollution control and noise abatement problems. On the other hand mining equipment suppliers have been faced in many cases with reduced markets for their equipment due to cut backs resulting from severe environmental problems in particular mineral industries such as asbestos and copper smelting. In this regard, equipment markets are also adversely affected by delays in the start-up of new projects caused by the lack of effective co-ordination among government jurisdictions involved in providing regulatory approvals governing environmental conditions.

The principal market constraints identified by Canadian mining equipment manufacturers include the short planning periods provided by mining operators in connection with major mineral developments, the difficulty in obtaining reliable market projections, particularly in relation to the timing of new equipment requirements, as well as the uncertain political environment surrounding many new mining ventures in export markets.

#### Domestic Market

The Canadian market with its diverse and growing mineral output is particularly attractive to both domestic and foreign mining equipment manufacturers. Canada is a leading producer of no less than 17 of the world's most important minerals including: copper, iron ore, nickel, gold, potash, zinc, silver, asbestos, and uranium. The exploration, extraction and processing of these ores requires the full range of underground, surface and ore processing equipment and supplies. In this regard the Canadian market for mining machinery and equipment of all kinds in 1980 was approximately \$509 million and overall domestic demand for this equipment has increased by close to 6 per cent per annum from 1965 to 1980 in real terms.

TABLE III

REAL DOMESTIC MARKET FOR MINING EQUIPMENT  
IN NON-ENERGY MINERAL DEVELOPMENT

<u>Year</u>	<u>\$Million*</u>
1965	227.8
1966	296.3
1968	314.8
1970	320.4
1972	333.6
1974	360.2
1976	395.7
1978	331.8
1980	509.2

\* (1980 dollars)

The relative importance of the domestic market for Canadian mining equipment manufacturers appears to vary widely depending on the size and nature of the particular firm. For instance, a majority of the large firms contacted and many smaller ones as well, indicated that the Canadian market does not provide an adequate base to support their business and that at least some export activity is required. As indicated previously, only 15 per cent of the major subsidiaries of foreign firms operating in Canada which were contacted indicated that they did no export business at all. Some smaller firms, many supplying component parts and supplies, rely primarily on the domestic market with export sales undertaken on a very irregular basis. Overall, the export orientation of mining equipment production is 60 per cent.

International Market

While the United States remains Canada's largest market for mining machinery and equipment, the increasing pace of mineral exploration and developments outside North America has provided growing export opportunities for Canadian equipment manufacturers. Canadian mining equipment firms have made substantial export sales in recent years to South and Central America, Australia and the Pacific Rim countries and are making steady progress in the Eastern European countries, Africa and the Middle East.

The increase in the number of new opportunities for the sale of mining machinery in the developing countries has brought Canadian equipment suppliers into very competitive markets where such factors as the availability and competitiveness of Canadian export financing, turnkey capability on the part of manufacturers, and the influence of consulting engineers are of prime importance.

Foreign tariff and non-tariff barriers are very significant for Canadian mining equipment firms when competing in countries with indigenous machinery production capabilities. In particular, companies point to unusually high tariffs in certain Latin American countries notably Mexico and Brazil and to a lesser degree the U.S. market where tariffs can be a problem in specific product areas such as drill steel. In addition, non-tariff barriers such as the Buy America Act in the U.S. and local content provisions in many developing countries are also troublesome to Canadian mining equipment companies. In most developing country markets however, the availability of competitive export financing is of overriding concern to equipment buyers.

Among the several factors influencing the procurement preferences of major foreign purchases of mining equipment, the importance of price as a determining factor in equipment sales would appear to be significantly greater than for the domestic market. While quality, reliability and reputation remain strong factors in the export market, price was regularly stated by firms active in the export market to be the most important factor. In this regard, the importance of having competitive export financing available was regularly stressed.

Engineering consultants and EPC firms also play a major role in determining the source of mining equipment which is acquired for new foreign mining developments. This is especially so in developing countries where resource developers often lack sufficient resident engineering expertise to manage the total planning design and procurement phase of these projects. In these circumstances the nationality of the consulting firms undertaking the planning function is often a critical factor influencing the purchase decision since there will be a natural tendency for consultants to specify equipment and services with which they are familiar. Canadian consulting firms are becoming progressively more active in this field and are generally regarded as being supportive by Canadian equipment manufacturers.

SECTOR PERFORMANCE

Overall Performance

Shipments of mining equipment products were \$342.0 million in 1980 as compared to \$60.5 million in 1965 and production in 1980 represented 4.0 per cent of the total production of all machinery products in Canada. The sector grew at an average annual nominal rate of 12 per cent during the 15-year period, slightly higher than the 11 per cent average rate of growth experienced by the total machinery industry in the same period of time. Imports of mining equipment during this period increased substantially faster however moving from \$47.4 million to \$372.4 million (15 per cent annual increase) and increasing their share of the Canadian market from 52 per cent in 1965 to 73 per cent in 1980.

At the same time, exports grew from \$17.2 to \$205.2 million for an average annual rate of growth of 18 per cent or slightly higher than the 17 per cent growth in exports for all machinery in the same 15-year period. In this regard the export orientation of mining equipment products has moved up sharply from 28 per cent in 1965 to a position where fully 60 per cent of all mining equipment produced in Canada is now sold in the export market.

When pronounced cyclical effects are removed from the data, the performance trends in the mining equipment sector over the longer period follow closely the trend for all machinery products reflecting a pattern of increasing import penetration substantially offset by rising exports. In terms of domestic market share, the mining equipment sector has dropped from 47.8 per cent of the domestic market in 1965 to 26.9 per cent in 1980. However, by measuring the implicit self-sufficiency of the sector, i.e., the ratio of production (including exports) to the domestic market, the overall performance of the mining equipment sector can be presented from a different and more positive perspective. In this regard, the sector has expanded at a rate slightly faster than the domestic market, moving from an implicit self-sufficiency of 66.7 per cent in 1965 to 67.2 per cent in 1980, while during the same period, the implicit self-sufficiency of all machinery products has moved down from 57.6 per cent in 1965 to 54.7 per cent in 1980.

TABLE IV

MINING MACHINERY AND EQUIPMENT

	1965	1970	1975	1980	AVERAGE ANNUAL INCREASE %			
					65-80	65-70	70-75	75-80
	(\$ MILLION)							
Shipments	60.5	85.6	167.8	342.0(e)	12.2	7.2	14.4	15.3
Exports	17.2	30.1	84.8	205.2	18.0	11.8	23.4	19.3
Imports	47.4	84.8	183.1	372.4	14.7	12.3	16.6	15.3
Domestic Market	90.7	140.3	266.1	509.2	12.2	9.1	13.7	13.9
Exports/% of Shipments	28.4%	35.2%	50.5%	60.0%				
Imports/% of Domestic Market	52.2%	60.4%	68.8%	73.1%				
Implicit Self-Sufficiency	66.7%	61.0%	63.1%	67.2%				

(e) Estimate

TOTAL MACHINERY AND EQUIPMENT

	1965	1970	1975	1980	AVERAGE ANNUAL INCREASE %			
					65-80	65-70	70-75	75-80
	(\$ MILLION)							
Shipments	1814.9	2685.1	4723.6	8608.6(e)	10.9	8.1	12.0	12.8
Exports	364.8	690.3	1705.6	3765.3	16.8	13.6	19.8	17.1
Imports	1699.2	2252.7	5522.6	10908.4	13.2	5.8	19.6	14.6
Domestic Market	3149.3	4247.5	8540.6	15751.7	11.3	6.2	14.7	13.0
Exports/% of Shipments	20.1%	25.7%	36.1%	43.7%				
Imports/% of Domestic Market	54.0%	53.0%	64.7%	69.3%				
Implicit Self-Sufficiency	57.6%	63.2%	55.3%	54.7%				

(e) Estimate



Production

Overall production in mining equipment has grown at an average annual rate of 12 per cent during the period between 1965 and 1980. Production in 1980 by class of equipment is approximately as described below.

	<u>PRODUCTION - 1980</u> ( \$ Million )	
<u>UNDERGROUND MINING</u>	(23%)	78.7
Mining shaft conveyances and equipment, blast hole drilling equipment, extraction and bulk material handling, low profile dumptrucks, passenger carriers, load hall dump units		
<u>OPEN PIT MINING</u>	(20%)	68.4
Drill rigs, extraction and bulk material handling, draglines, power sources, large size conveyor systems		
<u>MINERAL BENEFICIATION</u>	(35%)	118.0
Grinding, crushing, flotation equipment, classifiers		
<u>SMELTING AND REFINING</u>	(15%)	53.0
<u>GENERAL PURPOSE EQUIPMENT</u>	( 7%)	23.9
Pumps, compressors		
<u>TOTAL</u>	<u>100%</u>	<u>342.0(e)</u>

(e) Estimate

Exports

The growing volume of export trade in mining machinery reflects the increasing significance of major new offshore mineral developments particularly in many third world countries. While the United States remains Canada's most important export market, and in fact has steadily increased its share of Canadian exports of mining equipment, there have been increasing exports to many world markets including: Mexico, Latin America, Australia, North Africa, and the Middle East. Table V indicates the shift in the volume and proportion of Canadian mining equipment exports by major market.

TABLE V

MINING MACHINERY AND EQUIPMENT EXPORTS

<u>Market Areas</u>	1975-79 (\$ Million)	Ranking %	1970-74 (\$ Million)	Ranking %
United States	273.2	54.2	75.5	41.2
South and Central America	76.0	15.1	39.7	21.7
Africa and Middle East	51.2	10.2	18.2	9.9
Western Europe	42.6	8.4	21.8	11.9
Pacific Rim	35.1	7.0	7.9	4.3
Australia and New Zealand	11.4	2.3	13.7	7.5
Eastern Europe	2.2	0.4	0.9	0.5
Others	<u>12.4</u>	<u>2.4</u>	<u>5.4</u>	<u>3.0</u>
<u>TOTAL</u>	<u>504.1</u>	<u>100.0</u>	<u>183.1</u>	<u>100.0</u>

The growing importance of the U.S. as a market for Canadian mining equipment manufacturers should be noted. The success of Canadian equipment suppliers in this market closely reflects the trend toward specialization in the sector, particularly in the area of hard rock drilling and related equipment. At the same time, it is apparent that a substantial volume of exports is in the form of intra-corporate shipments of components and parts by subsidiaries to U.S. parent equipment firms who have secured a turnkey position in other foreign markets. Viewed from this perspective, growing reliance on the American market for this kind of trade may represent lost opportunities to play a more direct role as major suppliers on large new developments in other foreign markets.

TABLE VI

MINING MACHINERY AND EQUIPMENT  
EXPORTS BY PRODUCT TYPE

	1971		1980		1971-1980 % AVG. ANN. GROWTH
	\$	%Distr.	\$	%Distr.	
Core drills, bits and parts	1.8	6.7	7.7	3.8	17.5
Rock drills and parts	2.3	8.6	32.0	15.6	34.0
Rock drill bits n.e.s.	1.9	7.1	5.8	2.8	13.2
Earth drilling boring	4.7	17.8	94.9	46.2	39.6
Mining, crushing, milling, quarrying, ore processing machinery and parts n.e.s.	16.1	59.8	64.8	31.6	16.7
TOTAL	26.8	100.0	205.2	100.0	25.4
EXPORT ORIENTATION	31.0%		60.0%		

Production drilling equipment, core drills, rock drill bits and parts accounted for about two-thirds of Canadian exports of mining machinery and equipment in the ten-year period between 1971-1980 with average annual growth equal to 33 per cent during this period. The remaining one-third of mining equipment exports were made up of a wide variety of mineral processing equipment such as crushing and milling machinery, quarrying and ore processing equipment and parts which increased on average about 17 per cent during the same period.

The shift in the balance of exports underlines the trend towards a specialization in drilling equipment, particularly hard rock drilling where Canada has achieved a considerable international reputation in recent years.

Imports

Imports now account for about 75 per cent of all mining equipment used in Canada as compared to 50 per cent in 1965 and imports have grown at a 14.7 per cent annual average rate since 1965 about the same growth for all machinery imports during the same period of time.

Import penetration of the domestic market is significant in all areas of mining machinery and equipment as outlined in Table VII.

TABLE VII

MINING MACHINERY AND EQUIPMENT  
IMPORTS BY PRODUCT TYPE

	1971		1980		1971-1980 % AVG. ANN. GROWTH
	\$	%Distr.	\$	%Distr.	
Core drills, bits and parts	0.3	0.3	3.8	1.0	32.6
Rock drills and parts	22.6	25.7	61.1	16.4	11.7
Rock drill, bits n.e.s.	15.7	17.8	101.0	27.1	23.0
Earth drilling boring	3.7	4.2	31.6	8.5	26.9
Crushing and milling machinery	15.9	18.1	37.1	10.0	9.9
Mining, quarrying and ore processing	29.8	33.9	137.8	37.0	18.5
TOTAL	88.0	100.0	372.4	100.0	17.4
IMPORT PENETRATION	59.0%		73.0%		

While imports are occurring over the entire range of equipment items, the heaviest import concentration tends to be in several major product areas which include open pit rotary drills, large capacity shovels, bucket wheel excavators and draglines, load haul dump units, rotary tunnel boring equipment, and a range of processing equipment such as classifier screens, special dryers and electrostatic precipitators. In addition to these products, components such as

diesel engines, hydraulic controls, and instrumentation acquired for equipment which is assembled in Canada also contributes significantly to the overall value of imported equipment related to this sector.

TABLE VIII

MINING MACHINERY AND EQUIPMENT  
IMPORTS BY MAJOR COUNTRY OF ORIGIN

	<u>1970</u>	<u>1980</u>	<u>Average Annual</u>
	<u>(\$ Millions)</u>		<u>Growth</u>
			<u>(%)</u>
United States	69.3	291.0	15.4
West Germany	3.4	33.6	25.7
United Kingdom	8.3	17.2	7.6
Sweden	1.2	11.5	25.4
Finland	N/A	3.3	N/A
Japan	N/A	2.6	N/A

MEDIUM TERM OUTLOOK

Domestic Market

Major new mineral developments planned for Canada in the coming decade should provide a major stimulus to the demand for mining machinery and equipment. Total new investments in a wide range of resource projects which utilize conventional mining processes, both underground and surface, are estimated to be in excess of \$50 billion during the next ten years. This is more than double the capital requirement of the 1970's.\*

TABLE IX

INVESTMENT\*

	<u>1970-1979</u>	<u>1980-1990</u>
	<u>(\$ Billion)</u>	
Non-fuel minerals	19.5	40.0
Uranium	N/A	3.0
Coal	N/A	10.0

\* In equivalent 1979 dollars

The substantial increase reflected in these investment projections results from an expected gradual but extended increase for most metal prices in world markets as these recover from the relatively depressed levels which existed during the 1970's. In addition, a strong push for thermal coal which will result from the need to reduce oil dependency in the major developed economies, as well as long awaited oil sands developments aimed at achieving self-sufficiency in oil consumption in Canada, should considerably strengthen mineral output derived by mining methods.

Accordingly, it is expected that the domestic market for mining machinery and equipment will grow from \$509.2 million in 1980 to \$911.0 million by 1990 in 1980 dollars, an average annual increase of 6 per cent. This is higher than the previous ten-year average growth of 5 per cent and also ahead of the growth expected to 1990 in the market for all machinery products of approximately 5 per cent in real terms.

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\* Source: Energy, Mines and Resources

While increased domestic demand for mining machinery and equipment will represent significant opportunities for Canadian equipment producers, the degree to which these opportunities can be realized by Canadian firms is an important question. For the non-fuel mineral developments for instance, Canadian firms should be in good competitive position as product coverage for a wide range of equipment utilized in the extraction and processing of these minerals is available from Canadian production. On the other hand, the opportunities for Canadian manufacturers to participate in supplying the machinery needs of the large open pit operations and the over size equipment requirements of the oil sands developments is more questionable. These developments will require Canadian manufacturers to compete head on with the world's largest integrated machinery and equipment producers with long established reputations in product areas requiring huge capital outlays. In any event, product areas which are considered to have above average growth potential during the coming decade include rotary blast hole drills, crawling drag lines, bulk conveyors and several items of mineral beneficiation equipment such as flotation cells and centrifugal dryers.

#### International Market

Based on the industry's established growth pattern, exports of mining equipment could grow from \$205 million in 1980 to \$367 million by 1990, an average annual increase of 6 per cent in real terms if significant additions are made to the range of Canadian-produced equipment. To a large extent, however, the realization of these export predictions hinge on the outlook in the U.S., Canada's largest foreign market for mining machinery and equipment. In this regard, much of the growth expected in mining activity in this market is expected to be in coal production, and will depend to a significant degree on whether the U.S. turns to coal to meet its future energy needs. Should this trend materialize, many of these new developments will involve vast new surface coal mine projects in the western states and the ability of Canadian equipment firms to obtain a reasonable portion of this potential market will depend on major new investments. An interesting aspect of these developments is that, by the end of the decade, surface mining equipment requirements in the U.S. are expected to be double that of underground mining equipment. Here again, the implications of this trend on the Canadian mining equipment sector are troublesome given Canada's relative weakness in open pit equipment capability.

In developing countries as well, new market opportunities, while attractive, will require Canadian equipment firms to meet increased competition from other foreign suppliers, in many cases armed with very favourable financing terms provided by their home governments.

Accordingly, while the industry should continue to achieve success in export markets there will be increasing pressure to enter into the production of products not previously manufactured in Canada, in order to meet shifting world demand patterns and to promote export sales vigorously to meet well established international competition.

### Technological Developments

The design and development of new mining machinery and equipment will be influenced, as in most areas of machinery production, by changes occurring in the demand patterns of user industries. For the mining equipment sector these changes are not likely to be revolutionary, but will require orderly adjustment to mining conditions which call for more efficient, larger, safer and environmentally acceptable machinery and equipment.

In particular, it is expected that during the forecast period progressively higher fuel and energy costs will require mine operators to continually evaluate the comparative costs of mine haulage by vehicles, mine cars and conveyors. The relative efficiency of each haulage method will affect the future demand mix for mining machinery. In addition, as lower grade ores are mined there will be a requirement for high capacity and energy efficient ore processing and beneficiation equipment to produce concentrates or refined products that can be economically shipped to smelters.

Of particular interest to Canadian mining equipment firms is the fact that much of Canadian base metal production comes from underground mines, and deeper mines will be increasingly required as higher grade and easily accessible ore bodies become exhausted. This new geological environment will require improved underground drilling equipment, more efficient material handling equipment as well as new developments related to increased ventilation and environmental requirements.

Energy conservation will also lead to new ore processing methods which will require equipment developed for or adapted to these new techniques. These new methods can be expected to evolve as individual mines review their operations in relation to energy use in order to continue to produce metals and minerals at the lowest costs possible. Mine safety will continue to be a major consideration in determining mining methods and therefore will have significant influence over the design of mining machinery. New safety features such as reinforced operator cabs, high intensity lights, and unique roof support systems, among others, will continue to be important areas



for the application of new technology. In the longer term, there will also be a requirement for new developments related to resource recovery systems which will recover metals and minerals from municipal waste.

Finally, it is expected that ocean mining will increase in importance during the forecast period and will bring with it the demand for a new breed of mining equipment. Some of the techniques and equipment presently used in offshore oil exploration and subsea production systems can be modified for use in exploring for metal and mineral nodules from the ocean floor. This area of equipment supply may offer important opportunities for Canada since the offshore petroleum equipment industry is developing rapidly in this country and an extension of this sector to the needs of ocean mining would appear to warrant consideration.

#### Summary of Outlook

On the basis of projected market trends total Canadian production of mining equipment is expected to grow at an average annual rate of 7 per cent in real terms from \$342 million in 1980 to \$672 million in 1990 and exports are expected to account for 55 per cent of this production. At the same time imports are expected to increase at 5 per cent annually from \$372 million in 1980 to \$606 million by 1990, all rates in real terms. While imports will continue to take a substantial portion of the domestic market, import penetration is expected to drop from 75 per cent of the market to approximately 65 per cent by 1990.

### MAJOR ISSUES

The foregoing review of the nature and outlook for the mining equipment sector in Canada indicates that this sector should continue to experience substantial growth in the years immediately ahead. It is possible however, to identify several structural and market constraints which, more than any others, appear to be preventing the sector from reaching its full potential. In this regard the major issues include:

- (1) the severe and increasing import competition in the domestic market;
- (2) the structural imbalance of the major foreign-owned subsidiaries which is reflected in restricted product coverage and export mandates, insufficient indigenous R & D and market development, and to some extent insufficient assembly-type operations, with low Canadian value added;
- (3) lack of international stature of many of the smaller, mostly Canadian-owned firms; and
- (4) the lack of any significant presence in many new high technology and growth areas at the leading edge of several future demand areas.

### Import Penetration

The extensive and sharply increasing import penetration of foreign produced mining machinery and equipment signals a long term concern for this sector. Imports have more than doubled in value over the five-year period between 1975 and 1980 and imports now take 75 per cent of the domestic market. As indicated earlier, imports are occurring in all major categories of mining equipment but are particularly heavy in areas where there is little or no domestic supply capability such as large scale equipment for open pit mining operations and several areas of specialized large underground machines such as complex underground tunnelling equipment. Imports are also occurring through the acquisition of large quantities of major component parts such as engines and hydraulic power trains and controls for mining equipment, much of which is being assembled in Canada by subsidiaries producing to their parent company's design.

The reasons for the propensity to import mining machinery and equipment are many and varied and for the most part are common to those influencing the Canadian market for machinery of all kinds. In the mining equipment sector, however, the most important factors include:

- (i) reluctance on the part of major mining developers to experiment with untried machines, preferring the more established reputation of large international equipment firms;
- (ii) the relative lack of turnkey capability in the Canadian mining equipment sector which prevents the provision of complete packages of equipment, particularly for integrated mineral processing plants; and,
- (iii) the absence of Canadian supply capability in several major equipment categories;
- (iv) tied or concessional financing arrangements provided by foreign governments on major domestic resource projects which favour the purchase of foreign equipment;

A major consequence of the severe import penetration into the Canadian market concerns the inability of equipment manufacturers in Canada to use their home market as a base for future growth. In this regard, the declining portion of the domestic market being served by Canadian manufacturers has increasingly prevented these firms from taking advantage of the high level of technology present in major resource development firms by inhibiting the development of new equipment based on Canadian process technology. Should this trend continue, the long-term result will be even further reliance on foreign technology and missed opportunity to get in on the ground floor of new equipment development which will lead to increasingly constrained growth prospects in both the domestic and foreign markets.

#### Structural Imbalance of Subsidiary Operations

The mining equipment sector is dominated by a small number of relatively large subsidiaries of MNEs with approximately a dozen firms accounting for 75 per cent of overall production. These firms demonstrate elements of structural imbalance similar to those found in subsidiaries in other sectors of the machinery industry and to a significant degree, in other areas of Canadian manufacturing.

In this regard, the inability of many subsidiaries of foreign owned firms to achieve complete export freedom or to develop indigenous R & D capability and marketing infrastructure has adverse implications for their development. Limitations of this kind are preventing these companies from engaging in the full range of product development and marketing activities needed to establish their continuing presence and hence their reputation in both the domestic and world markets. In addition, the nature of subsidiary operations, together with duty free access for a wide range of foreign mining machinery and equipment products, adds considerably to the difficulty in persuading these firms to commit much needed new investment in specialized or rationalized

production in Canada as opposed to expanding production in their home market.

In this regard, the Canadian management of subsidiaries will need to obtain commitments from their corporate parents for extensive new investment in Canadian production capability for a broadened range of products including significantly expanded R & D activities. In addition, subsidiary firms will need to be encouraged to undertake a more active role in multilaterally financed resource projects abroad and in turnkey operations.

#### Weaknesses of Small Canadian-Owned Firms

For the large number of small producers of mining equipment, the issues relate more directly to their relatively weak financial structure and hence their inability to match the international stature of their major competitors. In this regard, the need to tie up working capital to fill orders for large machines produced over extended periods of time, heavy costs for feasibility studies for supplying major resource projects, as well as the need to maintain large engineering staff during regular cyclical downturns, are all factors which constrain equipment manufacturers from developing at a faster rate.

These firms will need to be encouraged to assume the risks and high costs of maintaining larger scale product development programs, undertaking more extensive and continuous export development efforts and introducing productivity improvements to their operations, as means of competing more effectively against larger international firms.

#### Tariff Protection

The absence of effective tariff protection in the Canadian market for a broad range of mining machinery and equipment has been a long standing issue of concern to equipment manufacturers.

The present tariff schedule provides for substantially reduced tariff rates and in many instances no tariff protection at all, for approximately 70 per cent of all mining machinery and equipment imported specifically for use by the mineral industries. The origin of this special treatment dates back many years and is largely in recognition of the need to help mining companies moderate the unusually heavy cost and risk associated with mineral exploration and development, particularly in view of the fact that a large proportion of mineral production is sold in the export market.

At the same time it is possible that, as a result of this tariff policy, the Canadian mining equipment sector may not have

developed as fully as might otherwise have been the case. In the view of many firms in the sector there is a need to improve the tariff structure to provide for effective protection to the equipment sector particularly during the period when firms undertake early development and marketing of new products.

In contrast to the openness of the domestic market, the protection provided to indigenous equipment firms in the home market of Canada's major foreign competitors appears to be substantial. For instance, procurement preferences, such as the Buy America Act in the United States and subsidized pricing arrangements in favour of local manufacturers in many EEC countries, serve to provide a large measure of protection to these firms.

CONCLUSIONS AND OBSERVATIONS

While it is not the purpose of this report to outline specific policy options which could be developed to meet the needs of the mining equipment industry, it may be appropriate by way of conclusion to state very briefly some of the factors which appear to emerge from the foregoing analysis. These factors are:

- (a) The competitive and economic environment factors that govern the production of mining equipment are those that pertain to the machinery industry and by extension to manufacturing in general.
- (b) Much of the capital equipment used in minerals development is multi-purpose heavy equipment serving a variety of resource and industrial markets. Accordingly, investment decisions related to the production of equipment in Canada should take account of market forces across a wider range of user industries than minerals development alone.
- (c) There is a need for greater co-operation between the minerals industry and machinery producers in order to provide a link-up between equipment supply and mining process technology developments and to counter the traditional import bias which has existed in some mining development companies in Canada and in the EPC firms which serve them. In addition, a greater reliance by equipment suppliers on a firm domestic market base will be required in order to support meaningful R & D activities and carry out long-range investment planning.
- (d) It is essential to continue to encourage the export orientation of the industry. While the industry will face its major challenge in recapturing a representative share of the domestic market, investment in new machinery production capabilities can only be supported by exploiting opportunities in both the domestic and export markets.
- (e) A selective approach is required in extending the range of minerals equipment produced in Canada, one which recognizes the need to effect a significant reorientation of Canadian capabilities towards new high growth products, principally in several areas of surface mining and mineral beneficiation.
- (f) If a meaningful restructuring of this sector is to be achieved, major new investments in Canada by firms possessing advanced technological knowhow will be required. At the moment, the existence of large manufacturing facilities abroad -- particularly for technically advanced equipment -- acts as a disincentive to the creation of new rationalization production units in Canada.

APPENDIX A

MINING EQUIPMENT AVAILABLE FROM CANADIAN PRODUCTION

A. EXPLORATION

Canadian supply capability for diamond core drilling machinery and ancilliary equipment for exploratory activity is particularly strong with numerous Canadian firms producing all the requirements of this aspect of mining activity. Canadian content for diamond core drilling rigs is estimated to be in the order of 80 per cent; import requirements include certain specialized hydraulic components. Diamond core bits have a Canadian content of approximately 40 per cent, due mainly to the cost of diamonds which are imported by necessity, while other ancilliary drilling equipment (e.g., core barrels and rill rods) are produced in Canada with virtually complete Canadian content.

B. OPEN PIT MINING

Canadian equipment supply capabilities for open pit mining operations vary considerably depending on the requirements specified in any particular operation. However, it is considered that, on average, Canadian producers could supply some 50 per cent of the total requirement needs of open pit mining developments.

(1) Drill Rigs

Canadian supply capabilities are very weak for drilling equipment. Rotary blast hole drill rigs of a size used in open pit mining (e.g., utilizing drills with a 5 inch to 17½ inch diameter and for depths of more than 30 feet) and large tri cone drill bits (exceeding 7 inches) are not available from Canadian production. Participation by Canadian producers in this aspect of open pit activity is limited to the supply of drill rod and the possible utilization of Canadian steel in the fabrication of the drill rigs.

(2) Extraction and Bulk Materials Handling Equipment

2.1 Drag Lines

There are no Canadian producers of drag lines of the size required for open pit mining operations. However, since large capacity drag lines require on-site erection, Canadian components (notably tracks, buckets and structural steel) are utilized in varying degrees; it is estimated that a possible Canadian content of 30 per cent of the total installed value is achievable.

## 2.2 Feeders - Stackers - Reclaimers

Feeders, stackers and reclaimers are used extensively in open pit and underground as well as concentration operations. Canadian production of this equipment, available from several firms, is capable of fulfilling all of the mineral industries requirements. Canadian content in producing such equipment is over 80 per cent.

## 2.3 Power Shovels, Front End Loaders, Road Graders and Bulldozers

Hydraulic power shovels with capacities of up to 20 cubic yards are produced in Canada with an estimated Canadian content of 65 per cent; imported components required for production are power trains, e.g., engines, transmissions, etc. However large shovels, typical of the sizes used in open pit mining operations, are currently imported.

Front end wheel loaders are available from four Canadian manufacturers in sizes up to and including 14 cubic yards. Demand for sizes above the range is limited. Canadian content averages some 40 per cent due to the fact that major production components, e.g., engines, transmissions, axles, differentials and hydraulics, are not available in Canada.

Road grader production in Canada while it is limited to the activity of only one firm is sufficient to meet the total demands of the Canadian market. Domestic content in this production is over 80 per cent with only engines being imported.

Bulldozers are not produced in Canada.

## 2.4 Off-Highway Vehicles

Off-highway haulage vehicles with load capabilities of up to 300 tons are available from Canadian production and have a domestic content in excess of 50 per cent. Imports of engines, transmissions, axles and differentials are necessary and are facilitated through the Off-Highway Vehicles Remission Order which provides duty-free entry on the basis of Canadian production and value added requirements.

## 2.5 Conveyor Systems

There are a number of large Canadian producers of bulk conveyor systems capable of providing the entire requirements of the mineral industry. Canadian content is in excess of 90 per cent.

## C. UNDERGROUND MINING

Canadian producers have the capability of providing close to three-quarters of the equipment requirements for most underground metal mining operations. A few large foreign firms dominate the world market for the very specialized and high-cost equipment used in



underground coal extraction. Canadian capabilities do exist, however, in the production of various component parts to the extent that Canadian content would be approximately 25 per cent of the equipment needs for a longwall underground coal operation.

(1) Mine Shaft Conveyances and Equipment

Shaft conveyances and associated equipment, which would include such items as skips, cages, loading pockets, dump plates, sheaves, are all available from Canadian production at virtually 100 per cent Canadian content. Similarly, Canadian production can supply the complete requirements for mine hoists (single and double drum and friction type). Canadian content for those hoists made in Canada is estimated to be some 90 to 95 per cent.

(2) Blast Hole Drilling Equipment

2.1 Drill Jumbos

Large drill jumbos for underground blast hole drilling are available in electric/hydraulic, hydraulic and pneumatic form to fulfill the total Canadian demand for such equipment. Canadian content represents some 70 per cent of the value of large hydraulic or pneumatic drill jumbo production.

Smaller drill jumbo units, such as the "Long Tom", are also widely available from Canadian production with Canadian content equal to or greater than that realized in the production of the larger units.

Drill jumbo carriers are available from two Canadian sources with a Canadian content of some 75 per cent.

Major component imports for drill jumbo production include diesel engines, drive trane components, portions of hydraulics and drills having a piston diameter greater than 2 5/8 inches.

2.2 Raise Climbers

Raise climbers, Alimak type, are produced in Canada and have a Canadian content estimated at 80 per cent; imported components would include portions of the hydraulics.

2.3 Drills

Light-duty model pneumatic percussion drills (up to a diameter of 2 5/8 inches) used to drill blast holes are available from Canadian production. However, long hole (20 to 80 feet) pneumatic or hydraulic drills normally of sizes exceeding 2 1/2 inches in diameter are not available from producers in Canada.

Hydraulic drills, which are increasingly being preferred over pneumatic drills, are not produced in Canada. In addition, "down-the-hole" drills are not produced in Canada.

(3) Extraction and Bulk Materials Handling Equipment

The complete track-type mine car requirements for both surface and underground mining applications are produced in Canada with virtually total Canadian content. However, locomotives are not available from Canadian production.

Low profile end dump trucks with capacities up to 50 tons, rubber-tired personnel carriers and service vehicles (e.g., scissor lift-trucks) are available from Canadian production. Canadian content for such production is approximately 60 per cent with major component imports being engines, axles, and transmissions.

Diesel load-haul-dump vehicles (LHD), with a capacity of up to 8 cubic yards, and electric LHD units, up to 5 cubic yard capacities, are available from Canadian production. Imported components include portions of the hydraulics for both the diesel and electric units in addition to engines and drive trains for the diesel LHD unit; Canadian content for the diesel LHD unit is approximately 60 per cent and for the electric LHD unit 85 per cent.

Special underground overhead loaders (mucking machines) used primarily for loading ore and waste from development headings and stope draw-points are not available from Canadian production.

Slushers, both air and electric of up to 250 hp which fulfill the complete requirements of the mining industries needs are produced in Canada with some 90 per cent Canadian content; major imported components are bearings.

Scrapers are also available from Canadian production utilizing total Canadian parts.

(4) Pumps

Canadian supply capabilities exist for multi-stage centrifugal dewatering pumps used extensively in underground mining operations. Canadian content achieved in such products is estimated to be over 80 per cent with rough castings, bearings and seals being imported.

(5) Compressors

Compressors and their drivers (electric motors are used extensively in mining applications) are available from Canadian manufacturers with a high Canadian content. Portable air compressors are also widely used by mining operations and these also are readily available from Canadian producers. However, some very high capacity

portable air compressor requirements are not provided from current domestic production due to the low level of demand.

D. CONCENTRATING

Engineering requirements for concentrating are complex and highly specialized with the technology residing primarily with mining operations and engineering consulting firms. Canadian equipment manufacturers can provide the required machinery having an overall Canadian content exceeding 80 per cent for complete ferrous and non-ferrous concentrators.

(1) Crushers

For the most part, the various types of crushers used in the different stages of crushing operations are widely available from Canadian producers. These include jaw and gyratory crushers normally used in the primary crushing stage and cone and impact crushers utilized in the secondary and tertiary stages. Production of this type of equipment achieves virtually 100 per cent Canadian content with common component import requirements being bearings.

Crushers for the coal mining industry are produced under licence in Canada with virtually 100 per cent Canadian content.

(2) Grinding Mills

Canadian production can supply the complete requirements for grinding mill operations, either ball, rod pebble or autogenous. Major imported component include the peripheral gears; Canadian content in the production of grinding mills exceeds 90 per cent.

(3) Vibrating Screens and Ore Sorters

There are several Canadian producers of single and multiple deck vibrating screens providing the complete requirements of the mineral processing industry. Canadian content for such production approximates 70 to 75 per cent. Major component imports are the vibrating mechanisms.

(4) Flotation Cells, Launderers, Aerators, Mixers

Canadian production can provide for all the requirements for flotation cells, launders, aerators and mixers with Canadian content being in the range of 75 to 100 per cent. The major imported components are the agitation mechanisms.

(5) Filtration (Thickeners, Filters, Agitators and Clarifiers)

The various equipment used in the filtration stage is widely available from Canadian producers with an average Canadian content ranging from 75 to 85 per cent.

(6) Pumps

Slurry pumps widely used in concentration operations are produced in Canada by several manufacturers. In addition, other pump needs (e.g., diaphragm and re-agent pumps) are also available from Canadian production. Canadian content for pump production ranges from 70 to 80 per cent; major component import being bearings and, where applicable, rubber lining.

(7) Furnaces, Roasters, Dryers

The Canadian supply capabilities noted above apply particularly to copper, lead and zinc milling operations. Processing of minerals has additional specialized equipment needs. In this regard, asbestos milling requires a multiple crushing operation to avoid damaging the fibre with separation accomplished by forced air. Complete asbestos milling equipment requirements can be provided from Canadian production with Canadian content over 90 per cent.

For uranium milling, while the crushing and grinding stage utilizes the same equipment as for non-ferrous metal processing, the flotation process is omitted and separation is accomplished by means of ionization. The ion exchange units which fulfill this function are not manufactured in Canada.

E. SMELTING AND REFINING

(1) Non-Ferrous Metals

The major equipment requirements for smelting operations are made to individual user specifications. Canadian manufacturers can provide this custom fabrication on a very competitive basis for the full range of smelting equipment requirements. However, the lack of complete access to technology, which is closely guarded under licences by resource companies, has limited the development of Canadian production capability for smelting equipment, particularly for lead smelting.

The traditional copper smelting process involves three main phases each involving major equipment components -- roaster, reverberatory furnace and converter furnace. Following these stages the purified copper is passed through a kiln before refining. Canadian manufacturers have the capabilities to provide for the equipment requirement for stages of the traditional copper smelting process.

The traditional method of smelting copper is however, being replaced by continuous smelting processes which eliminate the various traditional smelting stages described above. Several continuous copper smelting processes have been developed by Canadian resource companies: Noranda's rotating reactor process; Inco's flash smelting process and Sheritt Gordon/Cominco's chemical process. While the machinery and equipment necessary for each of these processes varies considerably, Canadian producers are capable of providing all such requirements. Indeed, the fact that these technologies are resident in Canada should enhance the competitiveness and expertise of Canadian equipment manufacturers.

While Canadian equipment supply capabilities for lead smelting varies depending on the particular process used, overall, Canadian producers enjoy limited capability in providing lead smelting equipment as the majority of lead smelting processes are based on foreign technology.

On the other hand, Canadian producers have considerable competence in providing equipment for zinc smelting operations.

Process technology involved in nickel smelting is dominated by Canadian resource companies (i.e., Inco, Sheritt Gordon and Falconbridge) with the result that Canadian machinery firms have actively participated in providing the varied equipment needs.

Machinery and equipment used in the refining of copper, lead, zinc, nickel, gold and silver is widely available from Canadian producers.

MAJOR ITEMS OF MINING EQUIPMENT  
NOT AVAILABLE FROM CANADIAN PRODUCTION

Exploration

- All diamonds are imported

Extraction

(a) Open Pit Mining

- Shovels (with capacity exceeding 20 cubic yards)
- Draglines
- Open pit rotary blast hole drills (with capacity to drill a 3 to 17 inch hole to 30 feet plus)
- Tri cone drill bits (exceeding 7 inches)

(b) Underground Mining

- Underground locomotives (diesel, battery and trolley types)
- Full face circular tunnel and raise boring machines
- All types of underground coal excavators and ancilliary equipment
- Single/double face excavators (as for potash extraction)
- Pneumatic percussion blast hole drills
- Hydraulic blast hole drills
- Underground overhead loaders
- High head high volume centrifugal pumps

Concentration, Smelting and Refining

- Special crushers (impactors, pulverizers, hammer mills)
- Specialized control and instrumentation equipment
- Specialized furnaces, roasters and dryers, converters

APPENDIX C

CANADIAN MANUFACTURERS OF MINING  
MACHINERY AND EQUIPMENT

Abex Industries	Dux Machinery Corporation
Aerofall Mills Ltd.	Elliott Rubber & Plastics Ltd.,
Alcore Fabricating Ltd.	Division of Allis-Chalmers Canada
Allis-Chalmers Canada Ltd.	Envirotech Canada Ltd.
Atlas Steel Company	Eriez of Canada
Atlas Copco Ltd.	Esco Ltd.
Albany Engineered Systems	Euclid Canada Ltd.
Ajax Magnethermics Ltd.	Fahralloy Canada Ltd.
Armco Canada Ltd.	Forano Limited
Auburn Equipment Ltd.	Foster Wheeler Ltd.
Archimedes Machine Shop Ltd.	Fournier Asbestos Equipment Ltd.
Babcock Allatt Ltd.	FMC of Canada Ltd.
Bex Engineering Ltd.	Gas Machinery Ltd.
Boart Hardmetals (Canada) Ltd.	Gardner-Denver Co. (Canada) Ltd.
Boothe Engineering Co. Ltd.	Gatx-Fuller Ltd.
Boyles Operations, Division of Dresser Industries Canada Ltd.	General Motors of Canada Ltd.
Bauer (C-E Bauer Ltd.)	Greey Mixing Equipment Ltd.
Barber Industries Ltd.	Hazemag (Canada) Ltd.
Breco Ropeways Canada Ltd.	Hawker Siddeley Canada Ltd.
Brunner & Lay (Canada) Ltd.	Heath & Sherwood (1964) Ltd.
Bird Machine Co. of Canada Ltd.	HRE Industries Ltd.
Babcock & Wilcox Canada Ltd.	John T. Hepburn Ltd.
Canadian Ingersoll-Rand Co. Ltd.	Howden Canada Ltd.
Canadian Timken Ltd.	Harding Ltd., Koppers Inc.
Chapman Industries Ltd.	Infrasizers Ltd.
Cyclone Engineering Sales Ltd.	International Harvester of Canada Ltd.
Canadian Industries Ltd.	Interior Mill Equipment Ltd.
Canron Limited (Mechanical Division)	Jarvis Clark Co. Ltd.
Caterpillar of Canada Ltd.	Jeffrey Manufacturing Co. Ltd.
Clark Equipment of Canada Ltd.	Joy Manufacturing Co. (Canada) Ltd.
Canefco Limited	- Heavy Equipment Division
Can-Eng Limited	Joy Manufacturing Co. (Canada) Ltd.
Combustion Engineering Ltd.	- Precipitation Division
Champion Road Machinery Co. Ltd.	Joy Manufacturing Co. (Canada) Ltd.
Craig Bit Division, Kenrox Tools Ltd.	- Alpha Fan Division
Canadian Mine Services	Joy Manufacturing Co. (Canada) Ltd.
Davie Shipbuilding Ltd.	- Denver Equipment Division
Delro Industries	Kipp Kelly Ltd.
Drilco Industrial Canada	Komline-Sanderson Ltd.
Thomas A. Dillon (Canada) Ltd.	Lawjack Equipment Ltd.
Dominion Bridge Company Limited	Letco Ltd.
Dominion Engineering Works Limited	Linden-Alimak Inc.
Dorr-Oliver Canada	Longyear Canada Inc.
Domeq Mining Equipment, Ayer's Cliff Industries Ltd.	Lynn MacLeod Capital Equipment
Dowty Equipment Ltd.	Lovat Tunnel Equipment Ltd.
	Lamage Ltd.

MacLean Engineering Ltd.  
Milltronics Ltd.  
Nelson Machinery Co. Ltd.  
New Era Tool & Die Ltd.  
Nordberg Canada Ltd. (Rexnord)  
Ore Sorters Canada Ltd.  
O&K Orenstein & Koppel Canada Ltd.  
Pajari Instruments Ltd.  
Peacock Bros. Ltd.  
Pontiac Manufacturing Ltd.  
Prochem Ltd.  
Wm. R. Perrin Co. Ltd.  
Radmark Engineering Ltd.  
Ramsay Rec Ltd.  
Rosedale Machine Shop Ltd.  
Sala Machine Works Ltd., Division  
of Allis-Chalmers Canada  
Separator Engineering Ltd.  
Shaft Machines Ltd.  
Simon-Carves of Canada Ltd.  
Shaw-Almex Ltd.  
Sheldons Engineering Ltd.  
J.K. Smit & Sons International Ltd.  
Spincraft Manufacturing Co.  
State Industries Ltd.  
Stephens-Adamson Division, Allis-  
Chalmers Canada  
Surface Division, Midland-Ross  
of Canada  
Techniquip Ltd.  
Teledyne Canada Mining Products  
Thompson Products, Division of TRW  
Canada Ltd.  
Timberland Equipment Ltd.  
TRI-M Rock Drilling Accessories Inc.  
Tamrockdrills Inc.  
Trend Internatioal Tool Ltd.  
The W.S. Tyler Co. of Canada Ltd.  
Unit Rig & Equipment Co. (Canada)  
Versa-Hoe Equipment Ltd.  
Wabco Equipment of Canada  
Warren Equipment Ltd.  
A.C. Wickman Ltd.  
Williams & Wilson Ltd.  
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